PUBLIC REVIEW DRAFT

Environmental Assessment/ Regulatory Impact Review/
Initial Regulatory Flexibility Analysis
for a Proposed Amendment
to the Fishery Management Plan for Groundfish of the
Bering Sea/Aleutian Islands Management Area

Revise Bering Sea/Aleutian Islands Halibut Prohibited Species Catch Limits

May 2015

For further information contact: Diana Evans, North Pacific Fishery Management Council
605 W 4th Ave, Suite 306, Anchorage, AK 99501
(907) 271-2809

Abstract: This document analyzes proposed management measures to reduce Pacific halibut prohibited species catch (PSC) mortality limits in the Bering Sea/Aleutian Islands (BSAI) groundfish fisheries. PSC limit reductions are considered for various sectors, including the BSAI trawl limited access sector, the Amendment 80 sector, longline catcher vessels, longline catcher processors, and the Community Development Quota sector (i.e., a reduction to the CDQ's allocated prohibited species quota reserve). The objective of reducing PSC limits would be to minimize bycatch to the extent practicable and provide additional harvest opportunities in the directed halibut fishery.

List of Acronyms and Abbreviations

A80	Amendment 80
ABC	acceptable biological catch
ADFG	Alaska Department of Fish and Game
AFA	American Fisheries Act
AFSC	Alaska Fisheries Science Center
AKFIN	Alaska Fisheries Information Network
AKSC	Alaska Seafood Cooperative
BBEDC	Bristol Bay Economic Development Corporation
BPD	Bycatch Projection Delta
BSAI	Bering Sea and Aleutian Islands
BSAI TLA	Bering Sea and Aleutian Islands Trawl Limited Access sector
CAS	Catch Accounting System
CDQ	Community Development Quota
CEQ	Council on Environmental Quality
CFEC	State of Alaska Commercial Fisheries Entry Commission
CFOL	Commercial Fishery Over/Under Lag
CFR	Code of Federal Regulations
COAR	Commercial Operator's Annual Report
Convention	Convention between the U.S. and Canada for the Preservation of the Halibut Fishery of the North Pacific Ocean and Bering Sea
Council	North Pacific Fishery Management Council
CP	catcher processor
CSP	Catch Sharing Plan
CV	catcher vessel
CVRF	Coastal Village Region Fund
DMR	Discard mortality rate
DPS	distinct population segment
E	East
E.O.	Executive Order
EA	Environmental Assessment
EDR	Economic Data Report
EEZ	Exclusive Economic Zone
EFH	essential fish habitat
EFP	Exempted Fishing Permit
EIS	Environmental Impact Statement
ESA	Endangered Species Act
FCEY	fishery constant exploitation yield
FLCC	Freezer Longline Conservation Cooperative
FMP	fishery management plan
FR	*Federal Register*
FRFA	Final Regulatory Flexibility Analysis
ft	foot or feet
GHL	guideline harvest level
GOA	Gulf of Alaska
HER	Halibut Encounter Rate
IFQ	Individual fishing quota
IMS Model	Iterative Multi-year Simulation Model; model that is the basis of this analysis
IPHC	International Pacific Halibut Commission
IRFA	Initial Regulatory Flexibility Analysis

lb	pound(s)
LLP	license limitation program
m	meter or meters
M	million
Magnuson-Stevens Act	Magnuson-Stevens Fishery Conservation and Management Act
MMPA	Marine Mammal Protection Act
MSST	minimum stock size threshold
mt	metric ton
n.w.	Net weight
NEI	Northern Economics, Inc.
NEPA	National Environmental Policy Act
NMFS	National Marine Fishery Service
NOAA	National Oceanographic and Atmospheric Administration
NPFMC	North Pacific Fishery Management Council
NPV	Net present value
NSEDC	Norton Sound Economic Development Corporation
O26	Halibut that are over 26 inches in length
O32	Halibut that are over 32 inches in length
Observer Program	North Pacific Groundfish and Halibut Observer Program
OMB	Office of Management and Budget
OT AK	Other Alaska
PBR	potential biological removal
PPD	PSC Projection Delta
PRA	Paperwork Reduction Act
PSC	prohibited species catch
PSEIS	Programmatic Supplemental Environmental Impact Statement
PSQ	Prohibited species quota
QS	Quota share
r.w.	Round weight
RFA	Regulatory Flexibility Act
RFFA	reasonably foreseeable future action
RIR	Regulatory Impact Review
SAFE	Stock Assessment and Fishery Evaluation
SAR	stock assessment report
SBA	Small Business Act
Secretary	Secretary of Commerce
SHARC	Subsistence Halibut Registration Certificate
SPLASH	Structure of Populations, Levels of Abundance, and Status of Humpbacks
SPR	Spawning Potential Ratio
SW	southwest
SWHS	ADFG Statewide Harvest Survey
TAC	total allowable catch
TCEY	total constant exploitation yield
U.S.	United States
U26	Halibut that are under 26 inches in length
U32	Halibut that are under 32 inches in length
USFWS	United States Fish and Wildlife Service
W	West

Table of Contents

List of Tables

List of Figures

Executive Summary

This document analyzes proposed management measures to reduce Pacific halibut prohibited species catch (PSC) mortality limits in the Bering Sea/Aleutian Islands (BSAI) groundfish fisheries. PSC limit reductions are considered for various sectors, including the BSAI trawl limited access sector, the Amendment 80 sector, longline catcher vessels, longline catcher processors, and the Community Development Quota (CDQ) sector (i.e., a reduction to the CDQ's allocated prohibited species quota reserve). The objective of reducing PSC limits would be to minimize bycatch to the extent practicable and provide additional harvest opportunities in the directed halibut fishery.

Bycatch and PSC terminology

The Council manages the groundfish fisheries of the BSAI under the authority of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1802(2)), and through a Fishery Management Plan for the Groundfish of the BSAI Management Area (BSAI FMP). Bycatch, as defined by the MSA, "means fish which are harvested in a fishery, but which are not sold or kept for personal use, and includes economic discards[1] and regulatory discards." The term "regulatory discards" means "fish harvested in a fishery which fishermen are required by regulation to discard whenever caught, or are required by regulation to retain, but not sell." In the case of the BSAI FMP, the Council has designated Pacific halibut, along with several other fully utilized species such as salmon, herring, and crab species, as "prohibited species" in the groundfish fisheries, which fishermen are required by regulation to discard. These species are identified in the FMPs; their capture is required to be minimized; and their retention is prohibited. Unintended removals of prohibited species are separately monitored and controlled under the groundfish fishery management plans. In the context of the BSAI FMP, "halibut PSC" refers to the bycatch of halibut in the groundfish fisheries. This analysis primarily addresses halibut PSC mortality, i.e., the subset of halibut PSC that is assumed to be dead as a consequence of interactions with the groundfish fisheries. Mortality calculations are made for all halibut PSC in the groundfish fisheries, using discard mortality rates adopted triennially by the Council as part of the harvest specifications process. Halibut PSC limits, and removals of halibut PSC in the groundfish fisheries, are specified in terms of metric tons, round weight, of halibut PSC mortality.

The International Pacific Halibut Commission (IPHC) is responsible for the overall biologic assessment and conservation of Pacific halibut off the coasts of Alaska, British Columbia, and the western United States. In the parlance of the IPHC, "bycatch" refers to the mortality of Pacific halibut occurring in commercial fisheries that target other species, including halibut PSC mortality in the groundfish fisheries. This analysis refers to halibut PSC mortality in the context of the proposed action, except where appropriate to describe the IPHC catch limit process, or their research or stock assessment information. The IPHC manages and reports on halibut removals in pounds, net weight, of halibut mortality, and assumes that net weights are 75 percent of round weights.

Purpose and Need

Consistent with the MSA's National Standard 1 and National Standard 9, the Council and NMFS use halibut PSC mortality limits to minimize halibut bycatch (halibut PSC) in the groundfish fisheries to the extent practicable, while achieving, on a continuing basis, the optimum yield from the groundfish fisheries. The groundfish fisheries cannot be prosecuted without some level of halibut interception. Although fishermen are required by regulation to avoid the capture of any prohibited species in groundfish fisheries, the use of halibut PSC limits in the groundfish fisheries provides an additional constraint on halibut PSC mortality, and promotes conservation of the halibut resource. Halibut PSC limits provide a regulated upper limit to

[1] "Economic discards" are defined as "fish which are the target of a fishery, but which are not retained because of an undesirable size, sex, or quality, or other economic reason."

mortality resulting from halibut interceptions, as continued groundfish fishing is prohibited once a halibut PSC limit has been reached for a particular sector and/or season. This management tool is intended to balance the optimum benefit to fishermen, communities, and U.S. consumers which depend on both halibut and groundfish resources.

The halibut resource is fully allocated. The IPHC accounts for incidental halibut removals in the groundfish fisheries, recreational and subsistence catches, and other sources of halibut mortality before setting commercial halibut catch limits each year. Declines in the exploitable biomass of halibut since the late 1990s, and decreases in the Pacific halibut catch limits set by the IPHC for the directed BSAI halibut fisheries (IPHC Area 4)), especially beginning in 2012 for the directed fishery in the northern and eastern Bering Sea (Area 4CDE), have raised concerns about the levels of halibut PSC mortality by the commercial groundfish trawl and hook-and-line sectors. Reductions in BSAI halibut PSC mortality have not been proportional to the reductions in Area 4 directed halibut harvest limits since 2011. The Council acknowledges that BSAI halibut PSC mortality levels have declined in some sectors since the current PSC limits were implemented and that PSC mortality does not reach the established sector limits in most years. The Council also recognizes efforts by the groundfish industry to reduce total halibut PSC mortality in the BSAI, but these efforts have had the unintended effect of concentrating groundfish fishing effort in Area 4CDE, and increasing the proportion of Area 4CDE halibut exploitable biomass taken as PSC since 2011. In 2015, the levels of halibut PSC in Area 4CDE increased relative to 2014. Based on the stated IPHC harvest policy and the estimates of exploitable biomass and PSC, the 2015 directed fishery harvest limit for halibut in Area 4CDE could have been reduced to a level that the halibut industry deemed was not sufficient to maintain an economically viable fishery in some communities.

The Council does not have authority to set harvest limits for the commercial halibut fisheries, and halibut PSC mortality in the groundfish fisheries is only one of the factors that affects harvest limits for the commercial halibut fisheries. Nonetheless, halibut removals in the groundfish fisheries are a significant portion of total mortality in BSAI IPHC areas, and have the potential to affect harvest limits for the directed fisheries in Area 4 under the current IPHC harvest policy.

Under National Standard 8, the Council must provide for the sustained participation of and minimize adverse economic impacts on fishing communities. BSAI coastal communities are affected by reduced catch limits for the directed halibut fishery, especially in IPHC Area 4CDE. The Council must balance these communities' involvement in and dependence on halibut with community involvement in and dependence on the groundfish fisheries that rely on halibut PSC in order to operate, and with National Standard 4, which states that management measures shall not discriminate between residents of different states. National Standard 4 also requires allocations of fishing privileges to be fair and equitable to all fishery participants.

The proposed action would reduce the halibut PSC limits in the BSAI, which are established for the BSAI trawl and fixed gear sectors in Federal regulation, and in some cases, in the BSAI Groundfish FMP. Overall halibut PSC limits can be modified only through an amendment to the regulations and the FMP, although seasonal and some target fishery apportionments of those PSC limits would continue to be set annually through the BSAI groundfish harvest specifications process.

One purpose of the proposed action is to minimize halibut PSC mortality in the commercial groundfish fisheries to the extent practicable, while preserving the potential for the optimum harvest of the groundfish total allowable catches (TACs) assigned to the trawl and hook-and-line sectors. The proposed action aims to minimize halibut PSC mortality to the extent practicable in consideration of the regulatory and operational management measures currently available to the groundfish fleet, and the need to ensure that catch in the trawl and hook-and-line fisheries contributes to the achievement of optimum yield in the groundfish fisheries. Minimizing halibut PSC mortality to the extent practicable is necessary to maintain a healthy marine ecosystem, ensure long-term conservation and abundance of halibut, provide optimum benefit to fishermen, communities, and U.S. consumers that depend on both halibut and groundfish resources, and comply with the Magnuson-Stevens Act and other applicable Federal law.

Another purpose of this action is to provide additional harvest opportunities in the directed halibut fishery, especially in Area 4CDE for western Alaska and Pribilof Island coastal communities. Halibut savings that would occur from reducing halibut PSC mortality below current levels would provide additional harvest opportunities to the directed halibut fisheries in both the near term and long term. Near term benefits to BSAI halibut fisheries would result from the PSC mortality reductions of halibut that are over 26 inches in length (O26). These halibut would be available to the commercial halibut fishery in the area and year that the PSC mortality is foregone, or when the fish reach the legal size limit for the commercial halibut fishery (greater than or equal to 32 inches in total length). Longer term benefits to the directed halibut fisheries would accrue throughout the distribution of the halibut stock, from a reduction of halibut PSC mortality from fish that are less than 26 inches (U26). Benefits from reduced mortality of these smaller halibut would occur both in the Bering Sea and elsewhere as they migrate and recruit into the directed halibut fisheries.

Alternatives

The Council revised the original alternatives for analysis at initial review in February 2015; the amended alternatives are listed below. More than one option may be selected simultaneously, and different PSC reductions levels may selected under each option. Table ES-1 (below) identifies the proposed PSC limits under each reduction option, for each sector.

Alternative 1 No action.

Alternative 2 Amend the BSAI Groundfish FMP and Federal regulations to revise halibut PSC limits as follows *(more than one option can be selected)*.

Option 1 Reduce halibut PSC limit for the Amendment 80 Sector by:

Suboption 1 reducing the halibut PSC limit to Amendment 80 cooperatives by:

a) 10 percent b) 20 percent c) 30 percent d) 35 percent e) 40 percent f) 45 percent or g) 50 percent

Suboption 2 reducing the halibut PSC limit to Amendment 80 limited access fishery by:

a) 10 percent b) 20 percent c) 30 percent d) 35 percent e) 40 percent f) 45 percent g) 50 percent or h) 60 percent

Option 2 Reduce halibut PSC limit for the BSAI Trawl Limited Access Sector by:

a) 10 percent b) 20 percent c) 30 percent d) 35 percent e) 40 percent f) 45 percent or g) 50 percent

Option 3 Reduce halibut PSC limit for Pacific cod hook and line catcher processor sector by:

a) 10 percent b) 20 percent c) 30 percent d) 35 percent e) 40 percent f) 45 percent or g) 50 percent

Option 4 Reduce halibut PSC limit for other non-trawl (i.e., hook and line catcher vessels and catcher processors targeting anything except Pacific cod or sablefish) by:

a) 10 percent b) 20 percent c) 30 percent d) 35 percent e) 40 percent f) 45 percent or g) 50 percent

Option 5 Reduce halibut PSC limit for Pacific cod hook and line catcher vessel sector by:

b) 10 percent b) 20 percent c) 30 percent d) 35 percent e) 40 percent f) 45 percent or g) 50 percent

Option 6 Reduce the CDQ halibut PSQ limit by:

a) 10 percent b) 20 percent c) 30 percent d) 35 percent e) 40 percent f) 45 percent or g) 50 percent

Table ES-1 Proposed PSC Limits under Alternative 2 (in mt)

	Status quo	a) -10%	b) -20%	c) -30%	d) -35%	e) -40%	f) -45%	g) -50%	h) -60%
Option 1: Amendment 80*	2,325	2,093	1,860	1,628	1,511	1,395	1,279	1,163	930
Option 2: BS trawl limited access	875	788	700	613	569	525	481	438	
Option 3: Hook and line Pcod – CP	760	684	608	532	494	456	418	380	
Option 4: Hook and line CV and CP – targets other than Pcod or sablefish	58	52	46	41	38	35	32	29	
Option 5: Hook and line Pcod – CV	15	14	12	11	10	9	8	8	
Option 6: CDQ PSQ	393	354	314	275	255	236	216	197	

* Note, the eighth possibility in the range, h) -60%, only applies to Amendment 80 Suboption 2, which allows for a different PSC limit reduction for the Amendment 80 limited access fishery.

Environmental Assessment

Under Alternative 1, there would be no changes to the regulated BSAI PSC limits. Since 2008, halibut PSC mortality in the BSAI groundfish fisheries has been 70 to 84 percent of the regulated PSC limits (Table ES-2). At the Council's request, industry sectors have made voluntary efforts to reduce halibut PSC mortality in the BSAI over the 2014 and 2015 fishing seasons.

Table ES-2 Halibut PSC mortality in BSAI groundfish target fisheries, by sector, 2008 to 2014, in metric tons, and mortality as a percentage of the 2013 halibut PSC limit for each sector

Sector	2013 PSC limit		2008	2009	2010	2011	2012	2013	2014	Average PSC used 2008-2013
Amendment 80	2,325	mt	1,969	2,074	2,254	1,810	1,945	2,168	2,106	2,037
		%	78%	84%	93%	76%	84%	93%	91%	88%
BSAI TLA	875	mt	739	727	484	637	960	707	717	700
		%	84%	83%	55%	73%	110%	81%	82%	80%
Longline Pacific cod CPs	760	mt	564	554	489	477	550	458	412*	521
		%	74%	73%	64%	63%	72%	60%	50%	69%
Other non-trawl	58	mt	1	6	10	5	6	1	*	5
		%	2%	10%	17%	9%	10%	2%	*	9%
Longline Pacific cod CVs	15	mt	5	3	2	1	2	3	7	3
		%	33%	20%	13%	7%	13%	20%	47%	20%
CDQ	393	mt	214	151	159	223	252	265	244	210
		%	62%	44%	40%	57%	64%	67%	62%	53%
Total	**4,426**	mt	**3,493**	**3,516**	**3,398**	**3,153**	**3,714**	**3,603**	**3,406**	**3,301**
		%	**76%**	**78%**	**75%**	**70%**	**84%**	**81%**	**79%**	**75%**

* All 2014 halibut PSC mortality accruing to the other non-trawl PSC limit was intercepted by longline CPs, and is included with that amount.
Source: AKFIN.

Alternative 2 could reduce the amount of halibut PSC mortality in the trawl and longline groundfish fisheries. The alternative includes several options to apply PSC limit reductions to different sectors of the BSAI trawl and longline groundfish fleet. Some of the options under Alternative 2 would result in no change to the status quo, while others would result in constraining PSC limits under which industry may change fishing patterns in order to optimize their groundfish harvest with a minimum of halibut PSC mortality, in order to avoid fishery closures[2]. This could result in a response of reducing fishing effort, as the industry

[2] Note that neither the BSAI pollock fishery nor the BSAI trawl limited access Atka mackerel fishery is constrained by the current cap, nor are there options in the analysis to introduce such constraints. As a result, reduced PSC limits would not affect them directly.

chooses not to pursue less valuable fisheries in order to conserve halibut PSC mortality, or it could result in greater fishing effort at lower catch per unit effort, as vessels change fisheries patterns or seasonal changes in the timing of the fishing, to increase halibut avoidance. Shifts in the location or timing of fishing may occur as a result of Alternative 2. However, there is already considerable interannual variability in the patterns of fishing across the BSAI groundfish sectors, as environmental conditions and avoidance of PSC species have caused vessels to adjust their fishing patterns. Any shift in fishing is likely to occur within the existing footprint of the groundfish fishery in the BSAI.

Pacific halibut

Alternative 1 would result in no change to the amount of halibut PSC mortality in the trawl and longline groundfish fisheries, and it is unlikely that groundfish fishing under the status quo, or Alternative 1, has direct or indirect impacts on Pacific halibut sustainability. While the halibut biomass has declined from peaks in the late 1990s, the estimated female spawning biomass appears to have stabilized or be slightly increasing. Halibut mortality in the groundfish fisheries is taken into account when the commercial halibut quotas are set, to prevent significantly adverse impacts on the halibut stocks.

Halibut PSC removals in the groundfish fisheries are constrained by PSC limits, which provide an upper limit annually on halibut PSC mortality. The level of halibut removals in the trawl and longline groundfish fisheries under the status quo could result in reduced allocations to the directed halibut fisheries in Area 4 through reduced yield, as halibut removals are deducted from the total constant exploitation yield (TCEY) for the halibut stock before a directed fishery allocation is calculated. Any reductions in the directed fishery allocations affect the economic state of commercial halibut fishermen or the communities they impact. At the same time, hook-and-line and trawl industry efforts to reduce halibut PSC mortality in the prosecution of the groundfish fisheries may lower the amount of future removals the IPHC deducts from the TCEY. It is unlikely that halibut harvests in unguided sport and subsistence fisheries are impacted by Alternative 1 because these fisheries do not have caps on removals in Area 4, and harvests in the halibut subsistence and unguided sport fisheries are also deducted from the TCEY prior to the commercial fishery limits being set. Since subsistence and recreational removals are not restricted by catch limits, it is assumed that those sectors are not affected by the status quo or options that reduce the PSC limits.

Alternative 2 includes several options to apply PSC limit reductions to different sectors of the BSAI trawl and longline groundfish fleet, although not all of them result in a change to the status quo, given that the sectors regularly harvest less than the regulated PSC limit (Table ES-3). An important component of PSC mortality is the proportion of fish that is over and under 26 inches in length. Halibut that are over 26 inches (O26) that are killed as PSC would have been a part of the halibut fishery commercial catch limit (FCEY) had they not been killed. Halibut killed as PSC mortality that are under 26 inches (U26), will become available for removals, including to the commercial fishery, in later years. Reductions in O26 halibut mortality resulting from PSC will be directly reallocated to increased halibut yields available to harvesters in the directed halibut IFQ fisheries in Area 4, at an approximately 1:1 relationship between halibut PSC mortality “savings” and directed fishery yield. The O26 component is estimated to be 64 percent of the overall BSAI halibut PSC mortality in 2013 (the last full year of data). Because they are completely allocated to the directed halibut fishery, reductions in O26 halibut PSC mortality will have no effect on the halibut stock condition.

Table ES-3 Comparison of the alternatives and options in terms of harvest and revenue impacts in BSAI fisheries

Note, when numbers are shown as a range, they represent estimates from two Scenarios—Scenario A is a relatively “low impact” scenario and Scenario B is a relatively “high impact” scenario.

	Impacts to the Affected Groundfish Fisheries				Impacts to the Area 4 Commercial Halibut Fishery					
	PSC Limit	Annual Average PSC Taken under the Status Quo and Estimated Mean Future Reductions under the Options	Discounted Present Value (DPV) of Wholesale Revenues under the Status Quo and Foregone DPV under the Options from 2014 to 2023 (2013$ Millions)		Annual Average Status Quo Commercial Halibut Harvest Amounts and Reallocated Average Yield to the Fishery Under the Options. Includes yield from savings of both O26 and U26 PSC. (Net Weight Pounds 1,000s)				Discounted Present Value of Wholesale Revenue under the Status Quo and Gains under the Options. Includes both O26 & U26 ($2013 Millions)	
	(mt)	(mt)	10-Year Sum	Average Annual	4A	4B	4CDE	Area 4	10-Year Sum	Average Annual
Option 1: Reduce Halibut PSC Limits for Amendment 80 Catcher Processors (A80-CPs)										
Status Quo	2,325	2,037 - 2,031	$2,610 - $2,609	$261.0 - $260.9	1,576 - 1,577	1,382 - 1,383	276 - 283	3,234 - 3,242	$349.8 - $350.5	$35.0 - $35.0
1a): -10%	2,093	40 - 59	$5 - $32	$0.5 - $3.2	20 - 12	0 - 2	22 - 50	43 - 63	$4.6 - $6.8	$0.5 - $0.7
1b): -20%	1,860	192 - 217	$36 - $123	$3.6 - $12.2	83 - 28	1 - 7	119 - 195	203 - 230	$21.7 - $24.6	$2.2 - $2.5
1c): -30%	1,628	414 - 435	$105 - $263	$10.5 - $26.2	148 - 64	4 - 15	283 - 379	436 - 458	$46.6 - $49.0	$4.7 - $4.9
1d): -35%	1,511	532 - 562	$164 - $366	$16.3 - $36.5	173 - 81	5 - 31	382 - 480	560 - 592	$59.8 - $63.2	$6.0 - $6.3
1e): -40%	1,395	647 - 664	$229 - $469	$22.8 - $46.7	188 - 94	6 - 35	485 - 568	680 - 698	$72.5 - $74.7	$7.3 - $7.5
1f): -45%	1,279	764 - 777	$293 - $575	$29.2 - $57.2	232 - 114	7 - 43	564 - 659	803 - 816	$85.8 - $87.0	$8.6 - $8.7
1g): -50%	1,163	878 - 894	$375 - $699	$37.3 - $69.6	271 - 133	8 - 56	642 - 750	921 - 939	$98.6 - $100.2	$9.9 - $10.0
Option 2: Reduce Halibut PSC Limits in BSAI Trawl Limited Access Fisheries (BSAI TLA)										
Status Quo	875	699 - 697	$10,222 - $10,214	$1,022.2 - $1,021.4	1,576 - 1,577	1,382 - 1,383	276 - 283	3,234 - 3,242	$349.8 - $350.5	$35.0 - $35.0
2a): -10%	788	12 - 17	$5 - $15	$0.5 - $1.5	6 - 6	0 - 0	6 - 9	12 - 16	$1.3 - $1.7	$0.1 - $0.2
2b): -20%	700	28 - 41	$22 - $59	$2.2 - $5.9	12 - 15	1 - 3	12 - 20	25 - 37	$2.8 - $4.0	$0.3 - $0.4
2c): -30%	613	50 - 76	$59 - $110	$5.9 - $10.9	25 - 31	4 - 4	17 - 33	46 - 68	$4.9 - $7.3	$0.5 - $0.7
2d): -35%	569	60 - 101	$73 - $162	$7.2 - $16.1	29 - 44	4 - 6	20 - 42	54 - 92	$5.8 - $9.8	$0.6 - $1.0
2e): -40%	525	76 - 129	$91 - $208	$9.1 - $20.7	41 - 55	5 - 7	24 - 54	69 - 117	$7.4 - $12.4	$0.7 - $1.2
2f): -45%	481	93 - 165	$110 - $261	$10.9 - $26.0	49 - 66	6 - 8	30 - 75	85 - 150	$9.1 - $16.0	$0.9 - $1.6
2g): -50%	438	114 - 201	$153 - $322	$15.2 - $32.1	59 - 78	7 - 10	38 - 96	104 - 183	$11.1 - $19.6	$1.1 - $2.0
Option 3: Reduce Halibut PSC Limits for Hook and Line Catcher Processors (LGL-CPs) in Pacific Cod Target Fisheries										
Status Quo	760	521 - 521	$1,276 - $1,276	$126.0 - $126.0	1,576 - 1,577	1,382 - 1,383	276 - 283	3,234 - 3,242	$349.8 - $350.5	$35.0 - $35.0
3a): -10%	684	These options are non-constraining and have no material impact on the affected participants.								
3b): -20%	608									
3c): -30%	532	14 - 25	$10 - $22	$1.0 - $2.2	5 - 7	12 - 5	1 - 18	17 - 29	$1.9 - $3.2	$0.2 - $0.3
3d): -35%	494	32 - 46	$25 - $44	$2.5 - $4.4	8 - 11	19 - 8	12 - 33	38 - 53	$4.2 - $5.7	$0.4 - $0.6
3e): -40%	456	61 - 79	$50 - $89	$5.0 - $8.9	22 - 23	27 - 10	21 - 58	71 - 92	$7.6 - $9.8	$0.8 - $1.0
3f): -45%	418	100 - 118	$100 - $138	$10.0 - $13.7	39 - 35	30 - 12	46 - 87	115 - 135	$12.3 - $14.4	$1.2 - $1.4
3g): -50%	380	138 - 153	$152 - $191	$15.2 - $19.0	66 - 44	34 - 15	58 - 116	158 - 175	$16.9 - $18.8	$1.7 - $1.9
Option 4: Reduce Halibut PSC Limits for Hook and Line Catcher Processors and Catcher Vessels in Target Fisheries Other than Pacific Cod or Sablefish										
Status Quo	58	5	$11.95							
All Options	These options are non-constraining and have no material impact on the affected participants.									
Option 5: Reduce Halibut PSC Limits for Hook and Line Catcher Vessels (LGL-CVs) in Pacific Cod Target Fisheries										
Status Quo	15	3	$1.20							
All Options	These options are non-constraining and have no material impact on the affected participants.									
Option 6: Reduce Halibut PSC Limits for Vessels Participating in CDQ Groundfish Fisheries										
Status Quo	393	211 - 211	$1,606.3 - $1,606.3	$160.6 - $160.6	1,576 - 1,577	1,382 - 1,382	276 - 283	3,234 - 3,242	$349.8 - $350.5	$35.0 - $35.0
6a): -10%	354	These options are non-constraining and have no material impact on the affected participants.								
6b): -20%	314									
6c): -30%	275									
6d): -35%	255	2 - 2	$0.4 - $2.2	$0.0 - $0.2	2 - 3	0.0 - 0.0	2 - 0	4 - 3	$0.4 - $0.3	$0.0 - $0.0
6e): -40%	236	8 - 8	$2.7 - $9.3	$0.3 - $0.9	6 - 3	0.1 - 0.1	3 - 6	9 - 9	$1.0 - $1.1	$0.1 - $0.1
6f): -45%	216	18 - 17	$6.3 - $21.2	$0.6 - $2.1	8 - 5	0.1 - 0.1	12 - 13	19 - 18	$2.1 - $2.0	$0.2 - $0.2
6g): -50%	197	30 - 29	$15.2 - $36.7	$1.5 - $3.7	12 - 6	0.7 - 1.5	20 - 22	32 - 30	$3.4 - $3.2	$0.3 - $0.3

Table ES-4 Comparison of Halibut Fishery Yield Impacts from U26 PSC Savings in the BSAI, in Areas External to the BSAI (Gulf of Alaska, British Columbia, Pacific Coast)

	From Option 1 A80-CPs		From Option 2 BSAI TLA		From Option 3 LGL-CPs		Option 6 CDQ Fisheries	
PSC Limit Cut Percent	**Annual Average Harvest from U26 Savings** from 2019 to 2023 (1,000's n.w. lb)	**10-Year Sum of Future Discounted Present Value of Wholesale Revenue** (2013 $millions)	**Annual Average Harvest from U26 Savings** from 2019 to 2023 (1,000's n.w. lb)	**10-Year Sum of Future Discounted Present Value of Wholesale Revenue** (2013 $millions)	**Annual Average Harvest from U26 Savings** from 2019 to 2023 (1,000's n.w. lb)	**10-Year Sum of Future Discounted Present Value of Wholesale Revenue** (2013 $millions)	**Annual Average Harvest from U26 Savings** from 2019 to 2023 (1,000's n.w. lb)	**10-Year Sum of Future Discounted Present Value of Wholesale Revenue** (2013 $millions)
-10%	8 to 12	$0.34 to $0.50	4 to 5	$0.13 to $0.18	These suboptions are not expected to produce material impacts		These suboptions are not expected to produce material impacts	
-20%	38 to 43	$1.60 to $1.79	7 to 11	$0.30 to $0.44				
-30%	83 to 86	$3.48 to $3.64	12 to 19	$0.52 to $0.82	2 to 5	$0.10 to $0.18		
-35%	106 to 112	$4.47 to $4.72	16 to 26	$0.64 to $1.09	5 to 7	$0.23 to $0.33	0 to 0	$0.02 to $0.01
-40%	129 to 133	$5.44 to $5.59	19 to 32	$0.81 to $1.37	10 to 13	$0.42 to $0.56	1 to 2	$0.07 to $0.07
-45%	153 to 156	$6.44 to $6.54	24 to 42	$0.99 to $1.75	17 to 20	$0.70 to $0.84	4 to 4	$0.17 to $0.16
-50%	176 to 179	$7.38 to $7.53	29 to 50	$1.21 to $2.11	23 to 26	$0.98 to $1.09	6 to 6	$0.27 to $0.26

Note: The first yield increases from U26 PSC Savings that accrue as a result of PSC limit reductions are not realized until 2019. For this reason average annual harvests are estimated over the last five years only. Also note that when numbers are shown as a range, they represent estimates from two Scenarios—Scenario A is a relatively “low impact” scenario and Scenario B is a relatively “high impact” scenario.

Reductions in halibut PSC mortality of U26 fish will also contribute to increased halibut yields for the directed halibut fishery, at the same pound for pound relationship, but will be distributed across all regulatory areas as the fish contribute to the exploitable biomass. Based on the IPHC setline survey, Area 4 represents 22 percent of the exploitable biomass (halibut over 32 inches) for the coastwide halibut stock, therefore approximately 22 percent of the U26 halibut PSC mortality reductions would, at some future time, accrue back to the Area 4 directed fisheries as halibut yield (Table ES-3). The remainder of the U26 halibut “savings” would accrue to directed halibut users in other IPHC regions, in proportion to their share of the coastwide biomass (Table ES-4). With respect to whether removals of U26 halibut have an effect on the condition of the halibut stock, mortality of juvenile halibut will have an effect on the distribution of the surviving fish, and therefore the subsequent spawning biomass. It is not currently known how important the spatial distribution of the spawning stock may be to short or long-term stock productivity, but greater mortality at younger ages is likely to change this distribution more than mortality at older ages. Reductions in U26 halibut PSC mortality could make more halibut of various sizes available in the BSAI. The extent to which this may affect the halibut spawning biomass coastwide depends on the importance of spatial distribution of the spawning stock, but any effect of the PSC limit reductions in the BSAI will be tempered by the proportion of the reduction that affects U26 halibut (currently 34 percent of halibut PSC mortality), and the BSAI’s overall proportion of total coastwide biomass (currently 22 percent). It is notable that while the majority of coastwide U26 halibut PSC mortality occurs in Area 4CDE, the proportion of the coastwide biomass in this area has been stable with a slight increase over the last fifteen years.

A caveat of the simulation model used to analyze the options in Alternative 2 is that it does not account for changing halibut biomass levels; the model uses a static halibut biomass equivalent to the 2014 biomass estimate. While the biomass has been stable at around 200 million lb net weight in the last few years, this represents the lowest biomass level since 1996, although not in the historical time series. Fixing reduced halibut PSC limits for the groundfish fisheries at a time when the halibut biomass is at a lower abundance level raises questions about the implication of lower PSC limits when the biomass increases, potentially leading to higher encounter rates. An IPHC study (Leaman et al. 2015) tried to index halibut PSC to direct measures of juvenile or adult halibut abundance, or encounter rates of halibut in relation to target groundfish species abundance, and was unsuccessful. The study found that relationships of PSC mortality to halibut and target groundfish abundance are either lacking, or are temporally and spatially inconsistent. The historical patterns in PSC mortality are more likely driven by groundfish management factors than strictly by halibut abundance.

For the most part, the options in Alternative 2 which would result in a change from status quo, in terms of halibut PSC mortality, are unlikely to have a different effect on halibut, as catch will largely be reallocated from halibut PSC mortality to directed fishery catch, although there may be some conservation benefit to the stock with respect to reducing the mortality of U26 halibut. Alternative 2 is not anticipated to have a significant effect on the Pacific halibut biomass.

Other resource components

Under the status quo, the BSAI groundfish stocks are neither overfished nor subject to overfishing, and levels of fishing on ecosystem component species (including forage fish and prohibited species) are constrained by bycatch and PSC limits. Under the more constraining options of Alternative 2, reduced PSC limits may result in some groundfish fisheries closing before the total allowable catch (TAC) is reached, which will result in less impact on the stock, or fishing occurring in areas of lower catch per unit effort. While this may result in higher interception of incidental species, the groundfish stocks, forage fish and prohibited species are also managed under catch, bycatch and PSC limits, which mitigate risk to these stocks. Groundfish harvest reductions under the combined options could range between 1,400 to 147,800 mt annually, primarily affecting flatfish species. Prior to the implementation of Amendment 80 in 2008, flatfish harvests were routinely lower than current levels, by amounts in excess of the proposed harvest reductions projected in this analysis. For groundfish stocks, the biological effects are expected to be correctly incorporated in stock assessments and the harvest specifications process.

Marine mammal and seabird disturbance and incidental take are at low levels and are mitigated by groundfish fishery area closures. Under Alternative 2, there may be changes in fishing patterns that result in more fishing effort (at lower catch per unit effort), in response to potentially constraining PSC limits. This is most likely to occur in trawl fisheries, where limits are more constraining. Neither disturbance, incidental take, changes in prey availability or benthic habitat alteration, however, is anticipated to increase to a level that would result in population level effects on marine mammals or seabirds.

Previous analyses have found no substantial effects to habitat in the BSAI from fishing activities (NMFS 2005b). Under Alternative 2, any increase in fishing effort would still occur within the existing footprint of fishing and existing habitat and conservation measures, and is unlikely to be significant.

Regulatory Impact Review

The RIR describes the status quo with respect to participants in each of the affected sectors, catch and revenue, regional impacts, PSC limits and associated mortality in target fisheries, reliance on BSAI groundfish and diversification into other fisheries. A description of catch and revenue in the commercial halibut fishery is also included, along with a summary of its regional impact. To analyze the effects of Alternative 2, the analysis uses an iterated multi-year simulation model, which uses the basis years of 2008 to 2013 to forecast future impacts of the PSC limit reductions. There are two aspects to the modeling of impacts of PSC limit reductions: how to account for fishermen's response to constrained limits by optimizing their groundfish fishing to the extent possible (noting that their ability to respond effectively is more difficult when PSC limit reductions, or other management measures affecting them, are more constraining), and how "savings" of halibut PSC mortality in the groundfish fisheries affect other sectors, in this case, the commercial halibut fishery. The model uses two scenarios to mimic how industry would respond to a lower PSC limit, which is achieved in both cases by reducing groundfish fishing effort. The scenarios employ different methods of dropping groundfish harvest records to meet the new PSC limit, and they are intended to represent reasonable expectations of fishermen's behavioral response to the reduced limits, and illustrate lower and upper bounds of the impact of the PSC limit reduction. For the impact on the halibut fishery, the model uses algorithms that mimic the application of the IPHC blue line harvest policy application, to generate recommendations for the coming year's Fishery Constant Exploitation Yield (FCEY), or catch limit for the directed halibut fishery. For the public review draft of this analysis, the IMS Model has been modified to account for future yield increases from U26 fish, as well as immediate yield increases from O26 halibut.

Groundfish fisheries

Table ES-3 summarizes the Alternative 2 PSC limit reduction options in terms of their halibut PSC mortality reductions in the groundfish fishery and the foregone discounted present value associated with those reductions. The table also shows how halibut PSC reductions would translate into reallocations to the directed halibut fishery yield, and the associated gain in discounted present value, taking into account O26 fish as well as potential future U26 yield.

Only some of the options would result in a change to the status quo, given that the sectors regularly harvest less than the regulated PSC limit.

- For the Amendment 80 sector (Option 1), all of the PSC limit reduction options would have been constraining in some of the years 2008 to 2013, and all of the options are likely to be constraining in some future years.
- For the Bering Sea trawl limited access sector (Option 2), all of the PSC limit reduction options would have been constraining in some years from 2008 to 2013, and all of the options are likely to be constraining in some future years.
- For Pacific cod longline catcher processors (Option 3), reductions of 30 percent or higher would be likely to constrain this sector in the future. Reductions of 10 or 20 percent would not have constrained the fishery in any of the years from 2008 to 2013, and unless the Pacific cod TACs grow considerably larger in future, these options are unlikely to be constraining.
- There would not have been an effect of any of the reduction options on the PSC limit that is apportioned to other non-trawl fisheries (i.e., targeting species other than Pacific cod or sablefish) (Option 4), or on Pacific cod longline catcher vessels (Option 5), during the years 2008 to 2013. Given the current lack of growth in either of these fisheries, it is unlikely that any of the proposed options would be constraining in the future.
- For CDQ groups (Option 6), only reductions of 35 percent or higher would be likely to constrain this fishery in the future, unless the fishery continues its current rate of growth. Reductions from 10 to 30 percent would not have constrained the CDQ groundfish activities in any of the years from 2008 to 2013.

The impacts of equal PSC percentage reduction options across all sectors on total groundfish catch are illustrated in Figure ES-1 and ES-2. Figure ES-1 provides a pie chart showing the impacts of the PSC limit reduction options for all groundfish fisheries, including the pollock fishery. The reduction in groundfish catch resulting from each analyzed option is shown as a portion of the pie chart. The effect of increasingly larger PSC reductions, as applied across all sectors equally, is illustrated in the change in colors. The PSC reduction options result in a reduction in total groundfish harvest between 5.3 and 9.2 percent of status quo.

Figure ES-2 presents the same data, but excludes the pollock fishery, as the volume of the pollock tends to overshadow the impacts on groundfish fisheries, and the pollock fishery is exempt from a fishery closure even if the PSC limit for the BSAI trawl limited access sector pollock fishery category is attained. In the analysis, therefore, the options have no direct effect on the (non-CDQ) pollock fishery. In Figure ES-2, the reduction in groundfish harvest for all species except pollock ranges between 16.7 and 22 percent.

Figure ES-1 Impacts to in Total Groundfish Harvest (Including Pollock) Under the Combined PSC Limit Reduction Options for All Sectors

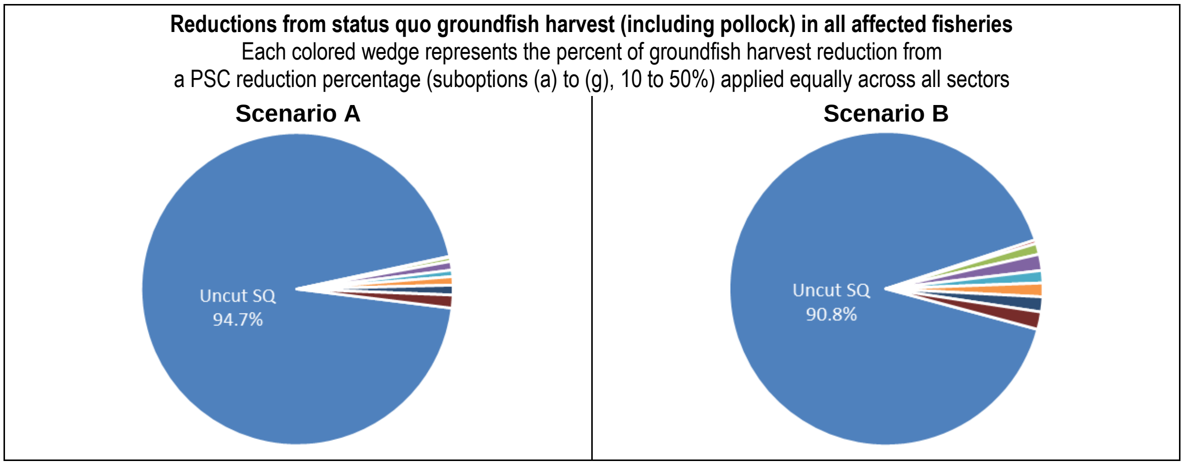


Figure ES-2 Impacts to Total Groundfish Harvest (Excluding Pollock) Under the Combined PSC Limit Reduction Options for All Sectors

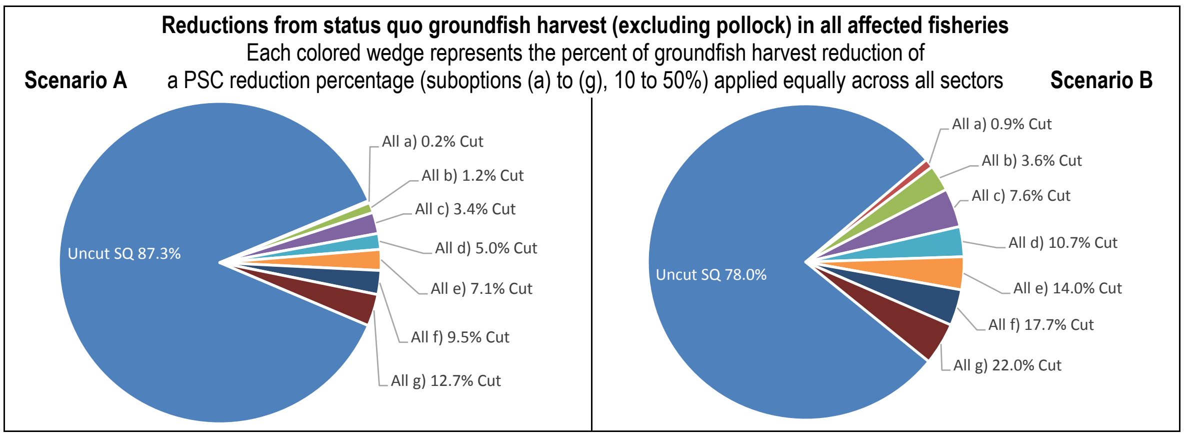
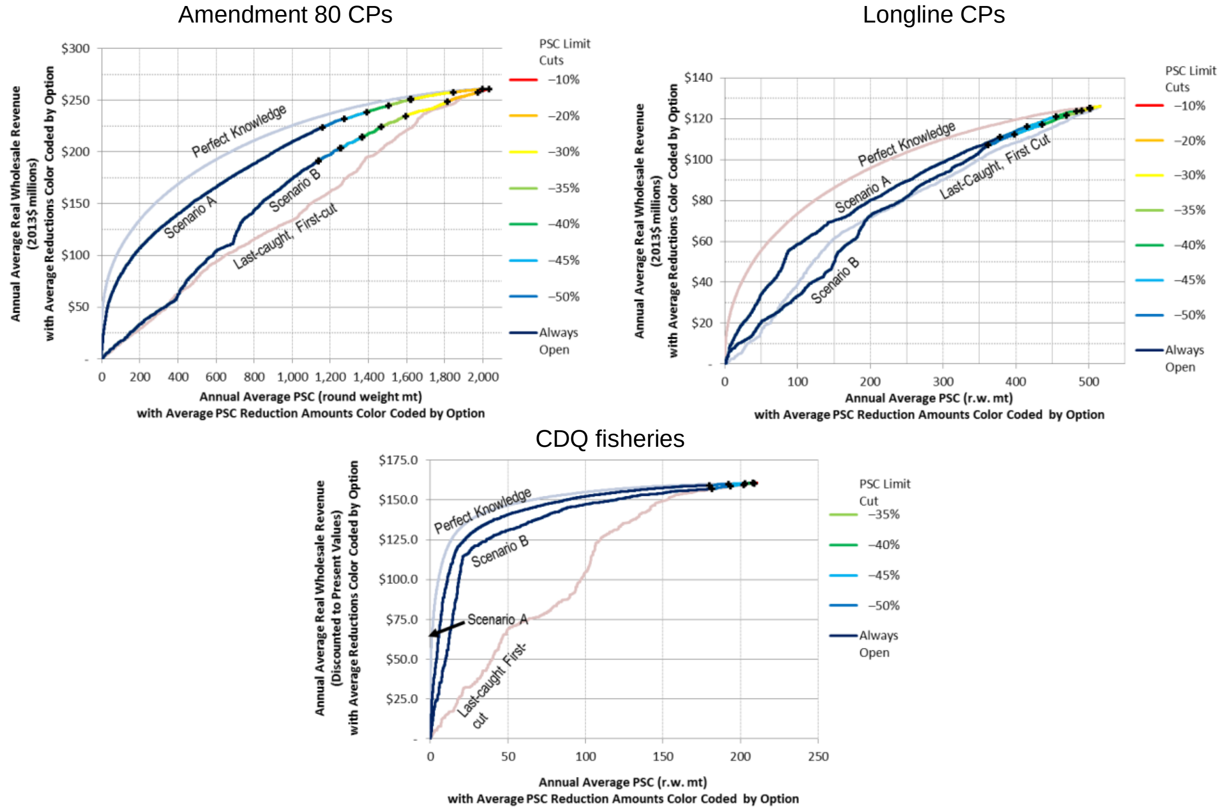


Figure ES-3 shows catch progression charts for the impacts of individual sectors, where it was possible to create them. The figures highlight that there is often not a strict linear relationship between the reduction of PSC mortality and the reduction of revenue to the sector. For example, for the Amendment 80 CPs, shows the Scenario A trajectory as a curve, which becomes flatter in the upper right-hand quadrant of the graph. The bolded **+** marks the spot on the catch progression line corresponding with the PSC reduction percentages in the Council's alternative, and the segments are incrementally color-coded to indicate the additional amount of annual average wholesale revenue (discounted to present values) that is projected as foregone with each percentage reduction. In Scenario A for Amendment 80, the additional foregone revenue associated with moving from a ten to a twenty percent reduction in the PSC limit is relatively little compared with the reduction in moving for example from a forty-five to a fifty percent reduction, for which the trajectory of the line is much steeper. It is important to note that in terms of absolute foregone revenue, the larger percentage reductions also incorporate the segments from all the previous reductions as well.

The Amendment 80 CP graph shows the catch progression line for Scenario B as well as alternative catch progression lines, for comparison. The 'perfect knowledge' line would result if the IMS Model had assumed the sector had perfect knowledge in advance about their upcoming harvests, and chose not to fish as many individual trips with the lowest revenue to PSC ratio as necessary in order to meet the PSC constraint. Conversely, the last-caught first-cut reduction methodology assumes that fishermen would not change behavior in any way in response to a reduced PSC limit, and vessels fish as they did historically until the fishery is closed. There is a much more linear relationship between PSC and revenue under the last-caught-first-cut methodology. For longline CPs, the fact that Scenario A and B are closer to the last-caught-first-cut catch progression line may be an indicator that the longline CPs are already operating in a manner that keeps PSC mortality at relatively low levels. For CDQ fisheries, the resemblance of the Scenario A and B lines to the "perfect knowledge" progression line is striking, and may be related to the fact that vessels operating CDQ groundfish fisheries are allowed to declare after the fact, whether a tow will count against a CDQ allocation, or whether it will be a part of the non-CDQ operations.

Figure ES-3 Annual Average Discounted Present Value of Wholesale Revenue and Halibut PSC under the PSC Limit Reduction Options for Amendment 80 CPs, Longline CPs and CDQ



One downside of using the catch progression lines to display impacts over multiple years is that the considerable interannual variability that occurs with respect to annual PSC mortality is lost. The actual model used to generate the impact analysis used the yearly equivalent of the catch progression lines shown in the figure. Table ES-2 illustrates this variability in the PSC mortality values for each sector for 2008 to 2014.

For groundfish sectors, in addition to overall harvest and revenue impacts, the analysis also summarizes the impacts of the PSC limit reduction options to crew members, and payments to crew members. Table ES-5 shows the annual average discounted present value of payments to crew under the status quo (for example, $71 million for Amendment 80) over the 10-year future period, and then shows the projected reductions in the annual average present value of crew payments under the options. Two alternative ways to deal with the reductions are also discussed in the RIR: companies can keep the same number of crew employees as under the status quo, and reduce everyone's compensation proportionally; or they can cut the number of persons employed and maintain the same level of payments per person. Most likely the end result will be a combination of both. For Amendment 80 vessels, the analysis further highlights two separate components of the Amendment 80 fleet: vessels with significant participation in Atka mackerel fisheries, and flatfish-focused vessels. In general, the Atka mackerel CPs and their crews are projected to experience smaller negative consequences on a percentage basis than CPs and crews that focus on flatfish. The primary reason for the differential impact is that in general, the Atka mackerel fishery has much lower halibut encounter rates than in the average flatfish target fishery. Similar subdivisions of the BSAI trawl limited access fleet, based on the relative dependence on the AFA pollock fishery, are described in the RIR and used to assess differential impacts to five different components of this relatively large and heterogeneous group of vessels.

Table ES-5 Average Annual Impacts of PSC Limits to Crew Members, for Amendment 80, BSAI trawl limited access, and longline CPs

DPV of Average Payments to Crew (2013 $millions)		Status Quo	1a: –10%	1b: –20%	1c: –30%	1d: –35%	1e: –40%	1f: –45%	1g: –50%
Amendment 80 CPs	Scen A	$71.05	($0.13)	($0.98)	($2.85)	($4.44)	($6.20)	($7.94)	($10.16)
	Scen B	$71.02	($0.87)	($3.32)	($7.13)	($9.93)	($12.70)	($15.58)	($18.96)
BSAI TLA	Scen A	$191.93	($0.12)	($0.45)	($1.14)	($1.39)	($1.76)	($2.08)	($2.73)
	Scen B	$191.75	($0.30)	($1.26)	($2.31)	($3.16)	($3.92)	($4.84)	($6.02)
Longline Pcod CPs	Scen A	$44.12	-	-	($0.36)	($0.87)	($1.76)	($3.49)	($5.30)
	Scen B	$44.12	-	-	($0.78)	($1.55)	($3.13)	($4.80)	($6.66)

There are three ways to reduce PSC mortality in the groundfish fisheries. The first is simply to reduce groundfish fishing effort. Second, the fleet can reduce encounters with halibut. This requires some knowledge of where halibut are, to avoid fishing in those areas to begin with, or at least requires a change in behavior for fishermen to move away from areas of high halibut interception once landings demonstrate that there are halibut on the grounds. The fleet also can modify the gear used in the water, to encourage halibut to escape before they can be landed. Third, reductions can be achieved by reducing the mortality of halibut that encounter the fishing gear. This can involve changes both to gear and handling procedures, to improve the survivability of halibut once they are released back into the water.

Mathematically, these three factors can be translated to halibut PSC (kg) = groundfish (mt) × halibut encounter rate (kg/mt) × discard mortality rate (DMR). A reduction of an equivalent percentage in any one of the three components has the same relative impact on halibut PSC. While reductions in halibut encounters and/or total groundfish are in the control of the fishermen, through changes in fishing patterns and techniques, the discard mortality rates are determined through the harvest specifications process.

In the impacts analysis for this action, the modelled response to reduced PSC limits is to reduce total groundfish harvest. The methodology includes, however, an assumption that, where possible, fishermen will optimize their harvest in response to constraining limits, for example by prioritizing fishing operations in the best target-area-months for revenue per mt of halibut PSC, and reducing effort in the least efficient months. The effect of optimization is to change both total groundfish and the halibut encounter rate to achieve PSC reduction. In most cases, changes in halibut encounters are larger, on a percentage basis, than changes in total groundfish harvest (Table ES-5), and this, the analysts assert, is an indication that behavior changes have occurred. For example, under the 50 percent reduction option with Scenario A for Amendment 80 CPs, a PSC mortality reduction of 43 perent is achieved with reductions in the halibut encounter rate of 32 percent and of the groundfish harvest by only 16 percent. The BSAI TLA sector, which still operates under a race for fish for some target fisheries, has fewer options to optimize fishing and respond with behavior change. For example, at a 50 percent reduction under Scenario A, to reduce halibut PSC by 27 percent requires a reduction in groundfish harvests of 21 percent.

Table ES-5 Groundfish Harvest Changes (Δ) and Resulting Changes in Halibut Encounters and Halibut Encounter Rates for Amendment 80 CPs, BSAI trawl limited access, and Longline CPs

		Percentage Change from Status Quo Under the Suboptions							
	Variable	1a: -10%		1b: -20%	1c: -30%	1d: -35%	1e: -40%	1f: -45%	1g: -50%
A80-CPs	**Scenario A**								
	Groundfish Harvest (Δ %)	-0.2%	-1.3%	-1.7%	-4.7%	-7.1%	-9.9%	-12.7%	-16.2%
	Halibut Encounters (Δ %)	-1.9%	-2.9%	-9.4%	-20.4%	-26.2%	-31.9%	-37.6%	-43.2%
	Halibut Encounter Rate (Δ %)	-1.7%	-1.6%	-7.8%	-16.4%	-20.6%	-24.4%	-28.5%	-32.2%
	Halibut PSC mortality (Δ %)	-2.0%	-2.9%	-9.4%	-20.3%	-26.2%	-31.8%	-37.5%	-43.1%
	Scenario B								
	Groundfish Harvest (Δ %)	-1.3%		-5.1%	-10.7%	-14.8%	-18.8%	-23.0%	-28.1%
	Halibut Encounters (Δ %)	-2.9%		-10.6%	-21.4%	-27.7%	-32.7%	-38.2%	-44.0%
	Halibut Encounter Rate (Δ %)	-1.6%		-5.8%	-11.9%	-15.1%	-17.1%	-19.8%	-22.2%
	Halibut PSC mortality (Δ %)	-2.9%		-10.7%	-21.4%	-27.7%	-32.7%	-38.2%	-44.0%
BSAI TLA (excluding pollock)	**Scenario A**								
	Groundfish Harvest (Δ %)	-0.9%		-3.4%	-8.2%	-10.2%	-13.4%	-15.8%	-21.0%
	Halibut Encounters (Δ %)	-2.8%		-6.4%	-11.6%	-13.8%	-17.7%	-21.8%	-26.8%
	Halibut Encounter Rate (Δ %)	-2.0%		-3.1%	-3.7%	-4.0%	-5.0%	-7.1%	-7.4%
	Halibut PSC mortality (Δ %)	-3.0%		-6.6%	-12.1%	-14.3%	-18.2%	-22.4%	-27.4%
	Scenario B								
	Groundfish Harvest (Δ %)	-2.3%		-10.0%	-18.4%	-24.9%	-31.0%	-38.1%	-45.9%
	Halibut Encounters (Δ %)	-3.9%		-9.6%	-17.8%	-24.1%	-30.8%	-39.4%	-48.3%
	Halibut Encounter Rate (Δ %)	-1.6%		+0.4%	+0.6%	+1.1%	+0.3%	-2.1%	-4.5%
	Halibut PSC mortality (Δ %)	-4.1%		-10.0%	-18.3%	-24.6%	-31.2%	-39.8%	-48.7%
LGL-CPs	**Scenario A**								
	Groundfish Harvest (Δ %)	-		-	-0.7%	-1.9%	-3.8%	-7.8%	-11.9%
	Halibut Encounters (Δ %)	-		-	-2.5%	-5.9%	-11.3%	-18.8%	-26.1%
	Halibut Encounter Rate (Δ %)	-		-	-1.8%	-4.1%	-7.7%	-12.0%	-16.1%
	Halibut PSC mortality (Δ %)	-		-	-2.7%	-6.2%	-11.7%	-19.2%	-26.4%
	Scenario B								
	Groundfish Harvest (Δ %)	-		-	-1.7%	-3.4%	-6.9%	-10.8%	-15.0%
	Halibut Encounters (Δ %)	-		-	-4.6%	-8.5%	-14.9%	-22.3%	-29.1%
	Halibut Encounter Rate (Δ %)	-		-	-3.0%	-5.3%	-8.5%	-12.9%	-16.5%
	Halibut PSC mortality (Δ %)	-		-	-4.8%	-8.8%	-15.3%	-22.6%	-29.4%

Even though handling practices that measurably reduce the discard mortality rate in a groundfish fishery would have the same effect as a reduction in actual PSC of the same percentage, these changes will not be accounted for in the estimation of PSC mortality without a change to the Council's process for calculating DMRs, which is currently based on a ten-year average of observed release condition. In 2015, one of the the Amendment 80 cooperatives is operating a deck sorting exempted fishing permit (EFP), which is evaluating a process to sort halibut on deck in order to improve release condition and survivability. Under the EFP, vessels are not subject to the assumed DMR adopted by the Council in the harvest specifications process for deck-sorted hauls, and will be credited with the actual halibut release condition for fish that are sorted on deck, although all halibut that are not sorted on deck and flow through to the factory will have a higher mortality rate assigned as the catch monitoring requirements of the EFP require them to be held longer than they would under normal fishing conditions. The EFP, if successful, will inform the development of a process for identifying an assumed DMR for deck-sorted tows that can be adopted on a periodic basis, as with current DMRs.

Directed halibut fishery

The net effect of this action on the directed halibut fishery will be the cumulative result of the chosen PSC reduction options for multiple sectors. Table ES-6 summarizes the impacts of applying the same percentage reduction option to each of the affected sectors. For example, the rows showing outcomes under a -10% change include a 10 percent reduction in halibut PSC limits for the Amendment 80 CPs, the BSAI trawl limited access fisheries, the longline CPs and the groundfish CDQ fisheries (there are no impacts associated under any of the percentage reduction levels for longline catcher vessels or the non-trawl other targets PSC limit; Table ES-3). For example, with 30 percent proposed PSC limit reductions for all sectors, it is projected that the entire Area 4 halibut fishery could realize an increase in annual average harvest volumes by up to 18 percent. Note that under PSC limit reductions of 50 percent, projected increases to harvest volumes in Area 4CDE would be expected to range between 275 and 349 percent of status quo levels, which, as modelled, were very low – lower, in fact, than current or historic levels of harvest. This is because the model mimics the blue line application of the IPHC harvest policy, without adjustments to the directed fishery harvest limit (as occurred in 2015 for Area 4CDE), so this represents an increase from the blue line catch limits for Area 4CDE, not the actual 4CDE harvest limit as adopted.

Table ES-6 Summary of harvest impacts for commercial halibut fishery from reductions across all sectors combined, in pounds net weight

Option	Commercial Halibut Fishery Impacts							
	Scenario A				Scenario B			
	4A	4B	4CDE	Area 4	4A	4B	4CDE	Area 4
	Average Annual Change from the Status Quo in Commercial Halibut (net weight 1,000s pounds)							
Status Quo	1,549	1,382	276	3,207	1,549	1,383	283	3,215
All Sectors: -10%	52	0.4	28	81	44	2	59	105
All Sectors: -20%	122	2	132	256	69	10	215	293
All Sectors: -30%	203	20	302	525	126	24	431	581
All Sectors: -35%	235	29	416	679	162	45	557	764
All Sectors: -40%	279	38	534	852	199	53	688	941
All Sectors: -45%	351	43	653	1,046	244	63	835	1,143
All Sectors: -50%	431	50	758	1,239	284	82	986	1,353

Table ES-4 provides a summary of impacts to areas outside of the BSAI, from future yield of U26 halibut. For example, with a 30 percent PSC reduction across all sectors, future annual yield to halibut fisheries outside of Area 4 would be up to 145,000 net weight pounds. Under a similar 50 percent reduction, the increased future yield would be up to 261,000 net weight pounds.

Community analysis

The community analysis evaluates community and regional participation patterns in the BSAI groundfish and halibut fisheries. In general, the potential beneficial impacts to the various halibut fisheries would be spread more widely among Alaska communities than would be the potential adverse impacts to the groundfish fisheries. While there are many more Alaska communities directly engaged in the BSAI halibut fisheries than in the BSAI groundfish fisheries in general, the communities that are assumed to have the greatest potential for realizing substantial beneficial impacts under Alternative 2 are 15 communities identified as halibut-dependent. These are Adak, Atka, Akutan, Chefornak, Hooper Bay, Kipnuk, Merkoyuk, Newtok, Nightmute, Savoonga, St. George, St. Paul, Toksook Bay, Tununak, and

Unalaska. Relative levels of BSAI halibut fishery engagement for these communities along with selected demographic characteristics are shown graphically in Table ES-8[3].

Table ES-8 Graphic Representation of Potentially Affected BSAI Halibut-Dependent Communities' Annual Average Engagement in BSAI Halibut Fisheries

Community	CDQ Group	Community Size	Proportion of Total Population			Shore-Based Processing Location	Number of Halibut CVs	Halibut Ex-Vessel Gross Revenues as Percentage of Total Ex-Vessel Gross Revenues	
			Alaska Native	Minority	Low-Income			Halibut CVs Only	All Community CVs
Adak		•	•	●	○	•	•	●	●
Akutan	APICDA	○	•	●	○	○	•		
Atka	APICDA	•	●	●	•	•	•		
St. George	APICDA	•	●	●	•	•	•		
Unalaska		○	•	○	•	●	●	●	○
St. Paul	CBSFA	•	●	●	•	○	●	●	●
Chefornak	CVRF	•	●	●	○	•	●	●	•
Hooper Bay	CVRF	○	●	●	●	•	○	●	•
Quinhagak*	CVRF	•	●	●	●	•	○		
Kipnuk	CVRF	•	●	●	●	•	●	●	•
Mekoryuk	CVRF	•	●	●	○	•	●	●	●
Newtok	CVRF	•	●	●	●		○	●	○
Nightmute	CVRF	•	●	●	○		○	●	●
Toksook Bay	CVRF	•	●	●	•	•	●	●	○
Tununak	CVRF	•	●	●	●	•	●	●	●
Nome*	NSEDC	○	○	○	•	○	○	○	•
Savoonga	NSEDC	•	●	●	●	•	○	●	●

*Note: Quinhagak and Nome were not identified as BSAI halibut-dependent communities. Quinhagak has been included to allow for more complete data disclosure than would be possible otherwise; Nome has been included as a regional center (and was close to a dependency threshold).

KEY for Table

Type/Level of Engagement		•	○	●
Community Size	2010 population =	less than 1,000	1,000 – 9,999	greater than 10,000
Alaska Native and Minority Proportion	2010 population =	less than 50 percent	50.0 – 74.9 percent	75.0 or more percent
Low-Income Population Proportion	2010 population =	less than 15 percent	15.0 – 24.9 percent	25.0 or more percent
BSAI Halibut Shore-Based Processing Participation	2008-13 annual avg. =	0.5 – 0.9 plants	1.0 – 1.9 plants	2.0 or more plants
BSAI Halibut Catcher Vessel Participation	2008-13 annual avg. =	1.0 – 4.9 vessels	5.0 – 9.9 vessels	10.0 or more vessels
BSAI Halibut Ex-Vessel Gross Revenue Proportion	2008-13 annual avg. =	less than 25 percent	25.0 – 49.9 percent	50.0 or more percent

[3] Note, there will be benefits realized to halibut-dependent communities in the GOA, British Columbia, and the Pacific coast also from the reduction in PSC mortality of U26 fish in the BSAI, as summarized in Table ES-4, but the effects of are much lower on halibut fisheries outside of Area 4, and will be realized over a long range of years, not beginning until 4 to 7 years after the instance of PSC reduction in the BSAI. As a result, this document focuses on community-level impacts to BSAI / Area 4 communities.

Relatively few Alaska communities directly and on a consistent basis participate in the BSAI groundfish fisheries, as determined by location of community resident-owned vessels participation in the fishery and/or location of shore-based processor participation in the fishery in 2008 to 2013. Table ES-9 summarizes BSAI groundfish fishery participation patterns for Alaska communities substantially dependent on or substantially engaged in the harvest or processing of fishery resources to meet social and economic needs of these communities and the likely community-level impacts of Alternative 2 on these communities. It should be noted also that CDQ communities participate in the BSAI groundfish fishery in multiple ways, not only through quota ownership but through investment in direct fishery participation in a variety of sectors as well, with specific direct fishery and sector participation engagement and dependency varying by CDQ group. Depending on specific patterns of investment in direct participation, individual CDQ groups and their communities could be impacted by any of the Alternative 2 options, suboptions, and level of BSAI halibut PSC reduction in ways similar to other direct fishery participants.

Table ES-9 Graphic Representation of Potentially Affected Alaska Communities' Annual Average Engagement in BSAI Groundfish and Halibut Fisheries

Note, however, that the Seattle metropolitan statistical area has the greatest engagement, by far, for all communities in all categories (except BSAI groundfish hook-and-line catcher vessels and being the location of BSAI groundfish and halibut shore-based processing). Newport (Oregon) has the second-highest engagement in the BSAI groundfish trawl catcher vessel sector.

Community	Relative Community Size	BSAI Groundfish Engagement					BSAI Halibut Engagement	
		Locally Owned Catcher Vessels		Locally Owned Catcher Processors		Shore-Based Processing Location	Locally Owned Catcher Vessels	Shore-Based Processing Location
		Trawl	Hook & Line	Trawl	Hook & Line			
Adak	•		•			○	•	•
Akutan	○					○	•	○
Anchorage	●		•	•	○	•		
King Cove	•					○		
Kodiak	○	●	•			•	●	
Petersburg	○				●			
Sand Point	•	•				○		
Unalaska	○		●			●	●	●

Note: the only Alaska communities not included in the table that have BSAI groundfish values in the ranges shown are Anchor Point and Juneau, with hook-and-line catcher vessel participation in the 1.0-2.9 and 0.5-0.9 annual average vessel categories, respectively.

KEY for Table

Type/Level of Engagement		•	○	●
Community Size	2010 population =	less than 1,000	1,000 – 9,999	10,000 or more
BSAI Groundfish Catcher Vessel Participation	2008-13 annual avg. =	0.5 – 0.9 vessels	1.0 – 2.9 vessels	3.0 or more vessels
BSAI Groundfish Catcher Processor Participation	2008-13 annual avg. =	0.5 – 0.9 vessels	1.0 – 2.9 vessels	3.0 or more vessels
BSAI Groundfish Shore-Based Processing Participation	2008-13 annual avg. =	0.5 – 0.9 plants	1.0 – 1.9 plants	2.0 or more plants
BSAI Halibut Catcher Vessel Participation	2008-13 annual avg. =	1.0 – 4.9 vessels	5.0 – 9.9 vessels	10.0 or more vessels
BSAI Halibut Shore-Based Processing Participation	2008-13 annual avg. =	0.5 – 0.9 plants	1.0 – 1.9 plants	2.0 or more plants

Outside of Alaska, substantial engagement in the BSAI groundfish fisheries is highly concentrated in the Seattle Metropolitan Statistical Area (Seattle MSA), with a secondary concentration in the BSAI groundfish trawl catcher vessel fleet in Newport, Oregon. The Seattle MSA is the community most substantially engaged in the BSAI groundfish fishery, but is among the least substantially dependent on those fisheries, of the engaged communities. While community-level dependence is not a salient issue for the Seattle MSA or Newport, potential adverse impacts of some of the Alternative 2 options and suboptions would be profound in terms of potential loss of revenues to individual operations and sectors and potential loss of income and/or employment to relatively large numbers of individuals. Given the type of high and adverse impacts that may accrue to some sectors within the Seattle MSA, environmental justice issues may be of concern as well, based on industry-supplied data that indicate high proportions of minority employees in the catcher processor sector[4].

Changes Since the Initial Review Draft

The following does not represent an exhaustive list, but major changes include:

- Revised **purpose and need** based on Council discussion in February 2015 (Section 1.2)
- **Revised options** based on Council's February 2015 motion, including expansion of the range of PSC reductions out to 40, 45, and 50 percent, and discussion of separate PSC limits for Amendment 80 between the cooperatives and the limited access sector (Chapter 2)
    - Staff reordered the options, discussed **implementation** of the options in the FMP and or regulations, and discussed how the Amendment 80 limited access suboption would be written in regulations (Section 2.2)
    - **Impacts** of the expanded range are included in each of the RIR impact sections (Section 4.8 through 4.12); Amendment 80 limited access specifically is in Section 4.8.2
- Additional information on **status of halibut and halibut management**, including more information on the stock assessment and estimates of spawning, exploitable, and juvenile biomass; changes in the understanding of stock status with the resolution of the retrospective bias in 2012; discussion of stock status with respect to overfishing; size at age information; discussions at the 2015 IPHC annual meeting (Sections 3.1.1 and 3.1.2)
- Additional information on **halibut PSC mortality**, including discard mortality rates (Section 3.1.3.2), summary of voluntary reductions in 2014 from industry reports in February 2015 and update on 2015 deck sorting exempted fishing permit (Section 3.1.3.6)
- Changes to the **economic model** – U26 fish now modeled explicitly, status quo is modeled using retrospective biomass values, assumptions are clearly identified (Section 4.6)
- Description of **groundfish fishery behavior changes** captured in the model, and discussion of other behavior changes that may be possible (Section 4.4.1.5 and sector impacts in Sections 4.8 through 4.12, Appendix B)
- Additional **metrics for economic analysis**: wholesale revenue per mt of halibut PSC (Section 4.4.1.4), crew impacts (Section 4.4.1.2 and sector impacts in Sections 4.8 through 4.12), CDQ ownership in groundfish fisheries (Section 4.4.6)
- Summary of **halibut fishery impacts** from reductions across all sectors, and discussion of impacts of this action on halibut fisheries coastwide (Section 4.13.1)
- **Community analysis** of halibut- and groundfish-dependency (Appendix C, Sections 4.13.1.3 and 4.13.2.3)
- Summary of **Halibut Act** and references to relevant sections for that and Magnuson-Stevens Act National Standards considerations (Chapter 6)

[4] Per CEQ guidance on environmental justice, under NEPA, the identification of a disproportionately high and adverse human health or environmental effect (including interrelated social, cultural, and economic effects) on a low-income population, minority population, or Indian tribe does not preclude a proposed agency action from going forward, nor does it necessarily compel a conclusion that a proposed action is environmentally unsatisfactory. Rather, the identification of such an effect should heighten agency attention to alternatives, mitigation strategies, monitoring needs, and preferences expressed by the affected community or population (http://www.epa.gov/environmentaljustice/resources/policy/ej_guidance_nepa_ceq1297.pdf).

1 Introduction

This document analyzes proposed management measures to reduce Pacific halibut prohibited species catch (PSC) mortality limits in the Bering Sea and Aleutian Islands (BSAI) groundfish fisheries. PSC limit reductions are considered for various sectors, including the BSAI trawl limited access sector, the Amendment 80 sector, longline catcher vessels, longline catcher processors, and the Community Development Quota sector (i.e., a reduction to the CDQ's allocated prohibited species quota reserve). The objective of reducing PSC limits would be to minimize bycatch to the extent practicable and provide additional harvest opportunities in the directed halibut fishery.

This document is an Environmental Assessment/Regulatory Impact Review/Initial Regulatory Flexibility Analysis (EA/RIR/IRFA). An EA/RIR/IRFA provides assessments of the environmental impacts of an action and its reasonable alternatives (the EA), the economic benefits and costs of the action alternatives, as well as their distribution (the RIR), and the impacts of the action on directly regulated small entities (the IRFA). This EA/RIR/IRFA addresses the statutory requirements of the Magnuson Stevens Fishery Conservation and Management Act (MSA), the National Environmental Policy Act, Presidential Executive Order 12866, and the Regulatory Flexibility Act. An EA/RIR/IRFA is a standard document produced by the Council and the National Marine Fisheries Service (NMFS) Alaska Region to provide the analytical background for decision-making.

1.1 Bycatch and PSC terminology

The Council manages the groundfish fisheries of the Bering Sea and Aleutian Islands under the authority of the MSA (16 U.S.C. 1802(2)), and through a Fishery Management Plan for the BSAI Management Area (BSAI FMP). The Council is guided in the management of groundfish by ten national standards (see Section 6.1) set forth in the MSA. In developing its fishery management policies, the Council often has to balance competing standards. In managing groundfish fisheries to achieve their optimal yields (National Standard 1), the Council uses the best available scientific information (National Standard 2) and also strives to provide for the sustained participation and to minimize adverse economic impacts on fishing communities (National Standard 8) and to minimize bycatch to the extent practicable, and the mortality associated with such bycatch (National Standard 9).

Bycatch, as defined by the MSA, "means fish which are harvested in a fishery, but which are not sold or kept for personal use, and includes economic discards[5] and regulatory discards." The term "regulatory discards" means "fish harvested in a fishery which fishermen are required by regulation to discard whenever caught, or are required by regulation to retain, but not sell." In the case of the BSAI FMP (and also the Fishery Management Plan for Gulf of Alaska Groundfish), the Council has designated Pacific halibut, along with several other fully utilized species such as salmon, herring, and crab, as "prohibited species" in groundfish fisheries, which fishermen are required by regulation to discard. These species are identified in the FMPs; their capture is required to be minimized; and their retention is prohibited. Unintended removals of prohibited species are separately monitored and controlled under the groundfish fishery management plans. In the context of the BSAI FMP, "halibut PSC" refers to the bycatch of halibut in the groundfish fisheries. This analysis primarily addresses halibut PSC mortality, i.e., the subset of halibut PSC that is assumed to be dead as a consequence of interactions with the groundfish fisheries. Mortality calculations are made for all halibut PSC in the groundfish fisheries, using discard mortality rates adopted triennially by the Council as part of the harvest specifications process. Halibut PSC limits, and removals of halibut PSC in the groundfish fisheries, are specified in terms of metric tons, round weight, of halibut PSC mortality.

[5] "Economic discards" are defined as "fish which are the target of a fishery, but which are not retained because of an undesirable size, sex, or quality, or other economic reason."

The International Pacific Halibut Commission (IPHC), which was established in 1923 by the Convention between the United States and Canada for the Preservation of the Halibut Fishery of the North Pacific Ocean and Bering Sea, is responsible for the overall biologic assessment and conservation of Pacific halibut off the coasts of Alaska, British Columbia, and the western United States (the Council makes allocative decisions with respect to Pacific halibut targeted off Alaska, under the authority of the Northern Pacific Halibut Act (Halibut Act) of 1982). In the parlance of the IPHC, “bycatch” refers to the mortality of Pacific halibut occurring in commercial fisheries that target other species, including the groundfish fisheries. The IPHC uses the term “wastage” to refer to halibut killed, but not landed in the commercial halibut Individual Fishing Quota (IFQ) fishery (e.g., due to lost gear, capture of undersized fish). This analysis refers to halibut PSC mortality in the context of the proposed action, except where appropriate to describe the IPHC catch limit process, or their research or stock assessment information. The IPHC manages and reports on halibut removals in pounds, net weight, of halibut mortality, and assumes that net weights are 75 percent of round weights.

1.2 Purpose and Need

Consistent with the MSA’s National Standard 1 and National Standard 9, the Council and NMFS use halibut PSC mortality limits to minimize halibut bycatch (halibut PSC) in the groundfish fisheries to the extent practicable, while achieving, on a continuing basis, the optimum yield from the groundfish fisheries. The groundfish fisheries cannot be prosecuted without some level of halibut interception. Although fishermen are required by regulation to avoid the capture of any prohibited species in groundfish fisheries, the use of halibut PSC limits in the groundfish fisheries provides an additional constraint on halibut PSC mortality, and promotes conservation of the halibut resource. Halibut PSC limits provide a regulated upper limit to mortality resulting from halibut interceptions, as continued groundfish fishing is prohibited once a halibut PSC limit has been reached for a particular sector and/or season. This management tool is intended to balance the optimum benefit to fishermen, communities, and U.S. consumers which depend on both halibut and groundfish resources.

The halibut resource is fully allocated. The IPHC accounts for incidental halibut removals in the groundfish fisheries, recreational and subsistence catches, and other sources of halibut mortality before setting commercial halibut catch limits each year. Declines in the exploitable biomass of halibut since the late 1990s, and decreases in the Pacific halibut catch limits set by the IPHC for the directed BSAI halibut fisheries (IPHC Area 4)), especially beginning in 2012 for the directed fishery in the northern and eastern Bering Sea (Area 4CDE), have raised concerns about the levels of halibut PSC mortality by the commercial groundfish trawl and hook-and-line sectors. Reductions in BSAI halibut PSC mortality have not been proportional to the reductions in Area 4 directed halibut harvest limits since 2011. The Council acknowledges that BSAI halibut PSC mortality levels have declined in some sectors since the current PSC limits were implemented and that PSC mortality does not reach the established sector limits in most years. The Council also recognizes efforts by the groundfish industry to reduce total halibut PSC mortality in the BSAI, but these efforts have had the unintended effect of concentrating groundfish fishing effort in Area 4CDE, and increasing the proportion of Area 4CDE halibut exploitable biomass taken as PSC since 2011. In 2015, the levels of halibut PSC in Area 4CDE increased relative to 2014. Based on the stated IPHC harvest policy and the estimates of exploitable biomass and PSC, the 2015 directed fishery harvest limit for halibut in Area 4CDE could have been reduced to a level that the halibut industry deemed was not sufficient to maintain an economically viable fishery in some communities.

The Council does not have authority to set harvest limits for the commercial halibut fisheries, and halibut PSC mortality in the groundfish fisheries is only one of the factors that affects harvest limits for the commercial halibut fisheries. Nonetheless, halibut removals in the groundfish fisheries are a significant portion of total mortality in BSAI IPHC areas, and have the potential to affect harvest limits for the directed fisheries in Area 4 under the current IPHC harvest policy.

Under National Standard 8, the Council must provide for the sustained participation of and minimize adverse economic impacts on fishing communities. BSAI coastal communities are affected by reduced catch limits for the directed halibut fishery, especially in IPHC Area 4CDE. The Council must balance these communities' involvement in and dependence on halibut with community involvement in and dependence on the groundfish fisheries that rely on halibut PSC in order to operate, and with National Standard 4, which states that management measures shall not discriminate between residents of different states. National Standard 4 also requires allocations of fishing privileges to be fair and equitable to all fishery participants.

The proposed action would reduce the halibut PSC limits in the BSAI, which are established for the BSAI trawl and fixed gear sectors in Federal regulation, and in some cases, in the BSAI Groundfish FMP. Overall halibut PSC limits can be modified only through an amendment to the regulations and the FMP, although seasonal and some target fishery apportionments of those PSC limits would continue to be set annually through the BSAI groundfish harvest specifications process.

One purpose of the proposed action is to minimize halibut PSC mortality in the commercial groundfish fisheries to the extent practicable, while preserving the potential for the optimum harvest of the groundfish total allowable catches (TACs) assigned to the trawl and hook-and-line sectors. The proposed action aims to minimize halibut PSC mortality to the extent practicable in consideration of the regulatory and operational management measures currently available to the groundfish fleet, and the need to ensure that catch in the trawl and hook-and-line fisheries contributes to the achievement of optimum yield in the groundfish fisheries. Minimizing halibut PSC mortality to the extent practicable is necessary to maintain a healthy marine ecosystem, ensure long-term conservation and abundance of halibut, provide optimum benefit to fishermen, communities, and U.S. consumers that depend on both halibut and groundfish resources, and comply with the Magnuson-Stevens Act and other applicable Federal law.

Another purpose of this action is to provide additional harvest opportunities in the directed halibut fishery, especially in Area 4CDE for western Alaska and Pribilof Island coastal communities. Halibut savings that would occur from reducing halibut PSC mortality below current levels would provide additional harvest opportunities to the directed halibut fisheries in both the near term and long term. Near term benefits to BSAI halibut fisheries would result from the PSC mortality reductions of halibut that are over 26 inches in length (O26). These halibut would be available to the commercial halibut fishery in the area and year that the PSC mortality is foregone, or when the fish reach the legal size limit for the commercial halibut fishery (greater than or equal to 32 inches in total length). Longer term benefits to the directed halibut fisheries would accrue throughout the distribution of the halibut stock, from a reduction of halibut PSC mortality from fish that are less than 26 inches (U26). Benefits from reduced mortality of these smaller halibut would occur both in the Bering Sea and elsewhere as they migrate and recruit into the directed halibut fisheries.

1.3 History of this Action

Halibut removals often occur in trawl fisheries targeting groundfish species (such as pollock, Pacific cod, and flathead sole). Interceptions of halibut also occur in groundfish hook-and-line and pot fisheries. Pacific halibut are designated as "prohibited" in the BSAI FMP, and regulations require that all halibut caught incidentally must be discarded, regardless of whether the fish is living or dead. The BSAI Groundfish FMP has been amended several times since implementation over thirty years ago, to expressly address halibut PSC limits.

Under PSC limits, the Council's intent is to control the bycatch of halibut intercepted in groundfish fisheries. These PSC limits are intended to optimize total groundfish harvest, while taking into consideration the anticipated amounts of halibut PSC mortality in each directed groundfish fishery. The halibut PSC allowances are apportioned by target fishery, gear type, and season. Essentially, these PSC limits direct fisheries, by area or time, to regions where the highest volume or highest value target species may be harvested with reduced halibut PSC mortality. Reaching a seasonal or sector halibut PSC limit results in closure of a directed groundfish fishery, even if some of the groundfish TAC for that fishery remains unharvested.

Halibut PSC limits in the BSAI Groundfish FMP and Federal regulations are specified at 3,675 mt of halibut mortality for trawl gear, and 900 mt of halibut mortality for non-trawl fisheries. A proportion of each of these overall limits is allocated to the CDQ program as a prohibited species quota (PSQ) reserve, which is not apportioned by gear or fishery. A proportion of the trawl PSC limit is specifically allocated to Amendment 80 (including an unallocated amount representing a phased-in reduction in that fleet's halibut usage following implementation of the Amendment 80 program). The remaining trawl and non-trawl PSC limits are then annually allocated in the harvest specifications process to the fishery categories specified in regulations, for annual or seasonal durations. Groundfish pot gear is exempted from halibut PSC limits because the halibut discard mortality rate and total mortality associated with this gear type is relatively low, and existing gear restrictions for pots (e.g., halibut excluders) are intended to further reduce halibut PSC mortality. Groundfish jig gear is also exempted, because of their low overall catch of groundfish in the BSAI. The Council also chooses not to set a halibut PSC limit for the IFQ sablefish hook-and-line fishery, which also has low halibut PSC mortality as legal-size halibut must be retained when a halibut permit holder is aboard with unused halibut IFQ.

The Council has reviewed several discussion papers, beginning in 2012, evaluating halibut PSC mortality in the BSAI groundfish fisheries, and impacts on the halibut stock. The Council initiated this analysis in June 2014. The Council articulated the following purpose and need statement to originate this action in June 2014. Note, while this statement has not been updated, the Council further articulated the purpose of this action at initial review in February 2015.

> *Halibut is an important resource in the Bering Sea and Aleutian Islands that supports commercial and subsistence fisheries. Halibut is also incidentally taken in commercial groundfish fisheries managed by the Council, and in the directed halibut fishery.*
>
> *Declines in halibut exploitable biomass since the late 1990s have raised concerns about levels of halibut PSC in the BSAI groundfish fisheries. This decline is particularly pronounced in Areas 4A, 4B, and 4CDE. These areas have incurred major reductions in halibut harvest limits since 2003. BSAI halibut Prohibited Species Catch (PSC) in non-directed fisheries have not declined at a rate proportional to harvest reductions in the directed fishery, and the effect of bycatch on the directed fisheries in Area 4CDE is the most pronounced. The IPHC uses the previous year's actual bycatch amount to set the following year's halibut harvest limits; thus, short-term reductions in BSAI halibut PSC could have immediate implications for directed halibut users. Under National Standard 8, the Council must consider the sustained participation of communities when making fisheries management decisions.*
>
> *The Council recognizes that efforts by various sectors of the industry in recent years have reduced halibut PSC; however, the current low status and continued declines in the halibut resource require immediate action by the Council and industry. Additional regulatory measures to avoid halibut, and further minimize halibut PSC mortality would help to improve halibut stock conditions, could provide additional harvest opportunities in the directed halibut fishery, and be consistent with objectives under National Standard 9.*

> *A range of management options are available to reduce halibut bycatch in the BSAI groundfish fisheries. These include reducing existing halibut PSC limits in the trawl and hook and line fisheries and changes in vessel operations that allow halibut to be returned to the sea sooner, thereby reducing halibut mortality.*

At initial review of this analysis in February 2015, the Council extended the range of reduction options for each sector from 10 to 35 percent to 10 to 50 percent. The Council noted that not all sectors were impacted by the smaller range of options, and at final action, the Council wanted to have the opportunity to consider parity among sectors in terms of the impact of PSC reductions. The Council was also stated its concern about preserving a directed halibut fishery in Area 4CDE, and considering proportionality between reductions already sustained by directed halibut fishermen, and those contemplated for groundfish fishery halibut PSC users.

The Council also included suboptions allowing different PSC reduction levels to be selected for Amendment 80 cooperatives and Amendment 80 limited access participants. While currently all Amendment 80 vessels participate in cooperatives, it is possible that vessels could elect to join the limited access sector in future, where there may be fewer opportunities for bycatch reduction. In this instance, the ability to implement a lower PSC limit for the limited access fishery would be a balance against losing the bycatch reduction tools available to vessels participating in a cooperative.

1.4 FMP requirements

Section 3.6.2.1.4 of the BSAI Groundfish FMP requires that annual BSAI-wide Pacific halibut PSC mortality limits for trawl and non-trawl gear fisheries be established in regulations, and may be amended by regulatory amendment. The Secretary, after consultation with the Council, is to consider specific information when initiating a regulatory amendment to change a halibut PSC mortality limit, listed below. This analysis contains the information required by the BSAI Groundfish FMP; the relevant section is noted in brackets adjacent to each item below.

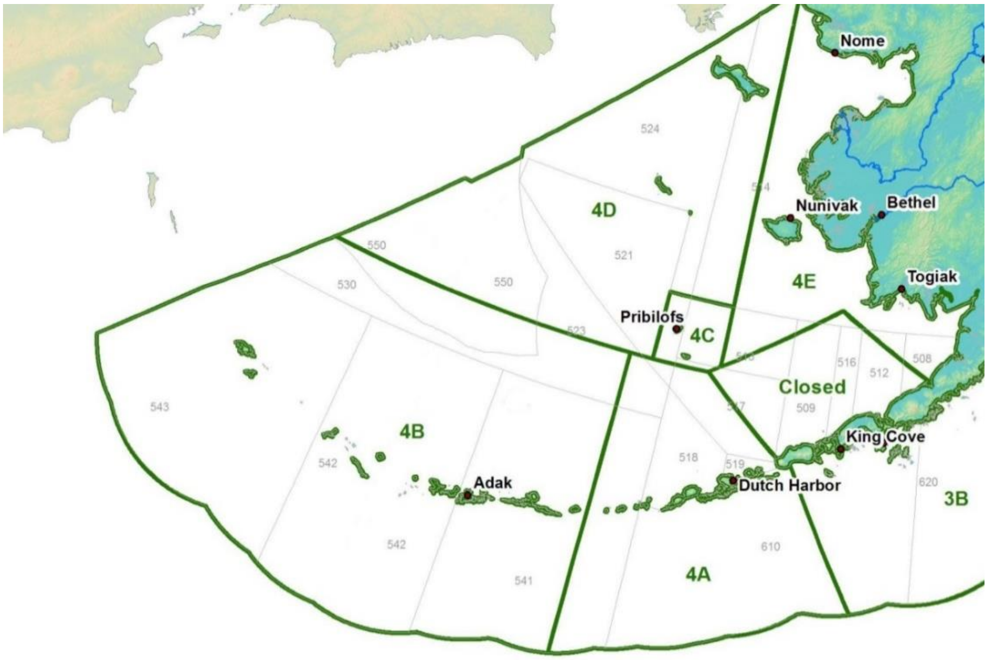
1. estimated change in halibut biomass and stock condition; [Sections 3.1.1]
2. potential impact on halibut stocks and fisheries; [Section 3.1.4]
3. potential impacts on groundfish fisheries; [Section 4]
4. estimated bycatch mortality during prior years; [Section 3.1.3]
5. estimated halibut PSC mortality; [Section3.1.3]
6. methods available to reduce halibut PSC mortality; [Section 0]
7. the cost of reducing halibut PSC mortality; and [Section 4]
8. other biological and socioeconomic factors that affect the appropriateness of a specific bycatch mortality limit in terms of FMP objectives. [Sections 3.2 to 3.7, 4]

Halibut PSC limits are established in the BSAI FMP for the trawl Amendment 80 and BSAI trawl limited access sectors (Section 3.7.5.2.1 of the FMP), as well as the total allocation of halibut PSC limit (from trawl and non-trawl) to the CDQ Program (Section 3.7.4.6 of the FMP). Halibut PSC limits for non-trawl fisheries are specified only in regulation.

1.5 Description of Action Area

The proposed action would be implemented in the BSAI groundfish management areas, which overlap IPHC regulatory areas 4A, 4B, 4C, 4D, and 4E (Figure 1-1).

Figure 1-1 Alaska groundfish reporting areas and IPHC regulatory areas for Pacific halibut.

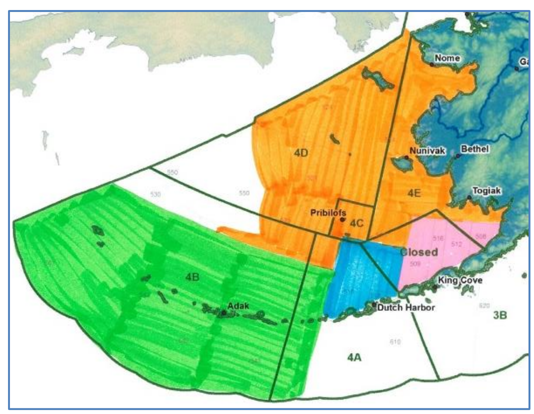


Source: Adapted from NMFS Alaska Region map by Northern Economics Inc.

NMFS management areas do not match exactly to IPHC regulatory areas (Figure 1-1). In IPHC management, and for the purposes of this analysis, the groundfish BSAI reporting areas are equated with IPHC areas as shown in Table 1-1.

Table 1-1 NMFS management area reassignments used to aggregate groundfish and halibut statistics to IPHC regulatory areas

NMFS Areas	Color on map	IPHC Area	Region
517, 518, 519	Green	4A	BSAI
541, 542, 543	Blue	4B	
513, 514, 521, 523, 524	Orange (4CDE)	4CDE and Closed area	
508, 509, 512, 516	Pink (Closed area)		



2 Description of Alternatives

NEPA requires that an EA analyze a reasonable range of alternatives consistent with the purpose and need for the proposed action. The alternatives in this chapter were designed to accomplish the stated purpose and need for the action. All of the alternatives were designed to reduce PSC limits, with the objective of minimizing bycatch to the extent practicable and providing additional harvest opportunities in the directed halibut fishery. The range of reduction levels was designed to allow the Council to consider parity among the groundfish sectors in terms of the impact of PSC reductions, noting that different PSC reduction levels may selected under each option.

The Council revised the original alternatives for analysis at initial review in February 2015; the amended alternatives are listed below. More than one option may be selected simultaneously.

Alternative 1 No action.

Alternative 2 Amend the BSAI Groundfish FMP and Federal regulations[6] to revise halibut PSC limits as follows *(more than one option can be selected)*.

Option 1 Reduce halibut PSC limit for the Amendment 80 Sector by:

Suboption 1 reducing the halibut PSC limit to Amendment 80 cooperatives by:

b) 10 percent b) 20 percent c) 30 percent d) 35 percent e) 40 percent f) 45 percent or g) 50 percent

Suboption 2 reducing the halibut PSC limit to Amendment 80 limited access fishery by:

b) 10 percent b) 20 percent c) 30 percent d) 35 percent e) 40 percent f) 45 percent g) 50 percent or h) 60 percent

Option 2 Reduce halibut PSC limit for the BSAI Trawl Limited Access Sector by:

b) 10 percent b) 20 percent c) 30 percent d) 35 percent e) 40 percent f) 45 percent or g) 50 percent

Option 3 Reduce halibut PSC limit for Pacific cod hook and line catcher processor sector by:

b) 10 percent b) 20 percent c) 30 percent d) 35 percent e) 40 percent f) 45 percent or g) 50 percent

Option 4 Reduce halibut PSC limit for other non-trawl (i.e., hook and line catcher vessels and catcher processors targeting anything except Pacific cod or sablefish) by:

c) 10 percent b) 20 percent c) 30 percent d) 35 percent e) 40 percent f) 45 percent or g) 50 percent

Option 5 Reduce halibut PSC limit for Pacific cod hook and line catcher vessel sector by:

d) 10 percent b) 20 percent c) 30 percent d) 35 percent e) 40 percent f) 45 percent or g) 50 percent

Option 6 Reduce the CDQ halibut PSQ limit by:

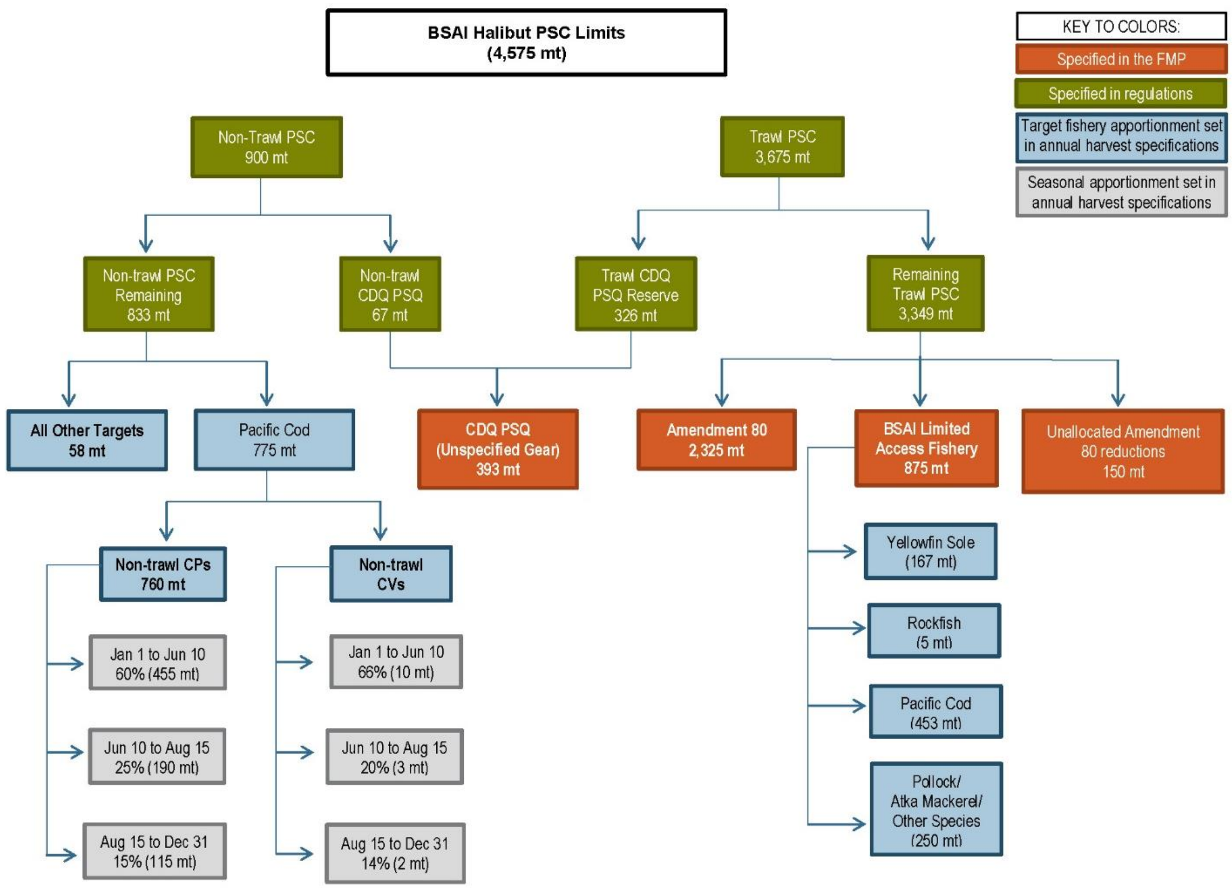
b) 10 percent b) 20 percent c) 30 percent d) 35 percent e) 40 percent f) 45 percent or g) 50 percent

[6] Note, staff has added the clarification "and Federal regulations" to clarify that some PSC limits are not currently specified in the FMP.

2.1 Alternative 1, No Action

Under the status quo, the BSAI trawl and non-trawl halibut PSC limits are set in regulation as an amount of halibut equivalent to 3,675 mt of halibut mortality for trawl gear, and 900 mt of halibut mortality for non-trawl fisheries. A proportion of each of these overall limits is allocated to the CDQ program as a prohibited species quota (PSQ) reserve, which is not apportioned by gear or fishery. A proportion of the trawl PSC limit is specifically allocated to Amendment 80 (including an unallocated amount of 150 mt representing a phased-in reduction in that fleet's halibut usage following implementation of Amendment 80 in 2008). The remaining trawl and non-trawl PSC limits can then be annually allocated in the harvest specifications process to the fishery categories specified in the regulations, on an annual or seasonal basis. Figure 2-1 illustrates how the PSC limits are currently apportioned. When an annual or seasonal PSC limit is reached, all vessels fishing in that fishery category must stop fishing for the remainder of the year or season. The exception is for the PSC limit applying to the pollock/Atka mackerel/"other species" fishery category, where reaching the PSC limit only closes directed fishing for pollock using nonpelagic trawl gear, but directed fishing for Atka mackerel, and for pollock with pelagic gear, is still permitted.

Figure 2-1 Flow Chart of BSAI Halibut PSC Limits for 2014



Source: Developed by Northern Economics based on NMFS AKR Groundfish Harvest Specification Tables.

With respect to the non-trawl PSC limit, there are six possible fishery categories to which the limit can be allocated. In practice, the PSC limit is only allocated to three of these (Pacific cod hook and line catcher vessels (CVs), Pacific cod hook and line catcher processors (CPs), and other nontrawl fisheries). The other three categories are for vessels using pot gear, jig gear, or fishing in the sablefish individual fishing quota (IFQ) fishery. In practice, vessels fishing in these fishery categories are exempt from halibut PSC limits. As described in the proposed rule for implementing harvest specifications for 2014-2015 (78 FR 74063), the pot gear fisheries have low halibut PSC mortality (2 mt in 2013), and halibut mortality in the jig gear fleet is negligible because of the small size of the fishery (the fleet harvested 11 mt of groundfish in 2013), and the selectivity of the gear. The proposed rule also explains that the sablefish and halibut IFQ fisheries have low halibut PSC mortality because the IFQ program requires legal-size halibut to be retained by vessels using hook and line gear if a halibut permit holder is aboard and is holding unused halibut IFQ. In 2013, NMFS estimated halibut PSC mortality in the sablefish fishery to be 1 mt, and 8 mt in 2014. At the Council's request, a discussion about establishing a PSC limit for sablefish was included in Appendix A.

2.2 Alternative 2, Revise Halibut PSC Limits

Options 1 through 6 under Alternative 2 propose reducing the halibut PSC limit for various BSAI sectors. The same seven suboptions are considered for each of the sectors, ranging from a 10 to a 50 percent reduction[7]. Table 2-1 identifies what the proposed PSC limits would be under each reduction option, for each sector.

Table 2-1 Proposed PSC Limits under Alternative 2 (in mt)

	Status quo	a) -10%	b) -20%	c) -30%	d) -35%	e) -40%	f) -45%	g) -50%	h) -60%
Option 1: Amendment 80*	2,325	2,093	1,860	1,628	1,511	1,395	1,279	1,163	930
Option 2: BS trawl limited access	875	788	700	613	569	525	481	438	
Option 3: Hook and line Pcod – CP	760	684	608	532	494	456	418	380	
Option 4: Hook and line CV and CP – targets other than Pcod or sablefish	58	52	46	41	38	35	32	29	
Option 5: Hook and line Pcod – CV	15	14	12	11	10	9	8	8	
Option 6: CDQ PSQ	393	354	314	275	255	236	216	197	

* Note, the eighth possibility in the range, h) -60%, only applies to Amendment 80 Suboption 2, which allows for a different PSC limit reduction for the Amendment 80 limited access fishery.

The halibut PSC limits for the trawl Amendment 80 and BSAI trawl limited access sectors are established in the BSAI FMP, along with the total allocation of halibut PSC limit (from trawl and non-trawl) to the CDQ Program. Changing these PSC limits, under Options 1, 2, and 6 would require an FMP (and regulatory) amendment. The halibut PSC limit for non-trawl fisheries combined is currently only specified in regulation, and would require only a regulatory amendment to change. The Council could choose to establish this limit in the FMP also, for clarity.

The regulations establish the current total BSAI non-trawl PSC limit of 900 mt, and authorize NMFS to apportion the remaining non-CDQ halibut PSC (833 mt) to the established fishery categories through the annual harvest specifications process. The regulations do not specify halibut PSC limits for the non-trawl sectors identified in Alternative 2 (i.e., hook-and-line Pacific cod CV, hook-and-line Pacific cod CP, and hook-and-line other target fisheries CV and CP). Establishing the halibut PSC limits for these sectors through the harvest specifications process enables the Council to annually determine the PSC apportionment among these sectors after considering relevant information such as changes in seasonal distribution of halibut or target groundfish species, changes in halibut biomass or groundfish total allowable catch (TACs), and variations in fishing effort that could occur during the upcoming year. Under Alternative 2 Option 2, the Council is retaining the ability to preserve this annual flexibility for the BSAI TLA sector, where the sector's PSC limit will continue to be apportioned among target fishery categories during the annual harvest specifications process.

[7] Except that the Council included Suboption 2 to reduce the PSC limit for Amendment 80 limited access extending up to 60%.

To implement the non-trawl PSC limit reductions under Alternative 2, NMFS could maintain this more flexible approach to apportioning halibut PSC among sectors by specifying in regulation only the total non-CDQ, non-trawl PSC limit. NMFS would calculate the limit by summing the PSC limits for each of the three sectors, as recommended by the Council in Alternative 2 Options 3, 4, and 5, and shown in Table 2-1. Under this approach, the halibut PSC limits for the hook-and-line Pacific cod CV, hook-and-line Pacific cod CP, and hook-and-line other target fisheries CV and CP sectors would not be specified in regulations.

Alternatively, NMFS could implement Alternative 2 by specificying the PSC limits for these sectors in regulation. This would clearly specify the sector apportionments in regulations, similar to the approach for the Amendment 80 and BSAI trawl limited access sectors. However, specifying the non-trawl sector limits would remove the Council's ability to annually change apportionments of halibut PSC among the non-trawl sectors through the harvest specifications process, in response to changes in biomass or distribution of halibut and target groundfish species, because the limits would be fixed in regulations. Under this approach, any changes to the non-trawl sector PSC limits would require a regulatory amendment. This would also effectively preclude the Council from recommending a PSC limit for the pot, jig, or sablefish hook-and-line IFQ fishery categories without a regulatory amendment. **NMFS requests that the Council recommend a preferred approach for implementation of the non-CDQ, non-trawl PSC limits recommended in Alternative 2.**

2.2.1 Option 1: Amendment 80 PSC limit reduction

The Amendment 80 halibut PSC limit is apportioned among Amendment 80 cooperatives and/or the Amendment 80 limited access sector according to prescribed formulas defined under the implementing regulations for Amendment 80. Option 1 allows the Council to choose a different halibut PSC reduction for the Amendment 80 cooperatives (Suboption 1) than for vessels fishing in Amendment 80 limited access (Suboption 2).

The PSC limit for the Amendment 80 cooperatives could be reduced by a range from 10 to 50 percent. If all Amendment 80 vessels are participating in cooperatives, which has been the case since 2011, this would represent a reduction from 2,325 mt (the current Amendment 80 PSC limit), to between 1,163 mt and 2,093 mt. For each of the Amendment 80 cooperatives, the halibut PSC limit is an annual hard cap, and it is not constrained by target fishery category.

The PSC limit for the Amendment 80 limited access sector could be reduced by a range from 10 to 60 percent. Amendment 80 vessels make an annual election to fish either in a cooperative or in the Amendment 80 limited access sector, so while all vessels have elected to fish in cooperatives since 2011, it is possible that the limited access sector may be utilized in the future.

NMFS annually specifies halibut PSC limits for Amendment 80 cooperatives by apportioning the Amendment 80 sector PSC limit specified in the FMP and in regulations (currently 2,325 mt) to each Amendment 80 species. Each Amendment 80 species PSC limit is apportioned to an Amendment 80 cooperative by multiplying the species PSC limit by the percentage of that Amendment 80 species quota share pool allocated to the cooperative. The sum of the Amendment 80 species PSC limits apportioned to the cooperative equals the total amount of halibut PSC assigned to the cooperative as cooperative quota. The sum of Amendment 80 species halibut PSC cooperative quota assigned to all Amendment 80 cooperatives equals the total amount of halibut PSC assigned to cooperatives. If any vessels elect to fish in the Amendment 80 limited access sector, NMFS assigns an overall PSC limit for all vessels fishing in the limited access fishery. NMFS calculates the PSC assigned to the limited access fishery by subtracting the amount of halibut PSC cooperative quota assigned to Amendment 80 cooperatives from the total Amendment 80 sector PSC limit.

If the Council recommends a larger PSC limit reduction for the Amendment 80 limited access sector than for Amendment 80 cooperatives under Option 1, the FMP and regulations would be amended to reduce the Amendment 80 sector PSC limit by the amount specified for Amendment 80 cooperatives (Option 1, Suboption 1). This reduced amount would be apportioned among Amendment 80 cooperatives as currently specified in the regulations and described above. The regulations would also be amended to specify that if any vessels elect to fish in the limited access fishery, NMFS would assign a PSC limit to the Amendment 80 limited access fishery based on the Amendment 80 sector PSC limit as reduced by the additional amount recommended by the Council in Option 1, Suboption 2.

The mechanism may best be explained with an illustration. As an example, if the Council selected a preferred alternative of Option 1, Suboption 1(c) and Option 1, Suboption 2(d), this would result in a 30 percent reduction for the Amendment 80 cooperative fishery and a 35 percent reduction for the Amendment 80 limited access fishery. To implement these reductions, the FMP and regulations would be amended to reduce the Amendment 80 sector PSC limit to 1,628 mt (a 30 percent reduction from 2,325 mt). NMFS would assign this halibut PSC limit to cooperatives based on the portion of the Amendment 80 species quota share pools assigned to cooperatives for that year. In this example, if 80 percent of the Amendment 80 species quota share pools is assigned to cooperatives, NMFS would assign 1,302 mt of halibut PSC as cooperative quota. This would represent a 30 percent reduction compared to a status quo assignment, in this example, of 1,860 mt (80 percent of the 2,325 mt status quo sector PSC limit).

For the Amendment 80 limited access fishery in this example, NMFS would assign a PSC limit of 303 mt. The additional reduction in the Amendment 80 limited access sector resulting from the difference between a 30 and 35 percent reduction from status quo would be calculated in the regulations implementing this amendment, by dividing the difference between the sector-level 30 and 35 percent reduction limits (1,628 mt – 1,511 mt = 117 mt) by the new Amendment 80 sector limit (117 mt / 1,628 mt = 7%). To assign the limited access fishery amount, NMFS would subtract the amount of halibut PSC cooperative quota assigned to Amendment 80 cooperatives from the total Amendment 80 sector PSC limit (1,628 mt – 1,302 mt = 326 mt), as in the current annual specifications process. NMFS would then apply the additional limited access fishery PSC reduction to the halibut PSC remaining after subtracting the PSC cooperative quota (326 mt * 7% = 303 mt). This would represent a 35 percent reduction from the status quo assignment of 465 mt (2,325 mt – 1,860 mt = 465 mt) for Amendment 80 limited access in this example.

2.2.2 Option 2: BSAI Trawl Limited Access Sector PSC limit reduction

Under Option 2, the PSC limit for the BSAI trawl limited access sector (BSAI TLA) would be reduced from 875 mt, to between 438 mt and 788 mt, depending on the suboption chosen. As in the status quo, the Council recommends, on an annual basis, how to apportion the sector's limit by fishery category, and whether to apportion it seasonally. In practice, the Council apportions this PSC limit among the yellowfin sole, rockfish, Pacific cod, and pollock/Atka mackerel/"other species" categories. Under the regulations, the Council also has the option to apportion the PSC limit to the Greenland turbot/arrowtooth flounder/Kamchatka flounder/sablefish category as well (but as there is no PSC limit apportioned in practice, no directed fishing is allowed for these species by this sector).

2.2.3 Options 3, 4, and 5: Longline PSC limit reductions

Options 3, 4, and 5 reduce the PSC limits for longline fisheries. As described under the status quo (Section 2.1), there are currently three different PSC limits established for the hook and line fisheries, and Options 3, 4, and 5 propose reductions to these ranging from 10 to 50 percent.

Under Option 3, the PSC limit for Pacific cod hook and line catcher processors (CPs) would be reduced from 760 mt to between 380 and 684 mt. Under Option 4, the all other targets hook-and-line fishery PSC limit would be reduced from 58 mt to between 29 and 52 mt. Technically, this PSC limit constrains both hook and line CVs and CPs, but since 2008 there have been no NMFS catch records that document participation by hook and line CVs in target fisheries for groundfish species other than Pacific cod or sablefish (which is currently exempt from the limit). Therefore, in practice, this option focuses on longline CPs that participate in the Greenland turbot fishery, which is the primary target fishery for groundfish species other than Pacific cod or sablefish for those vessels. Under Option 5, the PSC limit for Pacific cod hook and line catcher vessels (CVs) would be reduced from 15 mt to between 8 and 14 mt.

For this analysis, it is assumed that vessels fishing with pot or jig gear, and vessels fishing in the sablefish IFQ fishery would continue to be exempt from halibut PSC limits (note, Appendix A provides a discussion of setting a sablefish IFQ PSC limit for longline vessels). If the Council wishes to retain its ability to consider allocating the non-trawl halibut PSC limit to the exempt fishery categories on an annual basis through the harvest specifications, NMFs would implement Alternative 2 by specifying only the total non-CDQ, non-trawl PSC limit in regulations, rather than specifying PSC limits for each of the three non-exempt hook-and-line fishery categories, as described in Section 2.2. This approach would maintain the Council's ability to annually establish PSC limits for vessels fishing with pot or jig gear, and vessels fishing in the sablefish hook-and-line IFQ fishery, if it determined such limits were appropriate. However, if the Council establishes PSC limits for these other fishery categories in the future, the apportionment to the three non-exempt hook-and-line sectors would be reduced by the amount established for the exempt fishery categories, because the total non-CDQ, non-trawl PSC limit would be established in regulations and could not be exceeded.

2.2.4 Option 6: CDQ prohibited species quota reduction

Under Option 6, the current allocation of 393 mt of halibut mortality prohibited species quota (PSQ) to the CDQ Program would be reduced to between 197 and 354 mt. Under the current regulations, 7.5 percent of the nontrawl gear halibut PSC limit is allocated to the CDQ Program, and the remainder of the current allocation, as specified in the FMP, is allocated from the trawl halibut PSC limit. To implement Alternative 2, NMFS would specify the total amount of halibut PSC allocated to the CDQ Program in the FMP and in regulations. NMFS would specify the amount recommended by the Council in Alternative 2, and shown in Table 2-1. As the CDQ PSQ allocation is specified in the FMP, changing the allocation will require an FMP amendment.

Note that unlike allocations of groundfish to the CDQ Program, the CDQ halibut mortality PSQ is not tied to a default percentage of the total BSAI halibut PSC limit. The Council continues to have the flexibility to recommend an appropriate halibut PSQ mortality limit for the CDQ Program, as it deems appropriate.

2.3 Comparison of Alternatives

Under Alternative 1, there would be no changes to the regulated BSAI PSC limits. Since 2008, halibut PSC mortality in the BSAI groundfish fisheries has been 70 to 84 percent of the regulated PSC limits (Table 3-14). In June 2014, industry sectors were asked by the Council to voluntarily reduce halibut PSC mortality over the 2014 and 2015 fishing seasons, and have been reporting to the Council on measures they are undertaking to reduce halibut PSC mortality.

Alternative 2, which would reduce halibut PSC limits, could reduce the amount of halibut PSC mortality in the trawl and longline groundfish fisheries. The alternative includes several options to apply PSC limit reductions to different sectors of the BSAI trawl and longline groundfish fleet. Table 2-2 summarizes the options in terms of halibut PSC mortality “savings” under the PSC limit reductions, and associated benefits to the directed halibut fishery in Area 4 (the BSAI). The table also provides estimates foregone revenue in the groundfish fisheries and gains in the halibut fishery.

Table 2-2 Comparison of harvest and revenue impacts for BSAI groundfish and halibut fisheries

Note, when numbers are shown as a range, they represent estimates from two Scenarios—Scenario A is a relatively “low impact” scenario and Scenario B is a relatively “high impact” scenario.

	Impacts to the Affected Groundfish Fisheries				Impacts to the Area 4 Commercial Halibut Fishery					
	PSC Limit	Annual Average PSC Taken under the Status Quo and Estimated Mean Future Reductions under the Options	Discounted Present Value (DPV) of Wholesale Revenues under the Status Quo and Foregone DPV under the Options from 2014 to 2023 (2013$ Millions)		Annual Average Status Quo Commercial Halibut Harvest Amounts and Reallocated Average Yield to the Fishery Under the Options. Includes yield from savings of both O26 and U26 PSC. (Net Weight Pounds 1,000s)				Discounted Present Value of Wholesale Revenue under the Status Quo and Gains under the Options. Includes both O26 & U26 ($2013 Millions)	
	(mt)	(mt)	10-Year Sum	Average Annual	4A	4B	4CDE	Area 4	10-Year Sum	Average Annual
Option 1: Reduce Halibut PSC Limits for Amendment 80 Catcher Processors (A80-CPs)										
Status Quo	2,325	2,037 - 2,031	$2,610 - $2,609	$261.0 - $260.9	1,576 - 1,577	1,382 - 1,383	276 - 283	3,234 - 3,242	$349.8 - $350.5	$35.0 - $35.0
1a): -10%	2,093	40 - 59	$5 - $32	$0.5 - $3.2	20 - 12	0 - 2	22 - 50	43 - 63	$4.6 - $6.8	$0.5 - $0.7
1b): -20%	1,860	192 - 217	$36 - $123	$3.6 - $12.2	83 - 28	1 - 7	119 - 195	203 - 230	$21.7 - $24.6	$2.2 - $2.5
1c): -30%	1,628	414 - 435	$105 - $263	$10.5 - $26.2	148 - 64	4 - 15	283 - 379	436 - 458	$46.6 - $49.0	$4.7 - $4.9
1d): -35%	1,511	532 - 562	$164 - $366	$16.3 - $36.5	173 - 81	5 - 31	382 - 480	560 - 592	$59.8 - $63.2	$6.0 - $6.3
1e): -40%	1,395	647 - 664	$229 - $469	$22.8 - $46.7	188 - 94	6 - 35	485 - 568	680 - 698	$72.5 - $74.7	$7.3 - $7.5
1f): -45%	1,279	764 - 777	$293 - $575	$29.2 - $57.2	232 - 114	7 - 43	564 - 659	803 - 816	$85.8 - $87.0	$8.6 - $8.7
1g): -50%	1,163	878 - 894	$375 - $699	$37.3 - $69.6	271 - 133	8 - 56	642 - 750	921 - 939	$98.6 - $100.2	$9.9 - $10.0
Option 2: Reduce Halibut PSC Limits in BSAI Trawl Limited Access Fisheries (BSAI TLA)										
Status Quo	875	699 - 697	$10,222 - $10,214	$1,022.2 - $1,021.4	1,576 - 1,577	1,382 - 1,383	276 - 283	3,234 - 3,242	$349.8 - $350.5	$35.0 - $35.0
2a): -10%	788	12 - 17	$5 - $15	$0.5 - $1.5	6 - 6	0 - 0	6 - 9	12 - 16	$1.3 - $1.7	$0.1 - $0.2
2b): -20%	700	28 - 41	$22 - $59	$2.2 - $5.9	12 - 15	1 - 3	12 - 20	25 - 37	$2.8 - $4.0	$0.3 - $0.4
2c): -30%	613	50 - 76	$59 - $110	$5.9 - $10.9	25 - 31	4 - 4	17 - 33	46 - 68	$4.9 - $7.3	$0.5 - $0.7
2d): -35%	569	60 - 101	$73 - $162	$7.2 - $16.1	29 - 44	4 - 6	20 - 42	54 - 92	$5.8 - $9.8	$0.6 - $1.0
2e): -40%	525	76 - 129	$91 - $208	$9.1 - $20.7	41 - 55	5 - 7	24 - 54	69 - 117	$7.4 - $12.4	$0.7 - $1.2
2f): -45%	481	93 - 165	$110 - $261	$10.9 - $26.0	49 - 66	6 - 8	30 - 75	85 - 150	$9.1 - $16.0	$0.9 - $1.6
2g): -50%	438	114 - 201	$153 - $322	$15.2 - $32.1	59 - 78	7 - 10	38 - 96	104 - 183	$11.1 - $19.6	$1.1 - $2.0
Option 3: Reduce Halibut PSC Limits for Hook and Line Catcher Processors (LGL-CPs) in Pacific Cod Target Fisheries										
Status Quo	760	521 - 521	$1,276 - $1,276	$126.0 - $126.0	1,576 - 1,577	1,382 - 1,383	276 - 283	3,234 - 3,242	$349.8 - $350.5	$35.0 - $35.0
3a): -10%	684	These options are non-constraining and have no material impact on the affected participants.								
3b): -20%	608									
3c): -30%	532	14 - 25	$10 - $22	$1.0 - $2.2	5 - 7	12 - 5	1 - 18	17 - 29	$1.9 - $3.2	$0.2 - $0.3
3d): -35%	494	32 - 46	$25 - $44	$2.5 - $4.4	8 - 11	19 - 8	12 - 33	38 - 53	$4.2 - $5.7	$0.4 - $0.6
3e): -40%	456	61 - 79	$50 - $89	$5.0 - $8.9	22 - 23	27 - 10	21 - 58	71 - 92	$7.6 - $9.8	$0.8 - $1.0
3f): -45%	418	100 - 118	$100 - $138	$10.0 - $13.7	39 - 35	30 - 12	46 - 87	115 - 135	$12.3 - $14.4	$1.2 - $1.4
3g): -50%	380	138 - 153	$152 - $191	$15.2 - $19.0	66 - 44	34 - 15	58 - 116	158 - 175	$16.9 - $18.8	$1.7 - $1.9
Option 4: Reduce Halibut PSC Limits for Hook and Line Catcher Processors and Catcher Vessels in Target Fisheries Other than Pacific Cod or Sablefish										
Status Quo	58	5	$11.95							
All Options	These options are non-constraining and have no material impact on the affected participants.									
Option 5: Reduce Halibut PSC Limits for Hook and Line Catcher Vessels (LGL-CVs) in Pacific Cod Target Fisheries										
Status Quo	15	3	$1.20							
All Options	These options are non-constraining and have no material impact on the affected participants.									
Option 6: Reduce Halibut PSC Limits for Vessels Participating in CDQ Groundfish Fisheries										
Status Quo	393	211 - 211	$1,606.3 - $1,606.3	$160.6 - $160.6	1,576 - 1,577	1,382 - 1,382	276 - 283	3,234 - 3,242	$349.8 - $350.5	$35.0 - $35.0
6a): -10%	354	These options are non-constraining and have no material impact on the affected participants.								
6b): -20%	314									
6c): -30%	275									
6d): -35%	255	2 - 2	$0.4 - $2.2	$0.0 - $0.2	2 - 3	0.0 - 0.0	2 - 0	4 - 3	$0.4 - $0.3	$0.0 - $0.0
6e): -40%	236	8 - 8	$2.7 - $9.3	$0.3 - $0.9	6 - 3	0.1 - 0.1	3 - 6	9 - 9	$1.0 - $1.1	$0.1 - $0.1
6f): -45%	216	18 - 17	$6.3 - $21.2	$0.6 - $2.1	8 - 5	0.1 - 0.1	12 - 13	19 - 18	$2.1 - $2.0	$0.2 - $0.2
6g): -50%	197	30 - 29	$15.2 - $36.7	$1.5 - $3.7	12 - 6	0.7 - 1.5	20 - 22	32 - 30	$3.4 - $3.2	$0.3 - $0.3

Table 2-3 summarizes impacts to the directed halibut fishery in areas outside of Area 4, resulting from halibut that are under 26 inches (U26).

Table 2-3 Comparison of Halibut Fishery Yield Impacts from U26 PSC Savings in the BSAI, in Areas Outside of the BSAI (Gulf of Alaska, British Columbia, Pacific Coast)

	From Option 1 A80-CPs		From Option 2 BSAI TLA		From Option 3 LGL-CPs		Option 6 CDQ Fisheries	
PSC Limit Cut Percent	Annual Average Harvest from U26 Savings from 2019 to 2023 (1,000's n.w. lb)	10-Year Sum of Future Discounted Present Value of Wholesale Revenue (2013 $millions)	Annual Average Harvest from U26 Savings from 2019 to 2023 (1,000's n.w. lb)	10-Year Sum of Future Discounted Present Value of Wholesale Revenue (2013 $millions)	Annual Average Harvest from U26 Savings from 2019 to 2023 (1,000's n.w. lb)	10-Year Sum of Future Discounted Present Value of Wholesale Revenue (2013 $millions)	Annual Average Harvest from U26 Savings from 2019 to 2023 (1,000's n.w. lb)	10-Year Sum of Future Discounted Present Value of Wholesale Revenue (2013 $millions)
-10%	8 to 12	$0.34 to $0.50	4 to 5	$0.13 to $0.18	These suboptions are not expected to produce material impacts		These suboptions are not expected to produce material impacts	
-20%	38 to 43	$1.60 to $1.79	7 to 11	$0.30 to $0.44				
-30%	83 to 86	$3.48 to $3.64	12 to 19	$0.52 to $0.82	2 to 5	$0.10 to $0.18		
-35%	106 to 112	$4.47 to $4.72	16 to 26	$0.64 to $1.09	5 to 7	$0.23 to $0.33	0 to 0	$0.02 to $0.01
-40%	129 to 133	$5.44 to $5.59	19 to 32	$0.81 to $1.37	10 to 13	$0.42 to $0.56	1 to 2	$0.07 to $0.07
-45%	153 to 156	$6.44 to $6.54	24 to 42	$0.99 to $1.75	17 to 20	$0.70 to $0.84	4 to 4	$0.17 to $0.16
-50%	176 to 179	$7.38 to $7.53	29 to 50	$1.21 to $2.11	23 to 26	$0.98 to $1.09	6 to 6	$0.27 to $0.26

Note: The first yield increases from U26 PSC Savings that accrue as a result of PSC limit reductions are not realized until 2019. For this reason average annual harvests are estimated over the last five years only. Also note that when numbers are shown as a range, they represent estimates from two Scenarios—Scenario A is a relatively "low impact" scenario and Scenario B is a relatively "high impact" scenario.

Given that the sectors habitually harvest less than the regulated PSC limit, some of the options under Alternative 2 would result in no change to the status quo halibut PSC, while others would result in constraining PSC limits. For the Bering Sea trawl limited access sector and the Amendment 80 sector, any of the PSC limit reduction options would be constraining in some years, based on the multi-years simulation model described in Section 4, which uses the basis years of 2008 to 2013 to forecast how PSC limit reductions would affect the groundfish fisheries. For Pacific cod longline catcher processors, only reductions of 30 percent or higher would constrain this sector, and for CDQ groups, only a reductions of 35 percent or higher would be constraining. There is no effect of any of the reduction options on Pacific cod longline catcher vessels, or the PSC limit that is apportioned to other non-trawl fisheries (i.e., targeting species other than Pacific cod or sablefish).

Specific options under Alternative 2 may result in no change to the status quo halibut PSC, or may result in constraining PSC limits under which industry may change fishing patterns in order to to optimize their groundfish harvest with a minimum of halibut PSC mortality, in order to avoid fishery closures[8]. This could result in a response of reducing fishing effort, as the industry chooses not to pursue less valuable fisheries in order to conserve halibut PSC mortality, or it could result in greater fishing effort at lower catch per unit effort, as vessels change fisheries patterns or seasonal changes in the timing of the fishing, to increase halibut avoidance. Shifts in the location or timing of fishing may occur as a result of Alternative 2. However, there is already considerable interannual variability in the patterns of fishing across the BSAI groundfish sectors, as environmental conditions and avoidance of PSC species have caused vessels to adjust their fishing patterns. Any shift in fishing is likely to occur within the existing footprint of the groundfish fishery in the BSAI.

The community analysis evaluates community and regional participation patterns in the BSAI groundfish and halibut fisheries. In general, the potential beneficial impacts to the various halibut fisheries would be spread more widely among Alaska communities than would be the potential adverse impacts to the

[8] Note that the BSAI pollock fishery is not constrained by the current cap, nor are there options in the analysis to introduce such constaints. As a result, reduced PSC limits would not affect them directly.

groundfish fisheries. While there are many more Alaska communities directly engaged in the BSAI halibut fisheries than in the BSAI groundfish fisheries in general, the communities that are assumed to have the greatest potential for realizing substantial beneficial impacts under Alternative 2 are 15 communities identified as halibut-dependent. Relatively few Alaska communities directly and on a consistent basis participate in the BSAI groundfish fisheries, as determined by location of community resident-owned vessels participation in the fishery and/or location of shore-based processor participation in the fishery in 2008 to 2013. The Seattle metropolitan statistical area has the greatest engagement in the groundfish fisheries by far, for all communities in all categories (except BSAI groundfish hook-and-line catcher vessels and being the location of BSAI groundfish and halibut shore-based processing). Newport (Oregon) has the second-highest engagement in the BSAI groundfish trawl catcher vessel sector. While community-level dependence is not a salient issue for the Seattle MSA or Newport, potential adverse impacts of some of the Alternative 2 options and suboptions would be profound in terms of potential loss of revenues to individual operations and sectors and potential loss of income and/or employment to relatively large numbers of individuals.

2.4 Alternatives Considered but not Analyzed Further

In June 2014, when this analysis was initiated, the Council considered an option to apportion the BSAI trawl limited access sector halibut PSC limits between AFA vessels and non-AFA trawl catcher vessel sectors. The motion proposed that the halibut PSC limit be apportioned based on historic use by these vessel categories from 2009 to 2013. Effectively, this would change apportionment of the halibut PSC limit for BSAI TLA from an apportionment by fishery category (Pacific cod, yellowfin sole, and pollock) to one based on whether a non-Amendment 80 vessel participates in the AFA sector or not. The implementation of this option would have resulted in a halibut PSC hard cap to the AFA sector, which would then be internally allocated among CPs and CVs, and individual cooperatives or vessels. The Council chose to remove this option from consideration as part of this analysis, with the rationale that this option would result in significant allocative implications, which would require considerable analysis that would likely eclipse the discussions of halibut reduction that are the object of this analysis. In addition, the Council noted that including this option would not necessarily impact halibut bycatch performance, which can be achieved in the more straightforward options included in this analysis.

The Council originally initiated this analysis with an alternative that would have implemented measures in the Amendment 80 sector to provide opportunities for deck sorting of halibut, or other handling practices that may provide an opportunity to reduce mortality of halibut that cannot be avoided. The Council recognized that handling practices that measurably reduce the discard mortality rate in a groundfish fishery would have the same effect as a reduction in actual bycatch of the same percentage In compliance with the Council's intention, industry and NMFS have been working together to develop deck sorting procedures, and have determined that these need to be further tested through an Exempted Fishing Permit. As a result, the Council acknowledged that there is not yet sufficient information to analyze halibut mortality reductions as a result of this alternative in time for this amendment analysis, because its exact implementation procedures have not yet been fully developed. Progress with deck sorting procedures is reported in the analysis in Section 3.1.3.6.

The Council's June 2014 motion originating this analysis also included an option to establish a seasonal apportionment of the halibut PSC limit for the BSAI trawl limited access sector. The FMP and regulatory authority for this option already exists, and the Council has the option to apportion the halibut PSC limit seasonally during the harvest specifications process. This option was therefore removed from the analysis, although a discussion of the effect on PSC mortality in the BSAI trawl limited access fisheries from seasonally apportioning the halibut PSC limit during the harvest specifications process was included as a discussion item in the analysis (Appendix A).

3 Environmental Assessment

There are four required components for an environmental assessment. The need for the proposal is described in Section 1, and the alternatives in Section 2. This section addresses the probable environmental impacts of the proposed action and alternatives. A list of agencies and persons consulted is included in Section 7.

This section evaluates the impacts of the alternatives and options on the various environmental components. The socio-economic impacts of this action are described in detail in the Regulatory Impact Review (RIR) and Initial Regulatory Flexibility Analysis portions of this analysis (Sections 4 and 4.9).

Recent and relevant information, necessary to understand the affected environment for each resource component, is summarized in the relevant subsection. For each resource component, the analysis identifies the potential impacts of each alternative, and uses criteria to evaluate the significance of these impacts. If significant impacts are likely to occur, preparation of an EIS is required. Although an EIS should evaluate economic and socioeconomic impacts that are interrelated with natural and physical environmental effects, economic and social impacts by themselves are not sufficient to require the preparation of an EIS (see 40 CFR 1508.14).

The National Environmental Protection Act (NEPA) also requires an analysis of the potential cumulative effects of a proposed action and its alternatives. An environmental assessment or environmental impact statement must consider cumulative effects when determining whether an action significantly affects environmental quality. The Council on Environmental Quality (CEQ) regulations for implementing NEPA define cumulative effects as:

> *"the impact on the environment, which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time" (40 CFR 1508.7*).

The discussion of past and present cumulative effects is addressed with the analysis of direct and indirect impacts for each resource component below. The cumulative impact of reasonably foreseeable future actions is addressed in Section 3.7.

Documents incorporated by reference in this analysis

This EA relies heavily on the information and evaluation contained in previous environmental analyses, and these documents are incorporated by reference. The documents listed below contain information about the fishery management areas, fisheries, marine resources, ecosystem, social, and economic elements of the groundfish fisheries. They also include comprehensive analysis of the effects of the fisheries on the human environment, and are referenced in the analysis of impacts throughout this chapter.

Alaska Groundfish Harvest Specifications Final Environmental Impact Statement (NMFS 2007).

This EIS provides decision makers and the public an evaluation of the environmental, social, and economic effects of alternative harvest strategies for the federally managed groundfish fisheries in the GOA and the Bering Sea and Aleutian Islands management areas and is referenced here for an understanding of the groundfish fishery.[9] The EIS examines alternative harvest strategies that comply with Federal regulations, the Fishery Management Plan (FMP) for Groundfish of the GOA, the Fishery

[9] The alternatives considered in this EA will not cause any of the potentially significant impacts addressed in the Alaska Groundfish Harvest Specifications Final EIS to recur.

Management Plan (FMP) for Groundfish of the BSAI Management Area, and the Magnuson-Stevens Fishery Conservation and Management Act. These strategies are applied using the best available scientific information to derive the total allowable catch (TAC) estimates for the groundfish fisheries. The EIS evaluates the effects of different alternatives on target species, non-specified species, forage species, prohibited species, marine mammals, seabirds, essential fish habitat, ecosystem relationships, and economic aspects of the groundfish fisheries. This document is available from: http://alaskafisheries.noaa.gov/analyses/specs/eis/default.htm.

Stock Assessment and Fishery Evaluation (SAFE) Report for the Groundfish Resources of the BSAI (NPFMC 2014).

Annual SAFE reports review recent research and provide estimates of the biomass of each species and other biological parameters. The SAFE report includes the acceptable biological catch (ABC) specifications used by NMFS in the annual harvest specifications. The SAFE report also summarizes available information on the ecosystems and the economic condition of the groundfish fisheries off Alaska. This document is available from:
http://www.afsc.noaa.gov/refm/stocks/assessments.htm.

Final Programmatic Supplemental Environmental Impact Statement (PSEIS) on the Alaska Groundfish Fisheries (NMFS 2004).

The PSEIS evaluates the Alaska groundfish fisheries management program as a whole, and includes analysis of alternative management strategies for the GOA and Bering Sea/Aleutian Islands (BSAI) groundfish fisheries. The EIS is a comprehensive evaluation of the status of the environmental components and the effects of these components on target species, non-specified species, forage species, prohibited species, marine mammals, seabirds, essential fish habitat, ecosystem relationships, and economic aspects of the groundfish fisheries. This document is available from:
http://alaskafisheries.noaa.gov/sustainablefisheries/seis/intro.htm.

Analytical method

For each of the resource categories described in this chapter, a brief history of the state of the resource is included, along with reference to other documents, followed by an evaluation of the effects of the alternatives.

3.1 Pacific halibut

3.1.1 Life history, biomass, and distribution

Pacific halibut (*Hippoglossus stenolepsis*) is one of the largest species of fish in the world, with individuals growing up to eight feet in length and over 500 lb. The range of Pacific halibut that the International Pacific Halibut Commission (IPHC) manages covers the continental shelf from northern California to the Aleutian Islands and throughout the Bering Sea (Figure 1-1). Pacific halibut are also found along the western north Pacific continental shelf of Russia, Japan, and Korea.

The depth range for halibut is up to 250 fathoms (457 m) for most of the year and up to 500 fathoms (914 m) during the winter spawning months. During the winter (November through March), the eggs are released, move up in the water column, and are caught by ocean currents. Female halibut release a few thousand eggs to several million eggs, depending on the size of the fish. Eggs are fertilized externally by the males. Prevailing currents carry the eggs north and west. By the age of 6 months, young halibut settle to the bottom in shallow nearshore areas such as bays and inlets. Research has shown that the halibut then begin what can be called a journey back. This movement runs counter to the currents that carried them away from the spawning grounds and has been documented at over 1,000 miles for some fish. Most male halibut are sexually mature by about 8 years of age, while half of the females are mature by about age 11.6 (Stewart 2015). At this age, they are generally large enough to meet the minimum size limit for the commercial fishery of 32 inches.

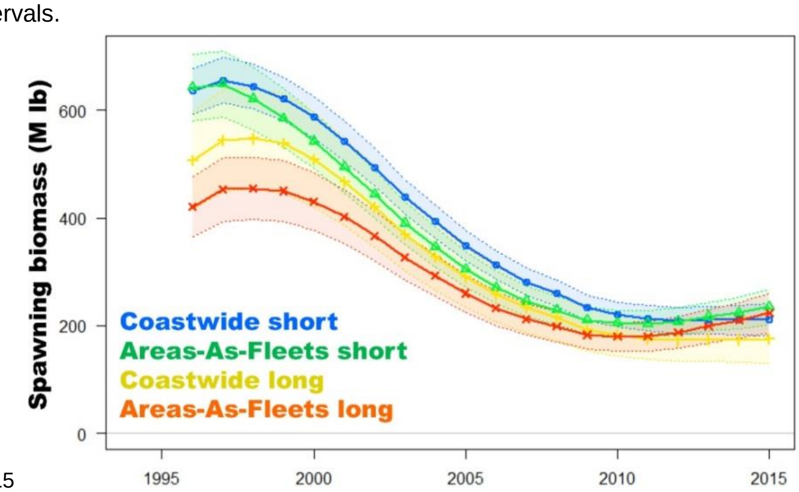
Halibut feed on plankton during their first year of life. Young halibut (1 to 3 years old) feed on euphausiids (small shrimp-like crustaceans) and small fish. As halibut grow, fish make up a larger part of their diet. Larger halibut eat other fish, such as herring, sand lance, capelin, smelt, pollock, sablefish, cod, and rockfish. They also consume octopus, crabs, and clams.

Halibut also move seasonally between shallow waters and deep waters. Mature fish move to deeper offshore areas in the fall to spawn, and return to nearshore feeding areas in early summer. It is not yet clear if fish return to the same areas to spawn or feed, year after year.

3.1.1.1 Biomass and abundance

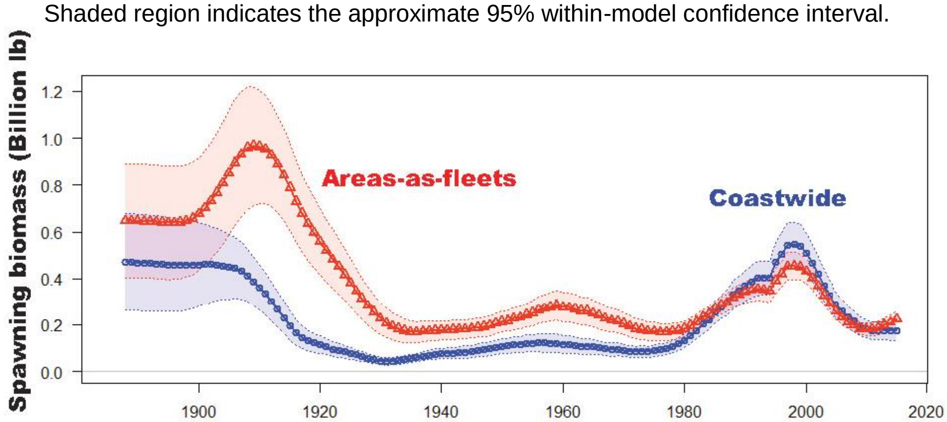
For the past two years, the IPHC has used an ensemble approach to its coastwide stock assessment for the Pacific halibut stock, described in Stewart and Martell (2015). In this approach, multiple models are included in the estimation of management quantities, and uncertainty about these quantities. For 2014, these included two coastwide models and two areas-as-fleets models, in each case one using more comprehensive data available only since 1996, and the other using the full historical record (Figure 3-1). Figure 3-2 shows only the models using the full historical record. The results of the 2014 assessment indicate that the stock declined continuously from the late 1990s to around 2010. That trend is estimated to have been a result of decreasing size-at-age, as well as recent recruitment strengths that are much smaller than those observed through the 1980s and 1990s. Since that time period, the estimated female spawning biomass appears to have stabilized near 200 million pounds, with flatter trajectories estimated in coastwide models and slightly increasing trends in areas-as-fleets models (Stewart and Martell 2015).

Figure 3-1 Trend in spawning biomass estimated from each of the four models included in the 2014 stock assessment ensemble.
Series indicate the maximum likelihood estimates, shaded intervals indicate approximate 95% confidence intervals.



Source: Stewart and Martell 2015

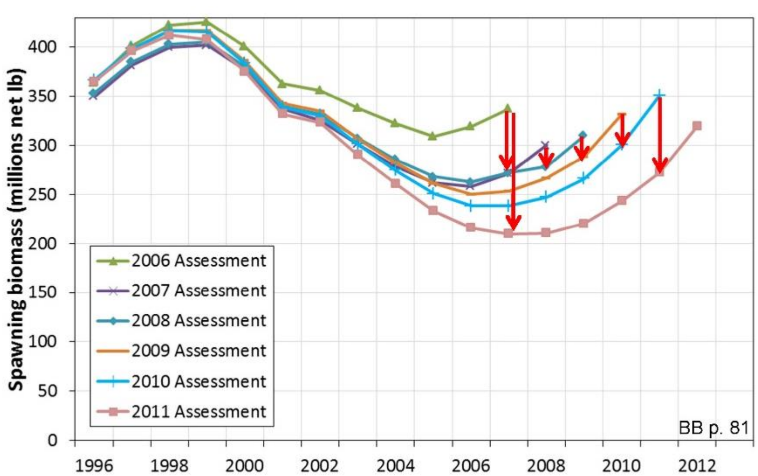
Figure 3-2 Spawning biomass estimates from the two long time-series models. Shaded region indicates the approximate 95% within-model confidence interval.

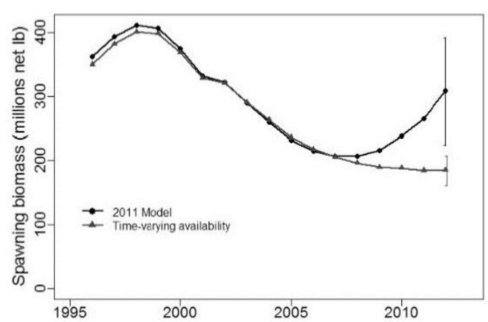


Source: Stewart and Martell 2015

The ensemble model approach was developed to more accurately convey the uncertainty in the estimation of stock status and as a more robust assessment tool to avoid abrupt changes in the halibut stock assessment, such as that occurring between annual cycles in 2011 and 2012. In 2012, IPHC staff reported that then-recent stock assessments for Pacific halibut had consistently overestimated biomass and underestimated harvested rates due to a retrospective bias in the stock assessment. Figure 3-3 illustrates that the stock assessments for 2006 through 2011 all overestimated the spawning biomass of halibut, and predicted stock increases that never appeared. As described in Stewart et al. (2013), this bias was corrected for the 2012 assessment by adding a time-varying availability element, capturing the dynamic that at a coastwide scale, there is interaction between the spatial distribution of the stock and differences in population characteristics among areas. The assessment results now tracked observed halibut trends, but estimates of stock size were decreased by approximately 30 percent compared to previous assessments.

Figure 3-3 Retrospective analysis of 2006 to 2011 halibut stock assessments, and comparison of 2011 model with model adjusted for time-varying availability





Source: Stewart et al. 2013

Following the correction of the retrospective bias, historical spawning and exploitable biomass of halibut have again been hindcast in the stock assessment. Table 3-1 provides biomass estimates from 1996 through 2015, and also identifies estimates of halibut fishing intensity (from all sources of estimated removals) during that time period. Fishing intensity (*F*) is the calculated fishing mortality rate at which the equilibrium spawning biomass per recruit is reduced to x percent of its value in the equivalent unfished stock.

Table 3-1 Median population (millions of pounds, net weight) and fishing intensity estimates (based on median Spawning Potential Ratio) from the 2014 halibut stock assessment

Year	Spawning Biomass	Fishing Intensity ($F_{xx\%}$)	Exploitable Biomass
1996	584.6	49%	779.2
1997	605.7	43%	809.6
1998	591.4	42%	762.7
1999	567.1	40%	746.8
2000	529.5	40%	688.3
2001	483.9	38%	603
2002	434.5	34%	532.2
2003	382.6	30%	460.5
2004	339.5	28%	403.6
2005	299.5	26%	352.6
2006	266.7	26%	307.9
2007	241.5	25%	266.9
2008	224.4	25%	236.3
2009	204.6	26%	203.9
2010	197.8	27%	186.4
2011	195.3	31%	175.6
2012	197.2	35%	169.2
2013	203.9	38%	168.8
2014	208.5	43%	169.7
2015	215.1	44%	180.6

Source: Stewart and Martell 2015

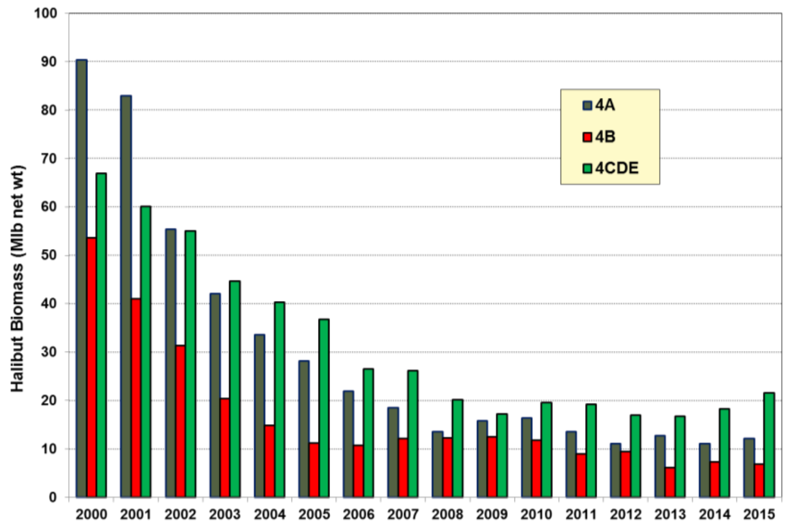
Generally, studies of similar BSAI groundfish have confirmed that an exploitation rate of $F_{35\%}$ is an adequate proxy for the level of fishing that will achieve maximum sustainable yield (F_{MSY}; Goodman et al. 2002), commonly used as an "overfishing level" in Alaskan flatfish and other groundfish fisheries. Catch that corresponds to an $F_{40\%}$ rate provides a safety buffer to account for uncertainty in the stock assessment and catch estimates. An $F_{40\%}$ harvest rate is considered a conservative maximum catch limit in Alaskan fisheries (established in the Council's formulas for setting allowable biological catch). In the past three years, the IPHC has set catch limits that result in a total fishing impact that would be considered conservative by fishery management scientists (Table 3-1). Fishing mortality was most intense during the mid to late 2000s, during the years that the halibut stock assessment model then in use contained the retrospective bias that overestimated biomass. During this time, fishing intensity rates of up to $F_{25\%}$ occurred.

In the last four years, there is no information to suggest that halibut is subject to "overfishing," as that term is commonly applied to stocks managed under the Magnuson-Stevens Act. The Halibut Act does not define "overfishing" or require that an overfishing limit be defined. However, the halibut stock is currently managed conservatively, in a manner that is not likely to result in a chronic long term decline in the halibut resource due to fishing mortality (from all sources of removals).

The current level of spawning biomass for halibut is estimated to be 42 percent of the equilibrium condition in the absence of fishing ($B_{42\%}$), with a 1 out of 10 chance that the stock is below $B_{30\%}$. The IPHC's harvest policy sets a threshold reference point of $B_{30\%}$ and the limit reference point of $B_{20\%}$ as triggers of reductions in halibut harvest rates. Generally speaking, the current harvest rates are considered risk-averse and safe relative to short or long term halibut resource sustainability.

The IPHC's harvest policy is based on the exploitable biomass of halibut, or fish that are accessible in the IPHC setline survey and to the commercial halibut fishery (generally halibut over 26 inches in length (O26)). Spatial apportionment of the coastwide exploitable biomass, from the stock assessment, is estimated on the basis of the annual setline survey results. Figure 3-4 provides a graph of the exploitable biomass in the three IPHC areas that comprise the BSAI. Area 4 measures of apportioned exploitable biomass indicate similar declines since 2000 as the coastwide results for trends in spawning biomass.

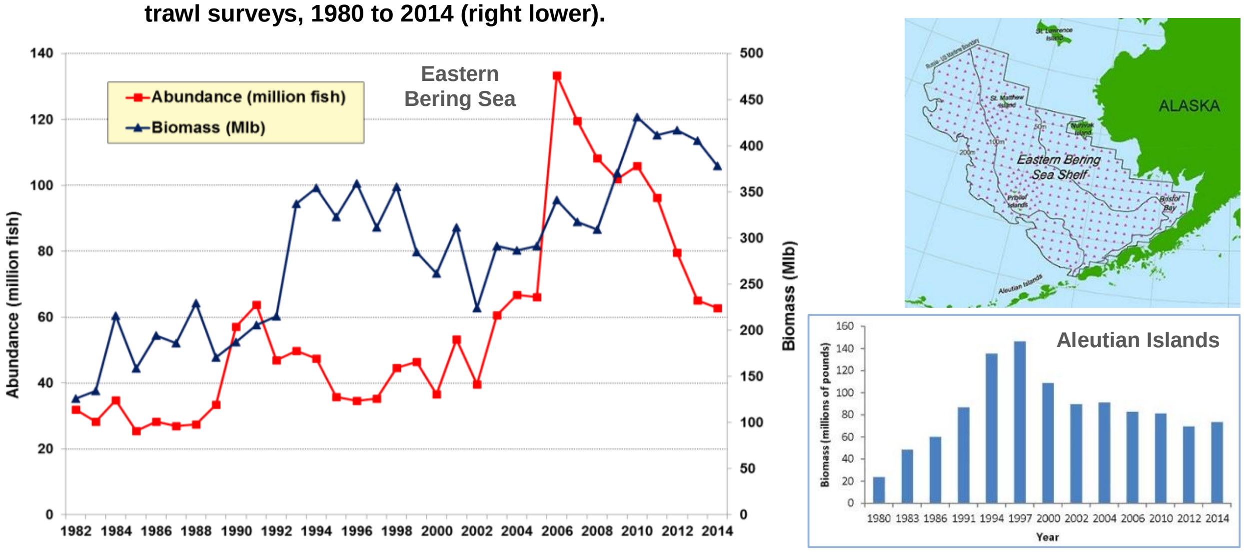
Figure 3-4 BSAI Exploitable Halibut Biomass in the BSAI (IPHC Area 4), 2000 to 2015



Source: Leaman et al. 2015

With respect to information on juvenile halibut in the BSAI, the NMFS trawl survey (Figure 3-5) provides an annual estimate of abundance and biomass for juvenile halibut in the eastern Bering Sea (Area 4CDE and the closed area, and part of NMFS reporting area 517 that is considered part of Area 4A). The survey produces swept-area estimates of halibut abundance and biomass, and is selective for smaller halibut, but far less so for large fish. There is also a biennial trawl survey in the Aleutian Islands (Sadorus et al. 2015a).

Figure 3-5 Halibut in NMFS Eastern Bering Sea Trawl Survey, 1982 to 2014 (left), with map of survey stations (right upper); and biomass estimates from each of the NMFS Aleutian Islands bottom trawl surveys, 1980 to 2014 (right lower).



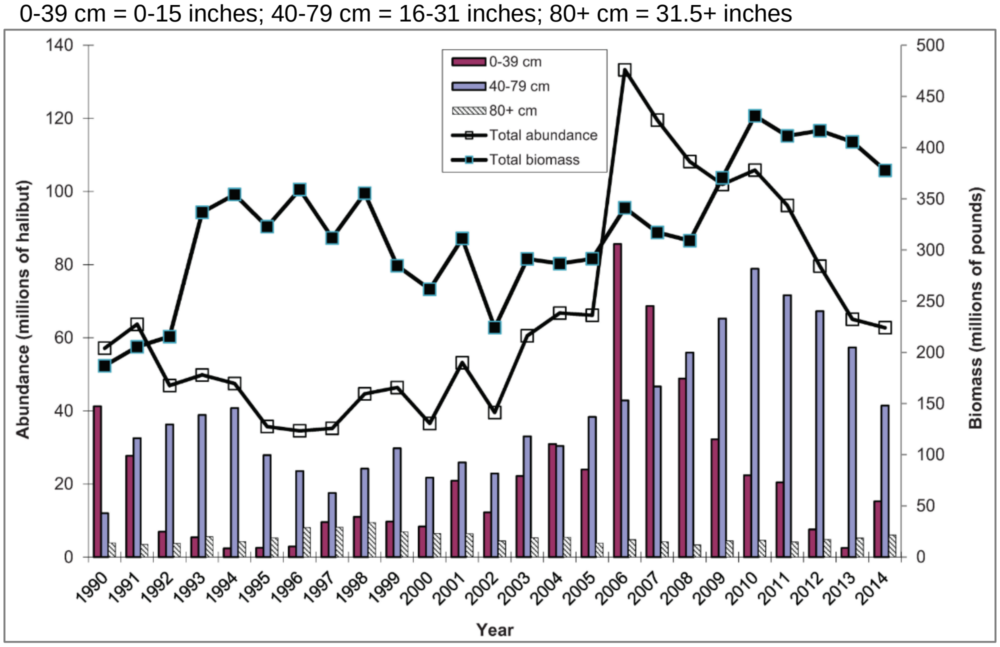
Source: Leaman et al. 2015 (left), Sadorus et al. 2015a (right)

Because the IPHC setline survey does not extend throughout the Bering Sea, IPHC staff use the eastern Bering Sea trawl and other surveys to extrapolate the IPHC setline results across Area 4CDE. As described in Webster (2014), in 2006, for the first time, a calibration study was conducted to scale the O32 fish from the trawl survey with the IPHC setline survey, and construct a weight per unit effort density index. This study has not been repeated since. The construction of the Area 4CDE index through this method is complex, and has evolved since 2006 with the advent of new data. The dependence on this index is important because a large proportion of the estimate of biomass for the Bering Sea is based on this single year's calibration study. However, IPHC staff will be redoing the calibration study in the summer of 2015, with the intent of incorporating results into the 2015 stock assessment. It is possible that the new data and its effects on the Area 4CDE index could have a significant impact on estimates of Bering Sea biomass in this year's assessment.

With respect to assessing the strength of incoming year classes, a primary difficulty is that there is no clear signal in the data until 8 to 10 years after they are spawned. In general, recruitment has decreased substantially since the highs of the 1980s. Cohorts born in 2004 to 2006 and observed in large numbers in the eastern Bering Sea trawl survey data (Figure 3-6) appear to have declined rapidly in abundance in the Bering Sea, and are not evident as strong year-classes in the fishery, setline survey, or NMFS GOA trawl surveys. The strength of these year classes could remain uncertain for several more years (Stewart et al. 2014b).

Figure 3-6 Halibut by length class (numbers of fish and net pounds of biomass), estimated from the NMFS EBS Survey, 1990 to 2014

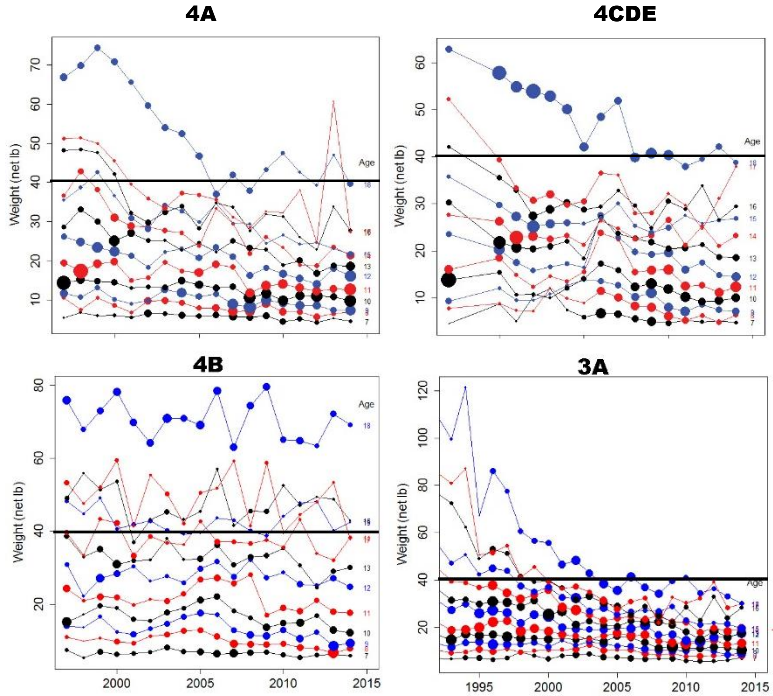
0-39 cm = 0-15 inches; 40-79 cm = 16-31 inches; 80+ cm = 31.5+ inches



Source: Sadorus et al. 2015b

As described in Stewart (2015), although there has been a very strong trend of declining weight-at-age coastwide in recent years, there are marked differences in the magnitude of this decline among regulatory areas. The coastwide trend is driven largely by trends in the GOA's Area 3, where the bulk of the commercially available biomass occurs. Overall, while there have been weight-at-age declines in Area 4, they have not been as steep as in, for example Area 3A (Figure 3-7). There do not appear to be consistent or strong trends from 2010 to 2014 in the area-specific data.

Figure 3-7 Female weight-at-age trends by regulatory area, from the IPHC setline survey



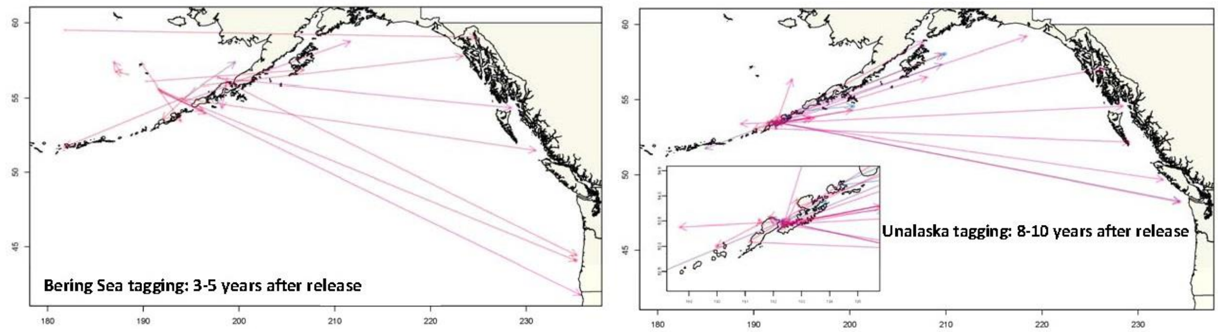
Source: Stewart 2015

3.1.1.2 Distribution and Migration

Stewart et al. (2014a) provides a general understanding of Pacific halibut distribution, indicating that the bulk of the pelagic juvenile halibut occurs in the western GOA, Aleutian Islands and southwestern Bering Sea. Densities of one to four year old halibut (not frequently encountered in setline surveys or the directed fishery) are typically also very high in these areas; this has been observed in trawl surveys, directed IPHC trawl investigations, and in the length-frequencies of halibut captured as bycatch in various trawl fisheries operating in these areas.

The aggregate result of historical IPHC tagging programs indicates that the Bering Sea and the near Aleutian Islands are net exporters of halibut of all sizes to all other regulatory areas. New analysis of historical tagging projects conducted by the IPHC in the BSAI has recently been undertaken (Webster 2015). Results of this analysis indicate that juvenile halibut tagged in the BSAI and near Unalaska tend to remain near the area of tagging for the first year at large, but then distribute broadly to the Aleutian Islands, Gulf of Alaska (70 to 90 percent), and Area 2 (Figure 3-8). This would imply that by the time they enter the directed fishery (and are fully selected by the setline survey), halibut spending their first few years of life in the Bering Sea could be in virtually any regulatory area. At present, it is not possible to correct for the spatial distribution of fishing effort in these data, which may lead to an overestimate of movement to areas (like the Gulf of Alaska) with more fishing activity and therefore a higher rate of tag recoveries (Webster 2015).

Figure 3-8 Release and recovery locations for juvenile halibut tagged in the Bering Sea, and near Unalaska



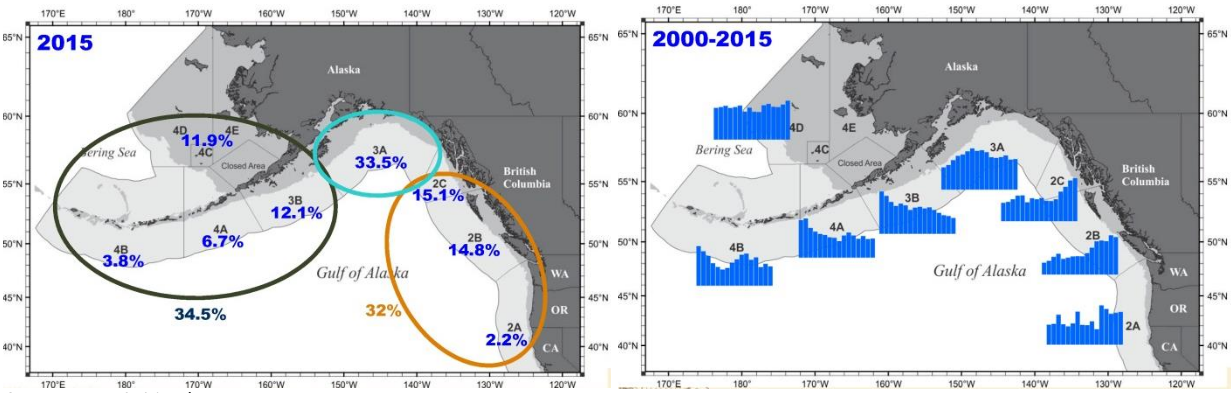
Source: Stewart et al. 2014a

Larger halibut are also estimated to move among regulatory areas, with the net result that Area 4 has a net emigration (Webster et al. 2013). Large halibut move from 4D to 4A at a rate of 6 percent per year, and to the Gulf of Alaska and Area 2 at a rate of 1.4 percent per year (Valero and Webster 2012; Table 14). No adult fish from areas outside the Bering Sea are estimated to move into 4CDE, save 0.2 percent of fish tagged in Area 4B. There are, however, seasonal movements within Area 4CDE associated with changes in ice cover (fish forced out of shallow water areas in winter months), summer feeding migrations (fish moving into shallower waters), and fall/winter spawning migrations (fish moving into deeper water for spawning). The net result of these movements is widespread mixing within the eastern Bering Sea (Stewart et al. 2014a).

In 2015, a new tagging pilot program will begin that is aimed at tagging halibut that are intercepted in the NMFS trawl surveys. The program is intended to be part of a long-term monitoring effort to examine the connectivity of Bering Sea halibut, primary juveniles, with the rest of the halibut stock in other regulatory areas. 2015 will be a pilot year, to see how many fish can be tagged without impeding the work of the survey. The trawl survey is a useful vehicle for this program because the survey catches many juveniles, and very little is understood about juvenile outmigration from the Bering Sea. The scale of the research program is not such that the study would be able to determine movement rates of halibut, but the recoveries should inform whether movement between the areas still exists.

Figure 3-9 illustrates the estimated distribution of the halibut stock greater than 32 inches in length (O32) across the IPHC regulatory areas. The observed distribution of the stock available to the directed fisheries in each year will reflect not only the historical fishing effort in each regulatory area, but also the interaction of recruitment distribution and movement rates (Stewart et al. 2014a). In 2015, Area 4 represents about 22 percent of the O32 halibut biomass. In the last sixteen years, the trend in the apportionment of the O32 biomass in Area 4CDE (including the Closed Area) has generally been stable, with a slight increase in the last two years. The apportionment estimate for both Area 4A and 4B has decreased over that time period, with a corresponding increase in the proportion of the stock occurring in Area 2.

Figure 3-9 Estimated distribution of the halibut stock for fish over 32 inches in length, by regulatory area for 2015, based on the IPHC setline survey weight per unit effort, and trends for 2000 to 2015



Source: IPHC 2014b.

3.1.2 Halibut fishery management in the BSAI

The Council and NMFS manage Pacific halibut allocations in Alaska in Federal regulations, under the authority of the Northern Pacific Halibut Act of 1982, while the International Pacific Halibut Commission is responsible for halibut stock assessment and catch recommendations. The IPHC was established in 1923 by the Convention between the United States and Canada for the Preservation of the Halibut Fishery of the North Pacific Ocean and Bering Sea (Convention). Its mandate is research on and management of the stocks of Pacific halibut within the Convention waters of both nations. The IPHC consists of three government-appointed commissioners for each country, and a director and staff. Annually, the IPHC meets to discuss and approve budgets, research plans, biomass estimates, catch recommendations, and regulatory proposals, which are then forwarded to the respective governments for implementation.

3.1.2.1 Bycatch and PSC terminology

The IPHC refers to halibut "bycatch" to describe the mortality of all sizes of halibut caught in the commercial groundfish fisheries (hook-and-line sablefish and Pacific cod; trawl Pacific cod, pollock, flatfish, and rockfish, and pot Pacific cod), and minor amounts in commercial shrimp trawl and crab pot fisheries. In the groundfish fisheries, Pacific halibut is a prohibited species, and bycatch mortality of halibut is referred to as halibut PSC mortality.

In IPHC terms, "wastage" describes halibut killed, but not landed by the directed (hook-and-line) halibut fisheries, due to lost and abandoned gear, and mortality of fish released due to the minimum commercial size limit. Wastage is not included in IPHC estimates of "bycatch", but is reported annually.

3.1.2.2 How are halibut catch limits determined?

Halibut fishery catch limits are the result of a multi-step process by the IPHC, with allocative input from U.S. and Canadian fishery management organizations, with the objective of determining how much can be harvested by the directed commercial fishery, given the IPHC's goals for stock conservation. The current harvest policy for Pacific halibut is based on two harvest targets: the distribution of harvest rates among regulatory areas, and scale of that harvest at the coastwide level. The process starts with IPHC staff determining the scale or size of the coastwide exploitable biomass (generally, halibut greater than 32 inches in length (O32), based on the IPHC's original harvest polic simulations) and then estimating its distribution or apportionment among each of eight major Regulatory Areas: 2A, 2B, 2C, 3A, 3B, 4A, 4B, and 4CDE (Figure 1-1) using the setline survey weight per unit effort adjusted for gear saturation and survey timing differences among areas.

Next, the exploitable biomass estimate by area is multiplied by the IPHC's target harvest rates from the harvest policy, to come up with a target distribution of the total amount of coastwide yield available for harvest, referred to as the Total Constant Exploitation Yield, or TCEY. The target harvest rates are area-specific: 21.5% in Areas 2 and 3A, and 16.125% in Areas 3B and 4 (Table 3-2). U26 mortality is accounted for implicitly in the harvest rate policy, and assumes a static level of U26 mortality consistent with the period over which the rates were developed (Hare 2011). The target harvest rates are lower than they would be in the absence of U26 mortality, but do not respond to changes in that level, or the ratio of U26 to O26 removals. The targets were developed based on average age-6 recruitment levels under both positive and negative phases of the Pacific Decadal Oscillation (PDO), where U26 fish were assumed to be less than age-6. In addition, the harvest policy includes a harvest control rule that reduces target harvest rates linearly if the stock is estimated to have fallen below given reference points for spawning biomass. Application of these calculations produces area-specific TCEY values.

Table 3-2 Example of IPHC TCEY calculation, using 2015 values

	2A	2B	2C	3A	3B	4A	4B	4CDE	Total
Apportionment	2.2%	14.8%	15.1%	33.5%	12.1%	6.7%	3.8%	11.9%	100.0%
Target harvest rate	21.5%	21.5%	21.5%	21.5%	16.1%	16.1%	16.1%	16.1%	19.6%
Target TCEY Distribution	2.4%	16.2%	16.5%	36.6%	9.9%	5.5%	3.1%	9.8%	100.0%

Source: Stewart 2015.

The third step is to subtract all other removals of halibut over 26 inches (O26) from the TCEY, in order to determine the Fishery Constant Exploitation Yield or FCEY (Table 3-3). The FCEY is calculated such that all O26 removals sum to the TCEY target within each regulatory area, and at the coastwide level. The FCEY includes commercial fishery limits in all areas, and other sectors in any area subject to Catch Sharing Plans for allocation of the halibut harvest. Note, Catch Sharing Plans are developed by the responsible fishery management organizations in each IPHC regulatory area. Non-FCEY removals include catches which either have no explicit limits on the amount of harvest (unguided sport harvest in Alaska, subsistence/personal use harvest in Canada and Alaska, and wastage from the commercial halibut fishery, except where this is explicitly included in catch-sharing plans), or catches which the IPHC has no authority to manage (bycatch mortality, such as halibut PSC mortality in Alaska). Non-FCEY values are assumed to remain constant at the previous year's level. Bycatch (including halibut PSC mortality) and wastage of halibut that is less than 26 inches (U26) is accounted for in the stock assessment with respect to total mortality on the halibut stock, but is not part of the TCEY.

The IPHC staff provides catch limit calculations in advance of the IPHC Annual Meeting in January, which are distributed to allow the halibut stakeholders to discuss and provide comment back to the IPHC. Once the Annual Meeting commences, the IPHC considers all of the input—public comment, recommendations from its advisory bodies, and the decision table—and then adopts fishery catch limits and other measures which seek to balance the advice it has received, with stock conservation being the primary consideration.

Application of the current IPHC harvest policy results in a set of catch limits (also known as the "Blue Line") which are reported each year (Table 3-3). Since 2013, alternative harvest levels representing lower and higher levels of removals than the current harvest policy (blue line) have also been presented, and evaluated with respect to risk against stock and fishery metrics, in a decision table (Table 3-4). The assessment estimates the fishing intensity rate associated with each alternative harvest level, including the blue line.

Table 3-3 IPHC catch table for 2015 blue line values

	2A	2B	2C	3A	3B	4A	4B	4CDE	Total
O26 Non-FCEY									
Comm. wastage	0.02	0.17	NA	NA	0.24	0.05	0.03	0.01	0.52
Bycatch	0.07	0.22	0.02	1.14	0.78	0.52	0.35	3.07	6.16
Sport (+ wastage)	NA	NA	1.14	1.49	0.02	0.02	0.00	0.00	2.67
Pers./Subs.	NA	0.41	0.40	0.25	0.02	0.01	0.00	0.03	1.11
Total Non-FCEY	0.08	0.80	1.55	2.88	1.06	0.60	0.38	3.11	10.46
O26 FCEY									
Comm. wastage	NA	NA	0.11	0.42	NA	NA	NA	NA	0.53
CSP Sport (+wastage)	0.31	0.69	0.79	1.89	NA	NA	NA	NA	3.68
Pers./Subs.	0.03	NA	NA	NA	NA	NA	NA	NA	0.03
Comm. Landings	0.41	4.27	3.40	7.81	2.46	1.35	0.72	0.37	20.78
Total FCEY	0.75	4.96	4.30	10.12	2.46	1.35	0.72	0.37	25.02
TCEY	0.84	5.75	5.85	13.00	3.51	1.95	1.10	3.48	35.48
U26									
Comm. wastage	0.00	0.01	0.01	0.02	0.04	0.00	0.00	0.00	0.08
Bycatch	0.00	0.02	0.00	0.47	0.46	0.39	0.05	1.75	3.15
Total U26	0.00	0.03	0.01	0.50	0.50	0.40	0.06	1.75	3.24
Total Mortality	0.84	5.78	5.85	13.49	4.01	2.35	1.16	5.23	38.72

Source: Stewart 2015.

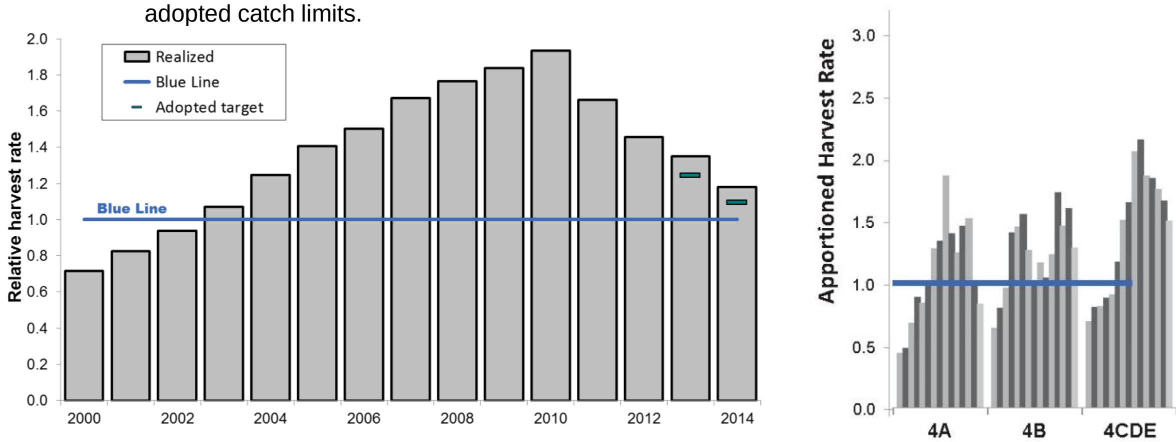
Table 3-4 Final IPHC decision table of 2015 yield alternatives (rows) and risk metrics (columns). Values in the table represent the probability, in "times out of 100" of a particular risk.

				Stock Trend				Stock Status				Fishery Trend				Fishery Status
				Spawning biomass				Spawning biomass				Fishery CEY from the harvest policy				Harvest rate
				In 2016		In 2018		In 2016		In 2018		In 2016		In 2018		In 2015
2015 Alternative	Total removals (M lb)	Fishery CEY (M lb)	Fishing intensity	Is less than 2015	Is 5% less than 2015	Is less than 2015	Is 5% less than 2015	Is less than 30%	Is less than 20%	Is less than 30%	Is less than 20%	Is less than 2015	Is 10% less than 2015	Is less than 2015	Is 10% less than 2015	Is above target
No removals	0.0	0.0	$F_{100\%}$	<1/100	<1/100	<1/100	<1/100	5/100	<1/100	1/100	<1/100	<1/100	<1/100	<1/100	<1/100	0/100
FCEY = 0	13.1	0.0	$F_{73\%}$	<1/100	<1/100	<1/100	<1/100	5/100	<1/100	2/100	<1/100	<1/100	<1/100	<1/100	<1/100	<1/100
	20.0	7.7	$F_{64\%}$	<1/100	<1/100	1/100	<1/100	6/100	<1/100	3/100	<1/100	<1/100	<1/100	<1/100	<1/100	<1/100
	30.0	16.5	$F_{54\%}$	3/100	<1/100	17/100	4/100	7/100	<1/100	5/100	<1/100	3/100	2/100	3/100	2/100	4/100
Blue Line	38.7	25.0	$F_{46\%}$	19/100	<1/100	40/100	23/100	8/100	<1/100	8/100	<1/100	37/100	22/100	36/100	23/100	50/100
status quo	41.4	27.5	$F_{45\%}$	26/100	1/100	47/100	30/100	8/100	<1/100	9/100	1/100	57/100	37/100	51/100	38/100	50/100
Final adopted	42.8	29.2	$F_{44\%}$	30/100	1/100	54/100	34/100	8/100	<1/100	10/100	1/100	69/100	47/100	60/100	46/100	78/100
Maintain 2014 SPR	43.3	29.5	$F_{43\%}$	31/100	1/100	56/100	36/100	8/100	<1/100	10/100	1/100	73/100	51/100	63/100	49/100	88/100
	50.0	36.0	$F_{39\%}$	44/100	5/100	75/100	51/100	9/100	1/100	13/100	1/100	99/100	91/100	95/100	84/100	>99/100
	60.0	45.8	$F_{34\%}$	65/100	22/100	96/100	82/100	11/100	1/100	23/100	2/100	>99/100	>99/100	>99/100	>99/100	>99/100
				a	b	c	d	e	f	g	h	i	j	k	l	m

Source: IPHC website http://iphc.int/meetings/2015am/Final_Adopted_catch_limits_1_30_15.pdf.

In 2015, the blue line harvest policy resulted in an estimated fishing intensity rate of $F_{46\%}$, while the adopted catch limits in 2015 resulted in $F_{44\%}$ (Table 3-4). Both this year and last year's fishing intensity rates have been more conservative than the harvest policy used in managing the Alaskan groundfish fisheries (Table 3-1), which define the overfishing level for comparable flatfish species at $F_{35\%}$, and set the allowable biological catch at a maximum of $F_{40\%}$. This has not been the case in previous years, however. Due to the retrospective bias in the 2006 to 2011 stock assessment, hindcasting from the current model shows that since 2003, relative harvest rates have consistently exceeded the harvest policy target at the coastwide level and in Area 4 (Figure 3-10).

Figure 3-10 Time-series of estimated coastwide (left) and area-specific (right) harvest rates from 2000 to 2014 (bars) relative to the annual harvest rate targets (line) from the current harvest policy. Values are hindcast based on the current ensemble estimates of exploitable biomass, not the estimates available each year. Dashes indicate the projected harvest rate from the 2013 and 2014 adopted catch limits.



Source: Stewart 2015b

The blue line catch limit is not the same as an overfishing limit (OFL) or acceptable biological catch (ABC) in the Alaska groundfish context. These are both biologically-based harvest limits that are not to be exceeded, within which the Council recommends annual TACs. The blue line represents a target level of removals from the application of the IPHC harvest policy, but the policy is not binding on Commissioners and is only one element of the staff advice. As illustrated by the IPHC decision table, the staff advice provides a broad suite of options to inform the Commission's decisions. Unlike the Magnuson-Stevens Act, the Halibut Act does not include specific provisions that require Commissioners to allocate quotas within, for example, an overfishing threshold; their broad mandate is the conservation of the halibut stock. In the last decade, the IPHC coastwide catch limit recommendation has exceeded the blue line catch limit in seven of ten years, and the area-specific catch limit recommendations have exceeded blue line catch limits in all areas at least once, and for some areas in most years (Table 3-5).

Table 3-5 Difference between the blue line recommendation and the adopted catch limit, coastwide and by regulatory area, 2006 to 2015

Coastwide:						**By regulatory area:**					
Year	**Staff recom-mendation/ blue line** (2006-2012/ 2013-2015)	**Adopted limit**	**Difference**			**Area**	**Number of years in the 10 year period 2006-2015 that the adopted limit …**				
							exceeded	% range	**fell below**	% range	**equaled**
			Pounds	%			**… the staff recommendation /blue line**				
2006	69.86	69.86	0			2A	7	7-39%	-	-	3
2007	66.97	65.17	-1.8	-3%		2B	8	6-54%	-	-	2
2008	59.24	60.4	1.16	2%		2C	4	9-19%	-	-	6
2009	54.08	54.08	0			3A	2	1-19%	1	-4%	7
2010	49.02	50.67	1.65	3%		3B	2	8-57%	2	-7-28%	6
2011	41.07	41.07	0			4A	1	56%	2	-4-27%	7
2012	33.14	33.54	0.405	1%		4B	3	39-134%	2	-4-27%	5
2013	22.55	31.03	8.48	38%		4CDE	5	12-127%	-	-	5
2014	24.44	27.515	3.075	13%							
2015	25.21	29.223	4.013	16%							

Source: IPHC website

At the December 2014 IPHC interim meeting, the IPHC staff announced a blue line FCEY for Area 4CDE of 370,000 pounds, a seventy percent reduction from the 2014 harvest limit of 1,285,000 pounds for the region. As the exploitable biomass in the area is basically stable or trending slightly upwards (Figure 3-4), the reduction in the harvest recommendation for the directed fishery was primarily due to the IPHC's estimate of halibut PSC mortality in the groundfish fisheries. The increase in the IPHC's estimate of halibut PSC mortality from 2013 to 2014 was due both to an increase in effort in Area 4CDE over this period, but also in part a function of the way the IPHC projects year-end halibut PSC mortality in the groundfish fisheries in order to complete the halibut stock assessment for the interim meeting. The 2013 halibut PSC mortality value for Area 4CDE underestimated actual 2013 halibut PSC mortality; these values get updated for each year's analyses. Additionally, the projection of the 2014 halibut PSC mortality estimate took into account that halibut PSC mortality in 4CDE, through October 25, was higher than it had been in the last two years, and in the past three years there has been a significant amount of fishing in that area in November and December. After discussions with NMFS in December, the actual 2014 bycatch as of 2014 year-end showed that this projection was an overestimate of halibut PSC mortality, and as a result, the IPHC blue line FCEYs were adjusted for all areas in Alaska; for Area 4CDE this adjustment was upwards, to 520,000 pounds.

At the January 2015 annual IPHC meeting, the Commissioners received presentations from many of the BSAI groundfish industry representatives about their awareness of the impact of halibut PSC mortality, and commitments to voluntarily reduce PSC mortality in 2015 in Area 4CDE. In June 2014, the Council had asked BSAI industry sectors to voluntarily reduce halibut PSC mortality for the second half of 2014 and 2015, which the fleets had already begun. In their efforts to reduce BSAI mortality, however, the Amendment 80 sector in particular had concentrated their catch in Area 4CDE and the closed area, which allowed them to meet the goal for BSAI PSC mortality reduction, but had the unintended effect of exacerbating the impact on the directed halibut fishery harvest limit for Area 4CDE. At the January 2015 IPHC meeting, the representatives explained how they intended to proportionally reduce PSC mortality in their sectors to a level that, if achieved overall, would allow for a 2015 Area 4CDE fishery of the same size as in 2014. Ultimately, the Commissioners approved the Area 4CDE harvest limit at that level, 1,285,000 pounds. Their decision was predicated on both the promised reductions by the groundfish fleet representatives, and a promise of regulatory action by the Council and NMFS through the vehicle of this PSC limit reduction analysis, and other long-term PSC management solutions.

IPHC staff have extended the historical framework for halibut management decisions, based on accounting for total mortality on the halibut stock (Stewart et al. 2015). Calculations in the current harvest policy do not respond to changes in projected U26 mortality, however changes in U26 removals affect directed fishery yield, and a Spawning Potential Recruit-based management framework can take into account mortality from all sources. The framework was presented to the IPHC at the 2015 annual meeting, but is still under evaluation. The extent to which the framework may supplement or replace the current harvest policy is unpredictable at this time.

3.1.2.3 Area 4 Catch Sharing Plan

The Bering Sea and Aleutian Islands management area equates approximately to the IPHC's Area 4 regulatory areas. Area 4CDE and the IPHC Closed Area are considered to be a single unit in all IPHC apportionment and harvest policy analyses. Halibut allocations of the IPHC catch limits to sectors within each of the Area 4 regulatory ares (Area 4A, 4B, and 4CDE) are under the jurisdiction of the Council and NMFS, rather than the IPHC.

The 4C, 4D, and 4E subareas were created to serve the needs of the Council's Area 4CDE Catch Sharing Plan (CSP). Annually, the IPHC adopts the Council's CSP to determine the specific catch limits for these subareas. The percentage share to these areas, as determined by the Council, are: Areas 4C and 4D each receive 46.43% of the IPHC's adopted catch limit for Area 4CDE, and Area 4E receives 7.14%. If the total catch limit for Area 4CDE exceeds 1.6576 Mlb, Area 4E receives 0.08 Mlb off the top of the total catch limit before the percentages are applied.

Within Area 4CDE, the annual catch limit is further allocated among CDQ and IFQ fishing within subareas. The amounts allocated to CDQ by area are: Area 4C 50%, Area 4D 30% and Area 4E 100%. There are also provisions within the CSP allowing Area 4C CDQ and IFQ to be harvested in Area 4D, and for allowing Area 4D CDQ fish to be harvested in Area 4E. The CDQ allocations are apportioned among the six CDQ organizations.

3.1.2.4 Process for obtaining halibut PSC mortality data

The IPHC relies upon the monitoring programs of the Council and NMFS for estimates of halibut bycatch (or halibut PSC mortality) in the Alaska groundfish fisheries. NMFS operates an observer program on federal groundfish and halibut fisheries, which collects information on catches, and these data are used to estimate bycatch by federal management area, gear, and target fishery.

The information provided by NMFS does not match exactly to the IPHC's needs, so the data undergo subsequent processing and recoding. First, groundfish fishery management is conducted according to NMFS management areas, which are not exactly the same as IPHC regulatory areas (Figure 1-1). NMFS areas are assigned to IPHC areas as shown in Table 3-6.

Table 3-6 NMFS management area reassignments used to aggregate groundfish and halibut statistics to IPHC regulatory areas

NMFS Areas	IPHC Area	Region
650, 659	2C	GOA
630, 640, 649	3A	
610, 620	3B	
517, 518, 519	4A	BSAI
541, 542, 543	4B	
508*, 509*, 512*, 513, 514, 516*, 521, 523, 524	4CDE and Closed area*	

Also, the IPHC convert weight units from metric tons, round weight, to pounds, net weight, to be consistent with standard IPHC weight accounting, according to the following:

$$W_{\text{lb net}} = (W_{mt} \text{ x } 2205) \text{ x } 0.75$$

where $W_{\text{lb net}}$ = weight in pounds, net weight,
W_{mt} = weight in metric tons, round weight,
2205 is the number of pounds per metric ton, and
0.75 is the conversion from round weight to net weight for Pacific halibut

Because data inputs are due to the halibut stock assessment team prior to the completion of the groundfish fishing year, IPHC staff also make projections of year-end bycatch, usually for November-December, in order to ensure a full accounting. The long-standing practice is to make projections by applying the average proportion taken by a similar date during the preceding 3-year period to the current partial year data, i.e., January-October, data. The projections are made by IPHC regulatory area and gear (IPHC 2014a).

The IPHC also applies an estimate of the proportion of the halibut PSC mortality, by regulatory area, over and under 26 inches. After the fishing year is finished, IPHC also applies that year's discard mortality rates (DMRs), calculated from NMFS observer data, to determine actual mortality incurred from fishing for IPHC databases. In 2014, for the first time, the assessment used the most recent observer data to estimate the relative proportion of halibut PSC mortality that was O26. NMFS also provided updated bycatch estimates for 2014 in early January, which were incorporated into the IPHC catch tables for the annual meeting.

In 2015, NMFS and the IPHC are working together to improve protocols on data sharing between the two agencies. The process began in December 2014, when the agencies met to discuss how the IPHC currently accesses NMFS' bycatch data from the Alaska fisheries, and opportunities for improvements. In 2014, the IPHC updated length distributions from bycatch in the groundfish fisheries to the most recent data available (2013). The staffs will agree on a data protocol to get the most up-to-date bycatch data in an expeditious manner given prescribed timelines. One of the difficulties with incorporating annual bycatch estimates into the stock assessment is that the IPHC assessment will always need to project bycatch through the end of the current year, because the assessment needs to be prepared for the interim meeting (in late November or early December). It was suggested that there may be a way for IPHC staff to interface with NMFS inseason managers, who are likely to have the most accurate information on the basis of which to project bycatch trajectories for the remainder of the year. There will also be discussion about the retrospective preparation and use of actual discard mortality rates for the groundfish fisheries, and the process for developing assumed rates that can be used for management of PSC limits inseason. Another area for improvement, which is a longer-term project, is to evaluate whether there is a better way to map groundfish bycatch, which is reported by NMFS reporting areas, to the IPHC management areas. The agencies will be working further on these issues in time for the 2015 halibut stock assessment cycle.

3.1.2.5 IPHC Closed Area

The IPHC has identified part of the Bering Sea shelf as a Closed Area, in which directed fishing for halibut is prohibited (Figure 1-1). The IPHC considers the halibut resource in this area to be biologically part of the Area 4CDE halibut stock unit.

The Bering Sea Closed Area was created by the IPHC in 1967 to protect a nursery area for juvenile halibut, in response to severe declines in halibut abundance. The current Closed Area is slightly smaller than the original definition due to reductions that occurred when Areas 4C and 4E were created. The Closed Area had historically accounted for a relatively small percentage (<10%) of the directed halibut landings in the Bering Sea but was a source of significant halibut mortality from foreign vessel bottom trawling. The IPHC recommended the closure to both directed halibut fishing, which was under IPHC jurisdiction, and to bottom trawling, which was not under Commission jurisdiction. However, through negotiations within the International North Pacific Fisheries Commission and bilateral agreements with foreign governments, the Closed Area was also closed to foreign bottom trawling. Throughout the late 1960s until the early 1970s, the Closed Area provided significant protection for juvenile halibut, with bycatch mortality dropping to an estimated low of 4.21 Mlb in 1985. Coincidentally, halibut abundance improved dramatically, fuelled in part by strong year classes of the mid 1970s.

With the Americanization of the Bering Sea trawl fisheries in the early 1980s, following promulgation of the U.S. Extended Economic Zone, the protection to juvenile halibut afforded by the Closed Area diminished. Mortality on halibut again increased substantially in the 1985-1991 period, reaching a peak of approximately 10.7 Mlb in 1992. Bottom trawling within the Closed Area accounts for a significant proportion of the halibut mortality in the Bering Sea. The Closed Area remains open to all fishing except directed halibut longline fishing.

The IPHC requested a review of the Closed Area in 1998 (Trumble 1999). That review examined the purpose of the Closed Area and its value to halibut management. The summary of that review is reproduced below:

> *The closed area does not reduce halibut PSC mortality. Bycatch is managed by bycatch mortality limits through the NPFMC, with quota reductions and harvest rate reductions by the IPHC.*
>
> *Ecosystem effects from the IPHC closed area have little benefit. The fishing by other gear types throughout the Bering Sea- Aleutian Island area, especially on the Bering Sea shelf, preclude an undisturbed ecosystem. A small no-trawl zone occurs on the eastern edge of the IPHC closed area. Evaluation of ecosystem stability in the Bering Sea must include the other fisheries, both in and out of the IPHC closed area and the no-trawl zone.*
>
> *Of the issues favoring development of MPAs, only uncertainty of the stock assessment and concomitant management program apply to Pacific halibut. Stock assessment results in the Bering Sea are currently inadequate because of insufficient time series of catch and survey data (Sullivan and Parma 1998), and because exploitation rates are low. Question still remain on stock assessment issue in the Gulf of Alaska.*

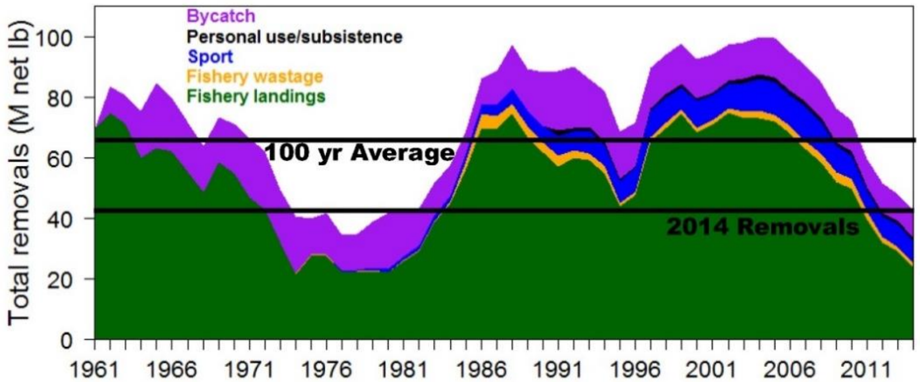
The IPHC requested another review of the Closed Area in 2012. The 2012 report noted that the area remained closed after 1989 as a hedge against uncertainty concerning assessment and management of halibut in the Bering Sea. Since 1998, the Commission has accumulated sufficient data and has been able to generate stock assessments for the Bering Sea with considerably greater confidence than was possible in 1998. Therefore, in 2012 the IPHC staff no longer saw a purpose for the Closed Area as a guard against uncertainty.

It also stated that halibut PSC mortality was managed through Prohibited Species Catch limits for various directed fisheries, with particular time and area specificity, and the IPHC Closed Area played no role in the management of bycatch. Therefore, in 2012 the IPHC staff conclusion was from a halibut assessment and management perspective, they perceived no continued purpose in maintaining the current Closed Area to the directed halibut fishery in the eastern Bering Sea. In 2012, the IPHC took no action to open the Bering Sea Closed Area to the directed halibut fishery. The IPHC treats Area 4CDE, including the Closed Area, as a single management unit. If the Closed Area was to open to the directed halibut fishery, allocations within the new area would have to be incorporated in the Council’s Area 4CDE halibut catch sharing plan.

3.1.3 Halibut PSC mortality in the BSAI groundfish fisheries

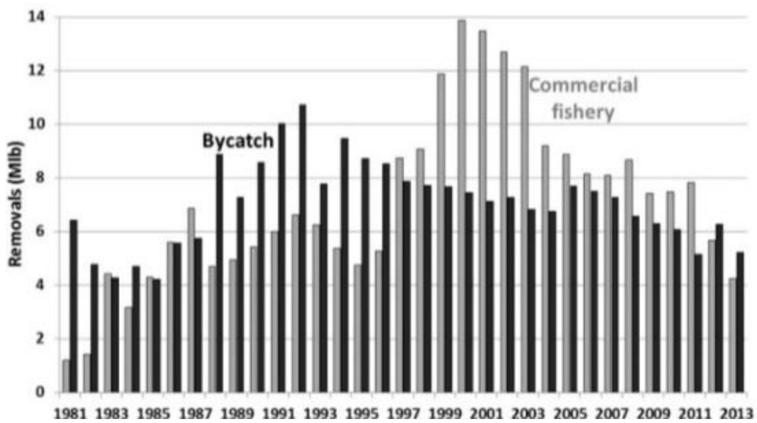
Although the commercial halibut longline fishery accounts for the majority of halibut removals coastwide (Figure 3-11), in the BSAI (Area 4, including the Closed Area), halibut PSC mortality (halibut bycatch in the groundfish fisheries) is an important proportion of halibut removals (Figure 3-12). Approximately two-thirds of bycatch removals of the halibut stock coastwide occur in Area 4. On a coastwide basis, total removals are at their lowest level since the early 1980s.

Figure 3-11 Total removals coastwide for the period 1961 to 2014.



Source: Stewart 2015.

Figure 3-12 Halibut PSC mortality (bycatch) and fishery landings in IPHC Area 4 (BSAI) in millions of pounds, net weight (right)



Source: Stewart et al. 2014a.

3.1.3.1 Management of halibut PSC in the BSAI groundfish fisheries

Pacific halibut is a prohibited species in the groundfish fisheries, which fishermen are required to return immediately to the sea with a minimum of injury, if caught incidentally in the groundfish fisheries[10]. These species are identified in law; their capture is required to be minimized; and their retention is prohibited. The mortality of halibut that is incidentally caught in the groundfish fisheries is separately monitored and controlled under the groundfish fishery management plans, and referred to as halibut PSC. Halibut PSC is managed in metric tons, round weight, of halibut mortality.

Regulations to control halibut PSC have been included in the BSAI FMP since its implementation over thirty years ago. Regulated measures that have reduced halibut bycatch include halibut PSC limits, seasonal and area allocations of groundfish quotas for selected target species, seasonal and year-round area closures, gear restrictions, careful release requirements, public reporting of individual bycatch rates, and gear modifications. Gear modifications to reduce halibut PSC mortality include (a) requiring biodegradable panels and halibut exclusion devices on groundfish pots and (b) requiring pelagic trawl gear specifications that enhance escapement of halibut.

[10] Except where their retention is authorized by other applicable law for biological sampling or for programs such as the Prohibtied Species Donation Program.

Annual halibut PSC mortality limits have long been used to control halibut removals in the groundfish fisheries off Alaska, where the attainment of a limit triggers fishery closures to a sector or gear type. Seasonal allocations of halibut PSC limits are also authorized, which can take advantage of seasonal differences in halibut and some groundfish fishery species distributions. PSC limits are intended to optimize total groundfish harvest, taking into consideration the anticipated amounts of incidental halibut catch in each directed fishery. They are apportioned by target fishery, gear type, and season. Essentially, these limits provide an incentive for specific fisheries to operate in times and areas where the highest volume or highest value target species may be harvested with minimal halibut bycatch. Reaching a PSC limit results in closure of an area or a groundfish directed fishery, even if some of the groundfish total allowable catch (TAC) for that fishery remains unharvested.

The overall BSAI halibut PSC limits for trawl and non-trawl gear are set in regulation, and are not tied to halibut abundance. Halibut PSC limits are set at 3,675 mt for trawl gear, and 900 mt to fixed gear (Table 3-7; Figure 2-1). Regulations also establish allocations of the BSAI trawl and non-trawl halibut PSC limits to the community development quota (CDQ) program, and allocate the trawl PSC limit between the BSAI trawl limited access sector (BSAI TLA) and the Amendment 80 sector (non-AFA trawl catcher processors). While the total trawl limit has not been reduced in regulation, allocations to the trawl sector were reduced by 150 mt, over five years, with the adoption of the Amendment 80 program in 2008. The limits are annually apportioned to specific fishery categories, for fisheries other than CDQ and Amendment 80, and may also be apportioned seasonally, through the groundfish harvest specifications process (guidelines are published in regulation). When an annual or seasonal PSC limit is reached, all vessels fishing in that fishery category must stop fishing for the remainder of the year or season. The exception is for the PSC limit applying to the pollock/Atka mackerel/“other species” fishery category, where reaching the PSC limit only closes directed fishing for pollock using nonpelagic trawl gear, but directed fishing for Atka mackerel, and for pollock with pelagic gear, is still permitted.

Table 3-7 BSAI halibut PSC limits, in metric tons and net pounds of halibut mortality

Defined in regulations / FMP				Annually apportioned – example from 2014			
Overall PSC limits		**By sector**		**By fishery category**		**By operational type**	
Trawl	3,675 mt (6,077,531 lb)	CDQ	326 mt (539,123 lb)				
		Amendment 80	2,325 mt (3,844,969 lb)				
		BSAI TLA	875 mt (1,447,031 lb)	Yellowfin sole	167 mt (276,176 lb)		
				Rockfish	5 mt (8,269 lb)		
				Pacific cod	453 mt (749,149 lb)		
				Pollock/ Atka mackerel/ ”other species”	250 mt (413,438 lb)		
Non-trawl	900 mt (1,488,375 lb)	CDQ	67 mt (110,801 lb)				
		Remaining non-trawl fisheries	833 mt (1,377,574 lb)	Pacific cod	775 mt (1,281,656 lb)	Catcher processors	760 mt (1,256,850 lb)
						Catcher vessels	15 mt (24,806 lb)
				Other non-trawl fisheries	58 mt (95,918 lb)		
CDQ	*(sum of CDQ allocations above)*	unspecified gear	393 mt (649,924 lb)				

Although by regulation, the non-trawl PSC limit could also be apportioned to vessels using pot gear, jig gear, or fishing in the sablefish individual fishing quota (IFQ) fishery, in practice, the Council has chosen to exempt vessels fishing in these categories from halibut PSC limits. As described in the proposed rule for implementing harvest specifications for 2014-2015 (78 FR 74063), the pot gear fisheries have low halibut PSC mortality (2 mt in 2013), and halibut PSC mortality in the jig gear fleet is negligible because of the small size of the fishery (the fleet harvested 11 mt of groundfish in 2013), and the selectivity of the gear. Existing gear restrictions for vessels using pot gear are also intended to further reduce mortality of halibut. The proposed rule also explains that the sablefish IFQ hook-and-line fishery has low halibut PSC mortality because the IFQ program requires legal-size halibut to be retained by vessels using hook and line gear if a halibut permit holder is aboard and is holding unused halibut IFQ. NMFS estimated halibut PSC mortality in the hook-and-line sablefish fishery to be 1 mt in 2013, and 8 mt in 2014. The IPHC does include estimates of halibut mortality from pot and jig gear and the sablefish IFQ hook-and-line fishery[11] as a source of total mortality for the stock assessment.

3.1.3.2 Discard mortality rates

As described above, BSAI halibut PSC limits are described in terms of halibut mortality. To track halibut mortality, and progress towards PSC limits inseason, discard mortality rates (DMRs) are established for each BSAI groundfish fishery category (including CDQ target fisheries), and applied to the total halibut catch to calculate halibut PSC mortality. In 2000, the Council adopted a plan in which the DMRs used to monitor halibut PSC mortality are an average of data from the most recent 10-year period. These 10-year mean DMRs for each fishery are used by NMFS for a 3-year period, with the justification being: 1) interannual variability of fishery DMRs is relatively small, and 2) a three-year period provides stability for the industry to better plan their operations. In 2015, the Council is in the third year of using DMRs in the BSAI that were adopted based on actual rates in the the 2002 to 2011 basis period (Table 3-8). The DMR for trawl fisheries is higher, mostly between 71 and 88 percent for non-CDQ fisheries, and much lower (4 to 13 percent) for pot and hook and line fisheries. For comparison, the IPHC calculates a 16 percent mortality rate to halibut discarded in the commercial halibut IFQ fishery. Research is currently underway to re-evaluate the actual DMR in the directed halibut fishery, given changes in fishery behavior and size-at-age since it was established in 1995.

Table 3-8 2013 to 2015 Pacific Halibut Discard Mortality Rates for the BSAI, as established in regulation

Non-CDQ			CDQ		
Gear	**Fishery**	**DMR (%)**	**Gear**	**Fishery**	**DMR (%)**
Trawl	Alaska plaice	71	Trawl		
	Arrowtooth flounder[2]	76			
	Atka mackerel	77		Atka mackerel	86
	Flathead sole	73		Flathead sole	79
	Greenland turbot	64		Greenland turbot	89
	Non-pelagic pollock	77		Non-pelagic pollock	83
	Pelagic pollock	88		Pelagic pollock	90
	Other flatfish[3]	71			
	Other species[1]	71			
	Pacific cod	71		Pacific cod	90
	Rockfish	79		Rockfish	80
	Rock sole	85		Rock sole	88
	Sablefish	75			
	Yellowfin sole	83		Yellowfin sole	86
Hook and line	Greenland turbot	13	Hook and line	Greenland turbot	4
	Other species[1]	9			
	Pacific cod	9		Pacific cod	10
	Rockfish	4			
Pot	Other species[1]	8	Pot		
	Pacific cod	8		Pacific cod	8
				Sablefish	34

[11] Through 2015, the halibut mortality estimate from the sablefish IFQ hook-and-line fishery has not been based on current NMFS data, but rather on a static estimate of 60,000 pounds carried forward since the implementation of the IFQ program in the 1990s. As part of recent efforts by NMFS and the IPHC to improve their data sharing, this estimate will likely be updated in the future on an annual basis.

IPHC staff uses groundfish observer data to calculate fishery-specific DMRs, using a consistent methodology that considers the length, area of harvest, and viability/injury assessment of sampled halibut. Groundfish observers on longline vessels record the injury level of intercepted halibut as either minor, moderate, severe, or dead. On trawl and pot vessels, observers record the condition of halibut as either excellent, poor, or dead. The IPHC then associates the recorded information with viability estimates for halibut released in these conditions, by length. In all cases, a minimum level of mortality is assumed for the halibut due to handling, so that even if the fish is released with minor injuries (longline) or in excellent condition (trawl), a mortality rate is assessed[12]. The survivability of halibut in excellent condition is estimated on the basis of studies conducted by the IPHC in the 1970s. Having evaluated the historical basis for these associations, the IPHC has determined that it is an appropriate time to revisit this estimation. New tools, particularly tagging technology, offer a new ability to directly estimate survival which may improve estimates of DMRs for some sizes of fish. These survivability studies are a high priority in the IPHC research program, and will begin in 2015. A significant hurdle in this projected research is estimating survival for the smaller size categories of fish (less than 40 cm / 16 inches) which are not amenable to even the newer electronic tagging technology.

Retrospectively, IPHC staff assess actual discard mortality rates in each of the Council target fisheries. Table 3-9 provides actual DMRs for non-CDQ BSAI target fisheries through 2011[13], and the Council used the most recent ten years of these data to adopt discard mortality rates for 2013 through 2015. Figure 3-13 compares the actual DMRs against the assumed DMRs since 2000 for select target fisheries; note that the y-axis is different from hook-and-line fisheries than for trawl. Over this time period, the longline Pacific cod fishery's assumed DMR has consistently been higher than the actual DMR; for flatfish trawl fisheries, the actual DMR is often higher than the assumed rate.

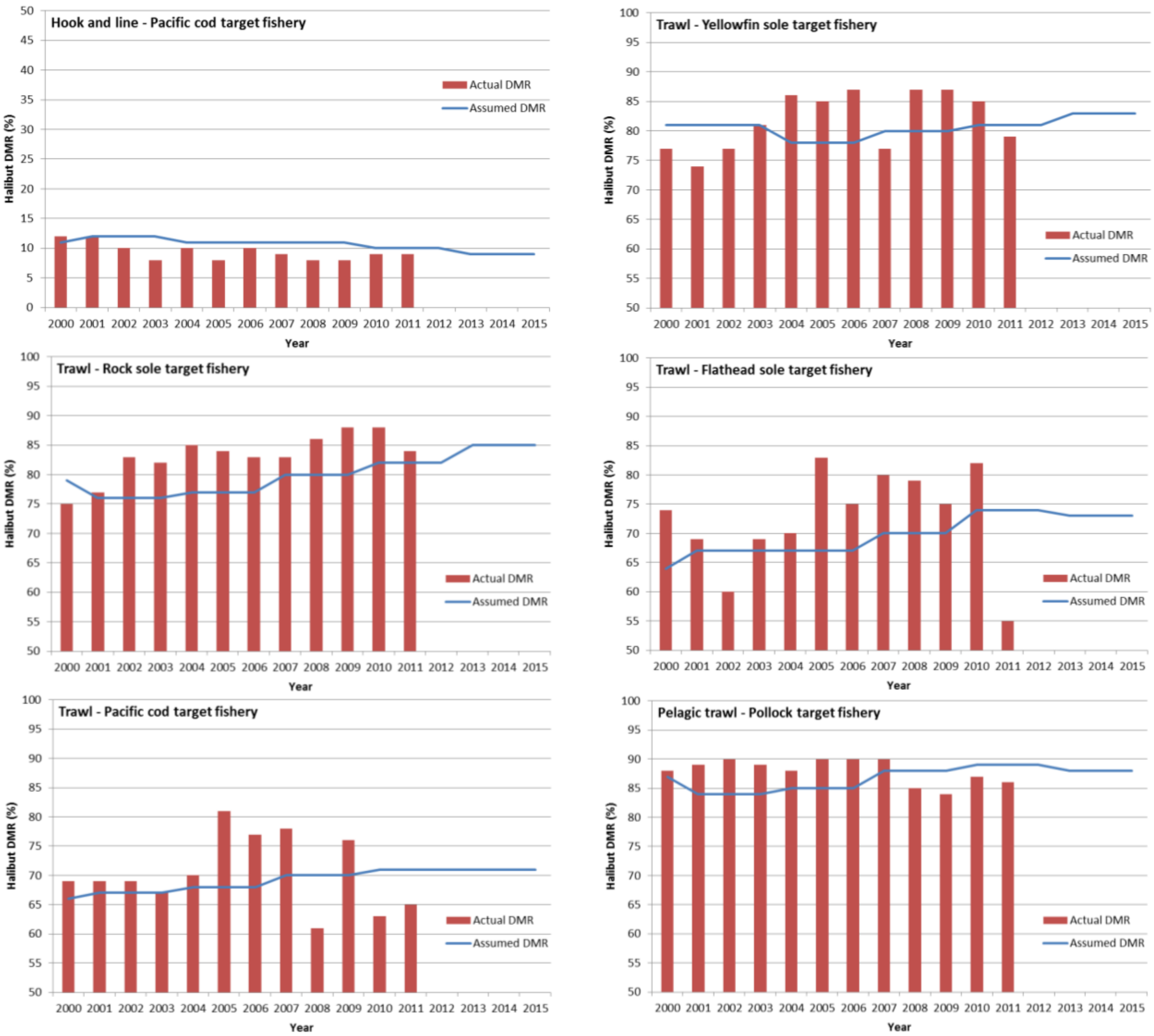
Table 3-9 Summary of halibut discard mortality rates in the BSAI non-CDQ groundfish fisheries, from 1990 to 2011

	Trawl												Hook and line			
	Midwater pollock	Bottom pollock	Pacific cod	Sablefish	Yellowfin sole	Flathead sole	Rock sole	Arrowth flounder	Other Flatfish	Greenland Turbot	Atka mackerel	Rockfish	Pacific cod	Rockfish	Sablefish	Greenland Turbot
1990	85	68	68	46	83	-	64	-	80	69	66	65	19	17	14	15
1991	82	74	64	66	88	-	79	-	75	55	77	67	23	55	32	30
1992	85	78	69	-	83	-	78	-	76	-	71	69	21	-	14	11
1993	85	78	67	26	80	-	76	-	69	-	69	69	17	6	13	10
1994	80	80	64	20	81	67	76	-	61	58	73	75	15	23	38	14
1995	79	73	71	-	77	62	73	-	68	75	73	68	14	-	-	9
1996	83	79	70	-	76	66	74	-	67	70	83	72	12	20	-	15
1997	87	72	67	-	80	57	77	-	71	75	85	71	11	4	-	22
1998	86	80	66	-	82	70	79	-	78	86	77	56	11	52	-	18
1999	87	74	69	90	78	79	81	-	63	70	81	81	12	-	-	17
2000	88	67	69	60	77	74	75	-	76	74	77	89	12	12	-	14
2001	89	74	69	-	74	69	77	-	81	68	73	85	12	10	-	6
2002	90	78	69	-	77	60	83	-	77	75	85	73	10	4	-	23
2003	89	65	67	-	81	69	82	67	79	67	67	84	8	-	-	7
2004	88	73	70	-	86	70	85	67	80	31	63	68	10	-	-	4
2005	90	79	81	-	85	83	84	90	65	82	67	79	8	-	-	6
2006	90	74	77	-	87	75	83	-	82	-	64	90	10	-	-	8
2007	90	69	78	-	77	80	83	-	-	-	89	87	9	-	-	-
2008	85	79	61	-	87	79	86	78	41	-	90	73	8	-	-	17
2009	84	88	76	-	87	75	88	-	-	-	90	83	8	-	-	35
2010	87	78	63	-	85	82	88	-	-	-	87	67	9	-	-	6
2011	86	85	65	-	79	55	84	-	-	-	67	87	9	-	-	9

Source: Williams 2012.

[12] 3.5% mortality is assumed for hook-and-line halibut PSC with minor injuries; 20% mortality is assumed for trawl halibut PSC in excellent condition.
[13] CDQ target fishery DMRs are available in Williams (2012).

Figure 3-13 Assumed versus actual discard mortality rates (DMRs) in longline Pacific cod, and trawl flatfish and cod, and pelagic trawl pollock target fisheries, 2000 to 2015.
Note, actual DMRs have not yet been calculated for target fisheries after 2011.



The intent is for the halibut PSC mortality resulting from actual DMRs, once they have been calculated, to be updated in the halibut stock assessment, and thus inform the IPHC's harvest policy decisionmaking[14]. A discussion of when, how, and by whom actual versus assumed discard mortality rates are calculated is part of the data reconciliation process that IPHC and NMFS staff are undertaking in 2015 (Section 3.1.2.4), to ensure that the most accurate data is being used by both agencies.

Once the results of any improved estimates of DMR are available, the IPHC will adjust their calculation of the survivability of halibut with different injury codes and release conditions. Any factor that changes the calculation of DMR for a fishery has a big impact on the estimation of PSC mortality from that fishery, equivalent to a comparable reduction in halibut encounters. The impact could be larger for longline fisheries, although the majority of halibut they encounter are observed as having a minor injury, because they encounter a large number of halibut (292,000 fish in 2011; Williams 2012). As a result even

[14] There is some question as to whether the stock assessment is currently using data from the actual or the assumed Alaska DMRs up through 2011 (actual rates have not been calculated past 2011). This will be researched when the 2015 stock assessment is prepared.

a small change in the percentage mortality associated with this category (currently 3.5 percent) has the potential to make a big change in the estimated total PSC mortality attributed to this sector.

A comprehensive evaluation of DMRs for all sizes of fish is not expected to be ready before December 2015, when the Council is scheduled to adopt its next three-year set of assumed DMRs for the Alaska fisheries, for 2016 through 2018. Once they are available, the recalculations of survivability and actual DMRs will be used in the halibut stock assessment to inform the IPHC process for assessing halibut harvest limits. Depending on when the results become available, the Council may or may not choose to revise the adopted DMRs that are used for the management of halibut PSC limits before the next scheduled review in December 2018.

3.1.3.3 Halibut PSC mortality estimates for groundfish fisheries

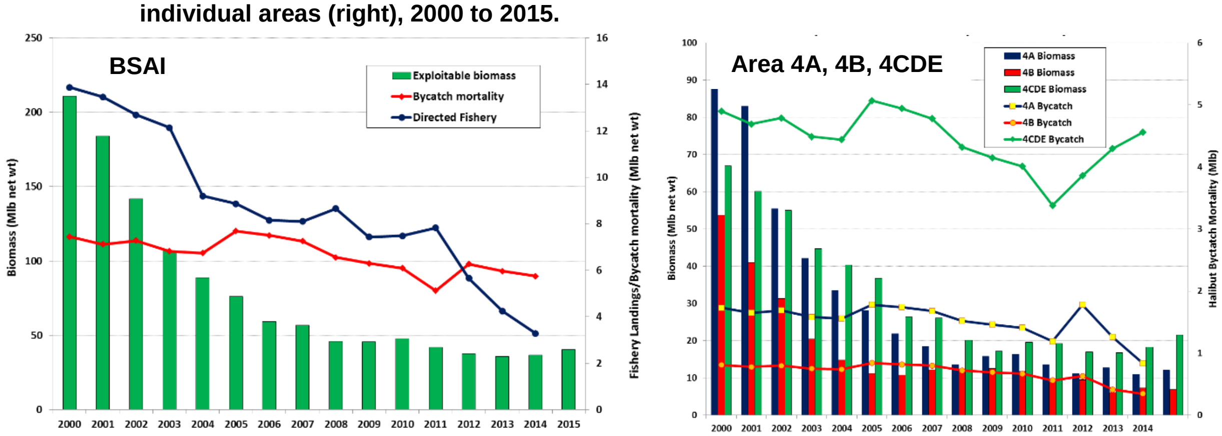
Halibut PSC mortality values for the BSAI (Area 4) since 1993 are shown in Table 3-10, and graphed in Figure 3-12. Figure 3-14 shows the trends in halibut PSC mortality for 2000 to 2015 for both the BSAI as a whole, and for the individual IPHC regions within Area 4. The graphs show PSC mortality reduction overall in the BSAI since 2012, and reductions in Areas 4A and 4B, but marked increases in PSC mortality in Area 4CDE (which includes the IPHC closed area) over that time period.

Table 3-10 Halibut PSC mortality in the BSAI (IPHC Area 4), in round mt

Year	BSAI PSC mortality (mt)	Year	BSAI PSC mortality (mt)
1993	3,012	2004	3,944
1994	4,857	2005	4,207
1995	4,647	2006	3,954
1996	4,669	2007	4,054
1997	4,512	2008	3,515
1998	4,159	2009	3,552
1999	4,066	2010	3,425
2000	4,046	2011	2,991
2001	4,084	2012	3,470
2002	4,276	2013	3,495
2003	4,202	2014	3,375

Source: AKFIN

Figure 3-14 Halibut PSC mortality and exploitable biomass in the BSAI / whole of Area 4 (left) and the individual areas (right), 2000 to 2015.



Source: Leaman et al. 2015

Halibut PSC mortality data is provided in the following tables. Most halibut PSC in the BSAI is intercepted on vessels that always have an observer onboard, either with 100% or 200% observer coverage (Table 3-11), and frequently have other monitoring requirements in place as well. In 2013, there were no observers onboard longline catcher vessels on trips when halibut PSC was estimated, and there was a small amount (70 mt) of halibut PSC estimated for BSAI trawl limited access catcher vessels, during trips where an observer was not onboard. 21 catcher vessels in the BSAI TLA sector had at least one trip during the year where they were in the partial coverage observer category, and were not required to take an observer.

Table 3-11 Observed halibut PSC in the groundfish fisheries in 2013

Sector	Vessels with at least 100% coverage all year	Vessels in partial coverage vessel or trip selection during at least one trip	Vessels in partial coverage zero selection	Halibut PSC intercepted without an observer onboard	Proportion of total halibut PSC that was observed
Amendment 80	All	-	-	0	100%
BSAI TLA CPs	All	-	-	0	100%
BSAI TLA CVs	61	21	-	70 out of 387 mt	82%
Longline CPs	All	-	-	0	100%
Longline CVs	-	5	4	All (3 mt)	0
CDQ	All	-	-	0	100%

Table 3-12 provides data on levels of halibut PSC mortality accruing to BSAI halibut PSC sector limits, from 2003 to 2014, in metric tons, and from 2008 to 2014, in net pounds (Table 3-13). Figure 3-15 provides the same information in a graph, illustrating the longer historical context for halibut PSC mortality in the groundfish fisheries. Table 3-14 provides the PSC limits over the 2008 to 2014 time period, for comparison, and identifies the percent of the limit taken in each year. Overall, the BSAI groundfish fisheries have taken 65% to 70% of the regulatory halibut PSC limits on an annual basis, in recent years. The trawl sectors have taken a higher proportion of their PSC limits than other sectors. Longline catcher vessels have very little halibut PSC mortality. The decline in halibut PSC mortality for the Amendment 80 sector in 2008 was associated with the implementation of that program.

Table 3-12 Halibut PSC mortality in BSAI groundfish target fisheries, by sector, 2003 to 2013, in metric tons

Sector	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Amendment 80	2,650	2,770	2,698	2,540	2,563	1,969	2,074	2,254	1,810	1,945	2,168	2,106
BSAI TLA	852	538	768	841	779	739	727	484	637	960	707	717
Longline Pcod CPs*	518	465	564	409	451	566	562	500	481	555	459	412
Longline Pcod CVs	3	5	6	3	5	5	3	2	1	2	3	7
CDQ	0	154	130	159	245	214	151	159	223	252	265	244
Total	**4,023**	**3,932**	**4,166**	**3,951**	**4,043**	**3,493**	**3,516**	**3,398**	**3,153**	**3,714**	**3,603**	**3,406**

* All halibut PSC mortality accruing to the other non-trawl PSC limit was intercepted by longline CPs, and is included with the longline Pacific cod CP amount.

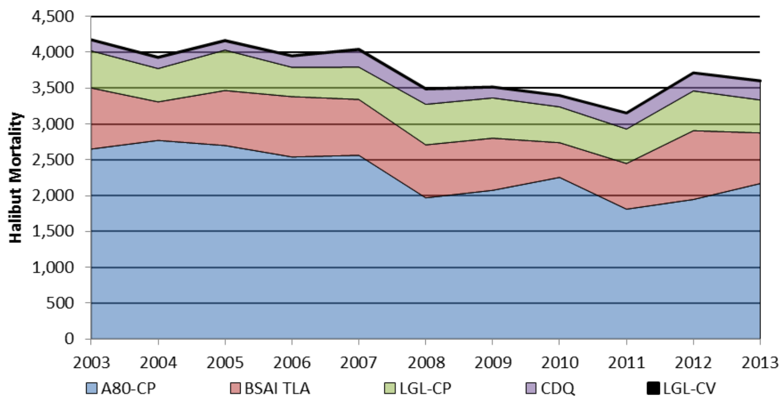
Source: AKFIN.

Table 3-13 Halibut PSC mortality in BSAI groundfish target fisheries, by sector, 2008 to 2014, in net pounds (in thousands)

Sector	2008	2009	2010	2011	2012	2013	2014
Amendment 80	3,256	3,429	3,727	2,994	3,217	3,585	3,483
Trawl limited access sector	1,222	1,202	801	1,054	1,588	1,169	1,186
Longline Pcod CPs	933	916	809	788	909	758	681*
Other non-trawl	2	11	17	7	9	2	*
Longline Pcod CVs	9	5	3	2	3	6	12
CDQ	354	250	262	369	416	438	404
All BSAI halibut PSC mortality accruing to limits	5,776	5,812	5,619	5,214	6,142	5,958	5,765

Source: AKFIN.

Figure 3-15 Halibut PSC mortality in BSAI groundfish target fisheries, by sector, 2003 to 2013



Source: AKFIN

Table 3-14 Percent of 2013 BSAI halibut PSC limit taken, by sector, 2008 to 2014

Sector	2008	2009	2010	2011	2012	2013	2014
Amendment 80	78%	84%	93%	76%	84%	93%	91%
Trawl limited access sector	84%	83%	55%	73%	110%	81%	82%
Longline catcher processors	69%	68%	61%	59%	68%	56%	50%
Longline catcher vessels	33%	20%	13%	7%	13%	20%	47%
CDQ	62%	44%	40%	57%	64%	67%	62%
All BSAI Halibut PSC Limits	**76%**	**78%**	**75%**	**70%**	**84%**	**81%**	**79%**

[1] PSC limit for Pacific cod longline catcher processor combined with other non-trawl.
Source: AKFIN.

Table 3-15 provides halibut PSC data by regulatory area and gear type, for 2011 through 2014. The overall IPHC area trends identified in Figure 3-4 are driven primarily by trawl halibut PSC mortality. PSC mortality has decreased in 4A and 4B since 2012, and increased in 4CDE, both in the IPHC closed area and in the rest of Area 4CDE.

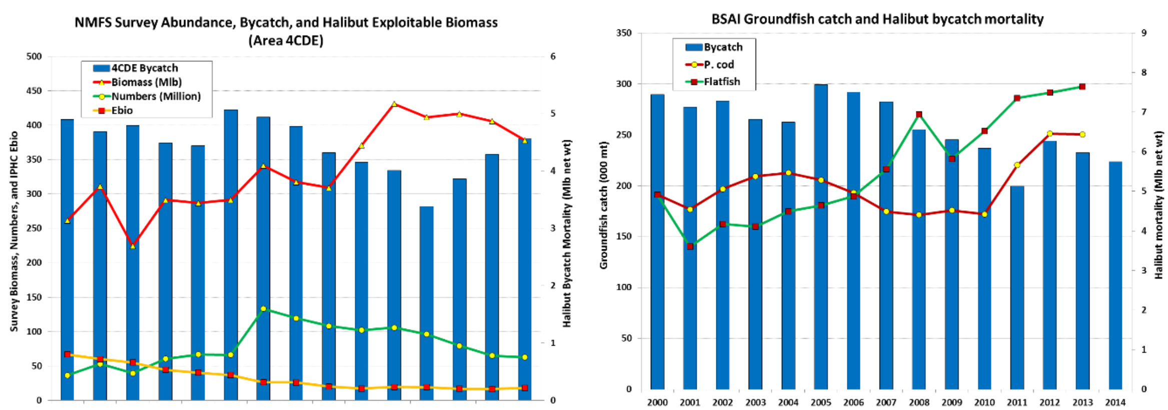
Table 3-15 BSAI halibut PSC mortality estimates, 2011 to 2014, by IPHC regulatory area, in metric tons and net pounds (in thousands).

Area	Gear	2011		2012		2013		2014[1]	
		mt	net lb	mt	net lb	mt	net lb	mt	net lb
4A	Hook and line	125	206.5	121	199.3	174	287.5	122	202.0
	Pot	4	6.6	2	3.5	1	1.4	2	3.0
	Trawl	533	880.7	936	1,547.8	582	961.6	384	634.5
	Total	662	1,093.8	1,059	1,750.6	756	1,250.4	508	839.6
4B	Hook and line	19	31.0	18	30.4	4	6.5	3	4.7
	Pot	0	90	1	926	0	296	0	40
	Trawl	254	420.2	337	556.9	246	406.9	207	342.2
	Total	273	451.4	356	588.3	250	413.8	210	347.0
4CDE	*Hook and line*	*277*	*458.6*	*296*	*489.3*	*198*	*327.2*	*251*	*414.9*
	Pot	*0*	*219*	*0*	*1*	*0*		*0*	*76*
	Trawl	*885*	*1.463.2*	*983*	*1,625.3*	*1,008*	*1,667.1*	*1,349*	*2,230.9*
Closed Area	*Hook and line*	*129*	*212.9*	*177*	*292.9*	*143*	*236.9*	*66*	*108.9*
	Pot	*1*	*1.9*	*2*	*3.3*	*1*	*1.9*	*1*	*2.2*
	Trawl	*940*	*1.554.4*	*863*	*1,426.5*	*1,244*	*2,057.1*	*1,089*	*1,801.2*
4CDE + Closed Area	Hook and line	406	671.5	473	782.2	341	564.2	317	523.8
	Pot	1	2.2	2	3.3	1	1.8	1	2.2
	Trawl	1,825	3,017.6	1,846	3,051.8	2,252	3,724.1	2,439	4,032.1
	Total	2,232	3,691.2	2,321	3,837.3	2,595	4,290.2	2,757	4,558.1
BSAI TOTAL		**3,167**	**5,236.3**	**3,735**	**6,176.1**	**3,601**	**5,954.5**	**3,474**	**5,744.7**

[1] Estimate as of 1/8/15

At the Council's request, an IPHC study (Leaman et al. 2015) tried to index halibut PSC to direct measures of abundance either of halibut or other groundfish species. The attempt was unsuccessful, finding that relationships of PSC mortality to direct measures of juvenile or adult abundance are either lacking, or are temporally and spatially inconsistent (Figure 3-14, Figure 3-16). At the Council's request, the IPHC is continuing the study looking at indirect links through the stock assessment's Spawning Potential Ratio framework.

Figure 3-16 Comparisons of halibut PSC mortality (bycatch) with direct metrics of abundance of halibut (left) or other groundfish species (right)



Source: Leaman et al. 2015

3.1.3.4 Spatial distribution of halibut PSC

The following series of maps depict the average groundfish catch and corresponding average halibut PSC rate in the BSAI, by fishery sector, from 2008 through 2013.

For both the Amendment 80 sector (Figure 3-18) and the BSAI trawl limited access sector (Figure 3-19), groundfish catches were highest within the IPHC Closed Area and just north on the border of reporting areas 513 and 514 (Area 4E), with a hotspot to the northwest on the eastern edge of 521 (on the border of Area 4C and Area 4D). Halibut PSC rates were highest outside of these areas, generally corresponding with areas of low groundfish catch. The hook-and-line sector (combined catcher vessel and catcher processors) had a very broad distribution of groundfish catch and halibut PSC rates along the Bering Sea shelf, corresponding with Areas 4C and 4D, and along the northeastern boundaries of Area 4A (Figure 3-20). The areas of highest halibut PSC rates within the Closed Area corresponded with areas of high groundfish catch for the hook-and-line sector.

For the hook-and-line Community Development Quota (CDQ) sector, most groundfish catch was outside the IPHC Closed Area along the Bering Sea shelf break (Figure 3-21). Areas of high halibut PSC mortality rates within the closed area correspond with relatively low groundfish catch within the closed area. Nearly all fishing by the non-pelagic trawl CDQ sector occurs within the IPHC closed area, and this sector has low overall halibut PSC rates (Figure 3-22).

Groundfish fishery closures in Bristol Bay

For trawl gear, there are also several closure areas in place which may afford protection to halibut spawning and nursery grounds (Figure 3-17). Many of these overlap the IPHC closed area. The nearshore Bristol Bay Trawl Closure Area (reporting areas 508 and 512) prohibits any trawl fishing at any time. The Red King Crab Savings Area, which straddles 509 and 516, is closed to non-pelagic trawling year-round (except for the subarea in certain years). There are also seasonal closures in the area. Federal reporting area 516 is closed to no fishing with trawl gear during March 15 through June 15, and the subarea of the Red King Savings Area is closed to nonpelagic trawling under certain conditions. Also, parts of Federal reporting areas 509 and 517 are part of the Catcher Vessel Operation Area (CVOA), and a catcher processor authorized to fish for BSAI pollock under § 679.4 is prohibited from conducting directed fishing for pollock in the CVOA during the pollock B season, defined at § 679.23(e)(2)(ii), unless it is directed fishing for pollock CDQ.

Figure 3-17 Bering Sea fishery closures for the protection of red king crab

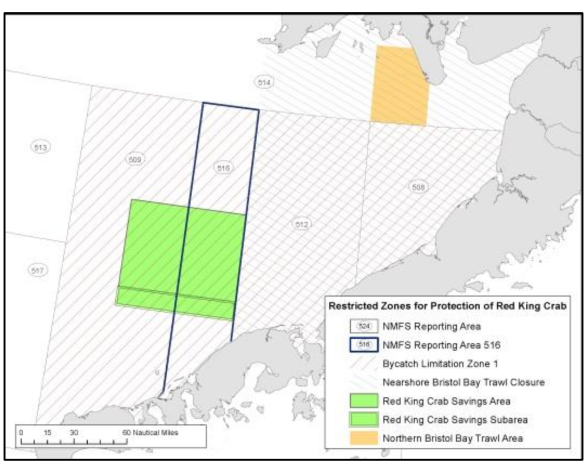


Figure 3-18 Average groundfish catch in metric tons (top panel) and average halibut PSC rates (bottom panel) in the BSAI from 2008 through 2013 by the Amendment 80 sector

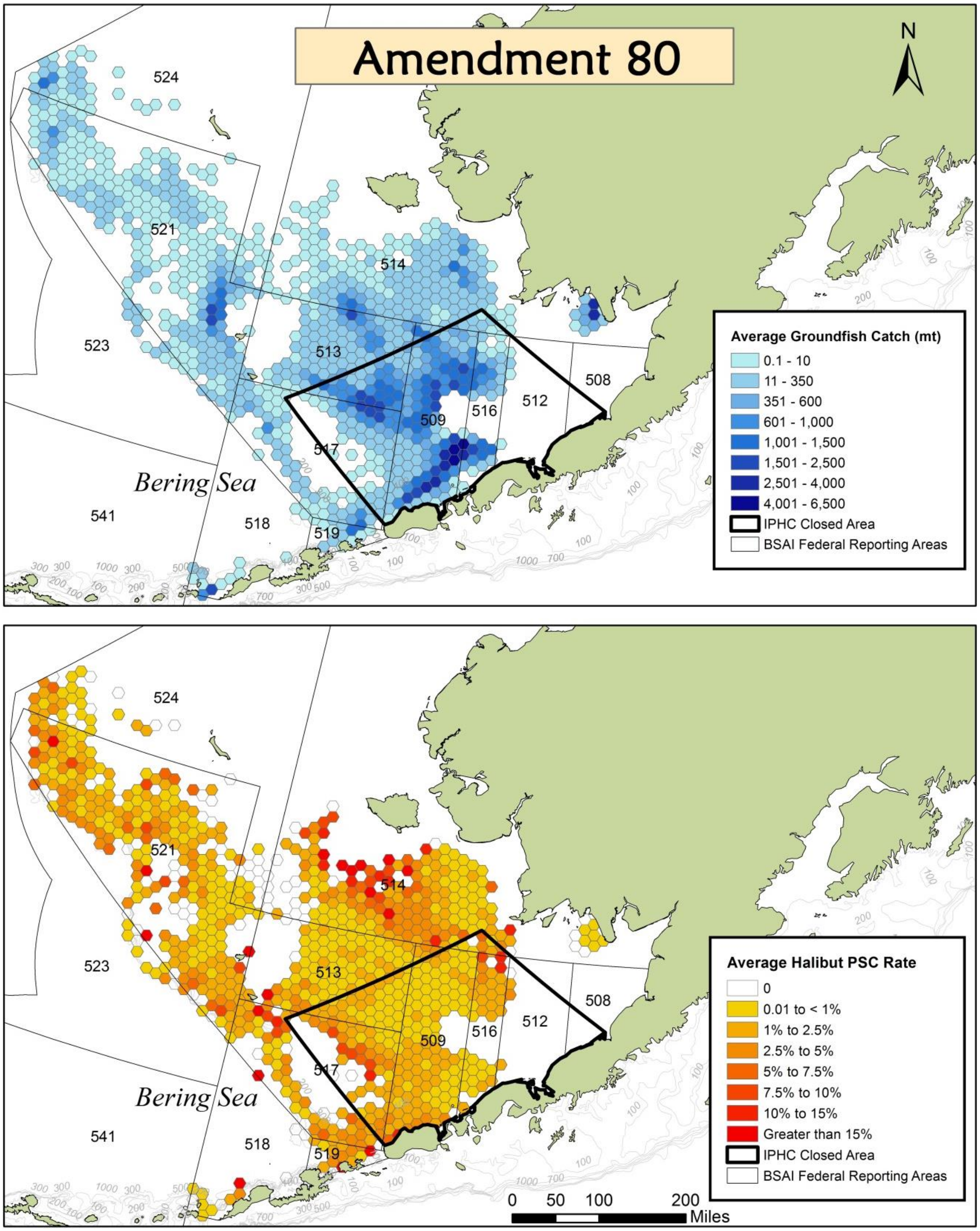
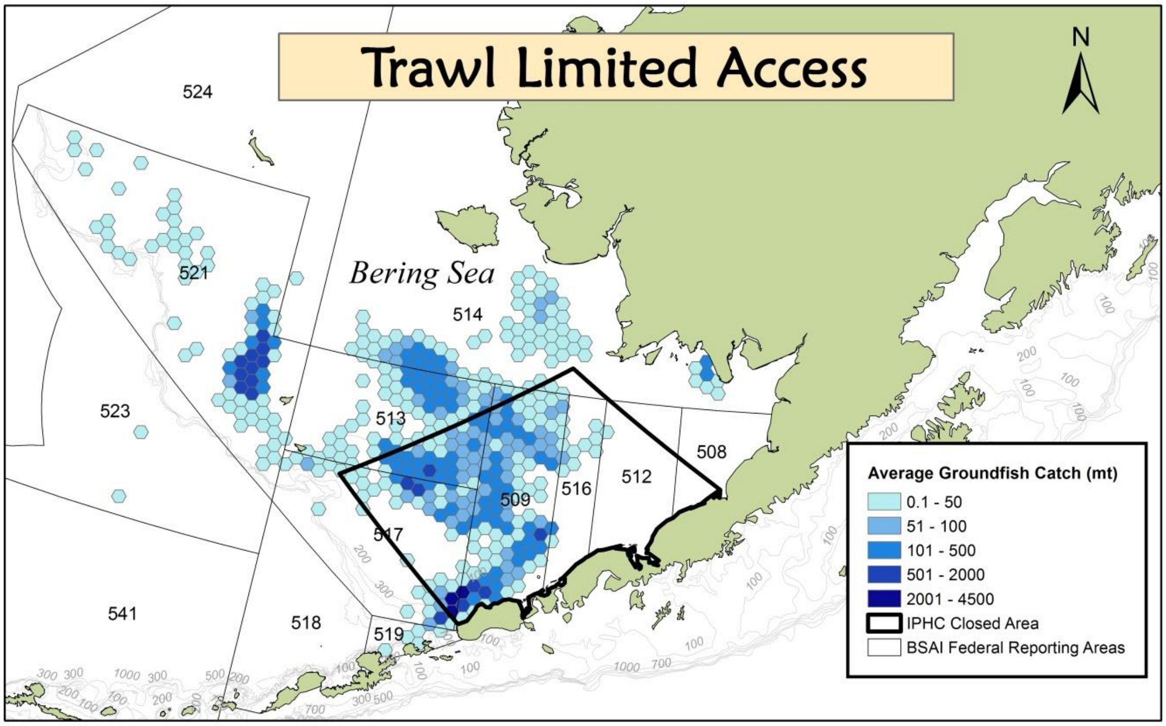


Figure 3-19 Average groundfish catch in metric tons (top panel) and average halibut PSC rates (bottom panel) in the BSAI from 2008 through 2013 by the BSAI trawl limited access sector



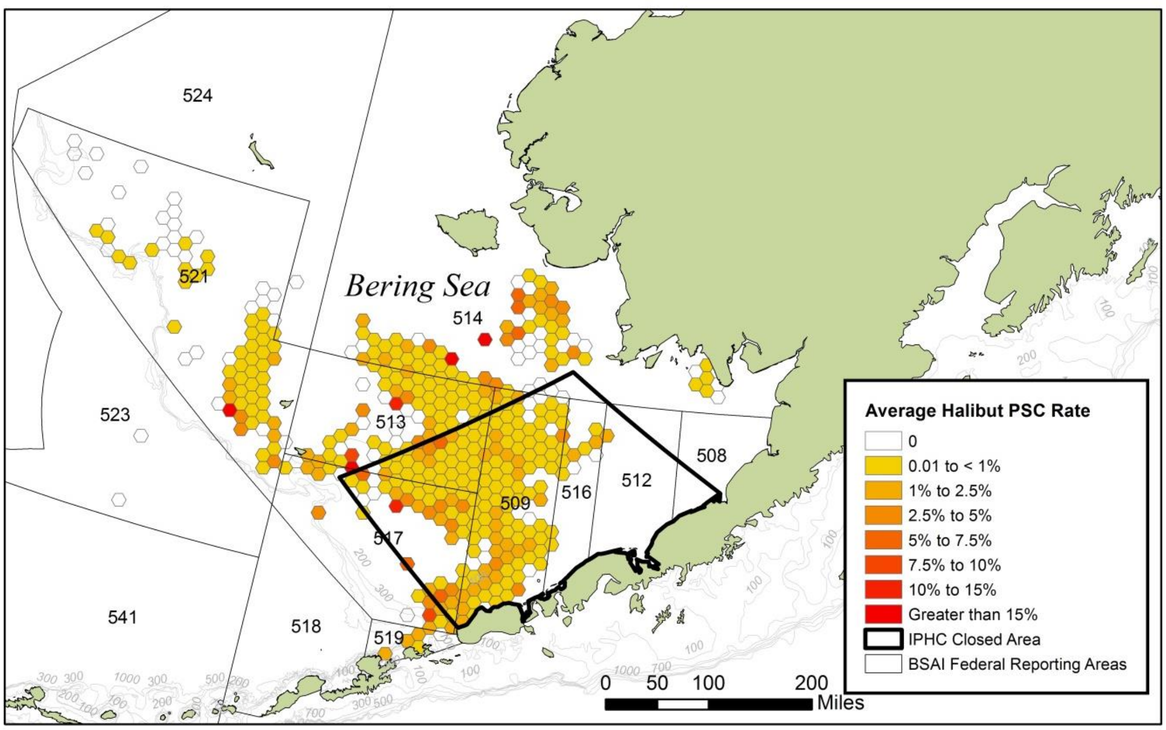


Figure 3-20 Average groundfish catch in metric tons (top panel) and average halibut PSC rates (bottom panel) in the BSAI from 2008 through 2013 by the hook-and-line catcher vessel and catcher-processor vessel sectors combined

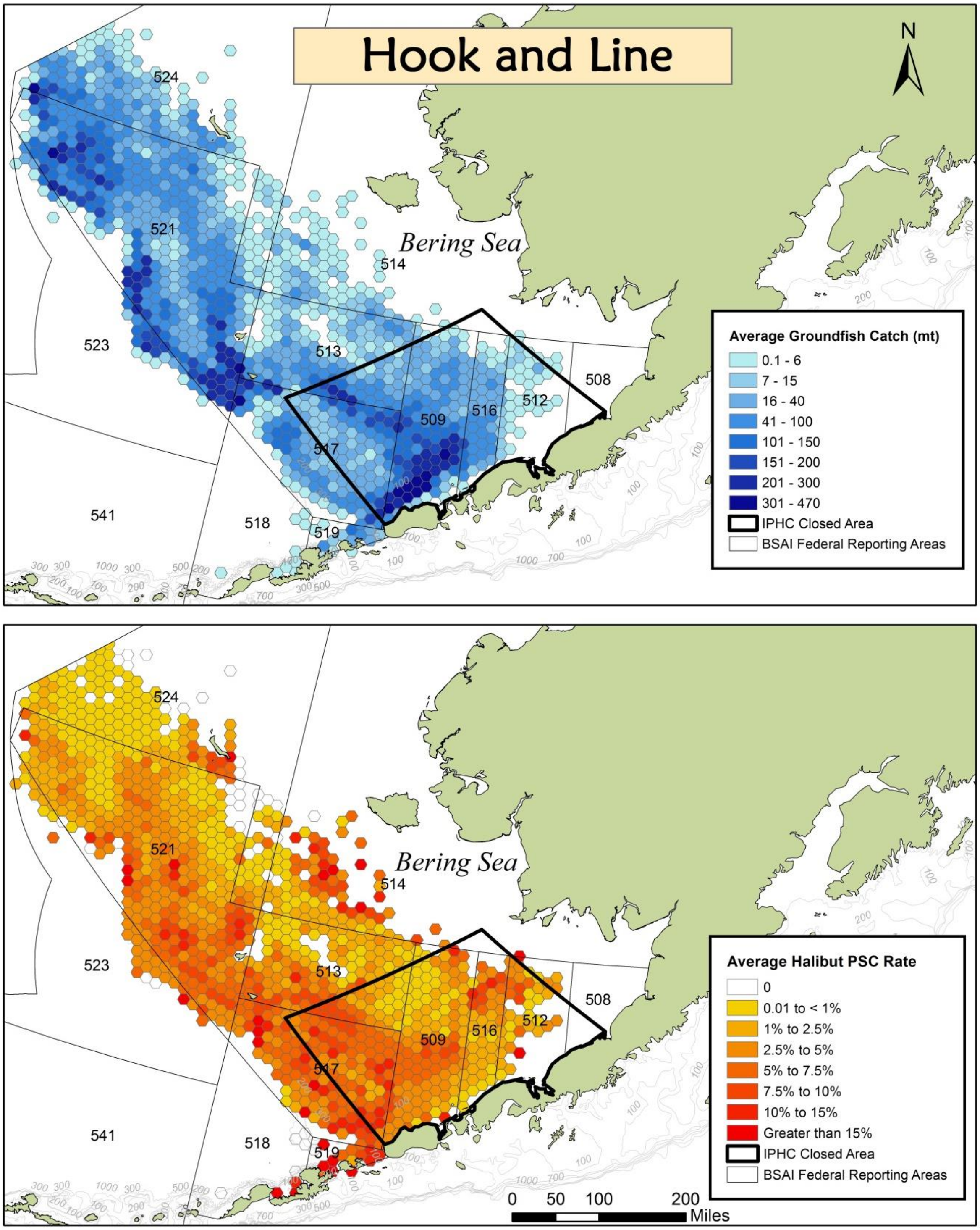


Figure 3-21 Average groundfish catch in metric tons (top panel) and average halibut PSC rates (bottom panel) in the BSAI and IPHC Closed Area from 2008 through 2013 by the hook-and-line Community Development Quota (CDQ) sector.

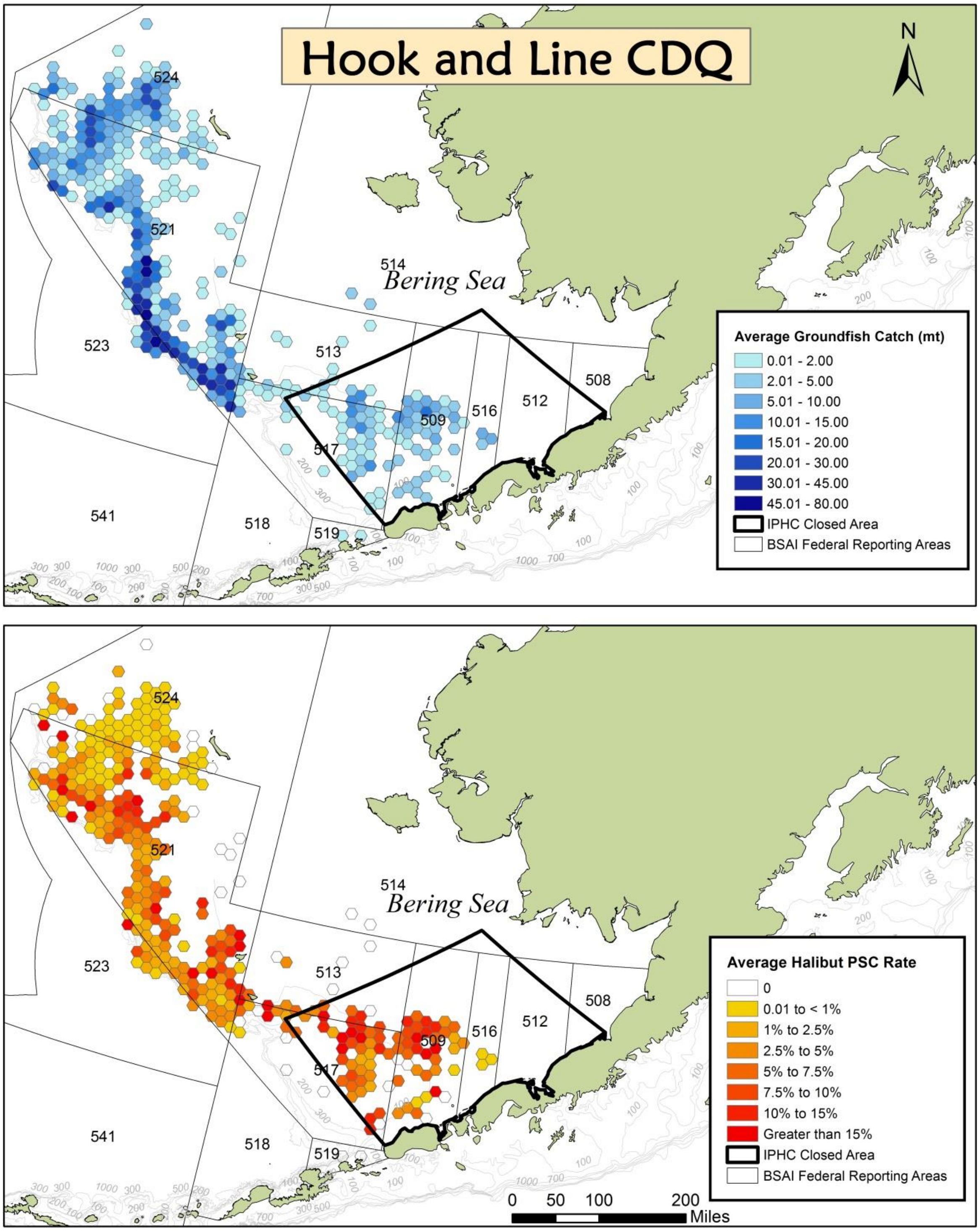
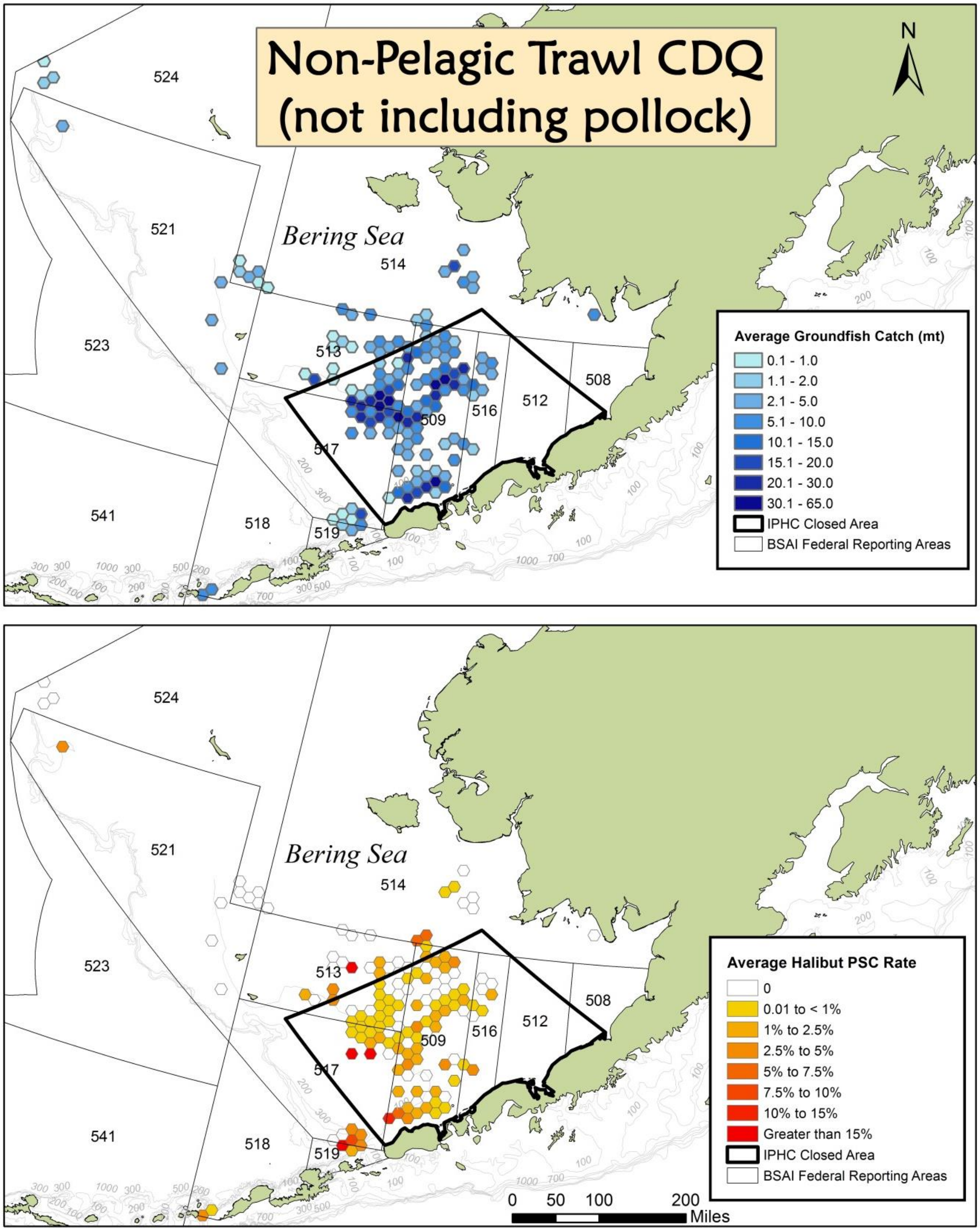


Figure 3-22 Average groundfish catch in metric tons (top panel) and average halibut PSC rates (bottom panel) in the BSAI from 2008 through 2013 by the non-pelagic trawl Community Development Quota (CDQ) sector.

Average groundfish harvests shown exclude CDQ catches of walleye pollock.



3.1.3.5 Size distribution of halibut PSC

Halibut PSC in the Alaska groundfish fisheries occurs for a range of halibut ages and sizes. Given the life history and population dynamics of the halibut stock, there are different ramifications to the stock and directed fisheries for different size categories of mortality. There are two size categories that are important for halibut:

- over 26 inches in size (O26); and
- under 26 inches in size (U26).

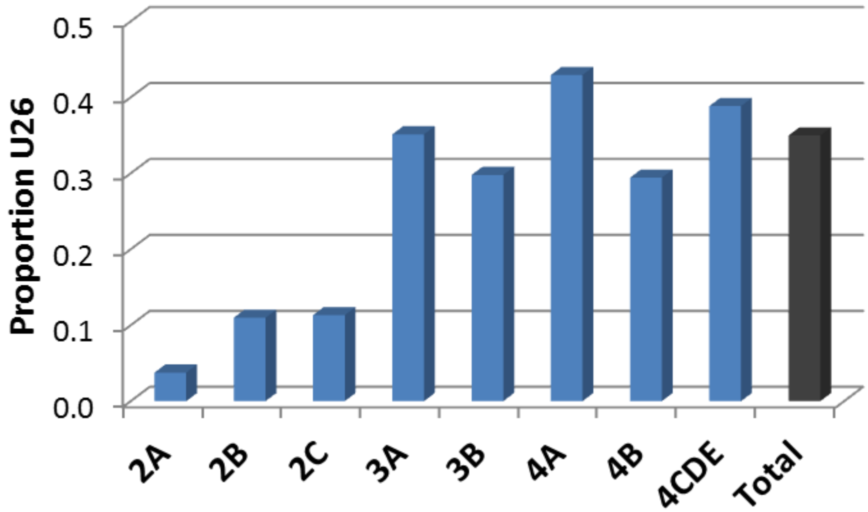
Within the O26 category, there are also two considerations: fish that are over 32 inches, and those from 26 to 32 inches. The 32 inch and over portion is relevant to the directed commercial IFQ fishery, which has a 32 inch size limit. Fish that are 26 to 32 inches are caught in directed sport and subsistence catch, which is not constrained by a size limit. A sizable fraction of halibut PSC is also over 26 inches but under 32 inches. The U26 category contains almost exclusively halibut PSC, as there is virtually no sport or subsistence catch smaller than 26 inches in length. In addition to the directed (commercial, sport, subsistence) fisheries, there is also the loss of halibut from prosecution of the directed commercial fishery, termed “wastage.” Virtually all wastage is above 26 inches in length and is deducted in whole from the TCEY.

Distinguishing between the O26 and U26 components is important. The O26 inch component taken as PSC has approximately the same effect on the halibut stock as O26 directed catch, and is treated the same: it is directly deducted from the TCEY. Thus any reduction in O26 halibut PSC mortality will accrue directly to the directed halibut fisheries. Based on IPHC’s evaluation of observer-collected length frequency samples, approximately 64 percent of halibut PSC mortality in the BSAI (Area 4) is O26. As halibut PSC mortality is reduced and the “savings” taken up by the directed fisheries, the impact on directed yield is a gain of 0.64 net pounds, per net pound of halibut PSC mortality reduction.

Removals of U26 halibut are included in the stock assessment, and therefore in the estimated productivity and current status of the stock. Because the stock assessment is conducted at the coastwide level, this means that U26 mortality is implicitly assumed to have an equal effect on the productivity of all regulatory areas. The U26 component of PSC mortality due to the groundfish fisheries, which is 36 percent of halibut PSC mortality in Area 4, is not immediately transferred to the directed halibut fisheries. The reason for this has to do with the small size and future potential of these fish. Nonetheless, the reduction in future yield to the directed fisheries from U26 PSC mortality cumulatively totals about a pound of directed yield per pound of halibut PSC mortality in groundfish fisheries. This yield is distributed coastwide among all regulatory areas.

IPHC staff estimated the proportion of the halibut PSC mortality that is comprised of U26 halibut in 4A and 4CDE as the highest among all regulatory areas over the last five years (Figure 3-23); in 4CDE this corresponded to estimates of 2.23 Mlb of O26 halibut and 1.42 Mlb of U26 halibut mortality in 2013 (or approximately 61% of the bycatch as O26 halibut) (Stewart et al. 2014a). For the 2015 stock assessment, IPHC used NMFS observer data from 2013 (the most recent complete year) to calculate the proportion of O26/U26 fish in halibut PSC mortality. The length frequency observations for each gear type (hook and line, trawl, and pot) were collected for each regulatory area, expanded to an aggregated weight to account for different sampling rates within fisheries, and divided by the aggregate weight for that gear type. The overall estimate of O26 fish in the BSAI halibut was 64%, based on 2013 data. This value is driven largely by the proportion of O26 fish in Area 4CDE and the Closed Area, where the majority of BSAI bycatch occurs, and where the proportion was similarly 64%. In Area 4B, the rate was much higher (88% O26 fish), and in Area 4A, a little lower (57% O26 fish).

Figure 3-23 Estimated proportion of U26 halibut PSC mortality by regulatory area, averaged over 2009 to 2013.



Source: Stewart et al. 2014a

In Section 4, the overall proportion of O26/U26 fish was evaluated for each major fishery sector (Amendment 80, Bering Sea trawl limited access sector, and longline catcher processors), using a similar methodology[15]. Table 3-16 illustrates the O26/U26 proportions for 2008 to 2013, by sector, that result from these calculations.

Table 3-16 Estimated proportion of halibut over and under 26 inches (O26/U26), by sector, 2008 to 2013

	Amendment 80 CPs		BSAI Trawl Limited Access Sector		Longline CPs	
	O26	U26	O26	U26	O26	U26
Year	Percent of Halibut Mortality by Year					
2008	61.8%	38.2%	68.6%	31.4%	75.2%	24.8%
2009	61.2%	38.8%	57.9%	42.1%	68.3%	31.7%
2010	56.4%	43.6%	59.0%	41.0%	69.8%	30.2%
2011	65.6%	34.4%	51.5%	48.5%	63.4%	36.6%
2012	64.7%	35.3%	43.9%	56.1%	61.5%	38.5%
2013	64.1%	35.9%	52.8%	47.2%	63.5%	36.5%
Weighted Average	61.6%	38.4%	56.2%	43.8%	66.6%	33.4%

Source: Developed by Northern Economics using AKFIN data (Fey 2014).

3.1.3.6 PSC reduction tools

There are two ways to reduce PSC mortality in the groundfish fisheries without simply reducing groundfish fishing effort. First, the fleet can reduce encounters with halibut. This requires some knowledge of where halibut are, to avoid fishing in those areas to begin with, or at least requires a change in behavior for fishermen to move away from areas of high halibut interception once landings demonstrate that there are halibut on the grounds. The fleet also can modify the gear used in the water, to encourage halibut to escape before they can be landed. Second, reductions can be achieved by reducing the mortality of halibut that encounter the fishing gear. This can involve changes both to gear modifications and handling procedures, to improve the survivability of halibut once they are released

[15] IPHC staff is working with NMFS in 2015 to improve the process of using NMFS observer data and the catch accounting system to assess halibut PSC mortality, which will include consideration of whether O26/U26 estimates can be expanded and weighted to fishery sectors.

back into the water. Handling practices that measurably reduce the discard mortality rate in a groundfish fishery will have the same effect as a reduction in actual bycatch of the same percentage.

Voluntary PSC reductions in 2014 and 2015 by the BSAI Groundfish Sectors

In June 2014, the Council asked all industry sectors[16] to voluntarily reduce halibut PSC mortality, and discards in the directed halibut fishery, by 10% (from the recent five-year average) during the 2014-2015 fishing years. Sectors with industry associations were asked to provide a progress report at the February 2015 meeting.

Table 3-17 summarizes the 2014 halibut PSC mortality by sector, looking both at the overall halibut PSC mortality amounts, as well as the rate of halibut PSC mortality per groundfish catch amount. For the calendar year, the BSAI groundfish fisheries as a whole were unsuccessful in reducing 2014 halibut PSC mortality by the target goal of 10 percent (although some sectors interpreted the Council's request as a goal to reduce PSC mortality by 10 percent for the remainder of the year, compared to the five year average for June through December, as the Council request was not made until June 2014). The hook and line catcher processor fisheries were able to achieve this reduction, but both the Amendment 80 sector and the trawl limited access sector increased their halibut PSC mortality over the five-year average, although only by a small percentage.

Table 3-17 2014 halibut PSC mortality compared to 2009 to 2013 average, in mt and rate of halibut per mt groundfish

Sector	Average PSC mortality 2009-2013	2014 PSC mortality	% change	2009-2013 rate	2014 rate
				(kg halibut PSC / mt groundfish)	
Amendment 80	2,050	2,179	+ 3%	6.27	6.55
Trawl limited access sector	703	717	+ 2%	0.69	0.58
AFA CPs – pollock	*172*	*79*	*- 49%*	*0.45*	*0.17*
AFA CVs – pollock	*113*	*57*	*- 50%*	*0.20*	*0.08*
AFA CPs – non-pelagic	*104*	*204*	*+ 158%*	*3.41*	*4.66*
Non-pelagic CVs	*315*	*304*	*- 3%*	*6.54*	*5.17*
Longline CPs	511	396	- 22%	4.31	2.88
Longline CVs	2	6	+ 173%	3.34	2.63
CDQ	210	244	+ 16%	1.39	1.38
All BSAI Halibut PSC mortality accruing to limits	**3,482**	**3,486**	**0 %**	**2.14**	**1.85**

Source: AKFIN, and NMFS for 2009-2013 rate.

The following is a brief summary of the reports provided to the Council in February 2015. Several sectors submitted written reports[17].

Amendment 80

Alaska Seafood Cooperative (AKSC) report – presentation by Mark Fina and Jason Anderson

Achievement relative to the Council's request

- AKSC met the 10% reduction target when calculated for the second half of 2014 (~90 mt reduction)

[16] As originally put forward, the Council's motion requested all industry sectors, including the directed halibut fishery, to undertake voluntary efforts to reduce halibut PSC mortality and discards (Amendment 80, Trawl Limited Access, CDQ, hook and line CV and CP). As part of clarifications on the motion, the Council discussed that it would be difficult to identify a spokesperson for the hook and line catcher vessel sector in the BSAI, and instead the motion was clarified to request that the same five sectors who reported in June 2014 would be asked to report again on their halibut PSC mortality reduction efforts. A short discussion of halibut discards ("wastage", in IPHC terminology) is, however, included in Section 3.1.4.2.

[17] Available at: http://legistar2.granicus.com/npfmc/meetings/2015/2/918_A_North_Pacific_Council_15-02-02_Meeting_Agenda.pdf

- For 2015, AKSC has committed to reduce PSC mortality by 218 mt (higher than the Council's 10% request – promised at the IPHC annual meeting in 2015)
- PSC mortality use has stepped down by the sector since the implementation of Amendment 80 in 2008, although the sector is constrained by multiple hard caps and competing objectives for reducing PSC for multiple species as well as increasing groundfish retention

Tools available for PSC reduction

- Halibut excluders – a variety are in use, but efficacy varies with fishing conditions. It is not practical to use them all the time.
- Deck sorting – AKSC vessels are intending to participate in the 2015 Exempted Fishing Permit (EFP) to sort halibut on deck in order to get them back in the water faster, and promote survivability (see more below)
- Attention to haul composition – wheelhouse personnel watch the trawl bag dump to assess halibut encounter rates, and particularly O26 halibut in the catch, in time to react
- Test tows – captains can make small tows in new fishing grounds to check for halibut rates
- Communication on the ground among captains – about halibut rates and avoidance strategies
- Fishery performance charts – through SeaState, charts will map PSC rates, including O26 interceptions, by target fishery and area
- Discourage night towing as it historically has higher halibut PSC, or if it is necessary, request captains to pay special attention when night towing
- Weekly fleet meetings with all captains to review halibut mortality performance, especially for Area 4CDE and O26 fish, and to discuss avoidance strategies

Alaska Groundfish Cooperative (AGC) report – presentation by Bill McGill

Achievement relative to the Council's request

- AGC did not meet the 10% target in 2014
- Halibut increases were due 1) to an increase in groundfish catch, 2) the fact that some of the AGC vessels had been fishing less in the basis years (2009 to 2013) due to shipyard time, 3) a change in fishing patterns from Atka mackerel to flatfish resulting from Steller sea lion restrictions in the Aleutian Islands; 4) despite avoidance efforts, vessels could not find fishing areas without a lot of halibut in the last half of 2014, and eventually resorted to stopping fishing

Tools available for PSC reduction

- Vessels have halibut excluders, but they are not always used

BSAI Trawl Limited Access

Pollock Conservation Cooperative report – presentation by Stephanie Madsen

Achievement relative to the Council's request

- PCC met the 10% reduction target for 2014
- For 2015, PCC has committed to reduce PSC mortality by 59 mt (higher than the Council's 10% request – promised at the IPHC annual meeting in 2015)
- Pollock vessels also have competing objectives, for halibut and salmon PSC avoidance

Tools available for PSC reduction

- Experiments with halibut excluders
- Some tools in use for Chinook avoidance are being used for halibut

  - Tracking vessel PSC rates through Sea State (will also have VMS tracks in 2015)
  - Individual accountability - ranking of best to worst vessels with respect to PSC rates, and distributing to fleet (dirty list)
  - Incentives – annual halibut bycatch award for best avoidance
  - Coop guidelines on best practice
- Other Chinook program tools are not as effective
  - Halibut are more evenly distributed, so time/area closures are not effective
  - No apparent correlation with towing speed
- Investigation into correlations between halibut PSC rates and eastern BS bottom temperature

<u>United Catcher Boats and Midwater Trawlers Association report</u> – presentation by Brent Paine and Heather Mann

Achievement relative to the Council's request

- Sector did not meet the 10% reduction target for 2014
- There are ten catcher vessels in the sector that are not part of an AFA coop, and therefore there is no mechanism to require them to use PSC reduction tools. AFA coop managers are communicating with those vessels to share with them the avoidance measures they are requiring of their own vessels.

Tools available for PSC reduction

- 100% use of halibut excluders
- 7 inch mesh size requirement in the cod fishery
- No night fishing
- 100% observer coverage allows the coops to assign individual bycatch quotas internally

Longline Catcher Processors

<u>Freezer Longline Coalition (FLC) report</u> – presentation by Chad See and Gerry Merrigan

Achievement relative to the Council's request

- FLC met and exceeded the 10% reduction target for 2014; 23.2% reduction in halibut PSC mortality, and 33.2% reduction in halibut mortality rate
- Additionally, all reported numbers for PSC mortality in the longline CP sector overestimate actual mortality, because the 2014 DMR is assumed to be 9%, but the observed actual DMR is actually 7.9%. If the observed actual DMR was used, mortality in the sector would go from 514 mt to 347 mt in 2014, and the rate would fall to 2.53 kg/mt gfish
- FLC has significantly reduced total mortality (both the encounter rate and the actual DMR) in the past ten years. A challenge has been the implementation of Amendment 85, which reduced the proportion of cod available in the A season, resulting in higher B season catch when halibut interception is higher.

Tools available for PSC reduction

- Weekly reports within coop on vessels' PSC (dirty list)
- Vessel catch monitoring– through SeaState, target and bycatch data mapped in near real time
- Careful release practices
- Annual meeting for crew officers
- 100% observers and scales – full monitoring and transparency
- FLC halibut bycatch committee – formed in 2014 to encourage fleet in avoidance efforts

CDQ Groups

Western Aleutian Community Development Association report – presentation by Angel Drobnica and Paul Patton

Achievement relative to the Council's request

- CDQ groups did not meet the 10% reduction target for 2014. Rates decreased in 2014 for hook-and-line and pelagic trawl, but increased for non-pelagic trawl.
- CDQ groups have, however, been consistently below their allocation, and in 2014 fished only 63% of their PSC limit. Increase in PSC is a result of increasing groundfish catch, and more fully prosecuting the allocated CDQ groundfish, especially in the non-pelagic trawl fisheries
- CDQ groups have set a sector-level target of reducing PSC by 10% in 2015 (21 mt). Each group has the autonomy to cut PSC in the most appropriate way for that group

Tools available for PSC reduction

- A challenge is that CDQ groups do not harvest their own fish, but rely on contracts with partners. They are also managing hard caps for both multiple species and multiple gear types.
- Indirectly, CDQ groups can rely on partners to implement changes on the water in terms of reducing handling time, using gear modifications, and implementing best practices)
- Rate parity provision - a direct measure could be included in CDQ contracts requiring that CDQ tows must have a similar halibut rates to non-CDQ tows (a similar provision exists for Chinook PSC, although the groups are still resolving how exactly it would apply to halibut)
- Reduce allocation of PSC to target fisheries internally (reducing groundfish catch)
- Incorporate bycatch avoidance provisions in harvest agreements – including defining rate triggers, conservative PSC apportionments, distributing PSC in phases during the year
- Communication among CDQ groups – about PSC rates and strategies

Halibut deck sorting on Amendment 80 Catcher Processors

In 2015, the AKSC is operating an EFP to explore deck sorting onboard Amendment 80 vessels that are part of the AKSC[18]. One of the key factors affecting halibut viability is the amount of time the fish spend out of water prior to being sampled by observers and returned to the sea. Current catch handling regulations for Amendment 80 fisheries require that all halibut be delivered to the factory for sampling by an observer. While these procedures are currently needed to ensure that all catch is accounted for, the downside is that some halibut remain out of the water for up to several hours, and consequently suffer higher mortality rates. Any viability gains that may derive from reducing haul sizes and tow times are lost by the time observers sample and discard halibut. Changes to fishing practices combined with modified catch handling regulations are necessary to make meaningful, cost-effective improvements in halibut bycatch survival.

Industry has suggested that if halibut could be sorted on deck and returned to the sea sooner, discard mortality rates could be reduced. Two exempted fishing permits (EFPs) have been issued in the past to explore this issue, and research under those permits has been completed to evaluate how modified fishing practices and deck sorting might be combined to reduce halibut PSC mortality (as reported in Appendix A). In 2015, the AKSC is operating a third EFP which expands the use of deck sorting to a larger number

[18] An exempted fishing permit is a permit issued by the Alaska Region of NMFS to allow groundfish fishing activities that would otherwise be prohibited under regulations for groundfish fishing. These permits are issued for limited experimental purposes to support projects that could benefit the groundfish fisheries and the environment. Examples of past projects supported by an EFP include the development of new gear types for an underutilized fishery and development of devices that reduce prohibited species interceptions.

and variety of Amendment 80 AKSC vessels. The EFP allows operators of these vessels to sort halibut on deck rather than routing halibut over the flow scale and below deck. The objectives for the EFP are to: (1) assess the reduction in halibut mortality when deck sorting is available as an optional catch handling procedure; (2) evaluate the frequency of tows where deck sorting is used relative to the existing catch handling procedures; (3) evaluate the percentage of a participating vessel's halibut catch that is sorted on deck; and (4) evaluate the utility of deck sorting in the context of the rules and constraints of the FEP.

The following progress report on the 2015 EFP was provided by John Gauvin, a representative of the applicant (AKSC)[19]. Although the AKSC received the EFP permit at the end of March, there have been difficulties in recruiting sufficient sea samplers to date. The first vessels to operate under the permit are scheduled to begin in mid-May, and by the end of June, there should be seven or eight boats engaged in decksorting under the EFP. In order to meet the conditions of the permit, vessel captains must follow certain specific requirements with respect to notifying the observer which hauls will be deck sorted. AKSC has hired two project managers who will go out on each vessel's first trip, to ensure that vessels adhere to the conditions of the permit.

In practice, most vessels in the 2015 EFP will only be able to use deck sorting for about half of their tows on EFP trips. Under the rules of the EFP, two sea samplers would be required for deck sorting operations to occur for more than 12 hours a day, but given the shortage of sea samplers, most EFP vessels will only have one sea sampler for most or all their EFP trips. For the tows during and EFP trip when a sea sampler is off duty (for EFP trips with one sea sampler), deck sorting will not be allowed, and the default catch handling procedures must be followed. For these tows, the assumed DMR for the target fishery will be applied.

For tows when deck sorting occurs, the mortality applied to the halibut PSC overall is a composite of rates. The actual DMR achieved is applied to halibut sorted on deck, according to the sea sampler's sampling of release condition (where the mortality rates are 20 percent for fish in excellent condition, 55 percent for fish in poor condition, and 90 percent for fish assessed to be dead). A default DMR of 90 percent is applied to halibut that were not sorted on deck (i.e., those collected in the factory). The default rate for fish in the factory is intended to account for the fact that it will take considerably longer to get those halibut back in the water than normally occurs[20]. For comparison, Table 3-8 lists assumed DMRs in Amendment 80 flatfish fisheries, which are in the range of 71 to 85 percent, depending on the target fishery.

Taking this into account, EFP vessels will receive credit in terms of lower DMRs if the modified procedures reduce mortality overall, relative to the assumed rates for the target fisheries. Essentially, the proportion of halibut sorted on deck will have to be high enough to compensate for the higher default rate (90 percent) for halibut that flow through to the factory, and the actual DMR for the halibut that are sorted on deck will need to be low enough to create net mortality savings relative to what would have occurred without deck sorting. At the outset of this EFP, vessels are focusing on sorting for only the first 20-30 minutes, when a large fraction of the halibut are expected to still be in "excellent condition" (20 percent mortality rate).

In the 2012 deck sorting EFP (EFP 12-01), the net result on halibut PSC from fish both sorted on deck and collected in the factory was approximately a 20% savings in mortality, relative to what would have occurred while fishing without deck sorting under the existing rules. The 2015 EFP extends the deck sorting experiment to a larger group of vessels with different vessel characteristics and on-deck practices,

---

[19] John Gauvin, personal communication, May 10, 2015.

[20] As part of the EFP rules for data collection and monitoring procedures, all catch from an EFP tow must remain in the vessel's stern tank until sorting operations are completed. Additionally, all halibut collected in the factory from a deck sorting tow will be placed in a tote and accounted for after all the fish from a deck sorting have passed over the vessel's flow scale.

fishing in normal conditions, and simultaneously using other halibut avoidance practices (e.g., moving to avoid areas of high encounter, and using halibut excluders). The EFP should be informative about whether a similar mortality savings can be achieved from an operational program. In 2015, however, the late start and low availability of sea samplers for the EFP will mean that the amount of savings on deck sorting trips is limited from the outset, as participants will not be able to engage in deck sorting as often as they might otherwise have done.

3.1.4 Other halibut removals

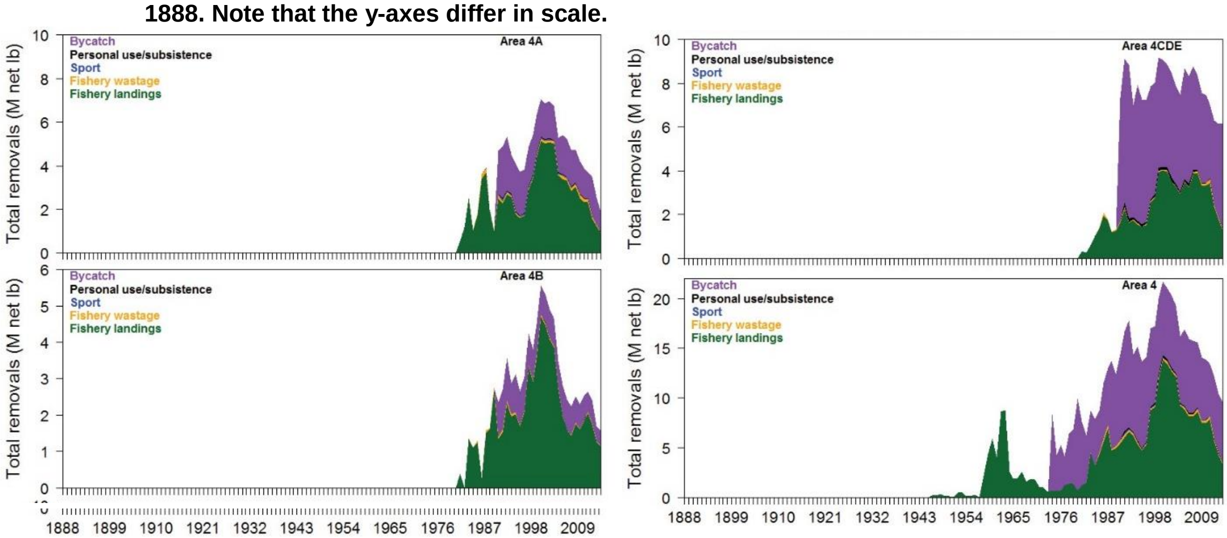
Commercial halibut landings and groundfish halibut PSC mortality comprise the majority of Pacific halibut removals in Area 4. Recreational removals, personal use, and fishery wastage are relatively minor in BSAI areas, contributing only 0.03, 0.04 and 0.17 million pounds of removals, respectively, in 2013 (Stewart et al. 2014a) (Figure 3-24). On a coastwide basis, annual removals were above the 100-year average from 1985 through 2010, peaking in 2004 (Figure 3-11). Commercial removals are the lowest since 1980. Table 3-18 lists total removals coastwide for the last five years.

Table 3-18 Total removals coastwide, 2010 through 2014, in millions of pounds

Year	Commercial Landings	Wastage	Sport	Personal use/ Subsistence	Bycatch	Total
2010	49.72	3.21	7.85	1.24	10.30	72.36
2011	39.51	2.46	7.10	1.14	9.42	59.64
2012	31.99	1.67	6.77	1.14	10.10	51.67
2013	29.04	1.43	7.59	1.14	8.84	48.04
2014*	23.69	1.29	7.08	1.14	9.32	42.51

*Preliminary, based on data as of November 11, 2014. Bycatch totals through the end of 2014 were projected.
Source: IPHC 2014b.

Figure 3-24 Total estimated removals by source in Areas 4A, 4B, 4CDE, and all of Area 4 combined, since 1888. Note that the y-axes differ in scale.



Source: Stewart 2015.

3.1.4.1 Commercial Halibut Hook and Line Fishery

The Council allocates Pacific halibut in Area 4 based on catch limits set by the IPHC. The Council adopted Individual Fishing Quota (IFQ) programs in 1992 for the Pacific halibut fixed gear fisheries, which were implemented in 1995. The IFQ system was put into place to end the “race for fish” caused by too many boats fishing during restricted seasons of a few days. The IFQ system has resulted in longer seasons, improved vessel safety, and fresh halibut being available about 8 months per year (the season is open from mid-March through mid-November). The IFQ programs assign the privilege of harvesting a percentage of the sablefish and halibut quotas to specific individuals with a history of harvest in the fisheries. The fishing privileges assigned to each person are proportional to their fixed gear halibut and sablefish landings during the qualifying period and are represented as quota shares (QS). Only persons holding QS are allowed to make fixed gear landings of halibut and sablefish in the regulatory areas identified on the permits. Those who do not hold QS are generally excluded from the fisheries, although the program contains several very limited provisions for "leasing" IFQ. Administrative actions provide for some limited adjustments to annual IFQ permit amounts resulting from underages or overages of IFQ the prior year; however, significant fishing in excess of an IFQ permit is a violation.

The program includes strict limits on how much QS can be held by any person, and caps on vessel use ensure continued participation by at least a minimum number of vessels. To meet the goal of an owner-operated fleet, catcher vessel QS may be transferred only to individuals who must be aboard the vessel when the fish are harvested and landed. Quota share and the annual IFQ that it yields are classified by species, regulatory area, vessel category, and whether it may be fished on a vessel in another size category ("fish up" or "fish down"). A variety of restrictions regarding harvesting, processing IFQ and non-IFQ species, landing, and reporting IFQ fish are also in place.

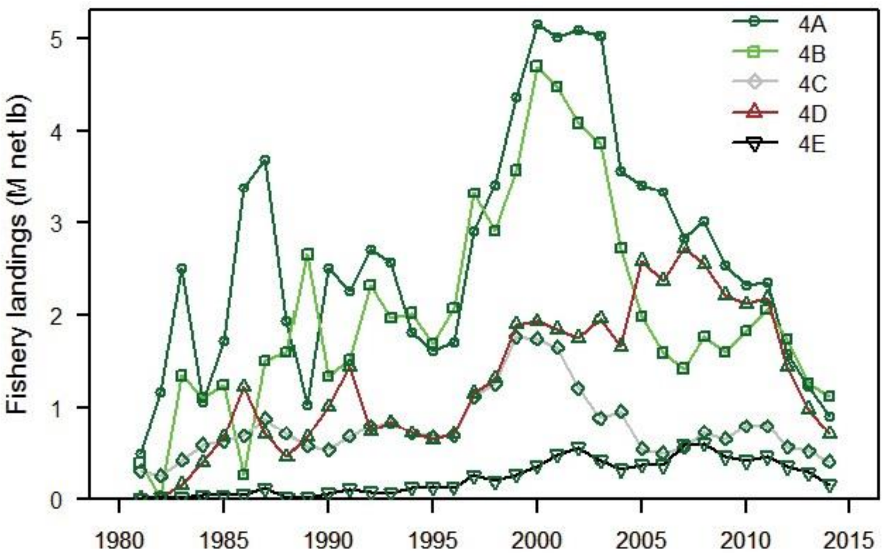
Commercial halibut fishery removals are delineated within Area 4 beginning in 1981 (Figure 3-25). From 1981 to 1984 the fishery in Area 4CDE removed from 0.3 to 1.0 million pounds (Figure 3-15). Fisheries in Areas 4A and 4B were of a similar magnitude during this period, and all three grew rapidly as the stock increased through the 1990s (Stewart and Martell 2014), peaking at 5.2 (4A), 4.5 (4B), and 4.0 million pounds (4CDE) in 2000 to 2001 (Table 3-19). Directed fisheries in the BSAI, as in all other regulatory areas, have since dropped to 2013 values of 1.2 (4A and 4B) and 1.8 million pounds (4CDE). These reductions are roughly consistent with proportional declines in fishery and survey catch rates (Figure 3-9). Over the last 3-5 years, the setline survey weight-per-unit-effort has exhibited a relatively flat trend, and in contrast to the coastwide level, individual size-at-age has been more stable throughout the recent period.

Table 3-19 Summary of halibut fishery landings in the BSAI – IPHC regulatory Areas 4A, 4B, and 4 CDE, in thousands of pounds, net weight.

Commercial Halibut Landings								
Year	**4A**	**4B**	**4CDE**		**Year**	**4A**	**4B**	**4CDE**
1995	1,620	1,680	1,440		2005	3,400	1,980	3,480
1996	1,700	2,070	1,510		2006	3,330	1,590	3,230
1997	2,910	3,320	2,520		2007	2,830	1,420	3,850
1998	3,420	2,900	2,750		2008	3,020	1,760	3,880
1999	4,370	3,570	3,920		2009	2,530	1,590	3,310
2000	5,160	4,690	4,020		2010	2,330	1,830	3,320
2001	5,020	4,470	3,970		2011	2,350	2,050	3,430
2002	5,090	4,080	3,520		2012	1,580	1,740	2,340
2003	5,020	3,860	3,260		2013	1,230	1,240	1,780
2004	3,560	2,720	2,920		2014*	900	1,120	1,260

* preliminary
Source: Stewart et al. 2014a; Stewart 2015

Figure 3-25 Recent landings of halibut by the directed commercial fishery, by Area 4 subarea



Source: Stewart 2015

Table 3-20 lists commercial catch limits of Pacific halibut from 2005 to 2014. The final adopted catch limits for 2014 resulted in FCEYs of 0.85 (4A), 1.14 (4B), and 1.29 million pounds (4CDE). These limits correspond to estimated harvest rates (based on apportionment of the coastwide exploitable biomass; Webster and Stewart 2014) of 16.125 percent in 4A, 20.7 percent in 4B, and 19.8 percent in 4CDE; the latter two were in excess of the current harvest policy targets (the blue line) for those areas (16.125 percent). Table 3-21 identifies the proportion of the catch limit achieved for each area, in 2005 to 2014. Area 4A is fully harvested in most years; Area 4B varies interannually, between 85 and 98 percent; and Area 4CDE has ranged between 92 and 98 percent harvested in the last five years.

Table 3-20 Commercial catch limits of Pacific halibut, 2005 to 2014, in thousands of pounds, net weight.

Area	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014*
4A	3,440	3,350	2,890	3,100	2,550	2,330	2,410	1,567	1,330	850
4B	2,260	1,670	1,440	1,860	1,870	2,160	2,180	1,869	1,450	1,140
4C	1,815	1,610	1,866.5	1,769	1,569	1,625	1,690	1,107	859	596
4D	1,815	1,610	1,866.5	1,769	1,569	1,625	1,690	1,107	859	596
4E	359	330	367	352	322	330	340	250	212	92

Note: Additional carryover from the underage/overage plans is not included.
* Preliminary
Source: Gilroy et al. 2015.

Table 3-21 Proportion of commercial Pacific halibut catch limit landed, 2005 to 2014.

Area	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014[1]
4A	99%	99%	98%	97%	99%	100%	98%	101%	92%	106%
4B	88%	95%	99%	95%	85%	85%	94%	93%	86%	98%
4CDE	87%	91%	94%	100%	96%	93%	92%	95%	92%	98%

[1] Preliminary
Source: Gilroy et al. 2015 and Stewart 2015.

A total of 362 unique halibut IFQ QS holders (as defined by unique combinations of species, areas, and vessel categories) held some Area 4 QS, as of early January 2015. Table 3-22 illustrates the distribution of QS holdings within Area 4 subareas, noting that there will be some duplication in the table as some persons hold QS for multiple areas. IFQ QS holders reported 342 vessel landings of IFQ halibut in Area 4 in 2014. Table 3-23 displays landings by regulatory area, and IFQ pounds as reported by Registered Buyers.

Table 3-22 Halibut QS holdings as of January 2015

Area	Alaskan		Non-Alaskan	
	Number of persons	QS Units	Number of persons	QS units
4A	125	7,520,428	75	7,037,941
4B	46	4,475,795	41	4,808,979
4C	30	1,702,440	22	2,082,183
4D	15	1,552,965	30	3,281,686
4E	84	117,285	12	22,307

Source: NMFS RAM, http://alaskafisheries.noaa.gov/ram/ifq/14ifqunitf.csv, accessed 1/9/15.

Table 3-23 2014 IFQ and CDQ halibut allocations and fixed-gear landings, net pounds (in thousands)

Fishery	Area	Vessel Landings	Total Catch Pounds	Allocation Pounds	Remaining Pounds	Percent Landed
IFQ	4A	145	827	850	23	97%
	4B	93	864	912	48	95%
	4C/4D	104	688	716	28	96%
CDQ	4B	*	*	228	*	*
	4C	*	*	298	*	*
	4D	176	120	179	59	67%
	4E[1]	240	152	92	-60	166%

* confidential

[1] 4D allocation may be fished in 4D or 4E. Harvest is debited from the account for the reported harvest area. This may cause 4E landings to appear overharvested and 4D underharvested.

Source: NMFS RAM, http://alaskafisheries.noaa.gov/ram/ifq/14ifqland.pdf

Table 3-24 shows the seasonality of the commercial fishery in the BSAI for 2014. In Area 4A, there was a moderate amount of fishing in April and May, a pulse in July, tapering off into the fall. 4B and 4CDE experienced higher levels of catch from April through August, with a pulse in June, and relatively less effort in the fall.

Table 3-24 Seasonal catch of commercial Pacific halibut landings in 2014 (not including research catch), for Area 4 subareas, by month, in total pounds net weight (preliminary).

Area	April	May	June	July	Aug.	Sept.-Oct.	Total
4A	148	153	91	246	131	58	827
4B	162*	200	290	222	150	65	1089
4CDE	211	228	410	232	139	25	1245
Area 4 total	521	581	791	700	420	148	3161

* Weight combined with landings in March for confidentiality purposes.

Source: Gilroy et al. 2015, based on landings from NMFS Restricted Access Management Division.

3.1.4.2 Wastage in the commercial halibut fishery

The IPHC reports annually on wastage in the commercial halibut fisheries, by area. Wastage includes the mortality of all halibut that do not become part of the landed catch, which are, by majority, fish that are captured and discarded because they are under the minimum 32" size limit for the fishery (U32). A calculation is also made for fish that die on lost or abandoned fishing gear. The final category of wastage is fish that are discarded for regulatory reasons (such as catching fish in excess of IFQ on the last fishing trip of the season), but the IPHC generally considers the latter to be only small amounts in Area 4, and not significant (Gilroy and Stewart 2015). Wastage of U32 fish is calculated using the IPHC setline survey as a proxy for the commercial fleet, so for the BSAI, the survey's ratio of U32 to O32 for Area 4 as a whole is multiplied by the estimated annual commercial catch for that area. A mortality rate is then applied to the discarded catch, to calculate mortality. Since the implementation of the IFQ system in Alaska (in

1995), a universal mortality rate of 16% has been applied to all halibut discards in the commercial fishery. Table 3-25 illustrates IPHC estimates of halibut discard mortality in the Area 4 IFQ fishery since 2014, distinguishing the U32 mortality by area, and providing an Area 4 total for the combined wastage from U32 and lost gear.

Table 3-25 IPHC estimates of halibut discard mortality in the commercial halibut fishery in Area 4, 1995 to 2014, in net pounds (thousands).

Year	Wastage from estimated U32 mortality						Wastage from U32 mortality plus lost gear
	4A	4B	4C	4D	4E	Total – Area 4	Total - Area 4
1995	16	13	6	1	1	37	61
1996	19	13	14	15	3	64	139
1997	31	19	23	23	5	101	179
1998	48	35	18	18	3	122	175
1999	33	46	15	16	2	112	205
2000	66	36	4	4	1	111	181
2001	99	47	7	8	2	163	251
2002	83	20	3	4	1	111	161
2003	85	26	4	8	2	125	175
2004	63	22	5	9	2	101	140
2005	127	11	5	25	4	172	203
2006	95	9	6	31	5	146	164
2007	127	19	9	45	10	210	234
2008	138	18	18	63	15	252	285
2009	145	11	15	50	10	231	265
2010	130	30	20	53	10	243	270
2011	134	35	41	112	24	346	378
2012	90	35	17	44	11	197	208
2013	62	32	15	29	9	147	161
2014	33	46	16	28	6	129	138

Source: Gilroy and Stewart 2015.

Beginning in 2013, NMFS implemented changes to the Observer Program that included deploying observers on commercial halibut boats, based on a scientifically defensible deployment plan for the fleet under observer coverage. Halibut vessels less than 40 ft in length fall into the zero observer coverage category, representing 79 percent of the vessels landing halibut, and 25 percent of the landed catch, in Area 4. Beginning in 2013, NMFS has used observer estimates extrapolated to the fleet to estimate the disposition of halibut (and other incidentally caught species) in the commercial halibut fishery. Table 3-26 shows that according to NMFS data, approximately 21% of halibut was discarded in 2013, and approximately 34% in 2014. The combined BSAI mortality estimates of discarded halibut, in net weight pounds, equate to NMFS' estimation of mortality from U32 halibut in Area 4. Comparing Table 3-25 and Table 3-26, the NMFS data estimate U32 mortality (wastage) in Area 4 fisheries slightly higher in 2013 (147,000 lb versus 165,350 lb), and substantially higher in 2014 (129,000 lb versus 232,670 lb). Part of the difference may be explained by the average weight used to calculate discards in the commercial halibut fishery by the Observer Program. The average weight is derived from all sizes of halibut, retained and discarded, even though there is a 32 inch minimum size limit in the halibut fishery. As such, fish discarded would have an average weight much smaller than the trip average. The other contributing factor is that the data used for extrapolation include all longline fisheries, not just directed halibut fisheries. This means that NMFS estimates of wastage in the IFQ halibut fishery are overestimates of the actual wastage. NMFS and IPHC are working together to review the discard and bycatch estimates, and the agencies plan to develop an improved process during the course of 2015.

Table 3-26 NMFS estimates of total and discarded halibut catch in the commercial halibut fishery in the Bering Sea and Aleutian Islands

Year	Area	Total catch of halibut (mt)	Discarded catch of halibut (mt)[1]	Discarded as proportion of total	Discarded catch of halibut (lb, net weight, thousands)	Mortality of discarded halibut[2] (lb, net weight, thousands)	Discard mortality as proportion of total catch
2013	AI	986	210	21.3 %	348	56	3.4 %
	BS	1,883	402	21.3 %	665	106	3.4 %
	BSAI combined	2,870	613	21.3 %	1,013	162	3.4 %
2014	AI	939	319	34.0 %	528	84	5.4 %
	BS	1,575	543	34.5 %	898	144	5.5 %
	BSAI combined	2,514	862	34.3 %	1,425	228	5.5 %
2013-14 average	**BSAI combined**			**27.4 %**			**4.4 %**

[1] A caveat to this estimation is that the mean weight used to calculate discards in the halibut fishery is derived from all sizes of halibut, retained and discarded, even though compulsory discards of fish below the 32 inch minimum size limit reduces the average weight of discards compared to the trip average.
[2] Applies the IPHC's 16% universal mortality rate for halibut discards in the commercial IFQ fisheries
Source: NMFS Catch Accounting System, queried by AKFIN 12/31/14.

3.1.4.3 Sport fishery

Halibut sport fishing is much less common in Bering Sea due to the relative remoteness of the ports. Management of sport halibut fisheries is the responsibility of NMFS, though data collection, fishery sampling and harvest estimation is conducted by the Alaska Department of Fish and Game (ADFG) Division of Sport Fish. The unguided (private) fishery harvest is projected using time series methods applied to estimates from the Statewide Harvest Survey (SWHS). As there is no sampling in the area, the IPHC has traditionally estimated the weight of the harvest in Area 4 by applying the average weight of halibut caught in Kodiak (Kaimmer 2014).

The sport fishery season in Area 4 is from February 1st to December 31st, with a two fish daily bag limit. The estimated 2014 harvests for these areas remain relatively low, at 25,000 pounds in Area 4A. Since 2005, annual harvests have ranged from 18,000 to 50,000 pounds in Area 4 (Table 3-27). A 6 percent release mortality rate is assumed for Area 4 (Kaimmer 2014).

Table 3-27 IPHC data on Area 4 halibut harvest history for sport fishers, subsistence/personal use, and retention of halibut under 32 inches in CDQ fisheries in Areas 4D and 4E, in thousands of pounds, net weight.

Year	Sport	Subsistence / personal use					
		4A	4B	4C	4D	4E	Retention of U32 in CDQ fisheries in 4D/4E
2005	50	36	1	8	6	54	23
2006	46	27	3	9	8	71	20
2007	44	15	2	15	3	52	19
2008	40	20	5	6	3	16	22
2009	24	34	1	6	1	9	11
2010	16	15	1	11	1	10	10
2011	17	14	1	2	1	6	17
2012	28	10	2	1	1	8	20
2013*	9	10	2	1	1	8	10
2014*	23	10	2	1	1	8	6

* preliminary: all 2014 data, and subsistence catches for 2013
Source: Kaimmer 2014 for subsistence, Gilroy and Williams 2015 for personal use, Williams 2015 for U32.

3.1.4.4 Subsistence Fisheries

Halibut is a widely used subsistence resource in Alaskan coastal communities. Management of subsistence halibut fisheries is the responsibility of NMFS, but data collection and harvest estimation is performed by the ADFG Division of Subsistence Fisheries under contract to NMFS. Halibut have been harvested for centuries by the indigenous coastal peoples of Southeast, Southcentral, and Western Alaska. Long ago, hooks were made of wood or bone, and often ornately carved with spirit figures to attract halibut. Lines were made of twisted fibers of cedar, animal sinew, or kelp. Halibut meat was preserved by drying or smoking.

Despite a long history of harvest, Federal halibut fishing regulations did not officially recognize and authorize the subsistence fishery until 2003. In May 2003, the NMFS published final regulations for a subsistence halibut fishery in Alaska. Residents of 118 rural communities and designated rural areas, and members of 123 tribes are eligible to participate. Members of federally recognized tribes as well as residents of designated rural areas and communities are eligible to obtain a Subsistence Halibut Registration Certificate (SHARC) in order to participate in this fishery. Special permits for community harvest, ceremonial, and educational purposes also are available to qualified Alaska communities and Alaska Native Tribes.

Subsistence harvest has been estimated in recent years using a survey of SHARC holders. Most of the subsistence harvest occurs in Southeast and Southcentral Alaska. The ADFG Division of Subsistence conducted a study to estimate the subsistence harvests of Pacific halibut in Alaska in 2012 (Fall and Koster 2014). Halibut subsistence harvests in Area 4, with proportion of the statewide total, were as follows:

- Area 4A (Eastern Aleutian Islands), 1% (9,543 lb)
- Area 4E (East Bering Sea Coast), 1% (8,384 lb)
- Area 4B (Western Aleutian Islands), less than 1% (1,698 lb)
- Area 4C (Pribilof Islands), less than 1% (1,176 lb)
- Area 4D (Central Bering Sea), less than 1% (672 lb)

Table 3-28 estimates the subsistence harvest of halibut from the Area 4 subareas, by community, in 2012. There are three communities in Area 4A: Akutan, Nikolski, and Unalaska-Dutch Harbor. Estimated harvest in 2012 was considerably lower than recent years (Figure 3-26; Table 3-27), and no Akutan residents returned the survey for 2012, so no subsistence harvest is estimated for Akutan. Area 4B (communities of Adak and Atka) experienced an increase in harvest compared to 2011. The 2012 estimate for Area 4C was the lowest since the SHARC program began in 2003. The number of valid SHARCs held by St. Paul residents has dropped to just 12 in 2012, compared to 246 in 2007, and an average of 43 for 2008 to 2011 (Figure 3-27). The 4D harvest estimate was slightly higher than the 2011 estimate, although the second lowest since the program began. In Area 4E, most of the harvest is from the Yukon-Kuskokwim Delta, with a smaller amount from Norton Sound and Bristol Bay, and the estimated harvest was an increase from 2011. Communities include Bethel, Chevak, Dillingham, Egegik, King Salmon, Kotlik, Koyuk, Manokotak, Naknek, Nightmute, Nome, Port Heiden, and Togiak. As with 4D, lower harvest estimates for Area 4E are likely in part attributable to the substantial drop in valid SHARCs held by tribal members and rural community residents of Area 4E in the last five years (Fall and Koster 2014).

Table 3-28 Estimated harvests of halibut in numbers of fish and pounds net weight by Area 4 subarea, 2012

Subarea	Reg. area	Number of SHARCs subsistence fished[c]	Est. subsistence harvest by gear type[a]									Est. sport harvest		
			Set hook gear			Hook and line or handline			All gear					
			Est. number respondents fished	Est. number halibut harvested	Est. pounds halibut harvested[b]	Est. number respondents fished	Est. number halibut harvested	Est. pounds halibut harvested[b]	Est. number respondents fished	Est. number halibut harvested	Est. pounds halibut harvested[b]	Est. number respondents fished	Est. number halibut harvested	Est. pounds halibut harvested[b]
Eastern Aleutians–East	4A	67	38	355	4,972	50	459	7,844	67	814	12,816	25	200	2,714
Eastern Aleutians–West	4A	5	4	14	330	4	20	460	5	33	790	7	11	255
Subtotal, Area 4A		**70**	**39**	**369**	**5,302**	**52**	**478**	**8,304**	**70**	**847**	**13,606**	**32**	**211**	**2,969**
Western Aleutians–East	4B	9	9	12	280	6	15	257	9	27	537	6	0	0
Subtotal, Area 4B		**9**	**9**	**12**	**280**	**6**	**15**	**257**	**9**	**27**	**537**	**6**	**0**	**0**
St. George Island	4C	4	4	20	490	0	0	0	4	20	490	0	0	0
St. Paul Island	4C	7	4	35	346	4	11	812	7	46	1,158	0	0	0
Subtotal, Area 4C		**11**	**8**	**55**	**836**	**4**	**11**	**812**	**11**	**66**	**1,648**	**0**	**0**	**0**
St. Lawrence Island	4D	8	7	22	556	3	1	60	8	23	615	0	0	0
Subtotal, Area 4D		**8**	**7**	**22**	**556**	**3**	**1**	**60**	**8**	**23**	**615**	**0**	**0**	**0**
Bristol Bay	4E	10	5	0	0	10	34	403	10	34	403	3	0	0
Yukon Delta	4E	78	26	198	2,089	65	497	3,194	78	695	5,283	6	14	264
Norton Sound	4E	5	5	21	482	0	0	0	5	21	482	0	0	0
Subtotal, Area 4E		**91**	**35**	**220**	**2,571**	**72**	**531**	**3,597**	**91**	**750**	**6,168**	**9**	**14**	**264**

a. "Setline" = longline or skate. "Hand-operated gear" = rod and reel, or handline
b. Weights given are "net weight." Pounds net (dressed, head off) weight = 75% of round (whole) weight.
c. Because fishermen may fish in more than one area, subtotals for regulatory areas might exceed the sum of the subarea values. Includes subsistence and sport fishing.

Source: ADF&G Division of Subsistence, SHARC survey, 2013, in Fall and Koster 2014.

Figure 3-26 Estimated subsistence halibut harvests, pounds net weight, by regulatory area fished, 2003 to 2011.

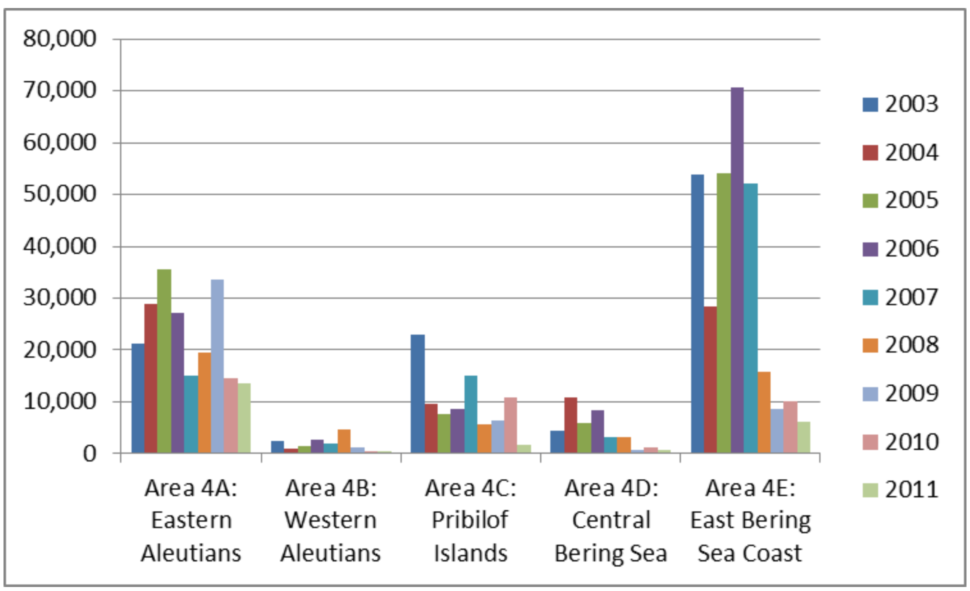
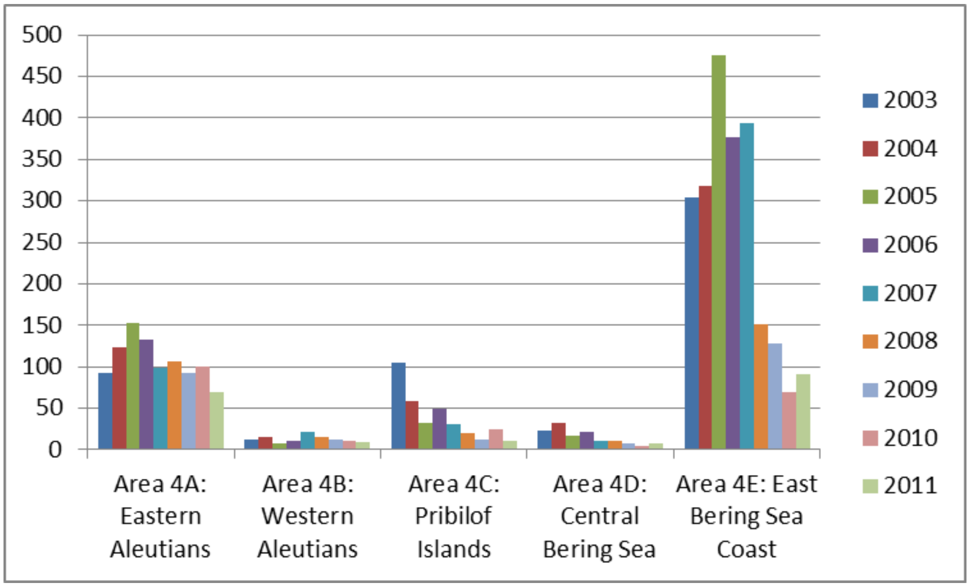


Figure 3-27 Estimated number of Alaska subsistence halibut fishermen in Area 4, 2003 to 2011, by regulatory area of tribe or rural community.



Retention of U32 halibut in the 4D/4E CDQ fisheries

Under an exemption requested by the Council, commercial halibut vessels fishing for certain CDQ organizations in Areas 4D and 4E have been permitted by the IPHC to retain halibut under 32 inches (U32), provided the vessels land all of their catch in Areas 4D or 4E. This harvest is in addition to the subsistence harvest reported by ADFG for these regulatory areas. The three CDQ groups to which this exemption applies are Bristol Bay Economic Development Corporation (BBEDC), the Coastal Villages Regional Fund (CVRF), and the Norton Sound Economic Development Corporation (NSEDC).

Overall amounts of U32 halibut retained by CDQ harvesters are reported in Table 3-27. In most years, the majority of the fish retained under this provision is from CVRF harvesters, although in 2014 there was a significant reduction in retained halibut. Generally, annual changes are a reflection of the amount of effort by the local small boat fleets, and the availability of fish in their nearshore fisheries (Williams 2015). Harvests by BBEDC fishermen were comparable to 2013, and there was a 12 percent decrease in NSEDC harvest, compared to 2013.

3.1.5 Effects of the Alternatives

Halibut PSC mortality in the groundfish fisheries, recreational and subsistence halibut catches, and wastage in the commercial halibut fishery are all considered before the IPHC sets commercial halibut catch limits each year. IPHC directed commercial fishery catch limits are reduced in consideration of the estimated mortality in other fisheries in order to minimize the chances of the stock decreasing below harvest reference points. However, the halibut stock is impacted by these removals in the form of reduced yield available to harvesters and reduced spawning biomass.

Impact criteria

Table 3-29 describes the criteria used to determine whether the impacts on Pacific halibut stocks are likely to be significant.

Table 3-29 Criteria used to estimate the significance of impacts on incidental catch of Pacific halibut.

No impact	No incidental take of Pacific halibut.
Adverse impact	There are incidental takes of Pacific halibut.
Beneficial impact	Natural at-sea mortality of Pacific halibut would be reduced – perhaps by the harvest of a predator or by the harvest of a species that competes for prey.
Significantly adverse impact	An action that diminishes protections afforded to Pacific halibut in the groundfish fisheries would be a significantly adverse impact.
Significantly beneficial impact	No benchmarks are available for significantly beneficial impact of the groundfish fishery on Pacific halibut, and significantly beneficial impacts are not defined for these species.
Unknown impact	Not applicable

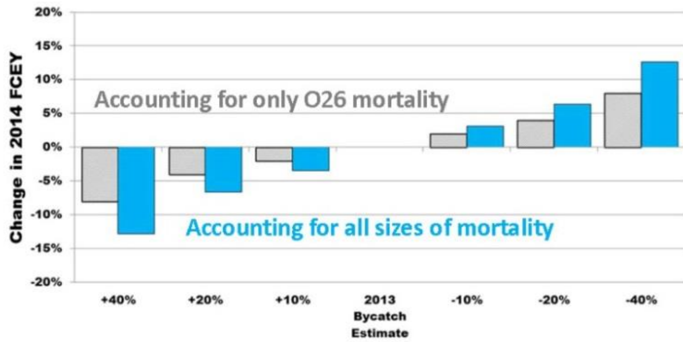
3.1.5.1 IPHC analyses on halibut PSC mortality impacts

Several previous IPHC analyses have investigated the effects of halibut PSC mortality on the halibut stock using metrics of fishery yield and lifetime spawning biomass contribution (Hare et al. 2012, Hare and Williams 2013). These analyses were conducted using equilibrium calculations based on relatively simple assumptions about growth and mortality. Results indicated that there was a 1.0 -1.14 pound loss of fishery yield per pound of bycatch (O26 and U26 combined). For each pound of bycatch, the potential lifetime contribution to female spawning biomass was found to be somewhat larger than the fishery yield.

More recently, Stewart et al. (2014a) reported to the Council on an evaluation of the impacts of halibut PSC limit reductions in the BSAI, using the stock assessment models, apportionment estimates, and current harvest policy calculations, and based on the actual bycatch estimates from each regulatory area in 2013. Coastwide TCEY and FCEY values were recalculated using coastwide and Area 4 bycatch values of 40, 20, and 10 percent above and below the estimates from 2013, and changes in bycatch showed a corresponding effect in Area 4 FCEYs. Results indicated that Area 4CDE is the most sensitive to bycatch fluctuations, as it has a much higher ratio of bycatch to directed fishery harvest. A second series of calculations addressed the impact of differing levels of U26 halibut PSC mortality, which are accounted for in the stock assessment as an effect on estimated productivity of the stock, but not explicitly addressed by the current harvest policy (see Section 3.1.2.2). Using the Spawning Potential Ratio (SPR)[21], which integrates fishing intensity across all sources and sizes of mortality, different levels of total and U26 bycatch were considered, and FCEY values adjusted via the stock assessment to maintain the same SPR target. The resulting response in directed fishery yields from proposed BSAI halibut PSC mortality reductions was greater than just the change in O26 mortality (accounting for the additional effect of the U26 removals). The results were consistent with previous analyses finding approximately a 1:1 relationship in total lost yield due to all sizes of bycatch (Figure 3-28). These changes were assumed to be distributed in proportion to the productivity of the stock as a whole, so affected other regulatory areas than just the BSAI.

[21] Spawning Potential Ratio is the spawning biomass per recruit at equilibrium, relative to an unfished level, given the current level of fishing mortality from all sources.

Figure 3-28 Coastwide impacts of halibut PSC mortality (bycatch) changes in the BSAI



Source: Stewart et al. 2014a

<u>Major sources of uncertainty</u>

There are several very important sources of uncertainty in the IPHC's analysis of current halibut stock status and impacts of halibut PSC mortality on yield, as described in Stewart et al. (2014a). Some of these sources are inherent to the biology and management of Pacific halibut and are not easily addressed (e.g., specific migration pathways and rates), while others are being worked on through additional data collection and analysis.

- Current uncertainty in setline survey indices in the Bering Sea is due to incomplete geographic coverage and could be improved through setline survey expansions planned over the next five years with better spatial coverage and a broader depth range. Pending logistical constraints, the IPHC is considering repeating the 2006 Bering Sea trawl survey calibration in 2015 (along with the Area 4D expansion), which could provide an updated estimate of the abundance in that area, particularly crucial given the current uncertainty in recent year classes.
- The current harvest policy makes the implicit assumption that the effects of this mortality are distributed across the entire stock, in proportion to the total productivity. If juveniles in some areas are less likely to disperse to other areas, or if these patterns change over time with environmental conditions or stock abundance, this assumption may not be a good one. Neither the directed fishery, nor the setline survey provides clear information on juvenile abundance distribution. Some information can be inferred from other sources, however, all of these are subject to many other uncertainties. The design of a targeted survey of juvenile halibut abundance and distribution is likely to be both technically unfeasible and prohibitively expensive.
- Juvenile natural mortality rates are highly uncertain, but are important to any evaluation of removals to population trend and productivity. For this analysis, several alternative comparisons were made of juvenile natural mortality rates resulting in the relative change in SPR being similar across alternatives.
- The stock assessment and application of the harvest policy relies on accurate and precise estimation of the removals from all fishing sectors, including the directed fishery, recreational and subsistence harvests, as well as discards from these fisheries and bycatch. There is a substantial amount of uncertainty in the current treatment of halibut PSC mortality due to: the estimation framework (data collection), the summary of the estimates (data processing), and the forecasting of bycatch and its biological properties from one year to the next. Under the current observer program, not all fisheries in the BSAI region have observer coverage of 100% of fishing trips, which may introduce bias into the estimates. Additionally, not all bycatch may be attributed to the correct regulatory area in each year, due to the imperfect alignment of IPHC and Alaska statistical reporting areas. Finally, IPHC receives halibut PSC mortality data in a form that makes it difficult to weight data among fishing sectors by size-, age-, and sex-specific estimates of the removals.

- The stock assessment and harvest policy calculations rely on an aggregate bycatch selectivity assumption. However, the size distribution of bycatch varies among regulatory areas, among fisheries and even annually within fisheries, in response to many extrinsic and intrinsic factors. Further, many of the tools proposed for bycatch reduction could have large effects on the potential size-distribution of future bycatch mortality through direct effects, or changes in the discard mortality estimates by fish size. These changes are difficult or impossible to predict, and therefore current practice is to use the values from the previous year for all calculations. This approach could introduce lags in response if clear trends occur.

Future directions for the total mortality accounting framework

The SPR-based evaluation method provides an accounting framework through which yield trade-offs can be evaluated. Specifically, it allows the explicit evaluation of trade-offs between removals of halibut associated with different fisheries and potential changes in the size structure of these removals in response to management actions. With respect to potential management actions such as are considered in this halibut PSC limit reduction analysis, this type of evaluation serves as a basis for direct comparisons within and among regulatory areas of the ‘exchange rate’ among fisheries, for example the groundfish fishery versus the directed halibut fishery, in terms of pounds of total halibut removals, and potential dollars earned in directed halibut fisheries and from fisheries for target species other than halibut which are responsible for incidental halibut removals.

The final report describing the methodology (Stewart et al. 2014b) suggests ways for the IPHC to add full accounting to the IPHC’s annual process. The total mortality accounting report is being reviewed by the IPHC in the 2014/2015 meeting cycle, and also by the Council’s Scientific and Statistical Committee at the February 2015 Council meeting.

3.1.5.2 Impacts of Alternative 1

Alternative 1 would result in no change to the amount of halibut PSC mortality in the trawl and longline groundfish fisheries. The Groundfish PSEIS (NMFS 2004a) and the Harvest Specifications SEIS (NMFS 2007) concluded that it is unlikely that groundfish fishing under the status quo, or Alternative 1, has direct or indirect impacts on Pacific halibut sustainability. While the halibut biomass has declined from peaks in the late 1990s, the estimated female spawning biomass appears to have stabilized or be slightly increasing (Section 3.1.1). Halibut mortality in the groundfish fisheries is taken into account when the commercial halibut quotas are set, to prevent significantly adverse impacts on the halibut stocks. Area closures to bottom trawl gear mitigate the potential for impacts to spawning habitat (Section 3.1.3.4, Figure 3-17).

Halibut PSC mortality removals in the groundfish fisheries are constrained by PSC limits, which provide an upper limit annually on halibut PSC mortality. Since 2008, halibut PSC mortality in the BSAI groundfish fisheries has been 70 to 84 percent of the regulated PSC limits (Table 3-14), and there is no indication that industry is intending to increase their halibut PSC mortality; on the contrary, industry members have been reporting to the Council on measures they are undertaking to reduce halibut PSC mortality (Section 3.1.3.6). The Groundfish PSEIS and the Harvest Specifications EIS evaluations cited above considered halibut PSC practices at times when halibut PSC mortality was higher in the BSAI, and found no impacts to sustainability.

There is a mismatch between the geographic scale at which halibut PSC in groundfish fisheries is managed (BSAI-wide), and the apportionment of IPHC catch limits. In fact, while the overall BSAI PSC mortality from groundfish fisheries has been decreasing, this PSC mortality change has not been uniform among IPHC regulatory areas, and PSC mortality in IPHC Area 4CDE has been increasing steadily since 2011 (Table 3-15). Based on the 2014 TCEY values, if the combined BSAI groundfish fishery sectors each took their full PSC limits as allowed under regulation, there are some scenarios (depending on the distribution of the BSAI PSC mortality by IPHC regulatory area) in which the IPHC subarea-specific TCEYs would be insufficient to accommodate the increased halibut PSC mortality. Therefore the TCEYs in other areas would need to be proportionally reduced to achieve the target total coastwide TCEY (Stewart 2015). From the coastwide management of the stock, accounting for halibut PSC mortality would still be deducted from the total TCEY before directed fishery catch limits are set. There could be effects on the spatial distribution of the stock, if the available yield is insufficient to cover the entire halibut PSC mortality and reductions are taken in other areas to compensate.

The level of halibut removals in the trawl and longline groundfish fisheries under the status quo could result in reduced allocations to the directed halibut IFQ fisheries in Area 4 through reduced yield. The economic impacts of taking no action are discussed in the Regulatory Impact Review (Section 4). Coastwide, commercial halibut allocations have declined substantially since 2010 (Figure 3-11), with corresponding declines in Area 4 (Figure 3-12). IPHC staff blue line calculations for 2015 included a further substantial reduction for the directed fishery in Area 4CDE, which was specifically a response to higher projected halibut PSC mortality levels in that area for 2014 (and rolled over to 2015). As noted in Section 3.1.2.2, the IPHC increased the catch limit for the 2015 directed fishery in Area 4CDE, based in large measure on commitments by BSAI groundfish fleet representatives, the Council, and NMFS to take action to reduce PSC mortality in 2015. Reductions in the directed fishery allocations affect the economic state of commercial halibut IFQ fishermen and the communities they impact. At the same time, hook-and-line and trawl industry efforts to reduce halibut PSC mortality taken in the prosecution of the groundfish fisheries may lower the amount of future removals the IPHC deducts from the TCEY.

It is unlikely that halibut harvests in unguided sport and subsistence fisheries are impacted by Alternative 1 because these fisheries do not have caps on removals in Area 4, and harvests in the halibut subsistence and unguided sport fisheries are also deducted from the TCEY prior to the commercial IFQ limits being set. Since subsistence and recreational removals are not restricted by catch limits, it is assumed that those sectors are not affected by the status quo or options that reduce the PSC limits.

3.1.5.3 Impacts of Alternative 2

Alternative 2 could reduce the amount of halibut PSC mortality in the trawl and longline groundfish fisheries. The alternative includes several options to apply PSC limit reductions to different sectors of the BSAI trawl and longline groundfish fleet. Table 2-2 summarizes the options in terms of halibut PSC mortality “savings” under the PSC limit reductions, and associated reallocations to the directed halibut fishery in terms of O26 and U26 fish. Not all of the options would result in a change to the status quo, given that the sectors regularly harvest less than the regulated PSC limit. For the Bering Sea trawl limited access sector and the Amendment 80 sector, any of the PSC limit reduction options would be constraining in some years, based on the multi-year simulation model described in Section 4, which uses the basis years of 2008 to 2013 to forecast how PSC limit reductions would affect the groundfish fisheries. For Pacific cod longline catcher processors, only reductions of 30 percent or higher would constrain this sector, and for CDQ groups, only reductions of 35 percent or higher would be constraining. There is no effect of any of the reduction options on Pacific cod longline catcher vessels, or the PSC limit that is apportioned to other non-trawl fisheries (i.e., targeting species other than Pacific cod or sablefish).

Reductions in O26 halibut mortality resulting from PSC limit reductions will be directly reallocated to increased halibut yields available to harvesters in the directed halibut IFQ fisheries in Area 4, and therefore will have no effect on the halibut stock condition. IPHC analyses of the impact of halibut PSC mortality on the halibut stock have found that there is approximately a 1:1 relationship in total lost yield due to O26 halibut PSC mortality (Section 3.1.5.1). The O26 component is estimated to be 64 percent of the overall BSAI halibut PSC mortality in 2013 (the last full year of data), although it varies by sector and area (Table 3-16). The O26 inch component taken as PSC has approximately the same effect on the halibut stock as O26 directed catch, and is treated the same: it is directly deducted from the TCEY. Thus any reduction in O26 halibut PSC mortality will accrue directly to the directed halibut fisheries in that regulatory area. As halibut PSC mortality is reduced and the "savings" taken up by the directed fisheries, the impact on directed yield is a pound for pound gain for the O26 component of that halibut PSC reduction.

These decreases in halibut mortality resulting from the PSC limit reduction options will also contribute to increased halibut yields available to harvesters in the directed halibut IFQ fisheries in all regulatory areas, in terms of U26 savings. U26 halibut are estimated to be 36 percent of halibut PSC mortality in the BSAI as a whole, based on the last full year of data (2013). The reduction in U26 halibut PSC mortality in groundfish fisheries is also estimated to result in a pound for pound increase in future yield to the directed halibut fisheries through increases to the exploitable biomass (Section 3.1.5.1), but removals of U26 halibut are implicitly assumed to have an equal effect on the productivity of all regulatory areas, and so the effects are distributed coastwide. Table 2-2 incorporates the total halibut mortality savings to Area 4 in U26 fish resulting under the options. Based on the setline survey, Area 4 represents 22 percent of the exploitable biomass (halibut over 32 inches) for the coastwide halibut stock (Figure 3-9), therefore approximately 22 percent of the U26 halibut PSC mortality reductions would, at some future time, accrue back to Area 4. The remainder of the U26 halibut "savings" would accrue to directed halibut users in other IPHC regions (Table 2-3), in proportion to their share of the coastwide biomass.

With respect to whether removals of U26 halibut have an effect on the condition of the halibut stock, IPHC studies have demonstrated that removal of smaller halibut causes a steeper reduction in spawning biomass recruit. Consequently, a lower target rate on larger fish is required in order to "compensate" the stock to keep the spawning biomass per recruit at the target level. Mortality of juvenile halibut will have an effect on the distribution of the surviving fish, and therefore the subsequent spawning biomass. It is not currently known how important the spatial distribution of the spawning stock may be to short or long-term stock productivity, but greater mortality at younger ages is likely to change this distribution more than older removals. Decreases in U26 halibut mortality resulting from halibut PSC limit reductions could make more halibut of various sizes available in the BSAI. The extent to which this may affect the halibut spawning biomass coastwide depends on the importance of spatial distribution of the spawning stock, but any effect of the PSC limit reductions in the BSAI will be tempered by the proportion of the reduction that affects U26 halibut (currently 34 percent of halibut PSC mortality), and the BSAI's overall proportion of total coastwide biomass (currently 22 percent). It is notable that while the majority of coastwide U26 halibut PSC mortality occurs in Area 4CDE, the proportion of the coastwide biomass in this area has been stable with a slight increase over the last fifteen years (Figure 3-9).

At a broader scale, fisheries management is much more robust to uncertainty of all types (harvest rates, incoming year-classes, fishery behavior, implementation, etc.) when the removals are taken from fish that have already been directly observed (in this case, halibut become available to the survey over roughly ages 6-10), those near the peak yield per recruit, and those that have reached the age at first maturity. A range of fishing mortality rates will produce similar yields when these conditions are met.

One caveat of the simulation model used in Section 4 is that it does not account for changing halibut biomass levels; the model uses a static halibut biomass equivalent to the 2014 biomass estimate. Section 3.1.1.1 provides perspective on the current status of the halibut stock compared to the historical time series. While the biomass has been stable at around 200 million lb net weight in the last few years (Figure 3-1, Table 3-1), this represents the lowest biomass level since 1996, although possibly not in the historical time series (Figure 3-2). Fixing reduced halibut PSC limits for the groundfish fisheries at a time when the halibut biomass is at a lower abundance level raises questions about the implication of lower PSC limits when the biomass increases, potentially leading to higher encounter rates. An IPHC study (Leaman et al.

2015) tried to index halibut PSC to direct measures of juvenile or adult halibut abundance, or encounter rates of halibut in relation to target groundfish species abundance, and was unsuccessful. The study found that relationships of PSC mortality to halibut and target groundfish abundance are either lacking, or are temporally and spatially inconsistent (Figure 3-14, Figure 3-16). The historical patterns in PSC mortality are more likely driven by groundfish management factors than strictly by halibut abundance.

Another source of uncertainty about halibut biomass is that the IPHC is also conducting a calibration study this summer between the setline and NMFS trawl survey, which may affect the Area 4CDE weight-per-unit-effort density index, and could have a significant impact on estimates of Bering Sea biomass in the 2015 halibut stock assessment. While there is no indication as to whether such a change would be to increase or reduce the Area 4CDE biomass estimate, if it is revised to be significantly lower, the Area 4CDE TCEY may be insufficient to accommodate halibut PSC mortality, even at the reduced PSC levels adopted under Alternative 2. As described in Alternative 1, the TCEYs in other IPHC areas would then be proportionally reduced to achieve the target total coastwide TCEY (Stewart 2015). From the coastwide management of the stock, the process of accounting for halibut PSC mortality before directed fishery catch limits are set would ensure that coastwide, fishery removals remain within the guidelines of the harvest policy, however there could be effects on the spatial distribution of the stock.

Any reductions in the amount of halibut PSC mortality under Alternative 2 should increase the amount available to the commercial IFQ fishery in the future. Council discussions of reducing the halibut PSC limits have resulted, and will likely continue to result, in members of industry working to develop methods to reduce halibut PSC mortality. Those efforts are ongoing under the status quo. The extent to which these efforts reduce the amount of PSC mortality depends on several factors. Those factors include changes in groundfish TACs, cost of implementing the measures to reduce PSC mortality, and external pressures applied to industry to reduce their halibut PSC mortality. As Alternative 2 options result in PSC limits that are more constraining, the groundfish fisheries will try to optimize their groundfish harvest with a minimum of halibut PSC mortality, in order to avoid fishery closures. Note that the pollock fishery is not constrained by the current cap, nor are there options in the analysis to introduce such constraints. As a result, reduced PSC limits would not affect them directly. For other groundfish fisheries, this may result in some change to fishing patterns, for example, to the timing of fisheries, to avoid halibut. This may also cause the fleet to move into areas of lower catch per unit effort for target groundfish species, if by doing so, they are likely to increase the probability of avoiding halibut. If the fleet is unable to manoeuver such as to avoid halibut, there will likely be a reduction in groundfish harvest in the flatfish and Pacific cod target fisheries. Similar reduced levels of flatfish harvest occurred regularly prior to the 2008 implementation of Amendment 80. Specific changes cannot be predicted, and will likely be annually variable, depending on the distribution of halibut encounters. Any changes to fishing under Alternative 2 would be to minimize the likelihood of halibut encounters in the groundfish fishery.

The economic impacts of reducing the halibut PSC limits are discussed in detail in Section 4. That analysis assumes that the benefits from decreasing the groundfish halibut PSC limits will accrue to the commercial halibut IFQ industry. Other users, such as halibut subsistence and unguided sport fisheries, will not be impacted because their halibut is accounted for before PSC mortality reductions are taken from the available halibut, although higher catch rates resulting from increased halibut biomass will benefit these fisheries.

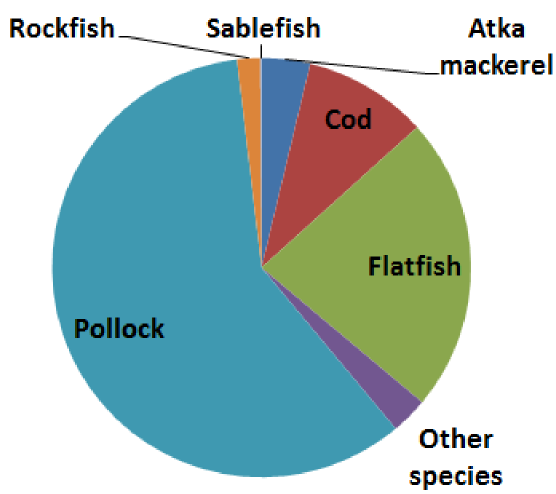
This analysis assumes that the relationship between reducing PSC limits and increased yield to the directed halibut fishery is a 1:1 relationship for both O26 and U26 fish, with O26 yield accruing exclusively to the Area 4 directed halibut fisheries, and U26 yield accruing coastwide (and out into the future), with the yield specifically to Area 4 being approximately 22 percent of that total (based on the Area 4 proportion of the coastwide biomass). For the most part, the options in Alternative 2 which would result in a change from status quo, in terms of halibut PSC mortality, are unlikely to have a different effect on halibut, as catch will largely be reallocated from halibut PSC mortality to directed fishery catch, although there may be some conservation benefit to the stock with respect to reducing the mortality of U26 halibut. Alternative 2 is not anticipated to have a significant effect on the Pacific halibut biomass.

3.2 Groundfish FMP species

The Council recommends annual catch limits and allocations for the commercial groundfish fisheries in the BSAI. Target species managed in the BSAI FMP include: walleye pollock, Pacific cod, sablefish, various flatfishes (yellowfin sole, Greenland turbot, arrowtooth and Kamchatka flounders, northern rock sole, flathead sole, Alaska plaice, and others), various rockfish species (Pacific ocean perch, northern rockfish, rougheye and blackspotted rockfish, shortraker rockfish, and others), Atka mackerel, skates, sculpins, sharks, squids, and octopuses. Commercial groundfish catch levels (total allowable catch, or TACs) in the BSAI are set at 2 million mt each year, which is generally well below the sum of acceptable biological catches (ABCs) for the groundfish species. In 2015, the sum of ABCs was equal to 2.85 million mt. Figure 3-29 shows the distribution of the sum of ABCs among groundfish species. Total allowable catches (TACs) quotas are set well below the ABC levels due to optimum yield constraints.

The BSAI FMP also includes species in the ecosystem component, which are caught incidentally in the prosecution of the groundfish fisheries, but which are not targeted. These include forage fish that are a critical food source for many marine mammal, seabird, and fish species. Directed fishing for these species is prohibited in regulation, as well as limitations on allowable bycatch retention amounts, limitations on the sale, barter, trade, or any other commercial exchange, and processing of forage fish in a commercial processing facility. The ecosystem component also includes prohibited species, such as halibut, but also Pacific salmon species, crab, and herring. As describe in Section 3.1.3, catch of these species must be avoided while fishing for groundfish, and they must be returned to the sea with a minimum of injury except when their retention is required or authorized by other applicable law. There are PSC limits in place for herring and crab in the trawl fisheries, and for salmon in the pollock fishery. While these species are not assessed on an annual basis in the SAFE report, the impact of the groundfish fisheries on these species is considered in the Groundfish PSEIS (NMFS 2004) and in the annual analysis supporting the harvest specifications, including NMFS' (2007a) Harvest Specifications EIS. The impact of salmon PSC in the pollock fishery is also under comprehensive review currently, and in initial review draft analysis was presented to the Council in December 2014 (NPFMC 2014).

Figure 3-29 BSAI groundfish species' proportion of total acceptable biological harvest (ABC), in 2015



Source: NPFMC 2014.

In the past, halibut PSC limits have been constraining on many BSAI groundfish fisheries. Directed fishing for many species has frequently been restricted before TACs were reached, in order to comply with PSC limits, even while TACs, especially for flatfish, were often set lower than they would otherwise have been. In 2008, the implementation of Amendment 80 established the opportunity for cooperative formation for the non-AFA head and gut catcher processor sector and gave them sector allocations for yellowfin sole, flathead sole, rock sole, Atka mackerel, Pacific ocean perch, and Pacific cod. In the same year, Amendment 85 created sector allocations for Pacific cod, allowing for a voluntary hook and line catcher processor cooperative to form in the Bering Sea in 2009. With these changes, many more vessels now have the flexible tools that allow them to maximize their groundfish catch while continuing to stay within the constraints of the halibut PSC limits that apply to their sectors.

For the purpose of setting halibut PSC limits, the BSAI Groundfish FMP sets separate PSC limits for trawl fisheries, hook-and-line fisheries, and CDQ fisheries. The hook and line PSC limit is apportioned in regulation to Pacific cod hook and line catcher processors (CPs) and catcher vessels (CVs), and to all other non-trawl fixed gear targets (noting that pot and jig gear, and the hook and line sablefish target fishery, are all exempt from PSC limits). The trawl PSC limits are apportioned between Amendment 80 and the Bering Sea trawl limited access sector, the latter allocated among the yellowfin sole fishery, the Pacific cod fishery, the rockfish fishery, and the pollock/Atka mackerel/ "other species" category. All the PSC limits are constraining on the sector or target fishery, meaning that the fishery closes when the limit is reached, with the exception of the pollock/Atka mackerel/"other species"[22] PSC limit, which only closes directed fishing for non-pelagic pollock, but not for Atka mackerel or midwater pollock.

The annual BSAI Groundfish SAFE Report (NPFMC 2014), which is considered by the Council during its annual December meeting for its determination of the biennial final harvest specifications, provides a detailed discussion of the status of individual groundfish stocks, and is incorporated by reference.

Effects of the Alternatives

The effects of the BSAI groundfish fisheries on target groundfish stocks are assessed annually in the BSAI SAFE report (NPFMC 2014). The effects of the fisheries on all groundfish FMP species were evaluated in the Alaska Groundfish Fisheries Harvest Specifications EIS (NMFS 2007a). Table 3-31 and Table 3-30 describe the criteria used to determine whether the impacts on target fish stocks, ecosystem component stocks, and prohibited species are likely to be significant.

Table 3-30 Criteria used to estimate the significance of impacts on incidental catch of ecosystem component (including prohibited) species.

No impact	No incidental take of the ecosystem component species in question.
Adverse impact	There are incidental takes of the ecosystem component species in question
Beneficial impact	Natural at-sea mortality of the ecosystem component species in question would be reduced – perhaps by the harvest of a predator or by the harvest of a species that competes for prey.
Significantly adverse impact	An action that diminishes protections afforded to ecosystem component species in the groundfish fisheries would be a significantly adverse impact.
Significantly beneficial impact	No benchmarks are available for significantly beneficial impact of the groundfish fishery on the ecosystem component species, and significantly beneficial impacts are not defined for these species.
Unknown impact	Not applicable

[22] includes sharks, skates, squids, sculpins, and octopuses

Table 3-31 Criteria used to determine significance of effects on target groundfish stocks.

Effect	Criteria			
	Significantly Negative	**Insignificant**	**Significantly Positive**	**Unknown**
Stock Biomass: potential for increasing and reducing stock size	Changes in fishing mortality are expected to jeopardize the ability of the stock to sustain itself at or above its MSST (minimum standing stock threshold)	Changes in fishing mortality are expected to maintain the stock's ability to sustain itself above MSST	Changes in fishing mortality are expected to enhance the stock's ability to sustain itself at or above its MSST	Magnitude and/or direction of effects are unknown
Fishing mortality	Reasonably expected to jeopardize the capacity of the stock to yield sustainable biomass on a continuing basis.	Reasonably expected not to jeopardize the capacity of the stock to yield sustainable biomass on a continuing basis.	Action allows the stock to return to its unfished biomass.	Magnitude and/or direction of effects are unknown
Spatial or temporal distribution	Reasonably expected to adversely affect the distribution of harvested stocks either spatially or temporally such that it jeopardizes the ability of the stock to sustain itself.	Unlikely to affect the distribution of harvested stocks either spatially or temporally such that it has an effect on the ability of the stock to sustain itself.	Reasonably expected to positively affect the harvested stocks through spatial or temporal increases in abundance such that it enhances the ability of the stock to sustain itself.	Magnitude and/or direction of effects are unknown
Change in prey availability	Evidence that the action may lead to changed prey availability such that it jeopardizes the ability of the stock to sustain itself.	Evidence that the action will not lead to a change in prey availability such that it jeopardizes the ability of the stock to sustain itself.	Evidence that the action may result in a change in prey availability such that it enhances the ability of the stock to sustain itself.	Magnitude and/or direction of effects are unknown

Under Alternative 1, the status quo, the BSAI groundfish stocks are neither overfished nor subject to overfishing. Biomass levels are projected to increase into 2015. Levels of fishing on ecosystem component species (forage fish and prohibited species) are constrained by bycatch and PSC limits. The BSAI groundfish fishery under the status quo is considered to be sustainable for groundfish and ecosystem component stocks.

Alternative 2 would establish halibut PSC limit reductions in the GOA groundfish fisheries. Different options mean different limit reductions for each of the sectors that are subject to a PSC limit. Under some options, the PSC limit would allow for groundfish fishing at current levels, and impacts would likely be similar to the status quo fishery. Under more constraining options, reduced PSC limits may result in the groundfish fisheries closing before the TAC is reached. Members of industry will typically try to allocate their halibut PSC mortality to fish species with the greatest economic value. It is assumed that in the Amendment 80 sector, the fleet will continue to maximize their catch of Atka mackerel and rockfish, and then will harvest Pacific cod, rock sole, and yellowfin sole to the extent possible. Constraints resulting from halibut PSC limit reductions are most likely to result in reductions in catch in the less valuable flatfish targets such as arrowtooth flounder and Alaska plaice. For the Bering Sea trawl limited access fishery, the pollock fishery may have less flexibility to respond to halibut PSC limit changes, as they are already constrained by PSC limits for salmon. However the halibut PSC limit does not close the pollock fishery if it is reached, so reductions in the limit are unlikely to result in any reduction in pollock harvest. For other target fisheries in the Bering Sea trawl limited access sector, to the extent that the limits under the options are constraining, there is likely to be a higher reduction in the yellowfin sole fishery than in Pacific cod. Even under the most severe PSC limit reductions for longline catcher processors and CDQ fisheries, the analysis assumes that these sectors will still be able to achieve over 95 percent of their groundfish harvests.

If the groundfish TAC is not fully harvested, then fishing will have less impact on the stock. Groundfish harvest reductions under the combined options could range between 1,400 to 147,800 mt annually (Table 2-2). It should be noted, however, that this assessment is based on a static assumption of halibut biomass. If the halibut stock returns to the high biomass levels of the later 1990s, then encounter rates with the groundfish fisheries may increase, and groundfish fisheries may find it more difficult to harvest target species under the reduced halibut PSC limits. Depending on the Council's selection of reduction levels by option, the analysis assumes that the foregone harvest will come largely from flatfish trawl target fisheries, with reductions also in Pacific cod trawl and longline target fisheries. The analysis assumed that the pollock harvest will not be affected, as this fleet is not constrained by their halibut PSC limit. To the extent that the pollock TAC is underfunded in order to allow other fisheries to be prosecuted under the 2 million mt cap, there may be a consequent increase in pollock fishing. No significantly adverse impact on the groundfish stocks from the fishery is expected. Prior to the implementation of Amendment 80 in 2008, flatfish harvests were routinely lower than current levels, by amounts in excess of the proposed harvest reductions projected in this analysis. There was no directed fishery for arrowtooth flounder before 2008. At the time, the Harvest Specifications EIS (NMFS 2007) comprehensively evaluated the impacts of the groundfish fisheries, and found no adverse impacts of the groundfish fisheries on groundfish stocks. The potential biological effects of the alternatives on groundfish harvests are expected to be correctly incorporated in the present stock assessment and harvest specifications system, since conservation goals for maintaining spawning biomass would remain central to the assessment.

A response to constraining halibut PSC limits could be for vessels to change fisheries patterns or seasonal changes in the timing of the fishing, to increase halibut avoidance. This may result in a lower catch per unit effort, assuming that under a non-constraining limit, fisheries would be fishing in areas with the highest catch per unit effort. For groundfish stocks, any changes would be monitored and updated in future stock assessment for target fisheries, and there is no anticipated adverse impact to the groundfish stocks that would result from groundfish fisheries with lower catch per unit effort. Ecosystem component species are also managed under bycatch and PSC limits, and thus the risks to the stocks are considered minor. Thus any changes in fishing patterns or the timing of fishing pressure would not be expected to affect the sustainability of the stocks. Alternative 2 is considered insignificant for target groundfish stocks, and to have an adverse effect, but not significantly so, for ecosystem component species.

3.3 Marine Mammals

Alaska supports one of the richest assemblages of marine mammals in the world. Twenty-two species are present from the orders Pinnipedia (seals and sea lions), Carnivora (sea otters), and Cetacea (whales, dolphins, and porpoises). Some marine mammal species are resident throughout the year, while others migrate into or out of Alaska fisheries management areas. Marine mammals occur in diverse habitats, including deep oceanic waters, the continental slope, and the continental shelf (Lowry et al. 1982).

A number of concerns may be related to marine mammals and potential impacts of fishing. For individual species, these concerns include—

- listing as endangered or threatened under the Endangered Species Act (ESA);
- protection under the Marine Mammal Protection Act (MMPA);
- announcement as candidate or being considered as candidates for ESA listings;
- declining populations in a manner of concern to State or Federal agencies;

- experiencing large PSC or other mortality related to fishing activities; or
- being vulnerable to direct or indirect adverse effects from some fishing activities.

Marine mammals have been given various levels of protection under the current fishery management plans of the Council, and are the subjects of continuing research and monitoring to further define the nature and extent of fishery impacts on these species. The Alaska groundfish harvest specifications environmental impact statement (NMFS 2007) provides information regarding fisheries interactions with marine mammals. The most recent status information is available in the Marine Mammal Stock Assessment Reports (SARs) (Allen and Angliss 2014).

Marine mammals, including those currently listed as endangered or threatened under the ESA, that may be present in the action area are listed in Table 3-32. All of these species are managed by NMFS, with the exception of Pacific walrus, polar bears, and Northern sea otters, which are managed by USFWS. ESA Section 7 consultations with respect to the actions of the Federal groundfish fisheries have been completed for all of the ESA-listed species, either individually or in groups. Of the species listed under the ESA and present in the action area, several species may be adversely affected by commercial groundfish fishing. These include Steller sea lions, humpback whales, fin whales, and sperm whales (NMFS 2006; NMFS 2010).

Table 3-32 Marine mammals likely to occur in the Bering Sea and Aleutian Islands subareas.

Common Name	Scientific Name	ESA Status
Northern Right Whale	*Balaena glacialis*	Endangered
Bowhead Whale	*Balaena mysticetus*	Endangered
Sei Whale	*Balaenoptera borealis*	Endangered
Blue Whale	*Balaenoptera musculus*	Endangered
Fin Whale	*Balaenoptera physalus*	Endangered
Humpback Whale	*Megaptera novaeangliae*	Endangered
Sperm Whale	*Physeter macrocephalus*	Endangered
Steller Sea Lion[1]	*Eumetopias jubatus*	Endangered
Beluga Whale	*Delphinapterus leucas*	None
Minke Whale	*Balaenoptera acutorostrata*	None
Killer Whale	*Orcinus orca*	None
Dall's Porpoise	*Phocoenoides dalli*	None
Harbor Porpoise	*Phocoena phocoena*	None
Pacific White-sided Dolphin	*Lagenorhynchus obliquidens*	None
Beaked Whales	*Berardius bairdii and Mesoplodon spp.*	None
Northern Fur Seal	*Callorhinus ursinus*	None
Pacific Harbor Seal	*Phoca vitulina*	None
Pacific Walrus[2]	*Odobenus rosmarus divergens*	Precluded
Northern Sea Otter[2]	*Enhydra lutis*	Threatened
Bearded Seal	*Erignathus barbatus*	Proposed Listing
Spotted Seal	*Phoca largha*	Threatened
Ringed Seal	*Phoca hispida*	Proposed Listing
Ribbon Seal	*Phoca fasciata*	None
Polar Bear[2]	*Ursus maritimus*	Threatened

[1] Steller sea lions are listed as endangered west of Cape Suckling, 144° W longitude.
[2] Pacific walrus, Northern sea otters, and polar bears are under the jurisdiction of the USFWS. A walrus ESA is warranted but precluded (76 FR 7634, February 10, 2011), and scheduled for 2017.

The PSEIS (NMFS 2004) provides descriptions of the range, habitat, diet, abundance, and population status for marine mammals. Marine mammal stock assessment reports (SARs) are prepared annually for the strategic marine mammal stocks (Steller sea lions, northern fur seals, harbor porpoise, North Pacific right whales, humpback whales, sperm whales, and fin whales)[23]. The SARs provide population estimates, population trends, and estimates of the potential biological removal (PBR) levels for each

[23] The SARs are available on the NMFS Protected Resources Division website at http://www.nmfs.noaa.gov/pr/sars/region.htm.

stock. The SARs also identify potential causes of mortality and whether the stock is considered a strategic stock under the MMPA. The information from the PSEIS and the SARs is incorporated by reference.

The Alaska Groundfish Harvest Specifications EIS provides information on the effects of the groundfish fisheries on marine mammals (NMFS 2007), and has been updated with Supplemental Information Reports (SIRs) [NMFS 2014a]. These documents are also incorporated by reference. Direct and indirect interactions between marine mammals and groundfish fishing vessels may occur due to overlap in the size and species of groundfish harvested in the fisheries that are also important marine mammal prey, and due to temporal and spatial overlap in marine mammal occurrence and commercial fishing activities. This discussion focuses on those marine mammals that may interact with or be affected by the BSAI groundfish fisheries (Table 3-33 and Table 3-34).

Table 3-33 Status of Pinnipedia and Carnivora stocks potentially affected by the action.

Pinnipedia and Carnivora species and stock	Status under the ESA	Status under the MMPA	Population trends	Distribution in action area
Steller sea lion – Western (W) and Eastern (E) Distinct Population Segment (DPS)	Endangered (W)	Depleted & a strategic stock	For the WDPS, regional increases in counts in trend sites of some areas have been offset by decreased counts in other areas so that the overall population of the WDPS appears to have stabilized (NMFS 2010a). The EDPS is steadily increasing and is delisted.	WDPS inhabits Alaska waters from Prince William Sound westward to the end of the Aleutian Island chain and into Russian waters. EDPS inhabit waters east of Prince William Sound to Dixon Entrance. Occur throughout AK waters, terrestrial haulouts and rookeries on Pribilof Islands, Aleutian Islands, St. Lawrence Island, and off the mainland. Use marine areas for foraging. Critical habitat designated around major rookeries, haulouts, and foraging areas.
Northern fur seal Eastern Pacific	None	Depleted & a strategic stock	Recent pup counts show a continuing decline in the number of pups surviving in the Pribilof Islands. NMFS researchers found an approximately 9% decrease in the number of pups born between 2004 and 2006. The pup estimate decreased most sharply on St. Paul Island.	Fur seals occur throughout Alaska waters, but their main rookeries are located in the Bering Sea on Bogoslof Island and the Pribilof Islands. Approximately 55% of the worldwide abundance of fur seals is found on the Pribilof Islands (NMFS 2007b). Forages in the pelagic area of the Bering Sea during summer breeding season, but most leave the Bering Sea in the fall to spend winter and spring in the N. Pacific.
Harbor seal – Gulf of Alaska	None	None	A moderate to large population decline has occurred in the GOA stock.	GOA stock found primarily in the coastal waters and may cross over into the Bering Sea coastal waters between islands.
Ribbon seal Alaska	None*	None	Reliable data on population trends are unavailable.	Widely dispersed throughout the Bering Sea and Aleutian Islands in the summer and fall. Associated with ice in spring and winter and may be associated with ice in summer and fall. Occasional movement into the GOA (Boveng et al. 2008)
Northern sea otters – SW Alaska	Threatened**	Depleted & a strategic stock	The overall population trend for the southwest Alaska stock is believed to be declining, particularly in the Aleutian Islands.	Coastal waters from Central GOA to W Aleutians within the 40 m depth contour. Critical habitat designated in primarily nearshore waters with few locations into federal waters in the GOA.

Sources: Allen and Angliss 2014; List of Fisheries for 2014 (79 FR 49053, August 19, 2014). Northern fur seal pup data available from http://www.alaskafisheries.noaa.gov/newsreleases/2007/fursealpups020207.htm.
*NMFS determined that ribbon seals were not to be listed on September 23, 2008. The Center for Biological Diversity and Greenpeace filed suit against NMFS regarding this decision on September 3, 2009.
**Northern sea otter information from http://www.nmfs.noaa.gov/pr/pdfs/sars/seaotter2008_ak_sw.pdf and 74 FR 51988, October 8, 2009.

Table 3-34 Status of Cetacea stocks potentially affected by the action.

Cetacea species/stock	Status under the ESA	Status under the MMPA	Population trends	Distribution in action area
Killer whale – AT1 Transient, E N Pacific transient, W Coast transient, AK resident, Southern resident	Southern resident endangered; remaining stocks none	AT1 depleted and a strategic stock, Southern Resident depleted. The rest of the stocks: None	Southern residents have declined by more than half since 1960s and 1970s. Unknown abundance for the Alaska resident; and Eastern North Pacific GOA, Aleutian Islands, and Bering Sea transient stocks. The minimum abundance estimate for the Eastern North Pacific Alaska Resident stock is likely underestimated because researchers continue to encounter new whales in the Alaskan waters.	Southern resident do not occur in GOA. Transient-type killer whales from the GOA, Aleutian Islands, and Bering Sea are considered to be part of a single population.
Dall's porpoise Alaska	None	None	Reliable data on population trends are unavailable.	Found in the offshore waters from coastal Western Alaska throughout the GOA.
Pacific white-sided dolphin	None	None	Reliable data on population trends are unavailable.	Found throughout the GOA.
Harbor porpoise GOA	None	Strategic	Reliable data on population trends are unavailable.	Primarily in coastal waters in the GOA, usually less than 100 m.
Humpback whale – Western and Central North Pacific	Endangered and under status review	Depleted & a strategic stock	Increasing. The Structure of Populations, Levels of Abundance, and Status of Humpbacks (SPLASH) abundance estimate for the North Pacific represents an annual increase of 4.9% since 1991–1993. SPLASH abundance estimates for Hawaii show annual increases of 5.5% to 6.0% since 1991–1993 (Calambokidis et al. 2008).	W. Pacific and C. North Pacific stocks occur in GOA waters and may mingle in the North Pacific feeding area.
North Pacific right whale Eastern North Pacific	Endangered	Depleted & a strategic stock	This stock is considered to represent only a small fraction of its precommercial whaling abundance and is arguably the most endangered stock of large whales in the world. A reliable estimate of trend in abundance is currently not available.	Before commercial whaling on right whales, concentrations were found in the GOA, eastern Aleutian Islands, southcentral Bering Sea, Sea of Okhotsk, and Sea of Japan (Braham and Rice 1984). During 1965–1999, following large illegal catches by the U.S.S.R., there were only 82 sightings of right whales in the entire eastern North Pacific, with the majority of these occurring in the Bering Sea and adjacent areas of the Aleutian Islands (Brownell et al. 2001). Critical habitat near Kodiak Island in the GOA
Fin whale Northeast Pacific	Endangered	Depleted & a strategic stock	Abundance may be increasing but surveys only provide abundance information for portions of the stock in the Central-eastern and southeastern Bering and coastal waters of the Aleutian Islands and the Alaska Peninsula. Much of the North Pacific range has not been surveyed.	Found in the GOA, Bering Sea and coastal waters of the Aleutian Islands.
Beluga whale-Cook Inlet	Endangered	Depleted & a strategic stock	2008 abundance estimate of 375 whales is unchanged from 2007. Trend from 1999 to 2008 is not significantly different from zero.	Occurrence only in Cook Inlet.
Minke whale Alaska	None	None	There are no data on trends in Minke whale abundance in Alaska waters.	Common in the Bering and Chukchi Seas and in the inshore waters of the GOA. Not common in the Aleutian Islands.
Sperm whale North Pacific	Endangered	Depleted & a strategic stock	Abundance and population trends in Alaska waters are unknown.	Inhabit waters 600 m or more depth, south of 62°N lat. Widely distributed in North Pacific. Found year-round In GOA.
Baird's, Cuvier's, and Stejneger's beaked whale	None	None	Reliable data on population trends are unavailable.	Occur throughout the GOA.

Sources: Allen and Angliss 2014; List of Fisheries for 2014 (79 FR 49053, August 19, 2014); http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/spermwhale.htm. North Pacific right whale included based on NMFS (2006a) and Salveson (2008). AT1 Killer Whales information based on 69 FR 31321, June 3, 2004. North Pacific Right Whale critical habitat information: 73 FR 19000, April 8, 2008. For beluga whales: 73 FR 62919, October 27, 2008.

Effects on Marine Mammals

Table 3-35 contains the significance criteria for analyzing the effects of the proposed action on marine mammals. Significantly beneficial impacts are not possible with the management of groundfish fisheries as no beneficial impacts to marine mammals are likely with groundfish harvest. Generally, changes to the fisheries do not benefit marine mammals in relation to incidental take, prey availability, and disturbances; changes increase or decrease potential adverse impacts. The only exception to this may be in instances when marine mammals target prey from fishing gear, as seen with killer whales and sperm whales removing fish from hook and line gear. In this example, the prey availability is enhanced for these animals because they need less energy for foraging.

Table 3-35 Criteria for determining significance of impacts to marine mammals.

	Incidental take and entanglement in marine debris	Prey availability	Disturbance
Adverse impact	Mammals are taken incidentally to fishing operations or become entangled in marine debris.	Fisheries reduce the availability of marine mammal prey.	Fishing operations disturb marine mammals.
Beneficial impact	There is no beneficial impact.	Generally, there are no beneficial impacts.	There is no beneficial impact.
Significantly adverse impact	Incidental take is more than PBR or is considered major in relation to estimated population when PBR is undefined.	Competition for key prey species likely to constrain foraging success of marine mammal species causing population decline.	Disturbance of mammal is such that population is likely to decrease.
Significantly beneficial impact	Not applicable	Not applicable	Not applicable
Unknown impact	Insufficient information available on take rates.	Insufficient information as to what constitutes a key area or important time of year.	Insufficient information as to what constitutes disturbance.

Incidental Take Effects

Marine mammals can be taken in groundfish fisheries by entanglement in gear (e.g., trawl, longline, and pot) and, rarely, by ship strikes for some cetaceans. The effects of the status quo fisheries on incidental takes of marine mammals are detailed in the 2007 harvest specifications EIS (NMFS 2007a) and Allen and Angliss (2014). The Harvest Specifications EIS contains a detailed description of the incidental take effects of the groundfish fisheries on marine mammals (NMFS 2007a) and is incorporated by reference. The annual Stock Assessment Report lists the species of marine mammals taken in the BSAI groundfish fisheries using observer data (Allen and Angliss 2014). In addition, the List of Fisheries for 2014[24] (79 FR 14418), describes known incidental takes of marine mammals in the groundfish fisheries. BSAI flatfish, pollock, and rockfish trawl fisheries are listed as category II, with occasional interactions with some marine mammals. The BSAI Pacific cod longline fishery is listed as category II, with a remote likelihood of interaction with Dall's porpoise and northern fur seal. Based on the annual stock assessment reports, the potential take of marine mammals in the BSAI groundfish fisheries is well below the PBRs or a very small portion of the overall human caused mortality for those species for which a PBR has not been determined (Allen and Angliss 2014). Therefore, the incidental takes under Alternative 1 have an insignificant effect on marine mammals.

Options under Alternative 2 may result in no change to the status quo, or may result in constraining PSC limits under which industry may change fishing patterns in order to maximize species with the greatest economic value. This could result in a response of reducing fishing effort, as the industry chooses not to

[24] http://www.nmfs.noaa.gov/pr/interactions/lof/final2014.htm

pursue less valuable fisheries in order to conserve halibut PSC mortality, or it could result in greater fishing effort at lower catch per unit effort, as vessels change fisheries patterns or seasonal changes in the timing of the fishing, to increase halibut avoidance. As a result, it is unclear exactly how the potential for incidental take of marine mammals will compare to the status quo under Alternative 2. Depending how constraining the halibut PSC limit is, however, the fisheries are unlikely to increase their take of marine mammals above the PBR, because they are currently well below that level in BSAI groundfish fisheries. Therefore, the incidental takes under Alternative 2 would have an insignificant effect on marine mammals.

Prey Availability Effects

Harvests of marine mammal prey species in the BSAI groundfish fisheries may limit foraging success through localized depletion, overall reduction in prey biomass, and dispersion of prey, making it more energetically costly for foraging marine mammals to obtain necessary prey. Overall reduction in prey biomass may be caused by removal of prey or disturbance of prey habitat. The timing and location of fisheries relative to foraging patterns of marine mammals and the abundance of prey species may be a more relevant management concern than total prey removals.

The Harvest Specifications EIS contains a detailed description of the effects of the groundfish fisheries on prey species for marine mammals (NMFS 2007a), and is incorporated by reference. The interaction of the BSAI groundfish fisheries with Steller sea lions, which potentially compete for prey, is comprehensively addressed in the Revised Steller Sea Lion Protection Measures EIS (NMFS 2014c). The BSAI groundfish fisheries may impact availability of key prey species of Steller sea lions, harbor seals, northern fur seals, ribbon seals; and fin, minke, humpback, beluga, and resident killer whales. Animals with more varied diets (humpback whales) are less likely to be impacted than those that eat primarily pollock and salmon, such as northern fur seals. Table 3-36 shows the BSAI marine mammal species and their prey species that may be impacted by BSAI groundfish fisheries.

Table 3-36 Prey species used by BSAI marine mammals that may be impacted by the BSAI groundfish fisheries.

Species	Prey
Fin whale	Zooplankton, squid, fish (herring, cod, capelin, and pollock), and cephalopods
Humpback whale	Zooplankton, schooling fish (pollock, herring, capelin, saffron, cod, sand lance, Arctic cod, and salmon)
Beluga whale	Wide variety of invertebrates and fish including salmon and pollock
Killer whale	Marine mammals (transients) and fish (residents) including herring, halibut, salmon, and cod.
Ribbon seal	Cod, pollock, capelin, eelpout, sculpin, flatfish, crustaceans, and cephalopods.
Harbor seal	Crustaceans, squid, fish (including salmon), and mollusks
Steller sea lion	Pollock, Atka mackerel, Pacific herring, Capelin, Pacific sand lance, Pacific cod, and salmon

Several marine mammals may be impacted indirectly by any effects that fishing gear may have on benthic habitat. Table 3-37 lists marine mammals that may depend on benthic prey and known depths of diving. Diving activity may be associated with foraging. The essential fish habitat (EFH) EIS provides a description of the effects of groundfish fishing on benthic habitat (NMFS 2005a). In the BSAI, estimated reductions of epifaunal and infaunal prey due to fishing are less than 1 percent for all substrate types. For living structure, overall impacts ranged between 3 percent and 7 percent depending on the substrate. In some local areas where pollock aggregate, effects are greater.

Sperm whales are not likely to be affected by any potential impacts on benthic habitat from fishing because they generally occur in deeper waters than where the groundfish fishery is conducted (Table 3-37). Harbor seals and sea otters are also not likely to have any benthic habitat affected by the groundfish fishery because they occur primarily along the coast where fishing is not conducted. Cook Inlet beluga whales also are not likely to have benthic habitat supporting prey species affected by the groundfish fishery because they do not range outside of Cook Inlet and do not overlap spatially with the trawl fisheries.

Table 3-37 Benthic dependent BSAI marine mammals, foraging locations, and diving depths

Species	Depth of diving and location
Ribbon seal	Mostly dive < 150 m on shelf, deeper off shore. Primarily in shelf and slope areas.
Harbor seal	Up to 183 m. Generally coastal.
Sperm whale	Up to 1,000 m, but generally in waters > 600 m.
Northern sea otter	Rocky nearshore < 75 m
Gray whale	Benthic invertebrates

Sources: Allen and Angliss 2010; Burns et al. 1981; http://www.adfg.state.ak.us/pubs/notebook/marine/rib-seal.php; http://www.afsc.noaa.gov/nmml/species/species_ribbon.php; http://www.adfg.state.ak.us/pubs/notebook/marine/harseal.php; http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/spermwhale.htm

The Harvest Specifications EIS determined that competition for key prey species under the status quo fishery is not likely to constrain the foraging success of marine mammals or cause population declines (NMFS 2007a). The Steller sea lion EIS (NMFS 2014c) provided an updated review of BSAI groundfish fishery interactions with respect to prey availability. Based on a review of marine mammal diets, and an evaluation of the status quo harvests of potential prey species in the BSAI groundfish fishery, the effects of Alternative 1 on prey availability for marine mammals are not likely to cause population level effects and are therefore insignificant.

Options under Alternative 2 may result in no change to the status quo, or may result in constraining PSC limits under which industry may change fishing patterns in order to maximize species with the greatest economic value. This could result in a response of reducing fishing effort, as the industry chooses not to pursue less valuable fisheries in order to conserve halibut PSC mortality, or it could result in greater fishing effort at lower catch per unit effort, as vessels change fisheries patterns or seasonal changes in the timing of the fishing, to increase halibut avoidance. Shifts in the location or timing of fishing may change the availability of prey species to marine mammals in particular areas. However, there is already considerable interannual variability in the patterns of fishing across the BSAI groundfish sectors, as environmental conditions and avoidance of PSC species have caused vessels to adjust their fishing patterns. Any shift in fishing is unlikely to occur outside of the existing footprint of the groundfish fishery. Therefore it is unlikely that Alternative 2 would introduce a shift in fishing patterns to such an extent that it would constrain the availability of prey to marine mammals in such a way as to cause a population-level decline. As a result, prey availability under Alternative 2 would have an insignificant effect on marine mammals.

Disturbance Effects

The Harvest Specifications EIS contains a detailed description of the disturbance of marine mammals by the groundfish fisheries (NMFS 2007a). The interaction of the BSAI groundfish fisheries with Steller sea lions, which potentially compete for prey, is comprehensively addressed in the Revised Steller Sea Lion Protection Measures EIS (NMFS 2014c). The EISs concluded that the status quo fishery does not cause disturbance to marine mammals at a level that may cause population level effects. Fishery closures limit the potential interaction between fishing vessels and marine mammals (e.g., 3-nm no groundfish fishing areas around Steller sea lion rookeriesm walrus protection areas). Because disturbances to marine mammals under the status quo fishery are not likely to cause population level effects, the impacts of Alternative 1 are likely insignificant.

The effects of the proposed reductions to halibut PSC limits under Alternative 2 on disturbance of marine mammals would be similar to the effects on incidental takes. If a groundfish fishery reduces fishing effort in specific fisheries to conserve halibut PSC mortality for a more valuable fishery, then less potential exists for disturbance of marine mammals. If a groundfish fishery increases the duration of fishing in areas with lower concentrations of halibut, there may be more potential for disturbance if this increased fishing activity overlaps with areas used by marine mammals. None of the disturbance effects on other marine mammals under Alternative 2 are expected to result in population level effects on marine mammals. Disturbance effects are likely to be localized and limited to a small portion of any particular marine mammal population. Because disturbances to marine mammals under Alternative 2 is not likely to result in population level effects, the impacts of Alternative 2 is likely insignificant.

3.4 Seabirds

Thirty-eight species of seabirds breed in Alaska. Breeding populations are estimated to contain 36 million individual birds in Alaska, and total population size (including subadults and nonbreeders) is estimated to be approximately 30% higher. Five additional species that breed elsewhere but occur in Alaskan waters during the summer months contribute another 30 million birds.

Species nesting in Alaska

Tubenoses-Albatrosses and relatives: Northern Fulmar, Fork-tailed Storm-petrel, Leach's Storm-petrel
Kittiwakes and terns: Black-legged Kittiwake, Red-legged Kittiwake, Arctic Tern, Aleutian Tern
Pelicans and cormorants: Double-crested Cormorant, Brandt's Cormorant, Pelagic Cormorant, Red-faced Cormorant
Jaegers and gulls: Pomarine Jaeger, Parasitic Jaeger, Bonaparte's Gull, Mew Gull, Herring Gull, Glaucous-winged Gull, Glaucous Gull, Sabine's Gull
Auks: Common Murre, Thick-billed Murre, Black Guillemot, Pigeon Guillemot, Marbled Murrelet, Kittlitz's Murrelet, Ancient Murrelet, Cassin's Auklet, Parakeet Auklet, Least Auklet, Wiskered Auklet, Crested Auklet, Rhinoceros Auklet, Tufted Puffin, Horned Puffin

Species that visit Alaska waters

Tubenoses: Short-tailed Albatross, Black-footed Albatross, Laysan Albatross, Sooty Shearwater, Short-tailed Shearwater
Gulls: Ross's Gull, Ivory Gull

As noted in the PSEIS (NMFS 2004), seabird life history includes low reproductive rates, low adult mortality rates, long life span, and delayed sexual maturity. These traits make seabird populations extremely sensitive to changes in adult survival and less sensitive to fluctuations in reproductive effort. The problem with attributing population changes to specific impacts is that, because seabirds are long-lived animals, it may take years or decades before relatively small changes in survival rates result in observable impacts on the breeding population.

More information on seabirds in Alaska's EEZ may be found in several NMFS, Council, and USFWS documents:

- The URL for the USFWS Migratory Bird Management program is at: http://alaska.fws.gov/mbsp/mbm/index.htm
- Section 3.7 of the PSEIS (NMFS 2004) provides background on seabirds in the action area and their interactions with the fisheries. This may be accessed at http://www.alaskafisheries.noaa.gov/sustainablefisheries/seis/final062004/Chaps/chpt_3/chpt_3_7.pdf
- The annual Ecosystems Considerations chapter of the SAFE reports has a chapter on seabirds. Back issues of the Ecosystem SAFE reports may be accessed at http://www.afsc.noaa.gov/REFM/REEM/Assess/Default.htm.

- The Seabird Fishery Interaction Research webpage of the Alaska Fisheries Science Center: http://www.afsc.noaa.gov/refm/reem/Seabirds/Default.htm
- The NMFS Alaska Region's Seabird Incidental Take Reduction webpage: http://www.alaskafisheries.noaa.gov/protectedresources/seabirds.html
- The BSAI and GOA groundfish FMPs each contain an "Appendix I" dealing with marine mammal and seabird populations that interact with the fisheries. The FMPs may be accessed from the Council's home page at http://www.alaskafisheries.noaa.gov/npfmc/default.htm
- Washington Sea Grant has several publications on seabird takes, and technologies and practices for reducing them: http://www.wsg.washington.edu/publications/online/index.html
- The seabird component of the environment affected by the groundfish FMPs is described in detail in Section 3.7 of the PSEIS (NMFS 2004).
- Seabirds and fishery impacts are also described in Chapter 9 of the Alaska Groundfish Harvest Specifications EIS (NMFS 2007).

Effects on Seabirds

The PSEIS identifies how the BSAI groundfish fisheries activities may directly or indirectly affect seabird populations (NMFS 2004a). Direct effects may include incidental take in fishing gear and vessel strikes. Indirect effects may include reductions in prey (forage fish) abundance and availability, disturbance to benthic habitat, discharge of processing waste and offal, contamination by oil spills, presence of nest predators in islands, and disposal of plastics, which may be ingested by seabirds.

Table 3-38 explains the criteria used in this analysis to evaluate the significance of the effects of fisheries on seabird populations.

Table 3-38 Criteria used to determine significance of impacts on seabirds.

	Incidental take	Prey availability	Benthic habitat
Insignificant	No substantive change in takes of seabirds during the operation of fishing gear.	No substantive change in forage available to seabird populations.	No substantive change in gear impact on benthic habitat used by seabirds for foraging.
Adverse impact	Non-zero take of seabirds by fishing gear.	Reduction in forage fish populations, or the availability of forage fish, to seabird populations.	Gear contact with benthic habitat used by benthic feeding seabirds reduces amount or availability of prey.
Beneficial impact	No beneficial impact can be identified.	Availability of offal from fishing operations or plants may provide additional, readily accessible, sources of food.	No beneficial impact can be identified.
Significantly adverse impact	Trawl and hook and line take levels increase substantially from the baseline level, or level of take is likely to have population level impact on species.	Food availability decreased substantially from baseline such that seabird population level survival or reproduction success is likely to decrease.	Impact to benthic habitat decreases seabird prey base substantially from baseline such that seabird population level survival or reproductive success is likely to decrease. (ESA-listed eider impacts may be evaluated at the population level).
Significantly beneficial impact	No threshold can be identified.	Food availability increased substantially from baseline such that seabird population level survival or reproduction success is likely to increase.	No threshold can be identified.
Unknown impacts	Insufficient information available on take rates or population levels.	Insufficient information available on abundance of key prey species or the scope of fishery impacts on prey.	Insufficient information available on the scope or mechanism of benthic habitat impacts on food web.

The impacts of the Alaska groundfish fisheries on seabirds were analyzed in the Harvest Specifications EIS (NMFS 2007a). That document evaluates the impacts of the alternative harvest strategies on seabird takes, prey availability, and seabird ability to exploit benthic habitat. The focus of this analysis is similar, as any changes to the groundfish fisheries in the BSAI could change the potential for direct take of seabirds. Potential changes in prey availability (seabird prey species caught in the fisheries) and disruption of bottom habitat via the intermittent contact with non-pelagic trawl gear under different levels of harvest are discussed in NMFS (2007a). These changes would be closely associated with changes in take levels. Therefore, all impacts are addressed by focusing on potential changes in seabird takes.

Incidental Take of Seabirds in Trawl Fisheries

Seabirds can interact with trawl fishing vessels in several ways. Birds foraging at the water surface or in the water column are sometimes caught in the trawl net as it is brought back on board. These incidental takes of seabirds are recorded by fisheries observers as discussed below. In addition to getting caught in the fishing nets of trawl vessels, some species strike cables attached to the infrastructure of vessels or collide with the infrastructure itself. Large winged birds such as albatrosses are most susceptible to mortalities from trawl-cable strikes. Third wire cables have been prohibited in some southern hemisphere fisheries since the early 1990s due to substantial albatross mortality from cable strikes. No short-tailed albatross or black-footed albatross have been observed taken with trawl gear in Alaska fisheries, but mortalities to Laysan albatrosses have been observed.

Average annual estimate of incidental take of birds in trawling operations in the BSAI was 706 birds per year from 2007 through 2013 (NMFS 2014e). Northern fulmars comprised the majority of this take, with shearwaters and gulls also taken in almost every year. An estimate of 9 Laysan albatross is attributed to the BSAI trawl fisheries in 2009. A small number of storm petrels were taken in 2007 and 2008; there were a number of murres taken in 2010 and 2011, and a couple in 2007 and 2013. Three auklets were estimated to be taken in 2008, and 4 in 2013. The estimated takes of gulls, fulmars, and shearwaters in the entire groundfish fishery are very small percentages of these species' populations (NMFS 2014e).

Seabird takes in the BSAI trawl fisheries are relatively low, based on standard observer sampling and NMFS estimation. However, standard species composition sampling of the catch does not account for additional mortality due to gear interactions such as net entanglements or cable strikes. Special data collections of seabird gear interactions have been conducted, and preliminary information indicates that mortalities can be greater than the birds accounted for in the standard species composition sampling (Melvin et al. 2011). To date, striking of trawl vessels or gear by the short-tailed albatross has not been reported by observers. The probability of short-tailed albatross collisions with third wires or other trawl vessel gear in Alaskan waters cannot be assessed; however, given the available observer data and the observed at-sea locations of short-tailed albatrosses relative to trawling effort, the likelihood of short-tailed albatross collisions are very rare, but the possibility of such collisions cannot be completely discounted. USFWS' Biological Opinion included an Incidental Take Statement of two short-tailed albatross for the trawl groundfish fisheries off Alaska (USFWS 2003b).

Incidental Take of Seabirds in Longline Fisheries

Seabirds can be killed (taken) when they are attracted to baited hooks as they are being set, and become entangled in the gear, or caught on the hooks. Hook and line gear accounts for the majority of seabird take in the North Pacific groundfish fisheries. Annual BSAI hook and line bycatch of seabirds has been substantially reduced over that time, however, to the current numbers of about 5,300 birds annually (average for 2008 to 2013). This reduction has largely been due to the use of seabird avoidance techniques such as paired streamer lines. The species composition for seabird bycatch in the combined BSAI hook-and-line fisheries is primarily northern fulmars, shearwaters, and gulls, with a small proportion of seabirds unidentified (NMFS 2014e). There are also annual albatross takes and small numbers of kittiwake and murre takes.

As described in NMFS (2014e), although albatross take increased in 2013 to 438 birds, an increase of 25 percent compared to the previous 5 year average of 350, this increase was attributable to the halibut and sablefish fisheries, while the Pacific cod freezer longline fishery experienced reduced albatross bycatch numbers. Two short-tailed albatross were observed taken in the BSAI longline Pacific cod fishery in August and September of 2010, leading to an estimated take of 15 birds. Another single take was reported in October, 2011, leading to an estimate of 5 short-tailed albatross. Again in 2014, two short-tailed albatross were observed taken. The Biological Opinion for the Short-tailed albatross (USFWS 2003) allows for an expected incidental take of 4 birds in each two-year period for the demersal longline fishery. Note that this take is based on numbers of birds observed rather than the estimate of total take derived from the observed take. The takes recorded in 2010 were the first ones observed since 1998.

Impacts under the alternatives

The effects of the status quo fisheries on incidental take of seabirds are described in the Harvest Specifications EIS (NMFS 2007a). Estimated takes in the BSAI trawl groundfish fisheries average 706 birds per year, and in the longline fishery, 5,300 birds per year; in both, they primarily consist of northern fulmars (NMFS 2014e). These take estimates are small in comparison to seabird population estimates, and under the status quo alternative, it is reasonable to conclude that the impacts would continue to be similar. However, observers are not able to monitor all seabird mortality associated with trawl vessels. Several research projects are currently underway to provide more information on these interactions.

Various spatial restrictions on the trawl fisheries in the BSAI have been established as part of the groundfish management program, and these closures decrease the potential for interactions with seabirds in these areas. These restrictions are not anticipated to change, so this protection would continue to be provided under any of the alternatives in this analysis.

Options under Alternative 2 may result in no change to the status quo, or may result in constraining PSC limits under which industry may change fishing patterns in order to maximize species with the greatest economic value. This could result in a response of reducing fishing effort, as the industry chooses not to pursue less valuable fisheries in order to conserve halibut PSC mortality, or it could result in greater fishing effort at lower catch per unit effort, as vessels change fisheries patterns or seasonal changes in the timing of the fishing, to increase halibut avoidance. If a groundfish fishery reduces fishing effort in specific fisheries to conserve halibut PSC mortality for a more valuable fishery, then less potential exists for incidental take of seabirds. If a groundfish fishery increases the duration of fishing in areas with lower concentrations of halibut, there may be more potential for incidental take, compared to the status quo, if this increased fishing activity overlaps with areas used by seabirds. Shifts in the location or timing of fishing may occur as a result of Alternative 2. However, there is already considerable interannual variability in the patterns of fishing across the BSAI groundfish sectors, as environmental conditions and avoidance of PSC species have caused vessels to adjust their fishing patterns. Any shift in fishing is unlikely to occur outside of the existing footprint of the groundfish fishery. Take estimates in the BSAI groundfish fisheries are already small, compared to seabird population estimates, and are unlikely to increase to a level that would have a population-level effect on seabird species. The exception to this is incidental take of short tailed albatross, but the take of this species in BSAI groundfish fisheries are already closely monitored with respect to the incidental take statement in the Biological Opinion. As a result, Alternative 2 is not expected to result in a significant impact on seabirds.

Prey Availability Disturbance of Benthic Habitat

As noted in Table 3-39, prey species of seabirds in the BSAI are not usually fish that are targeted in the groundfish fisheries. However, seabird species may be impacted indirectly by effects of fishing gear on the benthic habitat of seabird prey, such as clams, bottom fish, and crab. The essential fish habitat final environmental impact statement provides a description of the effects of the groundfish fisheries on bottom habitat in the appendix (NMFS 2005), including the effects of the commercial fisheries on the BSAI slope and shelf.

It is not known how much seabird species use benthic habitat directly, although research funded by the North Pacific Research Board has been conducted on foraging behavior of seabirds in the Bering Sea in recent years. Thick-billed murres easily dive to 100 m, and have been documented diving to 200 m; common murres also dive to over 100 m. Since cephalopods and benthic fish compose some of their diet, murres could be foraging on or near the bottom (K. Kuletz, USFWS, personal communication, October 2008).

A description of the effects of prey abundance and availability on seabirds is found in the PSEIS (NMFS 2004a) and the Harvest Specifications EIS (NMFS 2007a). Detailed conclusions or predictions cannot be made regarding the effects of forage fish bycatch on seabird populations or colonies. NMFS (2007a) found that the potential impact of the entire groundfish fisheries on seabird prey availability was limited due to little or no overlap between the fisheries and foraging seabirds based on either prey size, dispersed foraging locations, or different prey (NMFS 2007a). The majority of bird groups feed in vast areas of the oceans, are either plankton feeders or surface or mid-water fish feeders, and are not likely to have their prey availability impacted by the nonpelagic trawl fisheries. There is no directed commercial fishery for those species that compose the forage fish management group, and seabirds typically target juvenile stages rather than adults for commercial target species. Most of the forage fish bycatch is smelt, taken in the pollock fishery, which is not included in this action.

Table 3-39 Seabirds in the Bering Sea: foraging habitats and common prey species.

Species	Foraging habitats	Prey
Short-tailed albatross	Surface seize and scavenge	Squid, shrimp, fish, fish eggs
Black-footed albatross	Surface dip, scavenge	Fish eggs, fish, squid, crustaceans, fish waste
Laysan albatross	Surface dip	Fish, squid, fish eggs and waste
Spectacled eider	Diving	Mollusks and crustaceans
Steller's eider	Diving	Mollusks and crustaceans
Black-legged kittiwake	Dip, surface seize, plunge dive	Fish, marine invertebrates
Murrelet (Kittlitz's and marbled)	Surface dives	Fish, invertebrates, macroplankton
Shearwater spp.	Surface dives	Crustaceans, fish, squid
Northern fulmar	Surface fish feeder	Fish, squid, crustaceans
Murres spp.	Diving fish-feeders offshore	Fish, crustaceans, invertebrates
Cormorants spp.	Diving fish-feeders nearshore	Bottom fish, crab, shrimp
Gull spp.	Surface fish feeder	Fish, marine invertebrates, birds
Auklet spp.	Surface dives	Crustaceans, fish, jellyfish
Tern spp.	Plunge, dive	Fish, invertebrates, insects
Petrel spp.	Hover, surface dip	Zooplankton, crustaceans, fish
Jaeger spp.	Hover and pounce	Birds, eggs, fish
Puffin spp.	Surface dives	Fish, squid, other invertebrates

Source: USFWS 2006; Dragoo et al. 2010

Seabirds that feed on benthic habitat, including Steller's eiders, scoters, cormorants, and guillemots, may feed in areas that could be directly impacted by nonpelagic trawl gear (NMFS 2004b). A 3-year otter trawling study in sandy bottom of the Grand Banks showed either no effect or increased abundance in mollusk species after trawling (Kenchington et al. 2001), but clam abundance in these studies was depressed for the first 3 years after trawling occurred. McConnaughey et al. (2000) studied trawling effects using the Bristol Bay area Crab and Halibut Protection Zone. They found more abundant infaunal bivalves (not including *Nuculana radiata*) in the highly fished area compared to the unfished area. In addition to abundance, clam size is of huge importance to these birds. However, handling time is very important to birds foraging in the benthos, and their caloric needs could change if a stable large clam population is converted to a very dense population of small first year clams. Additional impacts from nonpelagic trawling may occur if sand lance habitat is adversely impacted. This would affect a wider array of piscivorous seabirds that feed on sand lance, particularly during the breeding season, when this forage fish is also used for feeding chicks.

Recovery of fauna after the use of nonpelagic trawl gear may also depend on the type of sediment. A study in the North Sea found biomass and production in sand and gravel sediments recovering faster (2 years) than in muddy sediments (4 years) (Hiddink et al. 2006). The recovery rate may be affected by the animal's ability to rebury itself after disturbance. Clams species may vary in their ability to rebury themselves based on grain size and whether they are substrate generalist, substrate specialist, or substrate sensitive species (Alexander, Stanton, and Dodd 1993).

Based on this information, the impacts of groundfish fisheries on seabird prey under both Alternative 1 (status quo) and Alternative 2 are insignificant because these fisheries do not harvest seabird prey species in an amount that would decrease food availability enough to impact survival rates or reproductive success, nor do they impact benthic habitat enough to decrease seabird prey base to a degree that would impact survival rates or reproductive success.

3.5 Habitat

Fishing operations may change the abundance or availability of certain habitat features used by managed fish species to spawn, breed, feed, and grow to maturity. These changes may reduce or alter the abundance, distribution, or productivity of species. The effects of fishing on habitat depend on the intensity of fishing, the distribution of fishing with different gears across habitats, and the sensitivity and recovery rates of specific habitat features. In 2005, NMFS and the Council completed the EIS for EFH Identification and Conservation in Alaska (NMFS 2005b). The EFH EIS evaluates the long term effects of fishing on benthic habitat features, as well as the likely consequences of those habitat changes for each managed stock, based on the best available scientific information. Maps and descriptions of EFH for groundfish species are available in the EFH EIS (NMFS 2005b). This document also describes the importance of benthic habitat to different groundfish species and the impacts of different types of fishing gear on benthic habitat.

Effects of the Alternatives

Table 3-40 describes the criteria used to determine whether the impacts on EFH are likely to be significant.

Table 3-40 Criteria used to estimate the significance of impacts on essential fish habitat.

No impact	Fishing activity has no impact on EFH.
Adverse impact	Fishing activity causes disruption or damage of EFH.
Beneficial impact	Beneficial impacts of this action cannot be identified.
Significantly adverse impact	Fishery induced disruption or damage of EFH that is more than minimal and not temporary.
Significantly beneficial impact	No threshold can be identified.
Unknown impact	No information is available regarding gear impact on EFH.

The EFH EIS (NMFS 2005b) found no substantial adverse effects to habitat in the BSAI caused by fishing activities. The analysis in the EFH EIS concludes that current fishing practices in the BSAI groundfish fisheries have minimal or temporary effects on benthic habitat and essential fish habitat. These effects are likely to continue under Alternative 1, and are not considered to be significant.

Options under Alternative 2 may result in no change to the status quo, or may result in constraining PSC limits under which industry may change fishing patterns in order to maximize species with the greatest economic value. This could result in a response of reducing fishing effort, as the industry chooses not to pursue less valuable fisheries in order to conserve halibut PSC mortality, or it could result in greater fishing effort at lower catch per unit effort, as vessels change fisheries patterns or seasonal changes in the timing of the fishing, to increase halibut avoidance. Shifts in the location or timing of fishing may occur as a result of Alternative 2. However, there is already considerable interannual variability in the patterns of fishing across the BSAI groundfish sectors, as environmental conditions and avoidance of PSC species have caused vessels to adjust their fishing patterns. Any shift in fishing is unlikely to occur outside of the existing footprint of the groundfish fishery in the BSAI, and therefore these impacts are not likely to be substantial. To the extent that Alternative 2 reduces effort in the BSAI groundfish fishery, those alternatives would reduce impacts on habitat relative to the status quo. Because the proposed alternatives are not likely to result in significantly adverse effects to habitat, the impacts are likely insignificant. Overall, the combination of the direct, indirect, and cumulative effects on habitat complexity for both living and non-living substrates, benthic biodiversity, and habitat suitability is not likely to be significant under Alternative 2.

3.6 Ecosystem

Ecosystems consist of communities of organisms interacting with their physical environment. Within marine ecosystems, competition, predation, and environmental disturbance cause natural variation in recruitment, survivorship, and growth of fish stocks. Human activities, including commercial fishing, can also influence the structure and function of marine ecosystems. Fishing may change predator-prey relationships and community structure, introduce foreign species, affect trophic diversity, alter genetic diversity, alter habitat, and damage benthic habitats.

The BSAI groundfish fisheries potentially impact the BSAI ecosystem by relieving predation pressure on shared prey species (i.e., species that are prey for both target groundfish and other species), reducing prey availability for predators of the target groundfish, altering habitat, imposing PSC and bycatch mortality, or by ghost fishing caused by lost fishing gear. Ecosystem considerations for the groundfish fisheries are summarized annually in the Stock Assessment and Fishery Evaluation report (Zador 2014). These considerations are summarized according to the ecosystem effects on the groundfish fisheries, as well as the potential fishery effects on the ecosystem.

As explained in Chapter 3, Section 3.3.1 of the Harvest Specifications EIS (NMFS 2007), NMFS and the Council continue to develop their ecosystem management measures for groundfish fisheries. The Council has created a committee to inform the Council of ecosystem developments and to assist in formulating positions with respect to ecosystem-based management. The Council's Scientific and Statistical Committee holds regular ecosystem scientific meetings, and the Council is considering development of a Bering Sea Fishery Ecosystem Plan. In addition to these efforts to explore how to develop its ecosystem management efforts, the Council and NMFS continue to initiate efforts to take account of ecosystem impacts of fishing activity by designating EFH protection areas and habitat areas of particular concern. Ecosystem protection is supported by an extensive program of research into ecosystem components and the integrated functioning of ecosystems, carried out at the AFSC. Exempted fishing permits currently support investigation of new management approaches for the control of halibut removals through halibut excluder devices http://alaskafisheries.noaa.gov/ram/efp.htm.

3.7 Cumulative Effects

NEPA requires an analysis of the potential cumulative effects of a proposed federal action and its alternatives. Cumulative effects are those combined effects on the quality of the human environment that result from the incremental impact of the proposed action when added to other past, present, and reasonably foreseeable future actions, regardless of which federal or non-federal agency or person undertakes such other actions (40 CFR 1508.7, 1508.25(a) and 1508.25(c)). Cumulative impacts can result from individually minor, but collectively significant, actions taking place over a period of time. The concept behind cumulative effects analysis is to capture the total effects of many actions over time that would be missed if evaluating each action individually. Concurrently, the Council on Environmental Quality (CEQ) guidelines recognize that it is most practical to focus cumulative effects analysis on only those effects that are truly meaningful. Based on the preceding analysis, the effects that are meaningful are potential effects on Pacific halibut, if the alternatives result in a change in the spatial or size distribution of halibut removals, and marine mammals and seabirds, to the extent that the fisheries respond to constraining limits by spatial or seasonal changes in fishing patterns that affect localized species. The cumulative effects on the other resources have been analyzed in numerous documents and the impacts of this proposed action and alternatives on those resources are minimal, therefore there is no need to conduct an additional cumulative impacts analysis.

The EA is intended to analyze the cumulative effects of each alternative and the effects of past, present, and reasonably foreseeable future actions (RFFAs). The past and present actions are described in the previous sections in this chapter. This section provides a review of the RFFAs that may result in cumulative effects on Pacific halibut, marine mammals or seabirds. Actions are understood to be human actions (e.g., a proposed rule to designate northern right whale critical habitat in the Pacific Ocean), as distinguished from natural events (e.g., an ecological regime shift). CEQ regulations require consideration of actions, whether taken by a government or by private persons, which are reasonably foreseeable. This requirement is interpreted to indicate actions that are more than merely possible or speculative. In addition to these actions, this cumulative effects analysis includes climate change.

Actions are considered reasonably foreseeable if some concrete step has been taken toward implementation, such as a Council recommendation or NMFS's publication of a proposed rule. Actions only "under consideration" have not generally been included because they may change substantially or may not be adopted, and so cannot be reasonably described, predicted, or foreseen. Identification of actions likely to impact a resource component within this action's area and time frame will allow the public and Council to make a reasoned choice among alternatives.

The following RFFAs are identified as likely to have an impact on a resource component within the action area and timeframe:

- Experimental fishing permits (EFPs) for deck sorting of halibut on Amendment 80 trawl catcher processors. As described in Section 3.1.3.6, industry is trying to work through the procedures required for sorting halibut on deck in the flatfish fisheries, so that the halibut can be returned to the sea more expeditiously, and hopefully improve the mortality rate of halibut intercepted in the fishery. An EFP has been approved for 2015 whereby the industry would pay for an additional sea sampler (observer) on deck, to monitor halibut discards. The implementation of deck sorting procedures should benefit the halibut stock by reducing the mortality of halibut resulting from groundfish fishery interactions.
- IPHC direct fishery harvests. The catch limit process for the halibut fisheries is under the authority of the IPHC. In the last two years (2013 and 2014), the IPHC has chosen to set catch limits that result in total removals of the halibut resource above the blue line recommendation of

the IPHC's harvest policy (Section 3.1.2.2). The IPHC is also in the process of reconsidering harvest rates that are part of the harvest policy. Any changes to the IPHC's harvest policy, or its implementation, will have an impact the Pacific halibut stock.

Considering the direct and indirect impacts of the proposed action when added to the impacts of past and present actions previously analyzed in other documents that are incorporated by reference and the impacts of the reasonably foreseeable future actions listed above, the cumulative impacts of the proposed action are determined to be not significant.

4 Regulatory Impact Review

This Regulatory Impact Review (RIR)[25] examines the benefits and costs of a proposed regulatory amendment to reduce Pacific halibut prohibited species catch (PSC) limits in the Bering Sea/Aleutian Islands (BSAI) groundfish fisheries. PSC limit reductions are considered for various sectors, including the BSAI trawl limited access sector, the Amendment 80 sector, longline catcher vessels, longline catcher processors, and the Community Development Quota sector (i.e., a reduction to the CDQ's allocated prohibited species quota reserve). The objective of reducing PSC limits would be to minimize bycatch to the extent practicable and provide additional harvest opportunities in the directed halibut fishery.

The preparation of an RIR is required under Presidential Executive Order (E.O.) 12866 (58 FR 51735: October 4, 1993). The requirements for all regulatory actions specified in E.O. 12866 are summarized in the following Statement from the E.O.:

> *In deciding whether and how to regulate, agencies should assess all costs and benefits of available regulatory alternatives, including the alternative of not regulating. Costs and Benefits shall be understood to include both quantifiable measures (to the fullest extent that these can be usefully estimated) and qualitative measures of costs and benefits that are difficult to quantify, but nonetheless essential to consider. Further, in choosing among alternative regulatory approaches agencies should select those approaches that maximize net benefits (including potential economic, environmental, public health and safety, and other advantages; distributive impacts; and equity), unless a statute requires another regulatory approach.*

E.O. 12866 requires that the Office of Management and Budget review proposed regulatory programs that are considered to be "significant." A "significant regulatory action" is one that is likely to:

- Have an annual effect on the economy of $100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, local or tribal governments or communities;
- Create a serious inconsistency or otherwise interfere with an action taken or planned by another agency;
- Materially alter the budgetary impact of entitlements, grants, user fees, or loan programs or the rights and obligations of recipients thereof; or
- Raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in this Executive Order.

4.1 Statutory Authority

Under the Magnuson-Stevens Fishery and Conservation Act (Magnuson-Stevens Act) (16 USC 1801, *et seq*.), the United States has exclusive fishery management authority over all marine fishery resources found within the exclusive economic zone (EEZ). The management of these marine resources is vested in the Secretary of Commerce (Secretary) and in the regional fishery management councils. In the Alaska Region, the Council has the responsibility for preparing fishery management plans (FMPs) and FMP amendments for the marine fisheries that require conservation and management, and for submitting its recommendations

[25] If the RIR/IRFA is a stand-alone document because the action qualifies for a CE, add this footnote: "The proposed action has no potential to effect individually or cumulatively on the human environment (as defined in NAO 216-6). The only effects of the action are economic, as analyzed in this RIR/IRFA. As such, it is categorically excluded from the need to prepare an Environmental Assessment."

to the Secretary. Upon approval by the Secretary, NMFS is charged with carrying out the federal mandates of the Department of Commerce with regard to marine and anadromous fish.

The BSAI groundfish fishery in the EEZ off Alaska is managed under the FMP for Groundfish of the BSAI Management Area. The proposed action under consideration would amend this FMP and Federal regulations at 50 CFR 679. Actions taken to amend FMPs or implement other regulations governing these fisheries must meet the requirements of Federal law and regulations.

4.2 Purpose and Need for Action

Consistent with the MSA's National Standard 1 and National Standard 9, the Council and NMFS use halibut PSC mortality limits to minimize halibut bycatch (halibut PSC) in the groundfish fisheries to the extent practicable, while achieving, on a continuing basis, the optimum yield from the groundfish fisheries. The groundfish fisheries cannot be prosecuted without some level of halibut interception. Although fishermen are required by regulation to avoid the capture of any prohibited species in groundfish fisheries, the use of halibut PSC limits in the groundfish fisheries provides an additional constraint on halibut PSC mortality, and promotes conservation of the halibut resource. Halibut PSC limits provide a regulated upper limit to mortality resulting from halibut interceptions, as continued groundfish fishing is prohibited once a halibut PSC limit has been reached for a particular sector and/or season. This management tool is intended to balance the optimum benefit to fishermen, communities, and U.S. consumers which depend on both halibut and groundfish resources.

The halibut resource is fully allocated. The IPHC accounts for incidental halibut removals in the groundfish fisheries, recreational and subsistence catches, and other sources of halibut mortality before setting commercial halibut catch limits each year. Declines in the exploitable biomass of halibut since the late 1990s, and decreases in the Pacific halibut catch limits set by the IPHC for the directed BSAI halibut fisheries (IPHC Area 4)), especially beginning in 2012 for the directed fishery in the northern and eastern Bering Sea (Area 4CDE), have raised concerns about the levels of halibut PSC mortality by the commercial groundfish trawl and hook-and-line sectors. Reductions in BSAI halibut PSC mortality have not been proportional to the reductions in Area 4 directed halibut harvest limits since 2011. The Council acknowledges that BSAI halibut PSC mortality levels have declined in some sectors since the current PSC limits were implemented and that PSC mortality does not reach the established sector limits in most years. The Council also recognizes efforts by the groundfish industry to reduce total halibut PSC mortality in the BSAI, but these efforts have had the unintended effect of concentrating groundfish fishing effort in Area 4CDE, and increasing the proportion of Area 4CDE halibut exploitable biomass taken as PSC since 2011. In 2015, the levels of halibut PSC in Area 4CDE increased relative to 2014. Based on the stated IPHC harvest policy and the estimates of exploitable biomass and PSC, the 2015 directed fishery harvest limit for halibut in Area 4CDE could have been reduced to a level that the halibut industry deemed was not sufficient to maintain an economically viable fishery in some communities.

The Council does not have authority to set harvest limits for the commercial halibut fisheries, and halibut PSC mortality in the groundfish fisheries is only one of the factors that affects harvest limits for the commercial halibut fisheries. Nonetheless, halibut removals in the groundfish fisheries are a significant portion of total mortality in BSAI IPHC areas, and have the potential to affect harvest limits for the directed fisheries in Area 4 under the current IPHC harvest policy.

Under National Standard 8, the Council must provide for the sustained participation of and minimize adverse economic impacts on fishing communities. BSAI coastal communities are affected by reduced catch limits for the directed halibut fishery, especially in IPHC Area 4CDE. The Council must balance these communities' involvement in and dependence on halibut with community involvement in and dependence on the groundfish fisheries that rely on halibut PSC in order to operate, and with National

Standard 4, which states that management measures shall not discriminate between residents of different states. National Standard 4 also requires allocations of fishing privileges to be fair and equitable to all fishery participants.

The proposed action would reduce the halibut PSC limits in the BSAI, which are established for the BSAI trawl and fixed gear sectors in Federal regulation, and in some cases, in the BSAI Groundfish FMP. Overall halibut PSC limits can be modified only through an amendment to the regulations and the FMP, although seasonal and some target fishery apportionments of those PSC limits would continue to be set annually through the BSAI groundfish harvest specifications process.

One purpose of the proposed action is to minimize halibut PSC mortality in the commercial groundfish fisheries to the extent practicable, while preserving the potential for the optimum harvest of the groundfish total allowable catches (TACs) assigned to the trawl and hook-and-line sectors. The proposed action aims to minimize halibut PSC mortality to the extent practicable in consideration of the regulatory and operational management measures currently available to the groundfish fleet, and the need to ensure that catch in the trawl and hook-and-line fisheries contributes to the achievement of optimum yield in the groundfish fisheries. Minimizing halibut PSC mortality to the extent practicable is necessary to maintain a healthy marine ecosystem, ensure long-term conservation and abundance of halibut, provide optimum benefit to fishermen, communities, and U.S. consumers that depend on both halibut and groundfish resources, and comply with the Magnuson-Stevens Act and other applicable Federal law.

Another purpose of this action is to provide additional harvest opportunities in the directed halibut fishery, especially in Area 4CDE for western Alaska and Pribilof Island coastal communities. Halibut savings that would occur from reducing halibut PSC mortality below current levels would provide additional harvest opportunities to the directed halibut fisheries in both the near term and long term. Near term benefits to BSAI halibut fisheries would result from the PSC mortality reductions of halibut that are over 26 inches in length (O26). These halibut would be available to the commercial halibut fishery in the area and year that the PSC mortality is foregone, or when the fish reach the legal size limit for the commercial halibut fishery (greater than or equal to 32 inches in total length). Longer term benefits to the directed halibut fisheries would accrue throughout the distribution of the halibut stock, from a reduction of halibut PSC mortality from fish that are less than 26 inches (U26). Benefits from reduced mortality of these smaller halibut would occur both in the Bering Sea and elsewhere as they migrate and recruit into the directed halibut fisheries.

4.3 Alternatives

The Council revised the original alternatives for analysis at initial review in February 2015; the amended alternatives are listed below. More than one option may be selected simultaneously, and different PSC reductions levels may selected under each option.

Alternative 1 No action.

Alternative 2 Amend the BSAI Groundfish FMP to revise halibut PSC limits as follows.

Option 1 Reduce halibut PSC limit for the Amendment 80 Sector by:

Suboption 1 reducing the halibut PSC limit to Amendment 80 cooperatives by:

a) 10 percent b) 20 percent c) 30 percent d) 35 percent e) 40 percent f) 45 percent or g) 50 percent

Suboption 2 reducing the halibut PSC limit to Amendment 80 limited access fishery by:

a) 10 percent b) 20 percent c) 30 percent d) 35 percent e) 40 percent f) 45 percent g) 50 percent or h) 60 percent

Option 2 Reduce halibut PSC limit for the BSAI Trawl Limited Access Sector by:

a) 10 percent b) 20 percent c) 30 percent d) 35 percent e) 40 percent f) 45 percent or g) 50 percent

Option 3 Reduce halibut PSC limit for Pacific cod hook and line catcher processor sector by:

a) 10 percent b) 20 percent c) 30 percent d) 35 percent e) 40 percent f) 45 percent or g) 50 percent

Option 4 Reduce halibut PSC limit for other non-trawl (i.e., hook and line catcher vessels and catcher processors targeting anything except Pacific cod or sablefish) by:

a) 10 percent b) 20 percent c) 30 percent d) 35 percent e) 40 percent f) 45 percent or g) 50 percent

Option 5 Reduce halibut PSC limit for Pacific cod hook and line catcher vessel sector by:

a) 10 percent b) 20 percent c) 30 percent d) 35 percent e) 40 percent f) 45 percent or g) 50 percent

Option 6 Reduce the CDQ halibut PSQ limit by:

a) 10 percent b) 20 percent c) 30 percent d) 35 percent e) 40 percent f) 45 percent or g) 50 percent

4.4 Description of BSAI Groundfish Fisheries

This section provides an overview of the BSAI groundfish fisheries in terms that are relevant to the proposed action to reduce halibut PSC limits.

Under Alternative 2 and its options, reductions in the current halibut PSC limits would be considered for five different components of the BSAI groundfish fishery. A separate subsection for each of these five components (as listed below) is provided beginning on page 143.

1) Amendment 80 Catcher Processors (A80-CPs) under Option 1;
2) Vessels participating in BSAI Trawl Limited Access (BSAI TLA) under Option 2;
3) Longline Catcher Processors (longline CPs) under Option 3 and Option 4;
4) Longline Catcher Vessels (longline CVs) under Option 4 and Option 5;
5) Community Development Quota (CDQ) groundfish harvesters under Option 6.

The remainder of this introductory section provides an overview of the affected groundfish fisheries. It should be noted that three components of the BSAI groundfish fishery are not directly analyzed in this assessment because they are not directly affected by proposed regulatory changes. These components include the following:

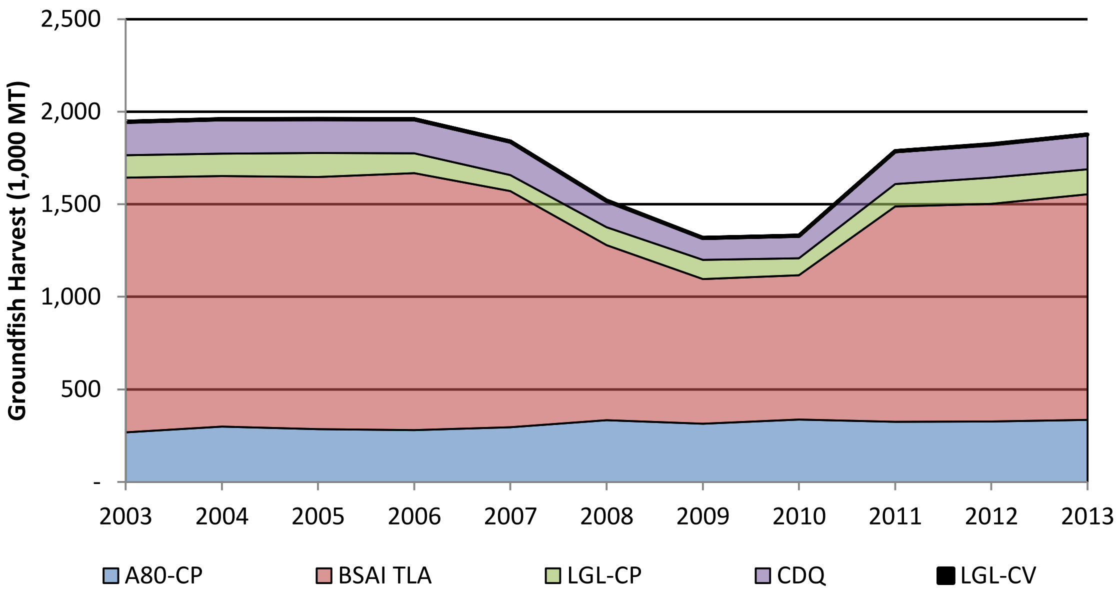
1) Participants in the Pacific cod pot and jig fisheries who are excluded because pot and jig gears are exempted halibut PSC limits.
2) Participants in the IFQ and CDQ fixed gear fisheries for sablefish are excluded because the halibut PSC mortality in these fisheries are exempted from the PSC limits.
3) Shore-based, floating and mothership processors are not separately analyzed. These processors are indirectly affected when CVs in the BSAI TLA are affected (Option 2), when longline CVs are affected (Options 4 and 6), or when CVs operating in the CDQ groundfish fisheries are affected.

4.4.1 Overview of Affected BSAI Groundfish Fisheries

4.4.1.1 Catch and Revenue in BSAI Groundfish Fisheries

The pages that follow contain a brief overview of the BSAI Groundfish fisheries that are affected by Alternatives. Figure 4-1 provides a summary of groundfish harvests by participant group. (Note that these data for 2008 to 2013 are reproduced along with wholesale revenue estimates in Table 4-1.) In Figure 4-1, the very noticeable drop in total catch from 2008 to 2010 reflects the reduction in the pollock TAC that occurred in those years. Overall groundfish catch rose again in 2011, largely due to increases in the pollock TACs, and have increased gradually each year since.

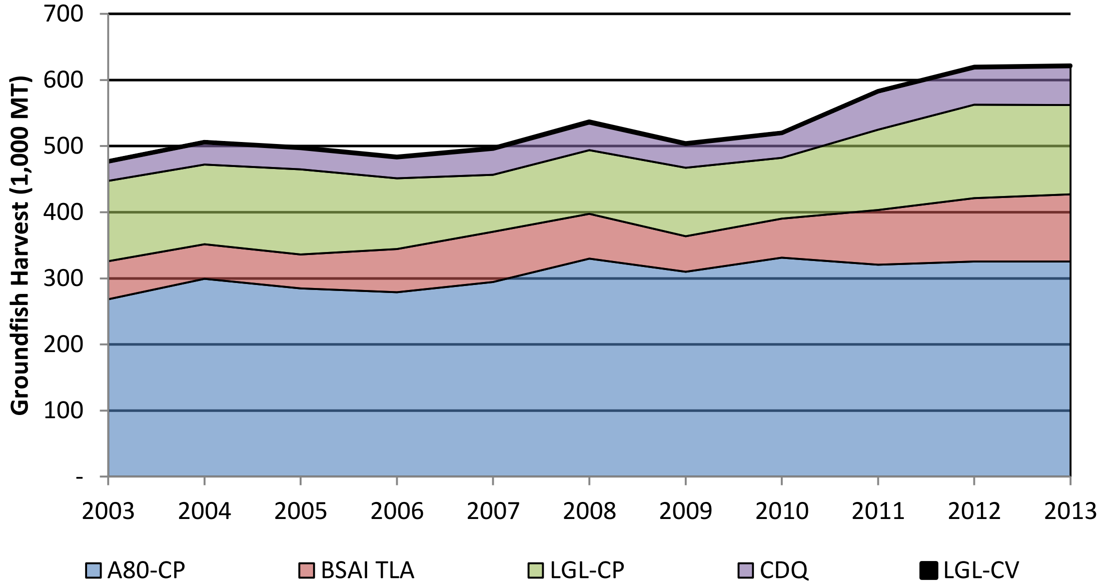
Figure 4-1 Groundfish Harvests of Affected Participants in the BSAI, 2003 to 2013



Notes: 1) LGL-CP = Longline CPs; LGL-CV = Longline CVs
2) Average harvests of the Longline CVs were less than 1,000 mt per year.
Source: Developed by Northern Economics using AKFIN data (Fey 2014).

As noted in the previous paragraph, changes in the pollock fishery of the BSAI TLA and CDQ participants tends to overwhelm changes in the other target fisheries. Figure 4-2 shows BSAI groundfish harvests of the affected participants excluding the pollock target harvests. From this "non-pollock" perspective, it is clear that groundfish harvests in all target fisheries increased steadily from 2003 to 2013.

Figure 4-2 BSAI Groundfish Harvests Excluding Pollock Target Harvests of Affected Groups, 2003 to 2013



Notes: 1) LGL-CP = Longline CPs; LGL-CV = Longline CVs
2) Average harvests of the Longline CVs were less than 1,000 mt per year.
Source: Developed by Northern Economics using AKFIN data (Fey 2014).

Table 4-1 provides more details regarding groundfish harvests and nominal wholesale revenues generated by the affected vessels and their processors. Wholesale revenues and implicit wholesale values per harvested tons of groundfish are summarized in more detail in the following pages.

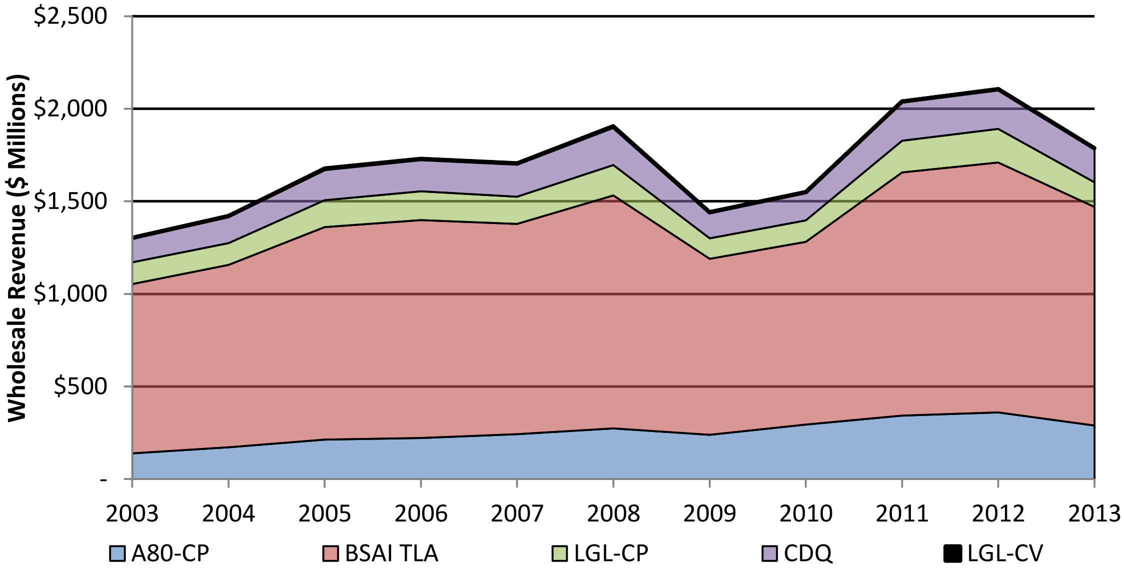
Table 4-1 Harvests and Nominal Wholesale Revenue in Groundfish BSAI Target Fisheries, 2007 to 2013

Affected Component	2007	2008	2009	2010	2011	2012	2013	Average
				BSAI Groundfish Catch (1,000 mt)				
A80-CP	294.88	332.81	314.70	336.76	324.68	327.02	334.52	323.63
BSAI TLA	1,276.82	946.43	780.55	780.31	1,162.84	1,175.57	1,219.60	1,048.87
Longline CP	86.30	96.66	103.78	91.70	121.83	141.33	135.11	110.96
CDQ	179.91	143.24	118.85	120.50	176.41	179.44	186.56	157.85
Longline CV	0.87	1.29	0.69	0.36	0.48	0.75	1.03	0.78
All Affected Components	**1,838.80**	**1,520.43**	**1,318.58**	**1,329.64**	**1,786.25**	**1,824.10**	**1,876.81**	**1,642.09**
				Nominal Wholesale Revenue ($ Millions)				
A80-CP	$243.22	$273.52	$238.65	$294.69	$343.22	$360.38	$289.04	$291.82
BSAI TLA	$1,135.09	$1,258.46	$950.99	$986.22	$1,312.29	$1,349.41	$1,181.16	$1,167.66
Longline CP	$146.09	$164.57	$111.18	$116.73	$171.92	$180.72	$133.11	$146.33
CDQ	$179.34	$206.16	$139.48	$152.23	$211.20	$213.83	$182.68	$183.56
Longline CV	$1.54	$2.24	$0.82	$0.52	$0.82	$1.23	$1.31	$1.21
All Affected Components	$1,705.28	$1,904.95	$1,441.12	$1,550.40	$2,039.45	$2,105.58	$1,787.30	$1,790.58

Source: Developed by Northern Economics using AKFIN data (Fey 2014).

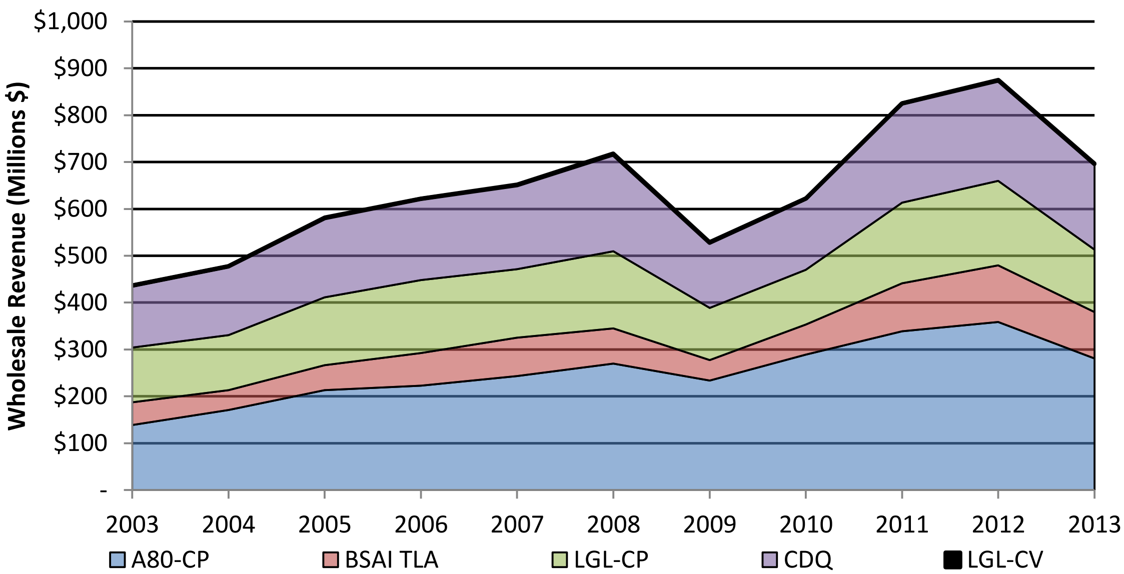
Figure 4-3 shows nominal wholesale revenue in the BSAI groundfish fisheries of affected participants. Revenue declines in 2009 and continued low revenue in 2010 appear to have been a combination of the global recession and the low pollock TACs. Relatively high prices for pollock offset much of the revenue impact of low pollock TACs in 2008. Figure 4-4 shows nominal wholesale revenues in the BSAI groundfish fisheries of affected participants excluding harvests in pollock target fisheries. This graphic clearly shows the effect of low prices in 2009 resulting from the global recession. The significant drop in wholesale revenues in 2013 does not appear to be linked to any single pervasive cause, and appears to have affected all sectors and all species.

Figure 4-3 Nominal Wholesale Revenue from BSAI Groundfish of Affected Participants



Notes: 1) LGL-CP = Longline CPs; LGL-CV = Longline CVs
2) Wholesale revenues of the Longline CVs averaged less than $1.5 million per year.
Source: Developed by Northern Economics using AKFIN data (Fey 2014).

Figure 4-4 Nominal Wholesale Revenues from BSAI Groundfish Excluding Harvests in Pollock Targets



Note: LGL-CP = Longline CPs; LGL-CV = Longline CVs
Source: Developed by Northern Economics using AKFIN data (Fey 2014).

Table 4-2 shows calculated nominal wholesale revenue per ton of groundfish harvest in target fisheries. The values shown represent wholesale values from harvests in trawl fisheries with the exception of the last row, which shows wholesale per harvested ton in Pacific cod longline target fisheries. The implicitly derived wholesale values in the table stretch back to 2007 in order to show the significant jump in wholesale prices that was experienced in 2008, and which led to an overall increase in total revenue in 2008 despite significantly lower harvests of pollock. The table also includes estimates of the year-over-year percentage change in wholesale values. The year-over-year percentage change serves to highlight pervasive declines in wholesale value per ton in 2013 that contributed to the significant drop in overall wholesale revenues from BSAI Groundfish.

It should also be noted that these imputed wholesale revenues per mt of groundfish are assigned to each target fisery using an algorithm developed in a collaborative process between NMFS AFSC and AKFIN. According to AKFIN (Fey 2015), the pricing algorithm uses a blended revenue per ton for all flatfish species, and therefore revenues per mt for low value target fisheries (e.g., yellowfin sole) may appear to be valued higher that might otherwise be expected, while revenues per mt for higher value flatfish target fishreies may be lower than expected. With the exception of the aggregation of flatfish, rockfish, and "other species" (skates, sculpins, squid, octopus, and sharks), all other species harvested and processed in the target fishery are assigned an average wholesale value per mt for that species based on information in COAR data for the year and processor type. We also note that harvests during a roe season for a given species are assigned the same value as harvests of the species in the non-roe season.

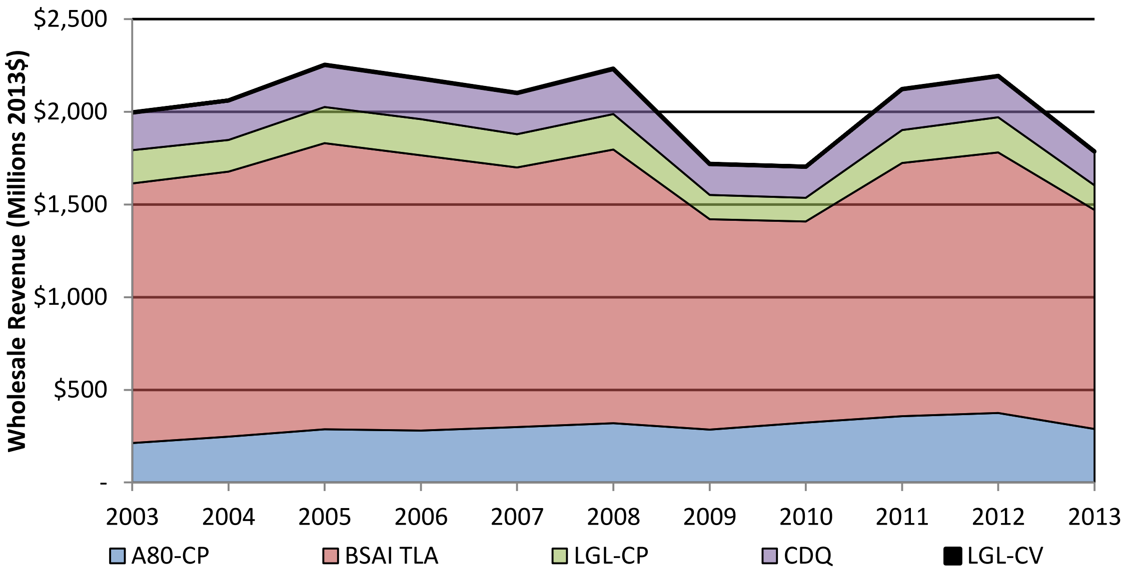
Table 4-2 Nominal wholesale Revenue per Harvested Ton of Groundfish by Target Fishery, 2007 to 2013

	2007	2008	2009	2010	2011	2012	2013
	Nominal Wholesale Revenue per mt of Harvest						
Yellowfin Sole	$714	$742	$673	$768	$893	$993	$773
Rock Sole	$782	$830	$699	$831	$944	$1,001	$784
Arrowtooth or Kamchatka Flounder	$716	$791	$698	$773	$905	$1,003	$804
Flathead Sole	$692	$837	$745	$822	$973	$1,016	$786
Atka Mackerel	$747	$816	$859	$1,073	$1,476	$1,495	$1,455
Rockfish	$1,062	$922	$852	$1,234	$1,790	$1,477	$1,147
Pollock	$887	$1,364	$1,251	$1,282	$1,127	$1,144	$971
Pacific Cod (Trawl Caught)	$1,267	$1,527	$993	$1,298	$1,484	$1,455	$1,131
Pacific Cod (Longline Caught)	$1,826	$4,576	$3,461	$3,767	$4,590	$3,826	$2,875
	Year over Year Change in Nominal Wholesale Revenue per mt of Harvest						
Yellowfin Sole	-8.2%	3.9%	-9.2%	14.1%	16.3%	11.2%	-22.1%
Rock Sole	-6.1%	6.1%	-15.8%	18.8%	13.6%	6.1%	-21.7%
Arrowtooth or Kamchatka Flounder	16.3%	10.5%	-11.7%	10.8%	17.0%	10.9%	-19.8%
Flathead Sole	-13.1%	21.0%	-11.0%	10.3%	18.4%	4.4%	-22.6%
Atka Mackerel	16.0%	9.3%	5.2%	25.0%	37.5%	1.3%	-2.7%
Rockfish	-23.4%	-13.2%	-7.6%	44.9%	45.1%	-17.5%	-22.4%
Pollock	5.3%	53.7%	-8.3%	2.5%	-12.1%	1.5%	-15.1%
Pacific Cod (Trawl Caught)	15.5%	20.5%	-34.9%	30.7%	14.3%	-1.9%	-22.3%
Pacific Cod (Longline Caught)	-11.5%	150.5%	-24.4%	8.8%	21.9%	-16.6%	-24.9%

Note: Year over year percentage changes are calculated by subtracting last year's value from this year's value and dividing the difference by last year's value.
Source: Developed by Northern Economics using AKFIN data (Fey 2014).

Figure 4-5 shows inflation-adjusted wholesale revenues from the affected BSAI groundfish fisheries. In general, the analysis will use inflation-adjusted revenue values. The inflation adjustment brings nominal dollar values up to the equivalent value of the dollar in 2013. The adjustments use the standard producer price index calculated by U.S. Bureau of Labor Statistics that is used by NMFS Alaska Fisheries Science Center for adjusting ex-vessel and wholesale values in the seafood industry. The index can be found at http://data.bls.gov/timeseries/WPU0223. A comparison of the inflation-adjusted wholesale values in Figure 4-5 to the nominal wholesale values shown in Figure 4-3 is instructive. From Figure 4-3 we might infer that the groundfish industry is doing quite well with total revenues increasing over time. In Figure 4-5, however, we see that wholesale revenues have really just been keeping up with inflation, with some poor years (2009, 2010, and 2013) where the industry revenues have lost ground, and some better years where revenues increased relative to inflation (2004, 2005, 2008, 2011, 2012).

Figure 4-5 Inflation Adjusted Wholesale Revenue from BSAI Groundfish (2013$) of Affected Participants



Notes: 1) LGL-CP = Longline CPs; LGL-CV = Longline CVs
2) Average harvests of the Longline CVs were less than 1,000 mt per year.
Source: Developed by Northern Economics using AKFIN data (Fey 2014).

4.4.1.2 Description of Participants in the BSAI Groundfish Fisheries

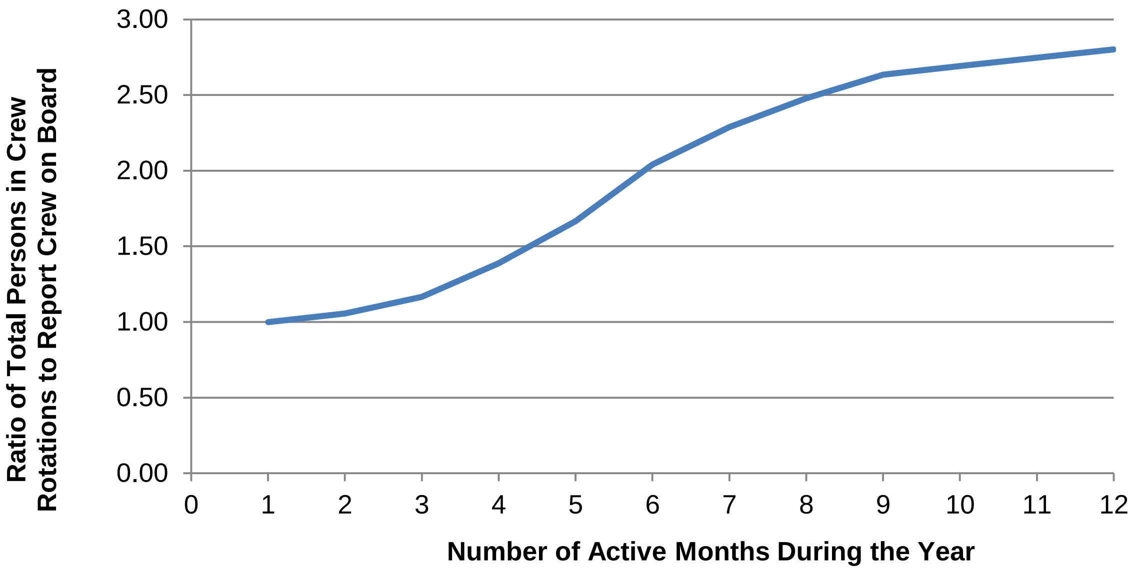
This section provides a brief overview of participation and earnings of vessels and crews operating in BSAI groundfish fisheries. Table 4-4. provides a count of the number of unique active vessels operating in the affected fisheries each year. More details on the types of vessels and the vessel owner's listed place of residence are presented in the sections for the individual sectors. Average crew size data have been provided by AKFIN.[26] To estimate participation and earnings for crew, Economic Data Reports (EDRs) required for participation in the A80 fishery were used as a basis to calculate average persons in crew rotation per vessel for the A80 fleet. Estimations for all other participants were then estimated using ratios generalized from the A80-CPs. This effectively assumes a similar crew rotation among all fishing vessels based on months fished. For example, if a vessel only fishes for one month, no additional crew members are needed for rotation. Conversely, if a vessel fishes in all months of the year, the total number of persons employed in crew rotations is assumed to be nearly 3 times the size of the average crew size per vessel. Estimates of the total persons employed in crew rotations are an aggregate of total crew employment for each vessel. The assumed ratio of total persons employed in crew rotations relative to the number of reported crew members on board is shown in Figure 4-6 on the following page. Because the information on these ratios is reported

[26] Since 2009 fish tickets and daily production reports have had a voluntary field for vessels to report the number of crew persons on the vessels. Because no data were reported for 2008, data on the average crew size from 2009 is used for 2008.

only for the A80-CPs, the analysts ask for public review comments on the total persons in crew rotations, and on assumed crew share percentages that are discussed below.

In addition to crew sizes, total payments made to crew as a percent of gross revenues are estimated using a similar methodology. Crew share percentages for AFA-CPs were assumed to equal crew shares reported in A80 EDR data at approximately 27 percent of wholesale revenue; while upward adjustments are made to LGL-CPs (35 percent of wholesale revenue). Trawl and LGL-CVs were assigned somewhat higher crew share percentages, noting that crew shares for CVs are calculated from ex-vessel revenues. Crew on AFA-CVs were assigned a share of 38 percent, Non-AFA Trawl-CVs were assumed to pay out 42 percent to crew members and LGL-CVs crew members were assumed to receive 45 percent. The crew share percentages that have been assumed for all groundfish vessels are reported in Table 4-3.

Figure 4-6 Assumed Ratios of the Total Number of Persons in Crew Rotations to Crew Members on Board



Source: Developed by Northern Economics based on information in A80 EDRs (Fissel, 2014).

Table 4-3 Average Crew Members on Board and Assumed Crew Share Percentages for Groundfish Vessels

Sector	AFA-CV	TRW-CV	LGL-CV	LGL-CP	A80-CP	AFA-CP
Average on Board Crew Size	4.6	4.0	4.0	18.9	37.0	114.2
	Share as a Percent of Ex-Vessel Revenue			Share as a Percent of Ex-Vessel Revenue		
Crew Share Percentage	38%	42%	45%	35%	27%	27%

Source: Developed by Northern Economics based on Crew Size data from AKFIN (Fey, 2014), EDR data from A80-CP (Fissel 2014), and on analysts experience and expertise.

As shown in Table 4-4, 189 vessels on average were active in all BSAI Groundfish fisheries with 7,149 total jobs between 2008 and 2013. On average, nearly $485 million were estimated to have been paid to crew and officers—an average income of $67,834 per person. Table 4-4 summarizes the BSAI Groundfish fishery as a whole by aggregating outcomes for each individual participant group or sector. These group outcomes are included in the subsequent participant sections.

Table 4-4 Summary of Participation and Earning By Vessels and Crew in BSAI Groundfish Fisheries That Are Potentially Affected by the Halibut PSC Reduction Alternatives

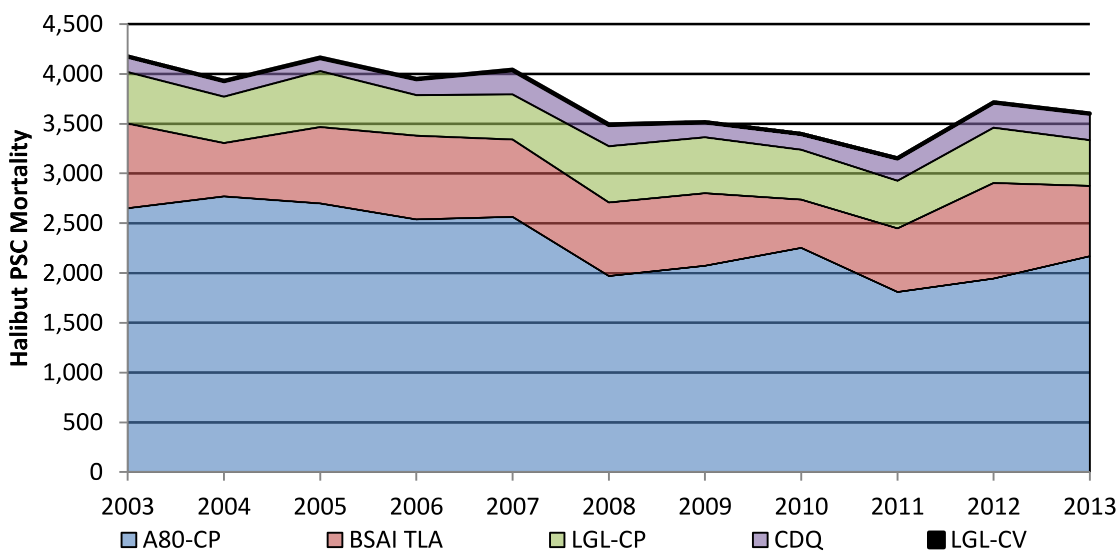
	2008	2009	2010	2011	2012	2013	6-Year Average
Number of Active Vessels	207	197	185	182	184	178	189
Weighted Average Crew Size (Incl. Officers)	19.7	19.1	20.4	20.5	20.3	20.4	20.0
Weighted Average Operating Months	6.9	6.4	6.4	7.7	7.4	7.3	7.0
Average Persons in Crew Rotation per Vessel	37.4	34.7	34.6	42.3	39.1	39.4	37.9
Total Persons in Employed in Crew Rotations	7,732	6,832	6,409	7,707	7,193	7,018	7,149
Weighted Average Crew Share Percent	36%	36%	36%	36%	36%	36%	36%
Total Payments to Crew and Officers (2013 $ Millions)	$570.3	$415.6	$406.2	$527.0	$547.0	$443.4	$484.9
Average Income Earned per Person (2013 $)	$73,751	$60,836	$63,378	$68,376	$76,053	$63,176	$67,834

Source: Developed by Northern Economics using AKFIN data (Fey 2014); and A80-CP Economic Data Report data (Fissel 2014).

4.4.1.3 Halibut PSC Limits and Halibut PSC Mortality in BSAI Groundfish Fisheries

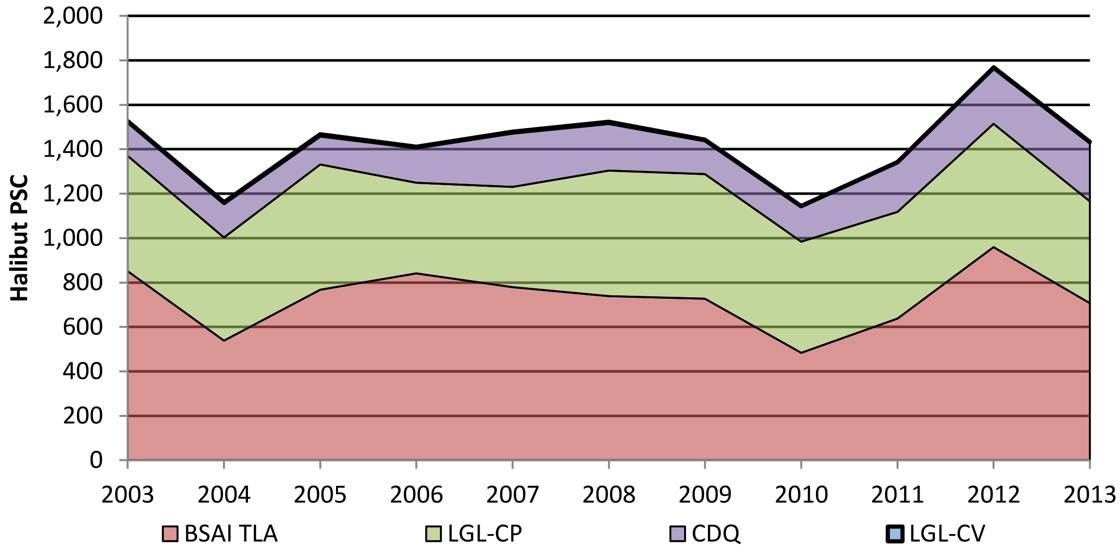
Figure 4-7 shows halibut PSC mortality in the BSAI groundfish target fisheries of affected participants from 2003 to 2013. In 2003, total halibut mortality across all participants was over 4,100 mt. By 2011, halibut PSC mortality dropped to 3,100 mt before jumping back above 3,500 mt in 2012 and 2013. As shown in Figure 4-8 on the following page, the overall decline is due mostly to reductions of the A80-CPs following implementation of A80 in 2008. As seen in Figure 4-9, halibut PSC mortality generated by other participants does not appear to have had a significant trend either up or down from 2003 forward.

Figure 4-7 Halibut PSC mortality in BSAI Groundfish Target Fisheries of Affected Participants, 2003 to 2013



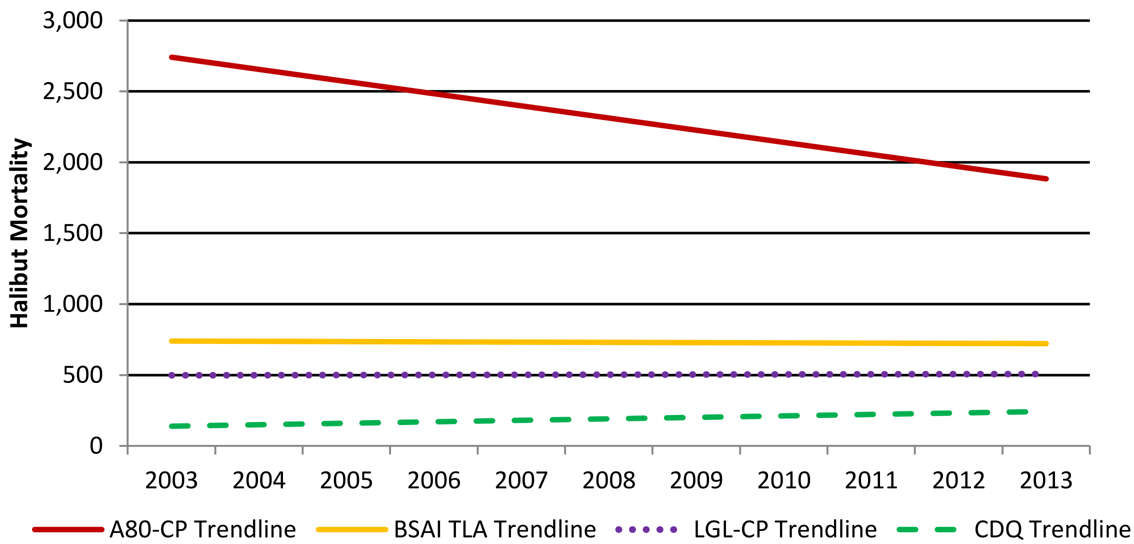
Notes: 1) LGL-CP = Longline CPs; LGL-CV = Longline CVs
2) Average halibut PSC mortality of Longline CVs was less than 3.6 mt per year.
Source: Developed by Northern Economics using AKFIN data (Fey 2014).

Figure 4-8 Halibut PSC mortality in BSAI Groundfish Target Fisheries of Affected Participants Excluding A80-CPs



Notes: 1) LGL-CP = Longline CPs; LGL-CV = Longline CVs
2) Average halibut PSC mortality of Longline CVs was less than 3.6 mt per year.
Source: Developed by Northern Economics using AKFIN data (Fey 2014).

Figure 4-9 Linear Trends in Halibut Mortality of Affected Participants, 2003 to 2013



Notes: 1) LGL-CP = Longline CPs; LGL-CV = Longline CVs
2) Average halibut PSC mortality of Longline CVs was less than 3.6 mt per year.
Source: Developed by Northern Economics using AKFIN data (Fey 2014).

Table 4-5 summarizes the halibut PSC limits that have been in place since 2008. The table also shows the percent of the effective limit taken in BSAI groundfish target during the year. The PSC limits for A80-CPs were reduced by a total of 150 mt under A80 regulations from 2,525 in 2008 to 2,375 in 2011 to 2013. Halibut PSC limits for groundfish CDQ fisheries increased by 50 mt in 2010 to 393 mt. PSC limits for the three remaining groups of affected participants were unchanged during the period. It should be noted that the limit for the BSAI TLA fleet was first defined and set in 2008 under A80. Also it should be noted that the PSC limit for the hook and line sectors (longline CPs and longline CVs) were not separately defined until 2008 under Amendment 85. Finally, we note that the PSC limit for "All Other Targets" excludes sablefish and is set at 58 mt. Technically, this PSC mortality apportionment is shared between longline CPs and longline CVs, but since 2008 there have been exactly zero instances of longline CVs being assigned a “target” other than Pacific cod or sablefish.

Table 4-5 Halibut PSC Limits in the BSAI and Percent Taken from 2008 to 2013

Affected Participants	2008	2009	2010	2011	2012	2013	Average
			PSC Limit (mt of Halibut Mortality)				
A80-CPs (Coops + A80 Limited Access)	2,525	2,475	2,425	2,375	2,325	2,325	2,408
BSAI TLA (All Target Fisheries)	875	875	875	875	875	875	875
Longline CPs (for Pacific Cod + All Other Targets)	818	818	818	818	818	818	818
CDQ (All Target Fisheries)	343	343	393	393	393	393	376
Longline CVs (for Pacific cod only)	15	15	15	15	15	15	15
All BSAI Halibut PSC Limits	**4,576**	**4,526**	**4,526**	**4,476**	**4,426**	**4,426**	**4,493**
			Percent of 2013 Limit Taken				
A80-CPs (Coops + A80 Limited Access)	78%	84%	93%	76%	84%	93%	85%
BSAI TLA (All Target Fisheries)	84%	83%	55%	73%	110%	81%	81%
Longline CPs (for Pacific Cod + All Other Targets)	69%	68%	61%	59%	68%	56%	64%
CDQ (All Target Fisheries)	62%	44%	40%	57%	64%	67%	56%
Longline CVs (for Pacific cod only)	33%	20%	13%	7%	13%	20%	18%
All BSAI Halibut PSC Limits	**76%**	**78%**	**75%**	**70%**	**84%**	**81%**	**77%**

Source: Developed from information on the NMFS Annual Specifications (NMFS 2014f) and from AKFIN data (Fey 2014).

The bottom half of Table 4-5 shows total PSC mortality of each of the affected participant groups by year as a percentage of the PSC limit in place during that year. This part of the table is particularly useful for getting a general sense of the potential impacts of reducing halibut PSC limits, particularly for affected groups for which the limits have been unchanged throughout the period. As an example, the CDQ groups have taken an average of 54 percent of their combined halibut PSC limit for pollock, Pacific cod and for all other targets. Relatively small reductions in the CDQ limit would not have affected the ability of the CDQ group to harvest the groundfish they harvested in any of the years. Significantly Lower limits (e.g. reductions of 30 or 35 precent) would potentially limit their ability to expand their operations and take a greater percentage of their CDQ apportionments.

4.4.1.4 Groundfish Wholesale Revenues Generated per Ton of Halibut PSC

In order to evaluate impacts of reductions in halibut PSC, this study assigns value to halibut PSC based on the wholesale revenues that are generated utilizing one mt of halibut PSC. The more wholesale revenue that can be generated per ton of halibut PSC, the more valuable that unit of halibut PSC becomes. This measurement represents the marginal wholesale revenue earned per mt of halibut and is referred to as wholesale revenue per halibut PSC. In general, wholesale revenue per halibut PSC can be increased three ways: 1) increased wholesale revenues (holding halibut PSC constant); 2) decreased halibut PSC (holding wholesale revenues constant); or 3) a combination of both. If wholesale revenue or halibut PSC change by the same relative amount, wholesale revenue per halibut PSC remains the same.

The data utilized in this analysis have been provided for each combination of harvest vessel, processor, target species, NMFS area, and date (monthly) and includes estimates of both ex-vessel value and wholesale value. Therefore, wholesale revenue per halibut PSC can be calculated for each unique observation. To graph the data, a relatively straightforward process allows us to view a “catch progression” throughout the year:

- Calculate the wholesale revenue per halibut PSC for each record.

- Assign a unique and random number to each record. Note that each record shows the fishery data for an individual vessel in a month, in a three digit management area, and a particular target fishery. The unique random number provides a variable by which to sort records that take place in the same target fishery, area, and month without adding any unintentional bias.
- Sort the records from low to high by year, by month, and by the unique random number for each sector or target fishery, whichever is more applicable. The random number sort provides a means to consistently sort vessel records within each month-area combination.
- Color code records by month moving through blue, green, yellow, orange, red, and finally purple.

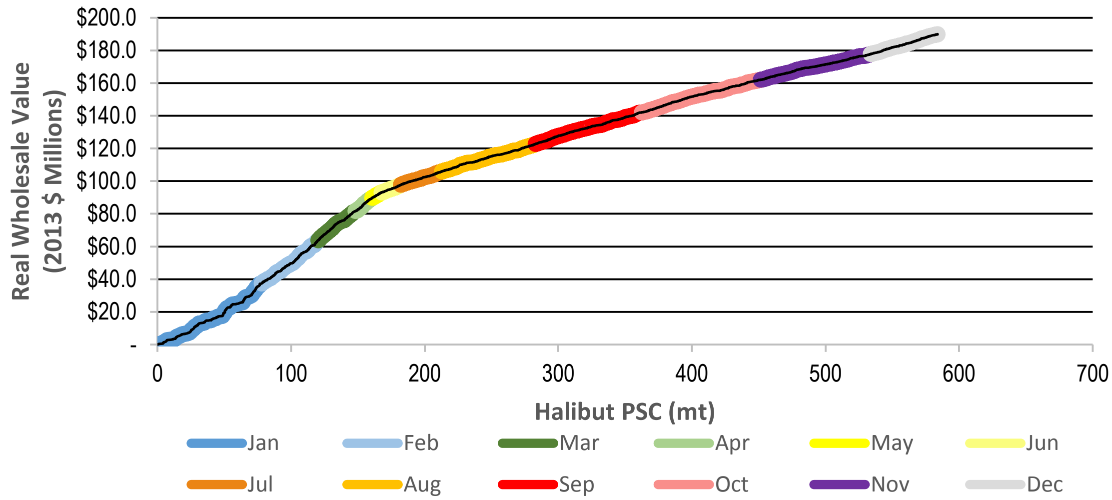
Figure 4-10 summarizes the average wholesale revenue per halibut PSC between 2008 and 2013 for hook-and-line gear. The slope of the line at any given point can be used to interpret the wholesale revenues generated per halibut PSC. When the line is steep, a small movement along the x-axis (halibut PSC) generates wholesale revenues more quickly than if the line were flatter. A steep catch curve represents higher wholesale value per halibut PSC. The catch progression line for hook-and-line gear in Figure 4-10 demonstrates both scenarios. As shown, approximately $100 million in wholesale revenue is generated using close to 175 mt of halibut PSC during the early part of the year. As the line becomes less steep in the latter part of the year, we see that to generate the next $100 million (bringing total to $200 million) in wholesale revenue requires over 3× the amount of halibut PSC (~600 mt).

On average between 2008 and 2013, approximately $190 million in wholesale revenue was generated utilizing 600 mt of halibut PSC—an average wholesale revenue per halibut PSC of $316,000 per mt of halibut PSC between 2008 and 2013. Since this is the average over the total catch progression, it combines both distinct slopes displayed in Figure 4-10. For instance, to reach the first $100 million in wholesale revenue, the average revenue per halibut PSC was nearly $500,000 per mt of halibut PSC.

All figures reflect monthly variation, as described by color. While it is tempting the think of the length of the line as an indication of the amount of effort in the fishery, the length of any monthly segment should be interpreted strictly as the combination of additional revenue and additional PSC—a line that appears longer than average means that either more revenue was generated than average, or that more halibut than average was taken during the month. While either **may** be an indication of effort, they are both imperfect in that regard. The figures below summarize all sectors in the BSAI Groundfish fishery by gear type. Subsequent sections for A80-CPs, BSAI TLA, and LGL-CPs detail individual target fisheries, by year.

It should also be noted that catch progression lines that are convex (i.e. rounded outward like a ball) mean that the wholesale value per halibut PSC is higher earlier in the year than later in the year. For fisheries that exhibit a convex catch progression line, the revenue impacts of a reduction in PSC are mitigated if the cuts come later in the year. If a catch progression line is concave (i.e. rounded inward like bowl) then cutting from the earlier part of the year will mitigate the revenue impacts of a PSC reduction. Finally, if a catch progression line is relatively straight (neither concave or convex) then the timing of cuts will not be a mitigating factor in terms of foregone revenue. The three catch progression lines shown below conveniently exhibit all three of these conditions. The catch progression line for the longline fisheries (Figure 4-10) is somewhat convex and thus revenue impacts of PSC cuts, if required, would be likely be mitigated if they came later in the fishing year. The catch progression line for the non-pollock trawl fisheries (Figure 4-11) is relatively straight, and on the surface it does not appear that the timing of cuts would cause differences in revenues impacts. In this case sorting non-pollock trawl fisheries by sector and target species is likely to reveal differences that are hidden by the aggregated nature of this particular catch progression line. Finally we note that the catch progression line for the pollock trawl fishery is concave, indicating that the impacts to revenue of a cut are mitigated if they are earlier in the year. This is somewhat counterintuitive given that the relatively high-value and lucrative pollock roe fishery occurs in the spring. It does, however, reinforce the fact that revenue is not the only determinant of optimality—costs and differences in the amount of groundfish catch per unit of effort must also be considered.

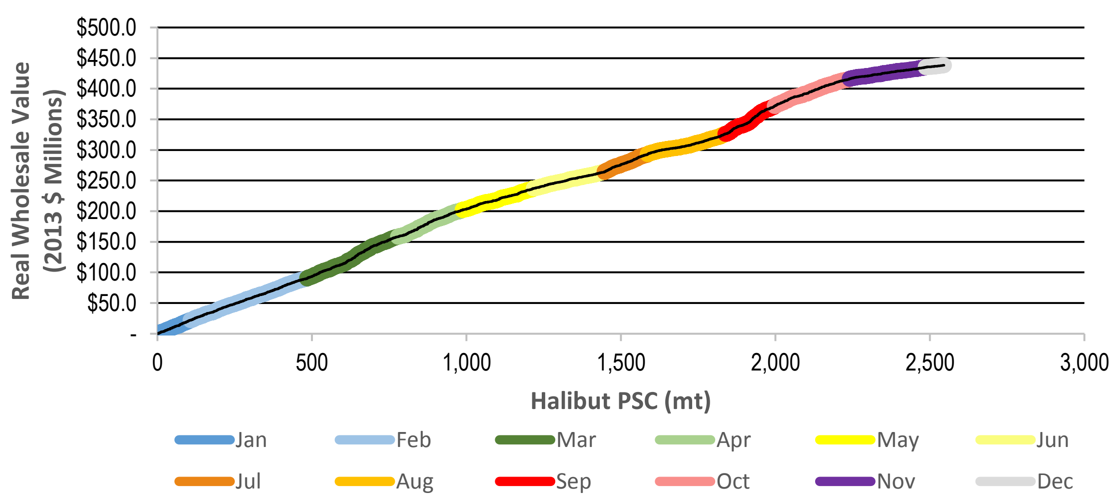
Figure 4-10 Average Annual Progression of Wholesale Revenues and Halibut PSC in the LGLCP and LGL-CV Fisheries, 2008 to 2013



Source: Developed by Northern Economics using AKFIN data (Fey 2014).

Figure 4-11 and Figure 4-12 display average wholesale revenues per halibut PSC for all trawl gear users in the BSAI groundfish fishery. Figure 4-11 summarizes wholesale revenues per halibut PSC for all target fisheries, excluding pollock. As shown, the wholesale revenues per halibut PSC are relatively consistent, on average, throughout the year, as indicated by consistent slope of the progression. Outside of January and December, fishing appears to occur consistently across months. On average between 2008 and 2013, approximately $450 million of wholesale revenues is generated, utilizing just over 2,500 mt of halibut PSC—or $180,000 in wholesale revenue per mt of halibut PSC.

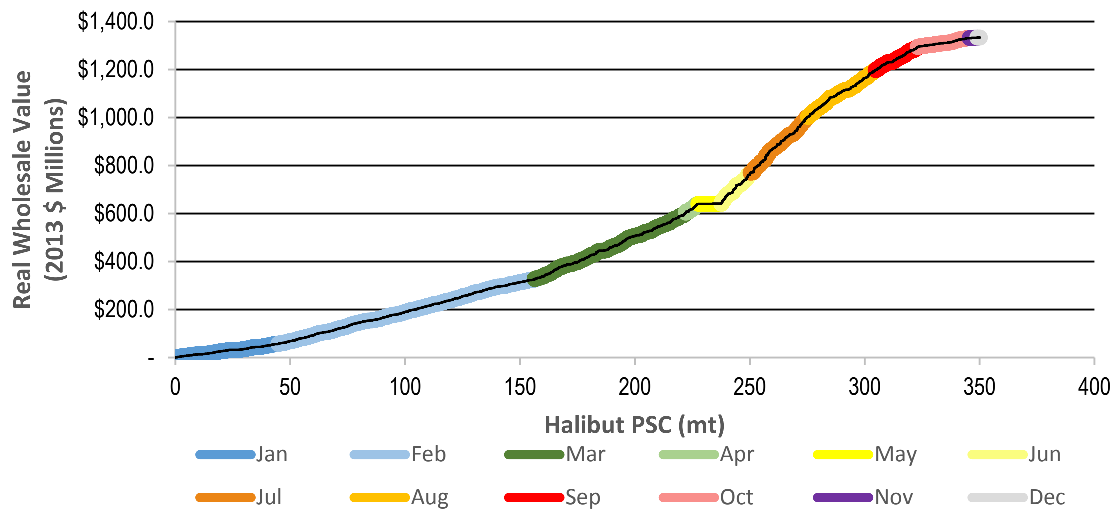
Figure 4-11 Annual Progression of Wholesale Revenues and Halibut PSC in the BSAI Non-Pollock Trawl Fisheries



Note: Include A80-CPs and BSAI TLA vessels.
Source: Developed by Northern Economics using AKFIN data (Fey 2014).

Wholesale revenues per halibut PSC in pollock target fisheries are shown in Figure 4-12. On average, wholesale revenues per halibut PSC in the pollock fishery are flatter in the first few months. In the latter part of the year, wholesale revenue per halibut PSC becomes greater, as indicated by the increased slope of the catch line. This is easily seen when comparing the amount of wholesale revenue generated by the first 100 mt of halibut PSC with the amount of wholesale revenue generated by the last 100 mt of halibut PSC. The first 100 mt of PSC generates approximately $200 million in wholesale revenue, while the last 100 mt of PSC generates approximately $600 million in wholesale revenue. Between 2008 and 2013, the pollock fishery generated over $1.3 billion in wholesale revenue while utilizing approximately 350 mt of halibut PSC—or approximately $3.7 million in wholesale revenue per ton of halibut PSC on average. This is nearly 10× larger than the wholesale revenue per ton of halibut PSC of hook-and-line gear, and over 30× larger than the non-pollock trawl group. It should be noted that comparing catch progression lines among different participants should be done with caution because of differences in the scales used across figures. As we will see later, comparisons are more appropriate by years and target fisheries within an individual participant group.

Figure 4-12 Annual Progression of Wholesale Revenues and Halibut PSC in the BSAI Groundfish Pollock Trawl Fisheries



Note: Includes both BSAI TLA vessels and A80-CPs.
Source: Developed by Northern Economics using AKFIN data (Fey 2014).

The A80-CP, BSAI TLA, LGL-CP and CDQ sections that follow provide similar figures, but detailed by individual target fishery and year. The figures are also used in the impact assessment sections to facilitate discussions of modelled behavioral changes that may allow the sector to best optimize wholesale revenues while cutting their halibut PSC.

4.4.1.5 Behavioral Changes and Halibut PSC

While there may be many potential ways to reduce halibut PSC, the primary focus of this study is to evaluate the economic impacts to the BSAI groundfish fisheries given reductions in PSC limits. Contingent upon how often those limits are reached, halibut PSC is always reduced by restricting the amount of groundfish caught. This can be thought of as removing segments of the annual progression lines shown above, to achieve the halibut PSC limit. The impacts are measured as the summation of wholesale revenue forgone at any given PSC limit.

One way to evaluate other behavioral changes is to begin with the calculation for halibut PSC. On the fishing grounds, halibut PSC is determined by multiplying the volume of total halibut encounters (HE), by the appropriate discard mortality rate (DMR).[27] Estimates of halibut encounters are summarized for each affected participant group in Table 4-6; DMRs were previously discussed and listed in Table 3-8. Halibut encounters are reported in kilograms (kg). As shown in Table 4-6, LGL-CPs encounter the most halibut—approximately twice the amount as the next largest participant, but because they have a relatively low DMR (approximately 10 percent), their overall PSC mortality is quite low.

Table 4-6 Halibut Encounters in Affected Groundfish Sectors from 2008 to 2013

	2008	2009	2010	2011	2012	2013
Affected Participants	**Halibut Encounters (kg)**					
A80-CP	2,532,194	2,667,283	2,823,434	2,276,469	2,469,452	2,678,915
BSAI TLA	955,579	932,234	641,296	818,505	1,242,433	916,359
CDQ	953,977	757,806	830,762	711,259	619,805	824,411
LGL-CP	5,140,733	5,100,069	4,988,273	4,808,378	5,546,639	5,100,520
LGL-CV	48,935	26,229	16,871	13,144	18,411	37,050

Source: Developed by Northern Economics using AKFIN data (Fey 2014) and NMFS (2014f).

A halibut encounter rate (HER) is calculated by dividing halibut encounters (in kg) by the total volume of groundfish caught (halibut encounter rates are typically reported as kg/ mt). Using the aforementioned halibut encounter rate equation, algebraic manipulation yields halibut PSC as the product of three factors—the halibut encounter rate, DMR, and total groundfish. Therefore, there are effectively three different ways to lower halibut PSC. A fleet can either catch less halibut (decrease its halibut encounters and thus decrease its halibut encounter rate), improve survivability rates (decrease DMR), or simply catch less groundfish. Mathematically, this translates to halibut PSC (kg) = groundfish (mt) × halibut encounter rate (kg/mt) × DMR. It is worth nothing that while reductions in halibut encounters and/or total groundfish can change instantaneously through changes in fishing patterns and techniques, a change in the DMRs is determined in regulations and would require much longer time period for changes to be realized. As previously noted in Section 3.1.3.2, DMRs are 10-year running averages, updated by NMFS every three years. Therefore, any attempts to improve DMRs will probably change halibut PSC at a much slower rate overall than decreasing halibut encounters or total groundfish. It is also possible, of course, that regulatory changes could be enacted that change the DMR updating process.

Because halibut PSC is the product of halibut encounter rates, DMR, and total groundfish tons, a reduction of 10 percent in any one of the three has the same relative impact on halibut PSC. Table 4-7 summarizes halibut encounter rates, DMR, and total groundfish caught by participants between 2008 and 2013. The table also shows the total change in halibut PSC given a 10 percent decrease in any one behavior. As shown in Table 4-7, the A80-CP fleet has the highest potential for decreasing halibut PSC with a 10 percent change in any one of the factors. This is a product of relatively high groundfish harvests, but especially high halibut encounter rates. Like vessels in the BSAI TLA, A80-CPs also have high average DMRs; however, BSAI TLAs' overall encounter rates are much smaller because so much of their groundfish is taken in the pollock fishery, most often with mid-water gear.

[27] This assumes that all halibut caught is discarded. Otherwise, this calculation would multiply only total halibut discards by DMR. Because halibut is a prohibited species in the BSAI Groundfish fisheries, nearly all halibut PSC is discarded.

Table 4-7 Key Factors that Influence Halibut PSC Mortality and the Change in Halibut that Results from a 10 percent Change in the Key Factors

Affected Participants	2008	2009	2010	2011	2012	2013
			Total Groundfish (mt)			
A80-CP	332,815	314,702	336,764	324,684	327,018	334,518
BSAI TLA	946,435	780,551	780,306	1,162,839	1,175,565	1,219,601
CDQ	143,240	118,853	120,502	176,413	179,442	186,560
LGL-CP	96,656	103,779	91,705	121,830	141,330	135,108
LGL-CV	1,288	694	360	483	750	1,027
			Halibut Encounter Rate (kg/mt)			
A80-CP	7.6	8.5	8.4	7.0	7.6	8.0
BSAI TLA	1.0	1.2	0.8	0.7	1.1	0.8
CDQ	6.7	6.4	6.9	4.0	3.5	4.4
LGL-CP	53.2	49.1	54.4	39.5	39.2	37.8
LGL-CV	38.0	37.8	46.9	27.2	24.5	36.1
			Average DMR (percentage)			
A80-CP	0.78	0.78	0.80	0.80	0.79	0.81
BSAI TLA	0.77	0.78	0.76	0.78	0.77	0.77
CDQ	0.22	0.20	0.19	0.31	0.41	0.32
LGL-CP	0.11	0.11	0.10	0.10	0.10	0.09
LGL-CV	0.11	0.11	0.10	0.10	0.10	0.09
	Change in Halibut PSC Given 10% Reduction in Total Groundfish, Halibut Encounter Rates, or DMR (percent)					
A80-CP	196.9	207.4	225.4	181.0	194.5	216.8
BSAI TLA	73.9	72.7	48.4	63.7	96.0	70.7
CDQ	21.4	15.1	15.9	22.3	25.2	26.5
LGL-CP	56.6	56.2	50.0	48.1	55.5	45.9
LGL-CV	0.5	0.3	0.2	0.1	0.2	0.3

Source: Developed by Northern Economics using AKFIN data (Fey 2014) and NMFS (2014f).

4.4.1.6 Attainment of Optimum Yield and Ability to Account for Variations and Contingencies

This section provides information to evaluate the BSAI Groundfish Fishery with respect to National Standard 1, which requires FMPs to achieve the optimum yield of fishery resources, and National Standard 6, which requires FMPs to account for variations and contingencies in the use of fishery resources. Information is presented on TAC, ABC, and total catch within the BSAI Groundfish fishery from 2008 to 2014. These data can be used to compare status quo harvests by individual species with projected harvests by species under the alternatives. For the BSAI groundfish complex, optimum yield is specified as a range (1.4 to 2.0 million mt) that represents 85 percent of the historical estimate of the maximum sustainable yield for the groundfish target species, which accounts for the combined influence of ecological, social, and economic factors.

Comparison of Biomass Estimates, with Allowable and Actual Harvests of BSAI Groundfish Fishery Species

This section compares the TAC and ABC for BSAI groundfish species, and harvests relative to TACs. The TAC and ABC for each analyzed species are presented in Table 4-8, while Table 4-9 shows the TAC as a percent of the ABC. In federal fishery management, TACs are most often set below the ABC to account for implementation uncertainty (i.e., imperfect management control that results in imprecision in achieving the target) and to remain within the upper limit (2 million mt) of the optimum yield range that has been established for the BSAI groundfish fishery, although they can also be reduced for ecological, social, or economic factors.

Table 4-8 Acceptable Biological Catch and Total Allowable Catch of BSAI groundfish Species, 2008 to 2014

Species	Area	Item	2008	2009	2010	2011	2012	2013	2014
Alaska Plaice	BSAI	TAC	50,000	50,000	50,000	16,000	24,000	20,000	24,500
Alaska Plaice	BSAI	ABC	194,000	232,000	224,000	65,100	53,400	55,200	55,100
Arrowtooth & Kamchatka	BSAI	TAC	75,000	75,000	75,000	25,900	25,000	25,000	25,000
Arrowtooth & Kamchatka	BSAI	ABC	244,000	156,000	156,000	153,000	150,000	152,000	106,599
Atka mackerel	BSAI	TAC	60,700	76,400	74,000	53,080	50,763	25,920	32,322
Atka mackerel	BSAI	ABC	60,700	83,800	74,000	85,300	81,400	50,000	64,131
Flathead Sole	BSAI	TAC	50,000	60,000	60,000	41,548	34,134	22,699	24,500
Flathead Sole	BSAI	ABC	71,700	71,400	69,200	69,300	70,400	67,900	66,293
Greenland Turbot	BSAI	TAC	2,540	7,380	6,120	5,050	8,660	2,060	2,124
Greenland Turbot	BSAI	ABC	2,540	7,380	6,120	6,140	9,660	2,060	2,124
Northern Rockfish	BSAI	TAC	8,180	7,160	7,240	4,000	4,700	3,000	2,594
Northern Rockfish	BSAI	ABC	8,180	7,160	7,240	8,670	8,610	9,850	9,761
Octopuses	BSAI	TAC				150	900	500	225
Octopuses	BSAI	ABC				396	2,590	2,590	2,590
Other Flatfish	BSAI	TAC	21,600	17,400	17,300	3,000	3,200	3,500	2,650
Other Flatfish	BSAI	ABC	21,600	17,400	17,300	14,500	12,700	13,300	12,400
Other Rockfish	BSAI	TAC	999	1,040	1,040	1,000	1,070	873	773
Other Rockfish	BSAI	ABC	999	1,040	1,040	1,280	1,280	1,159	1,163
Other Species	BSAI	TAC	50,000	50,000	50,000				
Other Species	BSAI	ABC	78,100	63,700	61,100				
Pacific Cod	BSAI	TAC	170,720	176,540	168,780	227,950	261,000	260,000	253,894
Pacific Cod	BSAI	ABC	176,000	182,000	174,000	235,000	314,000	307,000	270,100
Pacific Ocean Perch	BSAI	TAC	21,700	18,800	18,860	24,700	24,700	35,100	33,122
Pacific Ocean Perch	BSAI	ABC	21,700	18,800	18,860	24,700	24,700	35,100	33,122
Pollock	BSAI	TAC	1,019,000	834,000	832,000	1,271,000	1,219,000	1,266,000	1,286,000
Pollock	BSAI	ABC	1,028,200	841,900	846,100	1,306,700	1,252,500	1,412,300	1,404,048
Rock Sole	BSAI	TAC	75,000	90,000	90,000	85,000	87,000	92,380	85,000
Rock Sole	BSAI	ABC	301,000	296,000	240,000	224,000	208,000	214,000	203,800
Rougheye Rockfish	BSAI	TAC	202	539	547	454	475	378	416
Rougheye Rockfish	BSAI	ABC	202	539	547	454	475	378	416
Sablefish	BSAI	TAC	5,300	2,940	4,860	4,750	4,280	3,720	3,150
Sablefish	BSAI	ABC	5,300	4,920	4,860	4,750	4,280	3,720	3,150
Sculpins	BSAI	TAC				5,200	5,200	5,600	5,750
Sculpins	BSAI	ABC				43,700	43,700	42,300	42,318
Sharks	BSAI	TAC				50	200	100	125
Sharks	BSAI	ABC				1,020	1,020	1,020	1,022
Shortraker Rockfish	BSAI	TAC	424	387	387	393	393	370	370
Shortraker Rockfish	BSAI	ABC	424	387	387	393	393	370	370
Skates	BSAI	TAC				16,500	24,700	24,000	26,000
Skates	BSAI	ABC				31,500	32,600	38,800	35,383
Squids	BSAI	TAC	1,970	1,970	1,970	425	425	700	310
Squids	BSAI	ABC	1,970	1,970	1,970	1,970	1,970	1,970	1,970
Yellowfin Sole	BSAI	TAC	225,000	210,000	219,000	196,000	202,000	198,000	184,000
Yellowfin Sole	BSAI	ABC	248,000	210,000	219,000	239,000	203,000	206,000	239,800

Notes:

1) ABCs and TACs for Arrowtooth and Kamchatka flounder are combined
2) Subarea ABCs and TACs with BSAI are combined for Pollock, Pacific Cod and Sablefish

Source: Developed by Northern Economics based on information at NMFS-AKR (NMFS 2014f).

For the majority of BSAI Groundfish species, the TAC has been set close to (or equal to) the ABC, which suggests that the BSAI Groundfish fishery has become more predictable. Some notable exceptions are Alaska plaice, arrowtooth and Kamchatka flounder and rock sole, which have all had TACs set significantly below the ABC since 2008.

Table 4-9 Total Allowable Catch as a Percent of Acceptable Biological Catch of BSAI Groundfish Species, 2008 to 2014

Species	Area	Item	2008	2009	2010	2011	2012	2013	2014
Alaska Plaice	BSAI	TAC÷ABC	26	22	22	25	45	36	44
Arrowtooth & Kamchatka	BSAI	TAC÷ABC	31	48	48	17	17	16	23
Atka mackerel	BSAI	TAC÷ABC	100	91	100	62	62	52	50
Flathead Sole	BSAI	TAC÷ABC	70	84	87	60	48	33	37
Greenland Turbot	BSAI	TAC÷ABC	100	100	100	82	90	100	100
Northern Rockfish	BSAI	TAC÷ABC	100	100	100	46	55	30	27
Other Flatfish	BSAI	TAC÷ABC	100	100	100	21	25	26	21
Other Rockfish	BSAI	TAC÷ABC	100	100	100	78	84	75	66
Pacific Cod	BSAI	TAC÷ABC	97	97	97	97	83	85	94
Pacific Ocean Perch	BSAI	TAC÷ABC	100	100	100	100	100	100	100
Pollock	BSAI	TAC÷ABC	99	99	98	97	97	90	92
Rock Sole	BSAI	TAC÷ABC	25	30	38	38	42	43	42
Rougheye Rockfish	BSAI	TAC÷ABC	100	100	100	100	100	100	100
Sablefish	BSAI	TAC÷ABC	100	60	100	100	100	100	100
Sculpins	BSAI	TAC÷ABC				12	12	13	14
Sharks	BSAI	TAC÷ABC				5	20	10	12
Shortraker Rockfish	BSAI	TAC÷ABC	100	100	100	100	100	100	100
Skates	BSAI	TAC÷ABC				52	76	62	73
Squids	BSAI	TAC÷ABC	100	100	100	22	22	36	16
Octopuses	BSAI	TAC÷ABC				38	35	19	9
Other Species	BSAI	TAC÷ABC	64	78	82				
Yellowfin Sole	BSAI	TAC÷ABC	91	100	100	82	100	96	77

Notes:

1) ABCs and TACs for Arrowtooth and Kamchatka flounder are combined
2) Subarea ABCs and TACs with BSAI are combined for Pollock, Pacific Cod and Sablefish

Source: Developed by Northern Economics based on information at NMFS-AKR (NMFS 2014f).

Table 4-10 shows the total catch in the BSAI Groundfish Fishery from 2008 to 2013, while Table 4-11 compares the catch of each species to its TAC. In the BSAI, the groundfish fishery managers face the additional constraint in setting TACs that the sum of TACs over all species cannot exceed 2 million mt. The 2 million mt upper limit on the optimum yield range (often referred to as the OY cap) has been part of the BSAI Groundfish FMP from its earliest days.

Table 4-10 Total Catch (mt) in BSAI Groundfish Fishery 2008 to 2014

Species	2008	2009	2010	2011	2012	2013
Alaska Plaice	17,377	13,944	16,165	23,655	16,612	23,522
Arrowtooth & Kamchatka	21,370	29,900	38,881	30,166	31,885	28,272
Atka mackerel	58,082	72,807	68,647	51,810	47,825	23,181
Flathead Sole	24,269	19,359	20,008	13,405	11,233	17,252
Greenland Turbot	2,911	4,515	4,146	3,652	4,720	1,745
Northern Rockfish	3,287	3,111	4,332	2,764	2,479	2,038
Octopuses				587	138	224
Other Flatfish	3,471	2,064	2,037	3,036	3,400	1,471
Other Rockfish	596	566	756	929	926	777
Other Species	29,474	27,883	23,411			
Pacific Cod	170,802	175,723	171,531	219,646	250,792	250,255
Pacific Ocean Perch	17,436	15,347	17,852	24,004	24,143	31,393
Pollock	991,865	812,520	811,676	1,200,450	1,206,251	1,273,765
Rock Sole	51,276	48,716	53,221	60,631	76,098	59,806
Rougheye Rockfish	193	197	232	165	191	323
Sablefish	2,040	2,016	1,852	1,730	1,948	1,696
Sculpins				5,375	5,798	5,829
Sharks				107	96	116
Shortraker Rockfish	133	184	300	333	344	372
Skates				23,164	24,827	27,035
Squids	1,542	360	410	336	688	300
Unspecified	439	359	295	304	297	209
Yellowfin Sole	148,894	107,513	118,624	151,167	147,187	164,943
All Species Combined	**1,545,457**	**1,337,084**	**1,354,376**	**1,817,416**	**1,857,878**	**1,914,524**

Source: Developed by Northern Economics based on CAS data provided by AKFIN (Fey, 2014) and information from NMFS-AKR (NMFS 2014f).

Table 4-11 Total Catch (mt) as a Percent of Total Allowable Catch in BSAI Groundfish Fishery, 2008 to 2013

Species	2008	2009	2010	2011	2012	2013
Alaska Plaice	35	28	32	148	69	118
Arrowtooth & Kamchatka	28	40	52	69	75	81
Atka mackerel	96	95	93	98	94	89
Flathead Sole	49	32	33	32	33	76
Greenland Turbot	115	61	68	72	55	85
Northern Rockfish	40	43	60	69	53	68
Octopuses				392	15	45
Other Flatfish	16	12	12	101	106	42
Other Rockfish	60	54	73	93	87	89
Pacific Cod	100	10	102	96	96	96
Pacific Ocean Perch	80	82	95	97	98	89
Pollock	97	97	98	94	99	101
Rock Sole	68	54	59	71	87	65
Rougheye Rockfish	95	37	42	36	40	85
Sablefish	38	41	38	36	46	46
Sculpins				103	112	104
Sharks				215	48	116
Shortraker Rockfish	31	48	78	85	88	101
Skates				140	101	113
Squids	78	18	21	79	162	43
Yellowfin Sole	66	51	54	77	73	83

Source: Developed by Northern Economics based on CAS data provided by AKFIN (Fey, 2014) and information from NMFS-AKR webpage, (NMFS 2014f).

The remainder of the Section 4.4 is organized as follows:

- Section 4.4.2: Amendment 80 Catcher Processors
- Section 4.4.3: Bering Sea Trawl Limited Access Fisheries
- Section 4.4.5: Longline Catcher Vessels
- Section 4.4.6: Community Development Quota Fisheries for Groundfish

4.4.2 Amendment 80 Catcher Processors

Amendment 80 Catcher Processors (A80-CPs) have been formally defined since approval and implementation of Amendment 80 (A80) to the BSAI Groundfish FMP. A80 was implemented in 2008, and provided A80-CPs with the ability to rationalize their fishery by providing exclusive access to the sector's primary target fisheries and prohibited species limits. In addition, groups within the sector were authorized to form cooperatives to manage their catch and PSC.

Since 2008, A80-CPs have harvested approximately 58 percent of the non-pollock BSAI Groundfish fishery harvests by volume and have generated an average of $325 million in wholesale revenue (2013$). Overall, the A80-CPs generate approximately 16 percent of the wholesale revenue of affected groundfish fisheries.

4.4.2.1 Description of Participants in the A80-CP Fisheries

Table 4-12 summarizes the number of vessels participating in A80 target fisheries by year from 2008 to 2013. Since 2008, 23 unique A80-CP vessels participated in the BSAI Groundfish fisheries. The number of vessels participating in each target fishery has gradually decreased throughout the time series, from 22 unique vessels in 2008, to 18 unique vessels in 2013. This is primarily the result of consolidation taking place among Amendment 80 permit holders.

Table 4-12 Types and Numbers of Vessels Participating in BSAI Target Fisheries of A80-CPs, 2008 to 2013

	2008	2009	2010	2011	2012	2013	2008 to 2013
Yellowfin Sole	22	20	19	20	19	18	23
Rock Sole	21	21	19	18	19	17	23
Atka Mackerel	9	12	7	8	10	9	14
Arrowtooth or Kamchatka Flounder	16	15	12	20	19	15	22
Rockfish	10	11	14	16	15	15	19
Flathead Sole	15	15	14	12	13	11	19
Pacific Cod	11	15	14	14	13	16	20
All other targets	18	21	16	15	16	16	22
All Targets	**22**	**21**	**20**	**20**	**19**	**18**	**23**

Source: Developed by Northern Economics using AKFIN data (Fey 2014).

As seen in Table 4-13, all of the owners of A80-CPs are based outside of Alaska. One of the five companies, O'Hara Corporation, which owns three A80-CPs, is based in Maine, while the other four companies are based in Seattle.

Table 4-13 A80-CP Vessel Owner's Place of Residence, 2008 to 2013

	2008	2009	2010	2011	2012	2013	Unique Vessels
Region				Number of Participating Vessels			
NW Alaska	-	-	-	-	-	-	-
SW Alaska	-	-	-	-	-	-	-
Other Alaska	-	-	-	-	-	-	-
Other U.S.	22	21	20	20	19	18	23
Total	22	21	20	20	19	18	23

Source: Developed by Northern Economics using AKFIN data (Fey 2014).

Vessel and crew participation for the A80 fleet are summarized in Table 4-14 and Table 4-15. Table 4-14 summarizes earnings and participation for vessels in the A80 fleet primarily focused on flatfish, while Table 4-15 focuses solely on vessels primarily targeting Atka mackerel. While in general the analysis does not distinguish between these two groups of vessels, the initial model results of the PSC limit reduction alternatives indicate that the segment of the A80-CP fleet that has more of a flatfish focus is likely to experience greater negative consequences than the vessels that spend more of their time and effort in the Atka mackerel fishery.

The number of A80-CPs actively participating in flatfish-focused operations has declined from 14 in 2008 to 11 in 2013—reflective of the overall decline in A80-CPs describe above. On average, these vessels operated nearly 10 months of the year, and had an average crew size of 30, with the total estimated number of persons employed averaging 964 persons over the 6-year period. On average, total annual payments to crew were nearly $50 million, with an average income earned per person of $51,689.

Table 4-14 Summary of Participation and Earnings in the BSAI by Vessels and Crew in Flatfish Focused A80-CPs

	2008	2009	2010	2011	2012	2013	6-Year Average
Number of Active Vessels	14	14	13	13	12	11	13
Average Crew Size (Incl. Officers)	29.7	29.4	31.1	29.6	29.9	30.9	30.1
Average Operating Months	10.0	9.3	10.1	9.9	9.5	10.2	9.8
Average Persons in Crew Rotation per Vessel	76.1	70.3	75.5	72.8	76.8	80.5	75.3
Total Persons in Crew Rotation in Sector	1,066.0	984.1	981.8	946.7	921.2	885.5	964.2
Crew Share Percentage	27%	27%	27%	27%	27%	27%	27%
Total Payments to Crew and Officers (2013 $ Millions)	$48.5	$41.2	$48.5	$55.7	$59.7	$45.4	$49.8
Average Income Earned per Person (2013 $)	$45,537	$41,867	$49,407	$58,801	$64,817	$51,279	$51,689

Note: Operating Months, Crew Payments and Total Revenues include time spent and revenue generated when fishing CDQ allocations.

Source: Developed by Northern Economics using AKFIN data (Fey 2014), and A80-CP Economic Data Report data (Fissel, 2014).

Participation of A80-CPs that are primarily focused on Atka mackerel is summarized in Table 4-15. These vessels comprise all of the FCA vessels, as well as both vessels owned by Ocean Peace and one vessel (the Seafreeze) owned by U.S. Seafoods. As shown, the average crew size on Atka mackerel vessels is over 51, approximately 170 percent of the crew size on flatfish-focused vessels. We also see that the total number of active vessels fishing primarily for Atka mackerel (7) is slightly more than half the number of flatfish-focused vessels. Total persons employed on Atka mackerel vessels (841) is 87 percent as many as are employed on flatfish focus vessels. As will be discussed later in this section, the distinction between vessels with a flatfish focus and Atka mackerel vessels is important because the Atka mackerel fishery generally has more lower halibut encounter rates than flatfish, and therefore the Atka mackerel vessels may not be affected by PSC limit reduction options to the same extent as flatfish-focused vessels.

Table 4-15 Summary of Participation and Earnings in the BSAI by Vessels and Crew in A80-CPs with Significant Atka Mackerel Participation

	2008	2009	2010	2011	2012	2013	6-Year Average
Number of Active Vessels	8	7	7	7	7	7	7
Average Crew Size (Incl. Officers)	51.6	51.9	51.4	52.3	52.2	51.1	51.7
Average Operating Months	10.5	9.4	9.3	10.0	9.7	10.3	9.9
Average Persons in Crew Rotation per Vessel	111.8	121.2	118.5	122.4	117.6	114.1	117.6
Total Persons in Crew Rotation in Sector	894.7	848.1	829.3	857.0	823.5	799.0	841.9
Crew Share Percentage	27%	27%	27%	27%	27%	27%	27%
Total Payments to Crew and Officers (2013 $ Millions)	$44.1	$40.1	$44.6	$48.9	$48.7	$39.2	$44.3
Average Income Earned per Person (2013 $)	$49,313	$47,260	$53,753	$57,061	$59,142	$49,017	$52,567

Note: Operating Months, Crew Payments and Total Revenues include time spent and revenue generated when fishing CDQ allocations.

Source: Developed by Northern Economics using AKFIN data (Fey 2014) and A80-CP Economic Data Report data (Fissel 2014).

For the purpose of completeness Table 4-16 summarizes participation and crew payment over all A80-CPs. Over the six-year period from 2008 to 2013 the 20 vessel fleet is estimated to have employed an average of 1,806 persons who earned an average of $52,098, or a total of $94.1 million.

Table 4-16 Summary of Participation and Earnings in the BSAI by Vessels and Crew of all A80-CPs

	2008	2009	2010	2011	2012	2013	6-Year Average
Number of Active Vessels	22	21	20	20	19	18	20
Average Crew Size (Incl. Officers)	37.6	36.9	38.2	37.5	38.1	38.8	37.9
Average Operating Months	10.2	9.3	9.9	9.9	9.6	10.2	9.8
Average Persons in Crew Rotation per Vessel	89.1	87.2	90.6	90.2	91.8	93.6	90.3
Total Persons in Crew Rotation in Sector	1,961	1,832	1,811	1,804	1,745	1,684	1,806
Crew Share Percentage	27%	27%	27%	27%	27%	27%	27%
Total Payments to Crew and Officers (2013 $ Millions)	$92.7	$81.3	$93.1	$104.6	$108.4	$84.6	$94.1
Average Income Earned per Person (2013 $)	$47,260	$44,363	$51,397	$57,975	$62,139	$50,206	$52,098

Note: Operating Months, Crew Payments and Total Revenues include time spent and revenue generated when fishing CDQ allocations.

Source: Developed by Northern Economics using AKFIN data (Fey 2014) and A80-CP Economic Data Report data (Fissel 2014).

4.4.2.2 Catch and Revenue in Target Fisheries of A80-CPs

Following implementation of A80 in 2008, total groundfish harvest of A80 CPs has increased 13 percent (Figure 4-13). Since implementation, harvests in Pacific cod target fisheries have decreased to just 11 percent of their pre-Amendment 80 levels, from an average of 46 thousand mt per year (from 2003 to 2007) to an average of 5 thousand mt from 2008 to 2013. Those losses were largely offset by increases in yellowfin sole, rock sole, arrowtooth or Kamchatka flounder, and flathead sole. Total harvest in 2013 increased to nearly 334,500 mt, largely due to increased harvest in yellowfin sole; Table 4-17, following the figure, provides details of total groundfish harvest by target fishery from 2008 to 2013.

While the analysis primarily focuses on the years between 2008 and 2013, many figures in each of the subsequent subsections provide historical background dating back to 2003. Tables which accompany many of these figures provide detailed data for the years of primary focus (2008 to 2013).

Figure 4-13 Groundfish Harvests in Target Fisheries of A80-CPs, 2003 to 2013

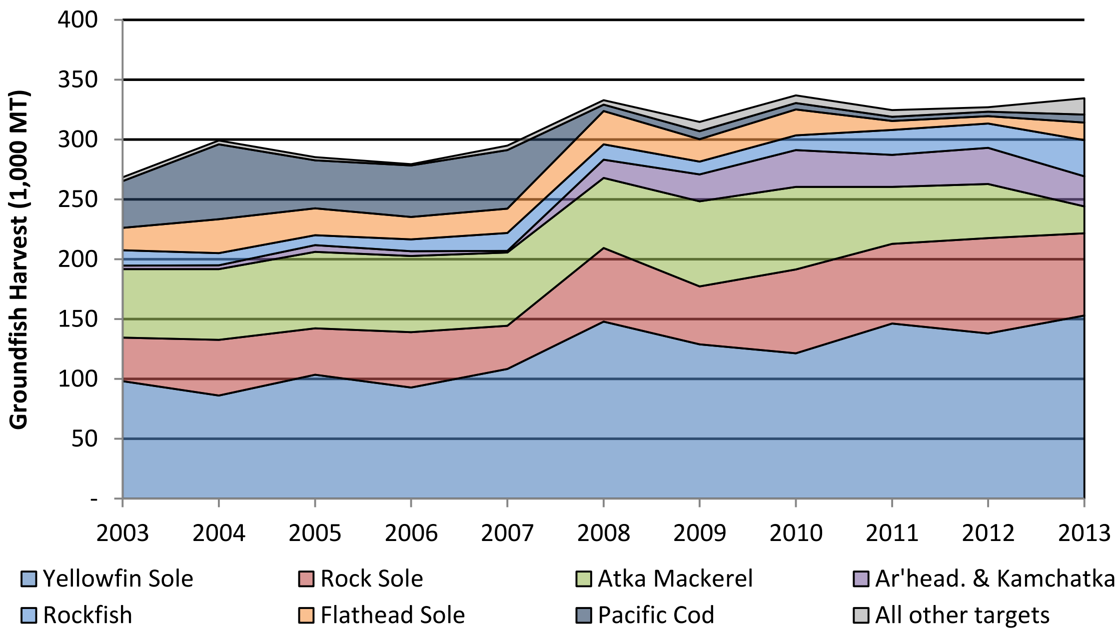


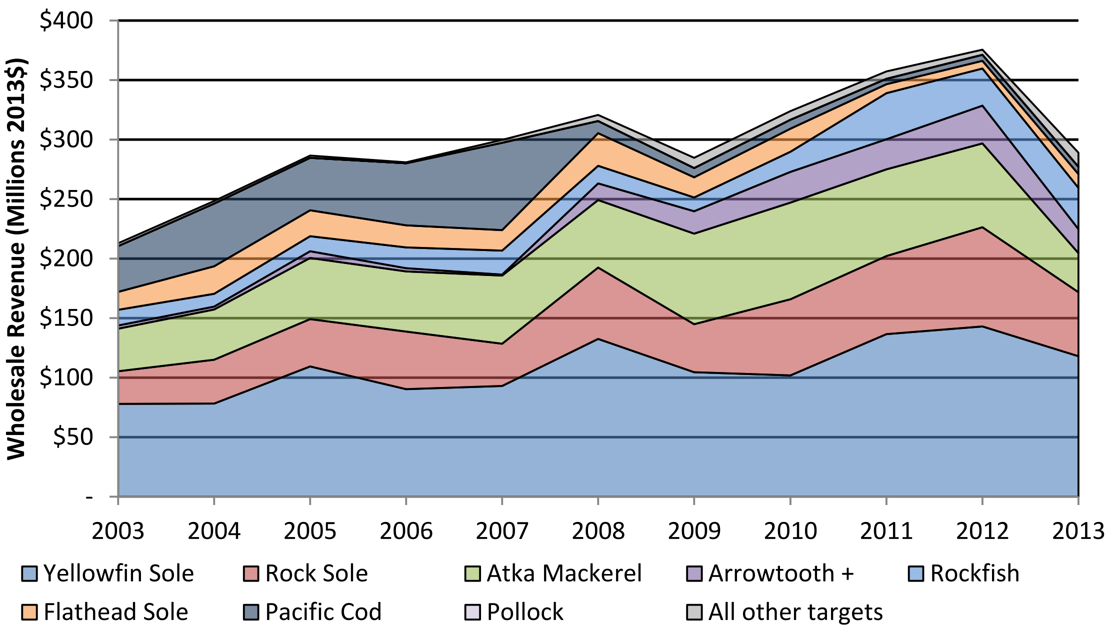
Table 4-17 Groundfish Harvest in Target Fisheries of A80-CPs, 2008 to 2013

	2008	2009	2010	2011	2012	2013	Total
Target Group	**Metric Tons of Groundfish (of All Species) Harvested in A80-CP Target Fisheries**						
Yellowfin Sole	147.77	128.75	121.45	146.31	138.04	152.86	835.16
Rock Sole	61.50	48.60	69.90	66.44	79.66	68.76	394.85
Atka Mackerel	58.57	70.93	69.11	47.69	45.08	22.53	313.92
Arrowtooth or Kamchatka Flounder	15.34	22.59	30.66	26.80	30.15	24.98	150.53
Rockfish	12.68	10.54	12.41	20.64	20.39	30.32	106.97
Flathead Sole	28.00	18.93	21.48	7.57	6.09	14.67	96.75
Pacific Cod	5.29	6.69	5.52	3.45	3.71	6.74	31.39
All other targets	3.67	7.68	6.24	5.78	3.90	13.66	40.94
All Targets	**332.81**	**314.70**	**336.76**	**324.68**	**327.02**	**334.52**	**1,970.50**

Source: Developed by Northern Economics using AKFIN data (Fey 2014).

As show in Figure 4-14, inflation-adjusted wholesale revenue has largely tracked total harvest since 2008; both increasing after implementation of A80 in 2008 and decreasing in 2009. Wholesale value increased steadily through 2012. However, in 2013, declines in wholesale revenue in the yellowfin sole, rock sole, Atka mackerel, arrowtooth or Kamchatka flounder, and rockfish target groups contributed to a 23 percent decrease in wholesale revenues, dropping to near 2009 levels, despite a slight increase in total harvest.

Figure 4-14 Wholesale Revenue in Target Fisheries of A80-CPs, 2003 to 2013



Source: Developed by Northern Economics using AKFIN data (Fey 2014).

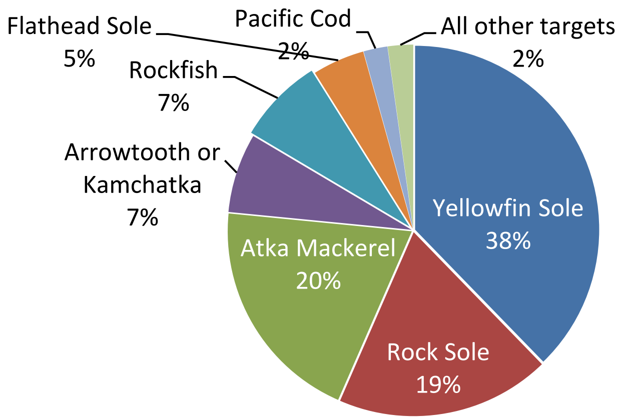
Table 4-18 Real Wholesale Revenue in Target Fisheries of A80-CPs, 2008 to 2013

	2008	2009	2010	2011	2012	2013	Total
Target Group	Wholesale Revenue (in millions of 2013 $)						
Yellowfin Sole	$132.39	$104.41	$101.92	$136.64	$142.96	$118.03	$736.35
Rock Sole	$60.04	$40.51	$63.84	$65.52	$83.44	$53.78	$367.14
Atka Mackerel	$56.77	$76.07	$81.18	$72.97	$70.39	$32.79	$390.16
Arrowtooth or Kamchatka Flounder	$14.14	$18.74	$25.90	$25.32	$31.70	$20.19	$135.99
Rockfish	$14.55	$11.67	$16.96	$38.54	$31.38	$34.64	$147.73
Flathead Sole	$27.48	$16.80	$19.44	$7.66	$6.45	$11.52	$89.36
Pacific Cod	$10.17	$8.00	$7.37	$4.43	$4.98	$6.14	$41.10
All other targets	$5.11	$8.58	$7.29	$6.23	$4.26	$11.94	$43.41
All Targets	**$320.65**	**$284.78**	**$323.90**	**$357.31**	**$375.56**	**$289.04**	**$1,951.24**

Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

Wholesale revenue of A80-CPs is largely dependent upon three target fisheries: yellowfin sole, Atka mackerel, and rock sole. These fisheries account for over two-thirds of revenue, as shown in Figure 4-15.

Figure 4-15 Average Percentage of Wholesale Revenue by Target Fishery for A80-CPs, 2008 to 2013



Source: Figure developed by Northern Economics using AKFIN data (Fey 2014).

4.4.2.3 Regional Impacts of A80-CPs

Since all of the A80-CPs are based outside of Alaska, the majority of economic impacts generated by A80 vessels accrue outside the State of Alaska. For most BSAI groundfish harvesting and processing sectors there have not been any recent peer-reviewed studies that estimate the full economic impact of the sector's activities. This is not the case for A80-CPs. A recent study published by Waters et al. (2014) evaluated the total economic contribution of the A80 sector (multiplier effects) and estimated the portion of the economic contribution for Alaska. The report estimates that the A80 sector's $281 million in first wholesale revenues (estimated from 2008 COAR data) led to a total economic contribution in the U.S. of approximately $1.03 billion, a multiplier effect of 3.56. The report estimated that approximately 47 percent total contribution (or $487 million) was generated in Alaska, 18 percent was attributed to the West Coast, and the final 35 percent was distributed elsewhere throughout the U.S.

4.4.2.4 Halibut PSC Limits and Halibut PSC Mortality in Target Fisheries of A80-CPs

Halibut PSC limits in the A80-CP target fisheries were reduced by 200 mt or 8 percent from 2008 to 2012. The halibut PSC limit reductions were built into A80 when it was approved by the Council and NMFS. Halibut PSC mortality is apportioned between A80 cooperatives based on the groundfish catch histories of the member vessels. Currently there are two A80 cooperatives that receive halibut PSC mortality apportionments, but prior to 2011 several vessels operated in the A80 limited access fishery, including all of the vessels owned by the Fishing Company of Alaska (FCA) Table 4-19 shows the overall PSC limit for A80-CPs along with historic allocations to cooperative the limited access fishery.

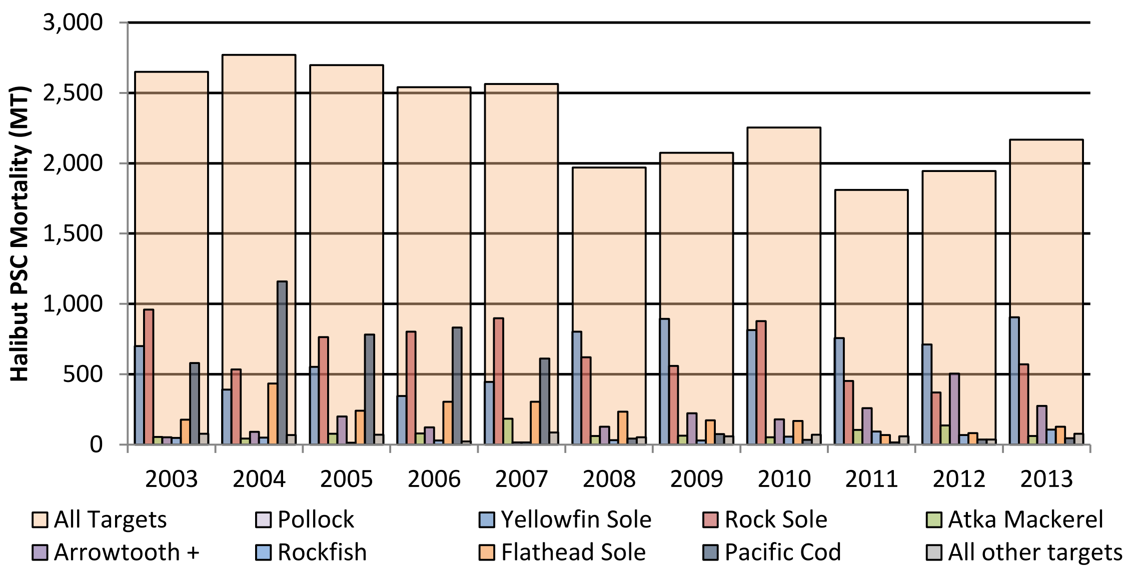
Table 4-19 Halibut PSC Limits and Apportionments for A80-CPs, 2008 to 2013

	2008	2009	2010	2011	2012	2013
	Halibut PSC Mortality Limit (in Round Weight mt)					
All A80-CPs Combined	**2,525**	**2,475**	**2,425 / 2,765**	**2,375**	**2,325**	**2,325**
Amendment 80 Limited Access Fishery	688	682	671	-	-	-
Best Use Cooperative/Alaska Seafood Cooperative	1,837	1,793	1,754 / 2,094	1,643	1,609	1,609
Alaska Groundfish Cooperative	-	-	-	732	716	716

Note: In 2010, the A80 cooperative received a 340 mt re-apportionment of PSC from the BSAI TLA Fisheries.
Source: Developed by Northern Economics using data from NMFS (2014f)

As shown in Figure 4-16, halibut PSC mortality decreased 23 percent in 2008. The biggest impact on a target fishery basis occurred in the Pacific cod target fishery, which experienced a dramatic drop in halibut PSC mortality in 2008. This decline is a result of the significant decrease in A80-CPs' activity in Pacific cod target fisheries, and in fact, the decrease in halibut PSC mortality in 2008 in the Pacific cod fishery is similar in proportion to the decrease in total harvest experienced by the Pacific cod fishery. Similarly, increases in halibut PSC mortality in both the yellowfin sole and arrowtooth or Kamchatka flounder target fisheries are correlated with increases in harvest in 2008. However, total halibut mortality decreased 23 percent in 2008 despite a 13 percent increase in total overall harvest.

Figure 4-16 Halibut PSC Mortality in A80-CPs Target Fisheries, 2003 to 2013



Source: Figure developed by Northern Economics using AKFIN data (Fey 2014).

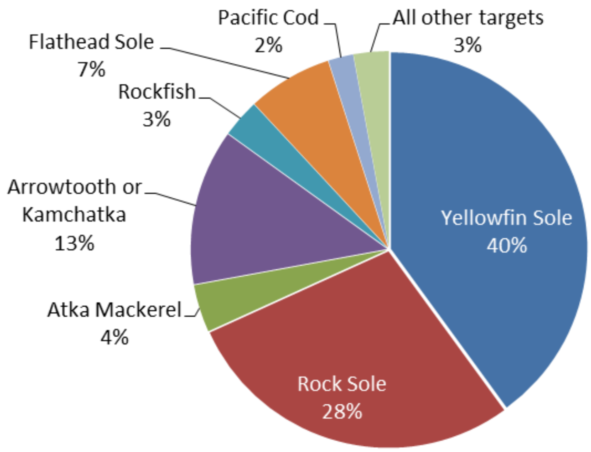
Table 4-20 Halibut PSC Mortality in A80-CPs Target Fisheries, 2008 to 2013

	2008	2009	2010	2011	2012	2013	Total
Target Group	Halibut PSC Mortality (in Round Weight mt)						
Yellowfin Sole	802.4	894.1	813.6	758.1	710.8	905.7	4,884.5
Rock Sole	620.5	558.1	878.5	453.3	370.8	570.2	3,451.4
Atka Mackerel	60.0	63.4	52.9	104.5	136.3	60.9	478.0
Arrowtooth or Kamchatka Flounder	127.1	222.8	178.8	257.9	504.3	274.5	1,565.5
Rockfish	32.3	29.5	55.5	92.4	67.0	107.7	384.4
Flathead Sole	233.1	172.1	168.5	68.4	82.5	126.1	850.7
Pacific Cod	42.4	74.9	34.7	16.7	36.9	46.1	251.7
All other targets	51.1	58.8	71.1	58.9	36.8	77.2	354.0
All Targets	**1,969.0**	**2,073.7**	**2,253.6**	**1,810.2**	**1,945.4**	**2,168.3**	**12,220.1**

Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

As shown in Figure 4-17, the yellowfin sole, rock sole, and arrowtooth/Kamchatka flounder target fisheries have accounted for over 80 percent of the halibut mortality of A80-CPs since 2008.

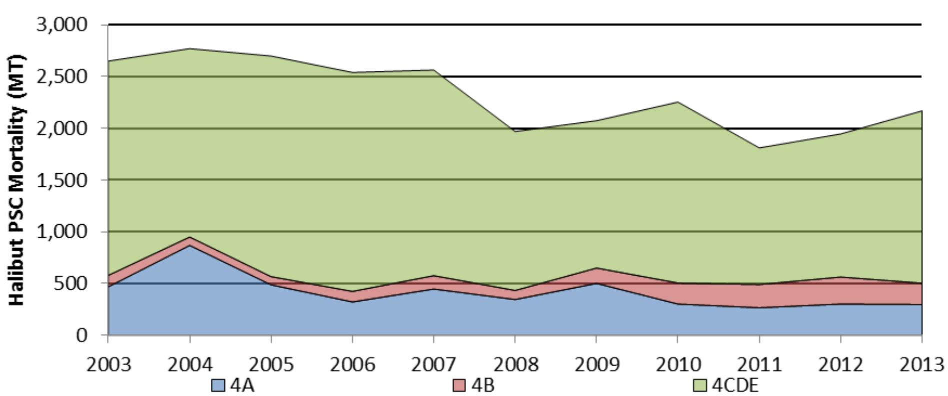
Figure 4-17 Average Percentage of Total Halibut PSC Mortality by Target Fishery for A80-CPs, 2008 to 2013



Source: Figure developed by Northern Economics using AKFIN data (Fey 2014).

The majority of halibut PSC mortality in the A80 sector takes place in IPHC Area 4CDE, as shown in Figure 4-18. However, after implementation of A80 in 2008, the IPHC Area 4CDE has also accounted for the majority of decreases in halibut PSC mortality. Since 2008, IPHC Area 4CDE accounted for 74 percent of total halibut PSC mortality in the A80 sector. Table 4-21, on the following page, provides the details of halibut PSC mortality by IPHC Area from 2008 to 2013.

Figure 4-18 Halibut PSC Mortality in A80 Fisheries, by IPHC Area



Source: Figure developed by Northern Economics using AKFIN data (Fey 2014).

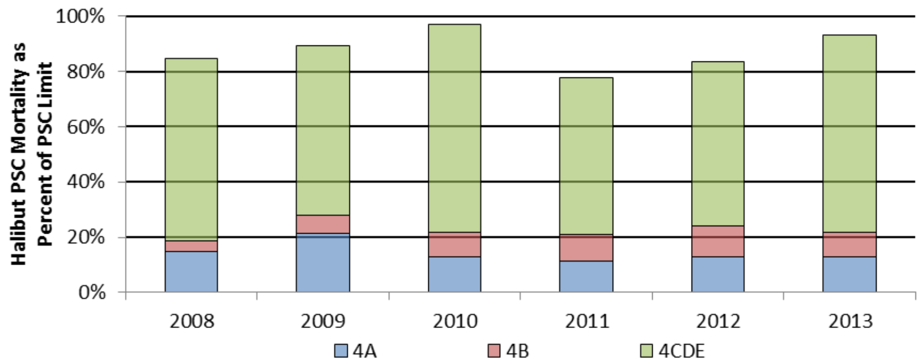
Table 4-21 Halibut PSC Mortality in A80 Fisheries by IPHC Area, 2008 to 2013

	2008	2009	2010	2011	2012	2013	Total
Target Group	Halibut PSC Mortality (in Round Weight mt)						
IPHC Area 4A	345.2	500.5	301.3	264.8	301.1	296.5	2,009.5
IPHC Area 4B	87.2	148.6	203.5	225.6	261.1	206.3	1,132.2
IPHC Areas 4CDE	1,536.6	1,424.6	1,748.8	1,319.8	1,383.3	1,665.5	9,078.5
All Areas	**1,969.0**	**2,073.7**	**2,253.6**	**1,810.2**	**1,945.4**	**2,168.3**	**12,220.1**

Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

Figure 4-19 shows the amount of halibut PSC mortality taken by the A80 sector as a percentage of the sector's current halibut PSC limit of 2,325 mt. The figure provides an indication that halibut PSC mortality taken in the A80 fishery increased from 2008 through 2010, when the fishery took 97 percent of its current halibut PSC limit. The percent of halibut PSC mortality harvested by the A80 sector fell below 80 percent of the current limit in 2011, but since then has moved upward through 2013, where halibut PSC mortality approached 93 percent of the current limit. On average between 2008 and 2013, the A80 fishery took 87.5 percent of its current halibut PSC limit.

Figure 4-19 Percentage of 2014 Halibut PSC Limits taken by A80-CPs, 2008 to 2013



Source: Figure developed by Northern Economics using AKFIN data (Fey 2014).

4.4.2.5 Groundfish Wholesale Revenues Generated per Ton of Halibut PSC in the A80 Fishery

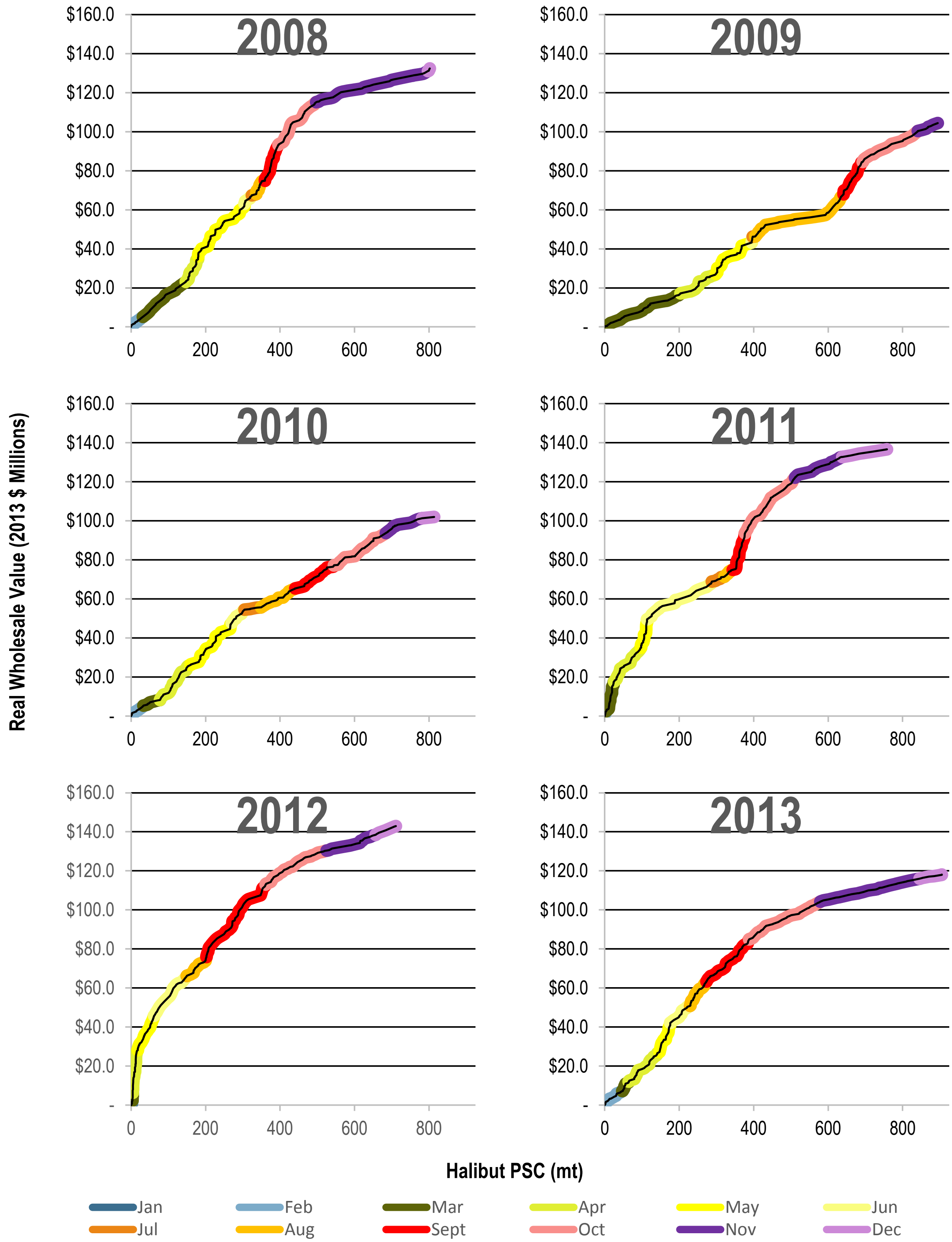
Figure 4-20, Figure 4-21, and Figure 4-22 summarize annual catch progressions for yellowfin sole, rock sole, and Atka mackerel, respectively for A80-CPs. As described earlier in Section 4.4.1.4, as the catch progression line becomes steeper, more wholesale revenue is being earned per halibut PSC. Conversely, the flatter the line becomes, the less wholesale revenue is earned per ton of halibut PSC.

Figure 4-20 shows the catch progression lines for the A80-CPs target fisheries for yellowfin sole, which generates the most wholesale revenues of any of the A80 target fisheries. As can be seen in the figure, the yellowfin sole fishery's wholesale revenues and halibut PSC are consistent year-to-year. The progression lines indicate that in most years, wholesale revenue per halibut PSC is greatest at the beginning of the year. The amount of wholesale revenue per halibut PSC progressively declines later in the year, as shown by the movement to a flatter line.

The rock sole target fishery, as shown in Figure 4-21, appears to also perform relatively consistently, with maybe slightly more variation than the yellowfin sole target fishery. As shown in the figure, and previously discussed, wholesale revenues were lowest in 2009, barely breaking $40 million. In 2012, the rock sole fishery had a tremendous year, recording the highest wholesale revenue and the lowest halibut PSC. This is shown by the steepness of the annual progression line.

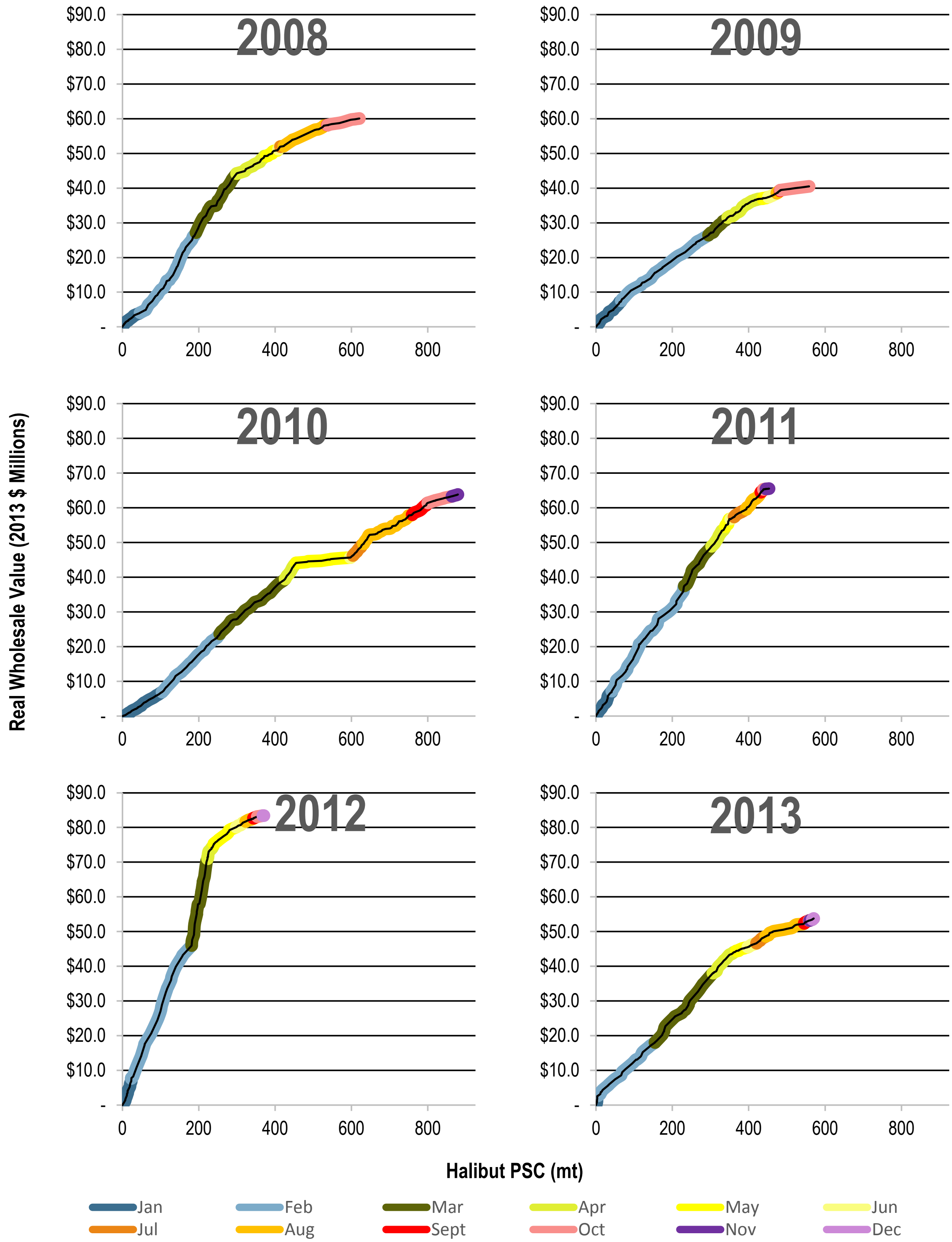
Figure 4-22 shows annual progression for the Atka mackerel target fishery. The Atka mackerel fishery tends to earn more wholesale revenue per halibut PSC in the beginning of the year. The largest amount of halibut PSC was recorded in 2012, reaching 136 mt, as shown in Table 4-20 earlier. In both 2011 and 2012, fishing in the latter part of the year progressively earned less wholesale revenue per mt of halibut PSC, as indicated by the annual progression line becoming less steep. In 2013, wholesale revenues only reached $32 million utilizing approximately 60 mt of halibut PSC—the same amount of halibut PSC used to generate much higher wholesale revenues in 2008, 2009, and 2010. It is assumed that the decline in Atka mackerel revenues in 2013 was primarily a function of constraints caused by measures aimed at safeguarding and enhancing the population of Steller sea lions.

Figure 4-20 Annual Progression of Wholesale Revenues and Halibut PSC in the A80-CP Yellowfin Sole Target Fishery



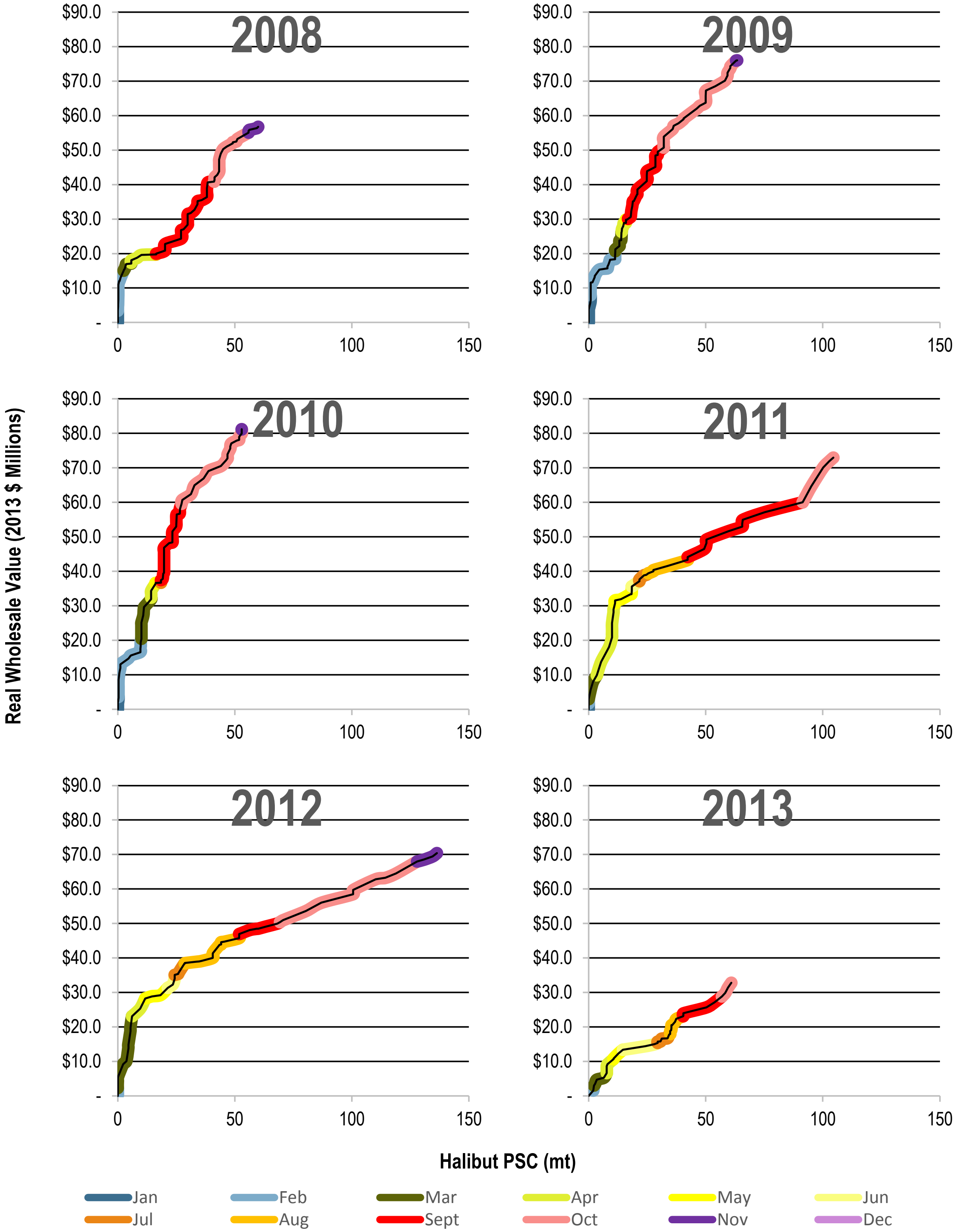
Source: Developed by Northern Economics using AKFIN data (Fey 2014).

Figure 4-21 Annual Progression of Wholesale Revenues and Halibut PSC in the A80-CP Rock Sole Target Fishery



Source: Developed by Northern Economics using AKFIN data (Fey 2014).

Figure 4-22 Annual Progression of Wholesale Revenues and Halibut PSC in the A80-CP Atka Mackerel Target Fishery



Source: Developed by Northern Economics using AKFIN data (Fey 2014).

Table 4-22 shows the average wholesale revenue generated by the A80 sector per ton of halibut PSC mortality over the entire year for each year from 2008 to 2013. On average over all target fisheries between 2008 and 2013, the A80 sector earned $160,000 per ton of halibut PSC mortality. The wholesale value generated per halibut PSC is a measure of how much revenue on average would be forgone if A80-CPs were to reduce their halibut PSC across the board without respect to seasonal or geographic differences. Average values per ton of halibut PSC mortality for specific target fisheries ranged from a low of $0.09 million in the arrowtooth or Kamchatka flounder target group, to a high of $0.82 million in Atka mackerel target fisheries.

The average values are useful for ranking particular target fisheries with respect to the value generated for the halibut they use. However using these average values to estimate foregone revenue impact due to cuts in halibut PSC limit will most likely overstate the effects. This is because reduction in PSC limits will most likely occur in months and target fisheries where the catch progression lines have the least slope. The averages shown in Table 4-22 can be represented by a line in the catch progression figures running between the origin and endpoint. If the slope of this straight diagonal line fairly closely approximates the actual catch progression line, then the average may be a reasonable approximation of the impact of PSC reduction. On the other hand, if the line from the origin to the end point is generally below the actual catch progression line, then using the average value shown in the table is likely to overestimate the impacts of the reduction.

Table 4-22 Average Wholesale Revenue per Ton of Halibut PSC Mortality in A80-CP Target Fisheries, 2008 to 2013

	2008	2009	2010	2011	2012	2013	Average
Target Group	**Average Wholesale Revenue Per Ton (in millions of 2013 $ per mt)**						
Yellowfin Sole	$0.16	$0.12	$0.13	$0.18	$0.20	$0.13	$0.15
Rock Sole	$0.10	$0.07	$0.07	$0.14	$0.23	$0.09	$0.11
Atka Mackerel	$0.95	$1.20	$1.53	$0.70	$0.52	$0.54	$0.82
Arrowtooth or Kamchatka Flounder	$0.11	$0.08	$0.14	$0.10	$0.06	$0.07	$0.09
Rockfish	$0.45	$0.40	$0.31	$0.42	$0.47	$0.32	$0.38
Flathead Sole	$0.12	$0.10	$0.12	$0.11	$0.08	$0.09	$0.11
Pacific Cod	$0.24	$0.11	$0.21	$0.27	$0.14	$0.13	$0.16
All other targets	$0.10	$0.15	$0.10	$0.11	$0.12	$0.15	$0.12
All Targets	**$0.16**	**$0.14**	**$0.14**	**$0.20**	**$0.19**	**$0.13**	**$0.16**

Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

4.4.2.6 Measures of Halibut PSC Mortality and Encounters

Table 4-23 summarizes key factors that result in the total amount of halibut PSC in the A80-CP target fisheries. The measures described below all contribute to the PSC total. By changing any one of the factors, A80-CPs can change total halibut PSC. From a mathematical perspective and assuming that all PSC halibut is discarded, halibut PSC mortality is the multiplicative product of three factors: 1) Groundfish caught (mt); 2) the halibut encounter rate (kg of halibut ÷ groundfish mt); and 3) the halibut discard mortality rate or DMR (the ratio of the volume of halibut that is dead when discarded to the total volume of halibut that is discarded). In other words, PSC (in kg) = Groundfish (mt) × halibut encounter rate (kg/mt) × DMR. A change in any one of these three factors results in a change in halibut PSC mortality. The last section of the table shows the changes in halibut PSC that would result if any one of the three factors alone or in combination were to change by 10 percent. When thinking of a combination of factor changes, it should be noted that percentage changes are multiplicative rather than additive. In other words, if groundfish catch were reduced by 10 percent and the halibut encounter rate were reduced by 10 percent, the result would be a 19 percent reduction in PSC mortality, because 90% × 90% = 81%. Similarly a 5 percent reduction in all three factors (Groundfish catch, halibut encounter rate and DMRs) would result in a 14.26 percent reduction because .95% × .95% × .95% = 85.74% and 1 – 85.74% = 14.26%.

As will be noted in the methodology discussions related to the impacts of PSC reduction alternatives, the projected impacts of the PSC limit reduction options are all based on more or less selective cuts in groundfish harvests. None of the impact estimates assume that "cost-free" behavioral changes occur. "Cost-free" behavior changes in PSC would be ones in which the number of halibut encounters was reduced without a simultaneous reduction in groundfish catch, or a change in the DMRs which does not also lead changes in fishing patterns that reduce groundfish catch or that reduce halibut encounters. Based on information in the table, a cost-free reduction in halibut PSC could be realized with a 10 percent reduction in the DMR—e.g. in the yellowfin sole fishery the DMR is reduced from 83 to 74.7 percent (83% × 90% = 74.7%). Alternatively a cost-free 10 percent reduction in PSC could be realized if the halibut encounter rate in the rock sole fishery from 2013 fell from 9.8 to 8.8 while the amount of groundfish taken remained constant at 2013 levels (67,759 mt). This implies that halibut encounters (the numerator of the halibut encounter rate) would have to drop from 670,781 kg to 603,703 kg.

Table 4-23 Measures of Halibut Mortality and Encounters in A80-CP Target Fisheries and Impacts of a 10 Percent Change in Key Factors

Sector and Target	2008	2009	2010	2011	2012	2013
			Total Groundfish (mt)			
All A80-CP Targets	**332,815**	**314,702**	**336,764**	**324,684**	**327,018**	**334,518**
Yellowfin Sole	147,768	128,746	121,447	146,308	138,035	152,860
Rock Sole	61,496	48,597	69,902	66,436	79,657	68,759
Atka Mackerel	58,569	70,930	69,111	47,693	45,080	22,534
			Halibut Encounter (kg)			
All A80-CP Targets	**2,532,194**	**2,667,283**	**2,823,434**	**2,276,469**	**2,469,452**	**2,678,915**
Yellowfin Sole	1,002,972	1,117,615	1,004,388	935,880	877,504	1,091,161
Rock Sole	775,652	697,637	1,071,359	552,747	452,209	670,781
Atka Mackerel	78,977	83,369	69,650	137,503	179,320	79,067
			Halibut Encounter Rate (kg halibut / mt of Groundfish)			
All A80-CP Targets	**7.6**	**8.5**	**8.4**	**7.0**	**7.6**	**8.0**
Yellowfin Sole	6.8	8.7	8.3	6.4	6.4	7.1
Rock Sole	12.6	14.4	15.3	8.3	5.7	9.8
Atka Mackerel	1.3	1.2	1.0	2.9	4.0	3.5
			Average DMR (percentage)			
All A80-CP Targets	**78**	**78**	**80**	**80**	**79**	**81**
Yellowfin Sole	80	80	81	81	81	83
Rock Sole	80	80	82	82	82	85
Atka Mackerel	76	76	76	76	76	77
Change in Halibut PSC by Target Given a 10 Percent Reduction in Total Groundfish, Halibut Encounter Rates, or DMR (percent)						
All A80-CP Targets	**196.9**	**207.4**	**225.4**	**181.0**	**194.5**	**216.8**
Yellowfin Sole	80.2	89.4	81.4	75.8	71.1	90.6
Rock Sole	62.1	55.8	87.9	45.3	8337.1	57.0
Atka Mackerel	6.0	6.3	5.3	10.5	13.6	6.1

Source: Developed by NEI based on data from AKFIN (Fey 2014)

4.4.2.7 Reliance of A80-CPs on BSAI Groundfish and Diversification of A80-CPs into Other Fisheries

Of the 23 unique A80 vessels participating in the BSAI groundfish fishery, between 13 and 17 participated in the GOA groundfish fishery between 2008 and 2013 (Table 4-24). In addition, A80-CPs also participated in the CDQ groundfish fishery and fixed gear sablefish fisheries. Wholesale revenue earned by A80-CPs in other fisheries increased 35 percent in 2010 to $44.7 million and 49 percent in 2011 to $66.4 million. Since 2011, wholesale revenues have returned to 2009 values.

Table 4-24 Number of A80-CPs Participating in Other Fisheries, 2008 to 2013

	2008	2009	2010	2011	2012	2013
Number of A80-CPs Participating in Other Fisheries						
BSAI Pot Groundfish	-	-	-	-	-	-
CDQ Groundfish	4	5	7	8	6	6
All Halibut	-	-	-	-	-	-
All Fixed Gear Sablefish	1	1	-	-	-	-
GOA Groundfish	13	17	16	16	16	13
AK Salmon	-	-	-	-	-	-
All Other AK Fisheries	-	-	-	-	-	-
West Coast Fisheries	-	-	-	-	-	-
A80-CP Wholesale Revenue in All Other Fisheries						
All Other Fisheries	$38.3	$33.2	$44.7	$66.4	$59.7	$44.3

Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

4.4.3 Bering Sea Trawl Limited Access Fisheries

The BSAI Trawl Limited Access (BSAI TLA) fisheries were formally defined under A80. A80 was implemented in 2008, and formally divided the trawl apportionments of the primary trawl target fisheries between the A80-CPs, and the remaining three harvest sectors of the trawl fishery including: 1) catcher processors authorized to fish for BSAI Pollock under the American Fisheries Act (AFA-CPs); 2) catcher vessels authorized to fish for BSAI Pollock under the American Fisheries Act (AFA-CVs); and 3) all other trawl catcher vessels that have licenses and endorsements to participate in trawl fisheries under the North Pacific License Limitation Program (LLP).

4.4.3.1 Description of Participants in the BSAI Trawl Limit Access Fisheries

BSAI TLA Harvesting Vessels

141 unique vessels participated in BSAI TLA fisheries between 2008 and 2013 (Table 4-26). Of the 141 unique vessels, 70 percent were AFA-CVs primarily targeting pollock[28] and Pacific cod. The remaining fleet operated as non-AFA CVs (18 percent) and AFA-CPs (12 percent) and targeted a wider array of species, although pollock was clearly the most important fishery for AFA-CPs and the least important for trawl CVs (non-AFA). To determine unique vessel counts, the study team counted each active vessel in a year once. However, within each harvest sector, the columns do not sum to the “All Target” total. This is due to the fact that some vessels participate in multiple target fisheries. In the table, the shaded cells indicate that fewer than three vessels participated in that year, meaning that catch and value data for that cell cannot be disclosed.

[28] In this table and throughout this subsection, the analysis uses the term “Pollock|Atka Mackerel|Other Species” because that is the term used by NMFS to apportion halibut PSC limits for the BSAI TLA. Almost all (99.7%) of the groundfish harvests in the “Pollock|Atka Mackerel|Other Species” target were actually taken in pollock target fisheries between 2008 and 2013 with the remaining 0.3 percent attributed to Atka Mackerel and exactly 0 percent attributed to the “Other Species” TAC category.

Table 4-25 Types and Numbers of Vessels Participating in BSAI TLA Target Fisheries, 2008 to 2013

	2008	2009	2010	2011	2012	2013	2008 to 2013
AFA-CPs			**Number of Unique Vessels**				
Pollock|Atka Mackerel|Other Species	16	14	14	15	16	16	17
Yellowfin Sole	12	8	9	9	10	8	13
Pacific Cod	1	1	2	2	4	1	6
All other targets	6	7	5	2	4	4	12
All Targets	**17**	**15**	**15**	**16**	**16**	**16**	**17**
AFA-CVs			**Number of Unique Vessels**				
Pollock|Atka Mackerel|Other Species	89	89	89	86	89	85	96
Yellowfin Sole	-	-	-	-	-	2	2
Pacific Cod	52	40	37	38	44	42	56
All other targets	-	-	-	-	1	-	1
All Targets	**95**	**96**	**92**	**92**	**94**	**90**	**99**
Trawl-CVs (Non-AFA)			**Number of Unique Vessels**				
Pollock|Atka Mackerel|Other Species	2	1	2	3	3	3	5
Yellowfin Sole	3	1	-	2	3	3	5
Pacific Cod	15	14	11	12	16	12	24
All other targets	2	2	2	3	3	3	5
All Targets	**15**	**14**	**11**	**13**	**16**	**12**	**25**
All BSAI TLA Vessels			**Number of Unique Vessels**				
Pollock|Atka Mackerel|Other Species	107	104	105	104	108	104	118
Yellowfin Sole	15	9	9	11	13	13	86
Pacific Cod	68	55	50	52	64	55	86
All other targets	8	9	7	5	8	7	18
All Targets	**127**	**125**	**118**	**121**	**126**	**118**	**141**

Note: Shaded cells indicate that catch and revenue data for that sub-set of vessels in that year for that target fishery cannot be disclosed due to confidentiality rules.
Source: Developed by Northern Economics using AKFIN data (Fey 2014).

Since 2008, BSAI TLA vessel owners predominately resided in states other than Alaska—primarily in Washington and Oregon (Table 4-27). The regions of residence displayed in this table are:

- Northwest Alaska (NW AK), which includes coastal areas north of Bristol Bay;
- Southwest Alaska (SW AK), including the Bristol Bay region, the AK Peninsula, Aleutian Islands, and Kodiak;
- Other Alaska (Other AK) which covers the all other regions in Alaska;
- Other U.S. (Other US) which includes all other U.S. participants.

Of the total number of unique vessels operating in the BSAI TLA fisheries between 2008 and 2013, only 12 of the 141 owners resided in Alaska at some point during the six-year period. This includes vessel owners that may have moved from Alaska to another state and vice versa. The number of vessel owners residing in Alaska in any given year ranged from five percent to seven percent between 2008 and 2013. Again, no vessel is included twice in any given year.

Table 4-26 Types and Numbers of Vessels Participating in BSAI TLA Target Fisheries, 2008 to 2013

	2008	2009	2010	2011	2012	2013	2008 to 2013
AFA-CPs				**Number of Unique Vessels**			
Pollock|Atka Mackerel|Other Species	16	14	14	15	16	16	17
Yellowfin Sole	12	8	9	9	10	8	13
Pacific Cod	1	1	2	2	4	1	6
All other targets	6	7	5	2	4	4	12
All Targets	**17**	**15**	**15**	**16**	**16**	**16**	**17**
AFA-CVs				**Number of Unique Vessels**			
Pollock|Atka Mackerel|Other Species	89	89	89	86	89	85	96
Yellowfin Sole	-	-	-	-	-	2	2
Pacific Cod	52	40	37	38	44	42	56
All other targets	-	-	-	-	1	-	1
All Targets	**95**	**96**	**92**	**92**	**94**	**90**	**99**
Trawl-CVs (Non-AFA)				**Number of Unique Vessels**			
Pollock|Atka Mackerel|Other Species	2	1	2	3	3	3	5
Yellowfin Sole	3	1	-	2	3	3	5
Pacific Cod	15	14	11	12	16	12	24
All other targets	2	2	2	3	3	3	5
All Targets	**15**	**14**	**11**	**13**	**16**	**12**	**25**
All BSAI TLA Vessels				**Number of Unique Vessels**			
Pollock|Atka Mackerel|Other Species	107	104	105	104	108	104	118
Yellowfin Sole	15	9	9	11	13	13	86
Pacific Cod	68	55	50	52	64	55	86
All other targets	8	9	7	5	8	7	18
All Targets	**127**	**125**	**118**	**121**	**126**	**118**	**141**

Note: Shaded cells indicate that catch and revenue data for that sub-set of vessels in that year for that target fishery cannot be disclosed due to confidentiality rules.
Source: Developed by Northern Economics using AKFIN data (Fey 2014).

Since 2008, BSAI TLA vessel owners predominately resided in states other than Alaska—primarily in Washington and Oregon (Table 4-27). The regions of residence displayed in this table are:

- Northwest Alaska (NW AK), which includes coastal areas north of Bristol Bay;
- Southwest Alaska (SW AK), including the Bristol Bay region, the AK Peninsula, Aleutian Islands, and Kodiak;
- Other Alaska (Other AK) which covers the all other regions in Alaska;
- Other U.S. (Other US) which includes all other U.S. participants.

Of the total number of unique vessels operating in the BSAI TLA fisheries between 2008 and 2013, only 12 of the 141 owners resided in Alaska at some point during the six-year period. This includes vessel owners that may have moved from Alaska to another state and vice versa. The number of vessel owners residing in Alaska in any given year ranged from five percent to seven percent between 2008 and 2013. Again, no vessel is included twice in any given year.

Table 4-27 BSAI TLA Vessel Owner's Place of Residence, 2008 to 2013

	2008	2009	2010	2011	2012	2013	2008 to 2013
AFA-CPs				**Number of Unique Vessels**			
NW Alaska	-	-	-	-	-	-	-
SW Alaska	-	-	-	-	-	-	-
Other Alaska	-	-	-	1	1	1	1
Other U.S.	17	15	15	15	15	15	17
Total Unique Vessels	**17**	**15**	**15**	**16**	**16**	**16**	**17**
AFA-CVs				**Number of Unique Vessels**			
NW Alaska	-	-	-	-	-	-	-
SW Alaska	5	5	5	5	5	5	6
Other Alaska	-	-	-	-	-	-	-
Other U.S.	90	91	87	87	89	85	95
Total Unique Vessels	**95**	**96**	**92**	**92**	**94**	**90**	**99**
Trawl CV (Non-AFA)				**Number of Unique Vessels**			
NW Alaska	-	-	-	-	-	-	-
SW Alaska	1	3	-	2	3	1	6
Other Alaska	1	1	1	-	-	-	1
Other U.S.	13	10	10	11	13	11	21
Total Unique Vessels	**15**	**14**	**11**	**13**	**16**	**12**	**25**
All BSAI TLA Vessels				**Number of Unique Vessels**			
NW Alaska	-	-	-	-	-	-	-
SW Alaska	6	8	5	7	8	6	12
Other Alaska	1	1	1	1	1	1	2
Other U.S.	120	116	112	113	117	111	133
Total Unique Vessels	127	125	118	121	126	118	141

Note: There were a total of 6 vessels whose owners lived in multiple regions over the 6-year period. Also note that shaded cells indicate that catch and revenue data for that sub-set of vessels in that year for that target fishery cannot be disclosed due to confidentiality rules.
Source: Developed by Northern Economics using AKFIN data (Fey 2014).

Vessel and crew participation in the BSAI TLA fisheries has been quantified using slightly more detailed vessel categories for AFA-CPs and AFA-CV than are shown Table 4-26. The refinement of these definitions is based on each vessel's relative dependence on pollock, and derives from the fact that the PSC limit for pollock fisheries in the BSAI TLA is non-binding. Therefore it is expected that the impacts of PSC limit reductions would be experienced primarily by vessels that are actively fishing in other target fisheries.

- Diversified AFA-CPs have generated revenues that are greater than one percent of their total revenues from 2008 to 2013 in Pacific cod, yellowfin sole and other target fisheries other than pollock. On average these eleven vessels generated 6.9 percent of their total revenue from fisheries other than pollock.
- Non-Diversified AFA-CPs have generated revenues in pollock fisheries that are 99 percent or more of their total revenue from 2008 to 2013. On average these eleven vessels generated 99.8 percent of their total revenue from fisheries other than pollock.
- Diversified AFA-CVs have generated revenues that are greater than one percent of their total revenues from 2008to 2013 in Pacific cod, yellowfin sole and other target fisheries other than pollock.
- Non-Diversified AFA-CVs have generated revenues in pollock fisheries that are 99 percent or more of their total revenue from 2008 to 2013.

Table 4-28 summarizes the participation and earnings on Diversified AFA-CPs. This category comprises 11 catcher processors with onboard crews of nearly 114 persons. Over the 7.4 months on average that they operate, the analysis estimates that on average the vessels employ 199.5 different people or a total of 2,133.5 persons. With an average crew share of 27 percent of wholesale revenues, it is estimated that a total of $119.6 million is paid to crew or an average $56,063 per person.

Table 4-28 Summary of Participation and Earnings by Vessels and Crew on Diversified AFA-CPs

	2008	2009	2010	2011	2012	2013	6-Year Average
Number of Active Vessels	11	10	10	11	11	11	11
Average Crew Size (Incl. Officers)	111.0	113.4	120.9	114.8	114.7	108.7	113.9
Average Operating Months	7.6	6.2	6.4	9.2	7.3	7.6	7.4
Average Persons in Crew Rotation per Vessel	201.4	183.1	183.7	234.4	204.2	190.3	199.5
Total Persons in Crew Rotation in Sector	2,215.1	1,830.7	1,836.9	2,578.4	2,246.2	2,093.5	2,133.5
Crew Share Percentage	27%	27%	27%	27%	27%	27%	27%
Total Payments to Crew and Officers (2013 $ Millions)	$148.9	$101.7	$100.1	$128.3	$133.4	$105.1	$119.6
Average Income Earned per Person (2013 $)	$67,234	$55,565	$54,515	$49,766	$59,390	$50,225	$56,063

Note: Operating Months, Crew Payments and Total Revenues include time spent and revenue generated when fishing CDQ allocations.

Source: Developed by Northern Economics using AKFIN data (Fey 2014 and A80-CP Economic Data Report data (Fissel 2014).

The five Non-Diversified AFA-CPs (see Table 4-29) tend to have slightly larger crews than their more diversified counterparts, but because they operate for a slightly shorter period during the year (on average) they employ slightly fewer people—117.3 per vessel and 968.6 over all five CPs in an average year. In an average year these vessels pay out $63.1 million to crew members or $65,079 per person employed.

Table 4-29 Summary of Participation and Earnings by Vessels and Crew on Non-Diversified AFA-CPs

	2008	2009	2010	2011	2012	2013	6-Year Average
Number of Active Vessels	6	5	5	5	5	5	5
Average Crew Size (Incl. Officers)	116.3	116.4	116.0	115.7	119.4	119.7	117.3
Average Operating Months	6.6	6.6	5.7	9.4	6.9	8.0	7.2
Average Persons in Crew Rotation per Vessel	201.6	185.4	147.1	214.5	169.5	204.1	187.0
Total Persons in Crew Rotation in Sector	1,209.8	926.8	735.7	1,072.4	847.6	1,020.7	968.8
Crew Share Percentage	27%	27%	27%	27%	27%	27%	27%
Total Payments to Crew and Officers (2013 $ Millions)	$73.7	$55.2	$52.2	$68.7	$67.0	$61.5	$63.1
Average Income Earned per Person (2013 $)	$60,898	$59,535	$70,990	$64,093	$79,078	$60,221	$65,079

Note: Operating Months, Crew Payments and Total Revenues include time spent and revenue generated when fishing CDQ allocations.

Source: Developed by Northern Economics using AKFIN data (Fey 2014) and A80-CP Economic Data Report data (Fissel 2014).

Table 4-30 and Table 4-31 show participation and crew earnings for the two categories of AFA-CVs. As with AFA-CPs, the Diversified AFA-CVs are likely to experience greater impacts from an action to reduce PSC limits, than their less diversified counterparts that focus almost exclusively on pollock. The reduced levels of impact result from the fact the halibut PSC limit for the pollock fishery is non-binding.

As shown in Table 4-30, an average of 49 Diversified AFA-CVs have been active between 2008 and 2013, while the count of active Non-Diversified AFA-CVs has averaged four fewer at 41 vessels (Table 4-31). In general, Non-Diversified AFA-CVs tend to have larger crews (5.0 v. 4.3) and operate for slightly longer portions of the year. These two factors push the estimated total number of persons in the crew rotation on the Non-Diversified AFA-CVs (448) above the number of persons employed on the Diversified AFA-CVs (393). Crew share as a percent of total ex-vessel value for both types of AFA-CVs was assumed to be equal at 37.5 percent. Total payments to crew on the Non-Diversified AFA-CVs have averaged 157 percent of the total crew payments made on Diversified AFA-CVs (implying the ex-vessel revenues have been higher by the same percentage). The higher overall payments to crew members bring the estimated earnings per person employed up to $125,788 on Non-Diversified AFA-CVs compared to average payments per person of $91,287 on Diversified AFA-CVs.

Table 4-30 Summary of Participation and Earnings by Vessels and Crew on Diversified AFA-CVs

	2008	2009	2010	2011	2012	2013	6-Year Average
Number of Active Vessels	51	51	47	47	48	47	49
Average Crew Size (Incl. Officers)	4.3	4.3	4.3	4.4	4.4	4.3	4.3
Average Operating Months	6.7	6.0	6.1	7.0	6.8	6.6	6.5
Average Persons in Crew Rotation per Vessel	8.2	7.5	7.6	8.6	8.4	8.3	8.1
Total Persons in Crew Rotation in Sector	420.6	384.4	357.0	405.3	401.9	389.6	393.1
Crew Share Percentage	38%	38%	38%	38%	38%	38%	38%
Total Payments to Crew and Officers (2013 $ Millions)	$45.4	$31.6	$26.0	$36.0	$41.2	$35.1	$35.9
Average Income Earned per Person (2013 $)	$108,036	$82,081	$72,915	$88,738	$102,613	$90,091	$91,287

Note: Operating Months, Crew Payments and Total Revenues include time spent and revenue generated when fishing CDQ allocations.

Source: Developed by Northern Economics using AKFIN data (Fey 2014 and A80-CP Economic Data Report data (Fissel 2014).

Table 4-31 Summary of Participation and Earnings by Vessels and Crew on Non-Diversified AFA-CVs

	2008	2009	2010	2011	2012	2013	6-Year Average
Number of Active Vessels	44	45	45	45	46	43	45
Average Crew Size (Incl. Officers)	5.1	5.0	5.0	5.0	5.0	5.0	5.0
Average Operating Months	6.8	6.1	6.0	7.2	7.0	6.7	6.6
Average Persons in Crew Rotation per Vessel	10.3	9.2	9.2	10.8	10.2	10.5	10.0
Total Persons in Crew Rotation in Sector	453.2	412.4	415.8	488.0	468.8	449.7	448.0
Crew Share Percentage	38%	38%	38%	38%	38%	38%	38%
Total Payments to Crew and Officers (2013 $ Millions)	$70.4	$51.5	$40.1	$59.7	$62.3	$54.1	$56.4
Average Income Earned per Person (2013 $)	$155,269	$124,873	$96,458	$122,389	$132,944	$120,268	$125,788

Note: Operating Months, Crew Payments and Total Revenues include time spent and revenue generated when fishing CDQ allocations.

Source: Developed by Northern Economics using AKFIN data (Fey 2014 and A80-CP Economic Data Report data (Fissel 2014).

The remainder of vessels operating in the BSAI TLA are non-AFA CVs. Non-AFA CVs fish for Pacific cod and yellowfin sole and do not participate in any pollock fishing. Vessel and crew participation for non-AFA CVs is summarized in Table 4-32. As discussed previously, non-AFA CVs accounted for 18 percent of vessels operating in the BSAI TLA. Non-AFA CVs have smaller crew sizes than AFA-CVs and operated an average of 5 months between 2008 and 2013, slightly less than that of their AFA counterparts. Because non-AFA CVs have operated in fewer months and have smaller crew sizes, the average number of persons in crew rotations per vessel is also smaller than that of AFA-CVs. In spite of the fact that crew shares as a percent of gross revenue are higher, Non-AFA CVs also tend to earn less income per person than AFA-CVs.

Table 4-32 Summary of Participation and Earnings in the BSAI by Vessels and Crew on Non-AFA Trawl CV Fisheries

	2008	2009	2010	2011	2012	2013	6-Year Average
Number of Active Vessels	14	14	11	13	16	12	13
Average Crew Size (Incl. Officers)	4.1	4.0	4.0	3.8	4.3	4.5	4.1
Average Operating Months	5.0	3.9	3.3	5.7	5.8	6.1	5.0
Average Persons in Crew Rotation per Vessel	5.6	4.7	4.5	5.0	5.4	6.3	5.3
Total Persons in Crew Rotation in Sector	78.8	65.5	49.8	64.4	86.5	76.1	70.2
Crew Share Percentage	42%	42%	42%	42%	42%	42%	42%
Total Payments to Crew and Officers (2013 $ Millions)	$4.1	$2.4	$2.4	$4.7	$6.6	$5.3	$4.2
Average Income Earned per Person (2013 $)	$51,732	$36,906	$48,566	$72,789	$76,496	$69,180	$60,510

Note: Operating Months, Crew Payments and Total Revenues include time spent and revenue generated when fishing CDQ allocations.

Source: Developed by Northern Economics using AKFIN and A80-CP Economic Data Report data (Fissel 2014).

Table 4-33 combines the five different categories of BSAI TLA vessels into a single table. Altogether, the BSAI TLA has had an average of 122 vessels participating, with an average crew size of 18.9 persons and an estimated annual average employee count 4,014 persons. Between 2008 and 2013 these vessels paid crew members an average of $279.2 million or $69,550 per employed crew member. It is important to reiterate that the estimates of employment as well as payments to crew members include revenue generated while these vessels fished for CDQ groundfish. It is estimated that from 2008 to 2013 a crew member received an average of $39.8 million from activities in CDQ fisheries—all but $0.9 million of this accrued to crew members on AFA-CPs.

Table 4-33 Summary of Participation and Earnings by Crew on All BSAI TLA Vessels

	2008	2009	2010	2011	2012	2013	6-Year Average
Number of Active Vessels	126	125	118	121	126	118	122
Average Crew Size (Incl. Officers)	19.2	17.7	19.2	19.2	18.8	19.2	18.9
Average Operating Months	6.6	5.8	5.8	7.2	6.8	6.7	6.5
Average Persons in Crew Rotation per Vessel	34.7	29.0	28.8	38.1	32.2	34.1	32.7
Total Persons in Crew Rotation in Sector	4,377.6	3,619.9	3,395.2	4,608.6	4,051.0	4,029.6	4,013.6
Crew Share Percentage	37%	37%	37%	37%	37%	37%	37%
Total Payments to Crew and Officers (2013 $ Millions)	$342.5	$242.4	$220.9	$297.4	$310.6	$261.1	$279.2
Average Income Earned per Person (2013 $)	$78,239	$66,955	$65,070	$64,540	$76,675	$64,786	$69,550

Note: Operating Months, Crew Payments and Total Revenues include time spent and revenue generated when fishing CDQ allocations.

Source: Developed by Northern Economics using AKFIN and A80-CP Economic Data Report data (Fissel 2014).

BSAI TLA Processors

There are six types of processors participating in the BSA TLA fisheries. These include the following:

1) **AFA shore-based plants and floating processors**: These plants are authorized under AFA to take deliveries of BSAI pollock and include the three plants in Dutch Harbor/Unalaska, three plants in Akutan, King Cove and Sandpoint, and a floating processor (the Northern Victor) operating out of

Beaver Inlet on the Northwest side of Unalaska Island. Another AFA shore-based plant (the Arctic Enterprise) has not operated since 2006.

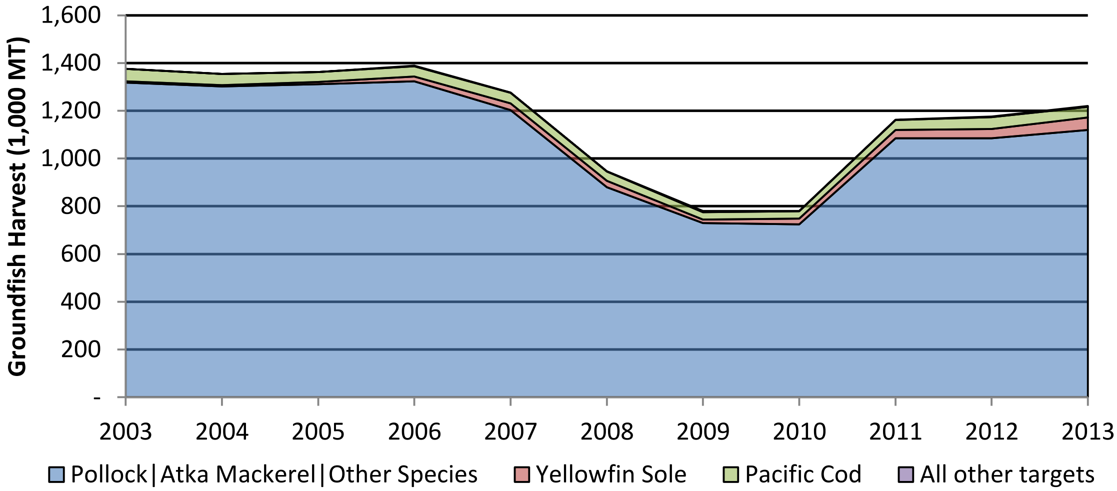
2) **Other shore plants**: Several other non-AFA shore plants in SW Alaska are presumed to have operated in BSAI TLA fishery. The data we have currently available to us do not allow us to generate a count of these processors.
3) **AFA motherships**: There are three motherships that are authorized under AFA to process BSAI Pollock—the Excellence, the Golden Alaska, and the Ocean Phoenix.
4) **AFA-CP**s: These are catcher processors authorized under AFA to catch and process BSAI Pollock. Seventeen AFA-CPs have operated in the BSAI TLA since 2008.
5) **Other floating processors**: Six floating processors have operated in the BSAI TLA from 2008 to 2013 including Arctic Star, Bering Star, Independence, Snopac Innovator, and the Gordon Jensen. Floating processors are defined separately from motherships because they only operate within State of Alaska waters. These vessels are not authorized to process BSAI pollock except as incidental catch.
6) **Other Motherships**: Six vessels that otherwise operate as either AFA-CPs or A80-CPs have also operated as motherships between 2008 and 2013. These include American Triumph, Katie Ann, and Northern Eagle (all AFA-CPs) and Ocean Peace, Seafreeze, and Seafisher (all A80-CPs). These vessels are not authorized to take deliveries and process BSAI pollock except as incidental catch.

4.4.3.2 Catch and Revenue in Target Fisheries of BSAI TLA

In this section and others that follow, groundfish harvests in BSAI TLA fisheries are reported based on target fishery groups for which the BSAI TLA is apportioned halibut PSC limits. Since 2008 (with A80), the BSAI TLA has been apportioned halibut PSC mortality for the following four Target Fishery Groups: 1) Pollock|Atka Mackerel|Other Species; 2) Pacific Cod; 3) Yellowfin Sole; and 4) Rockfish. Because landings in the rockfish fisheries have been very limited, landings data for some years are confidential and cannot be reported. Therefore, the analysis combines landings in the rockfish target fisheries with landings in all other target fisheries that were assigned to BSAI TLA vessels during the year. These miscellaneous targets include rock sole, Alaska plaice, flathead sole, and arrowtooth and Kamchatka flounder.

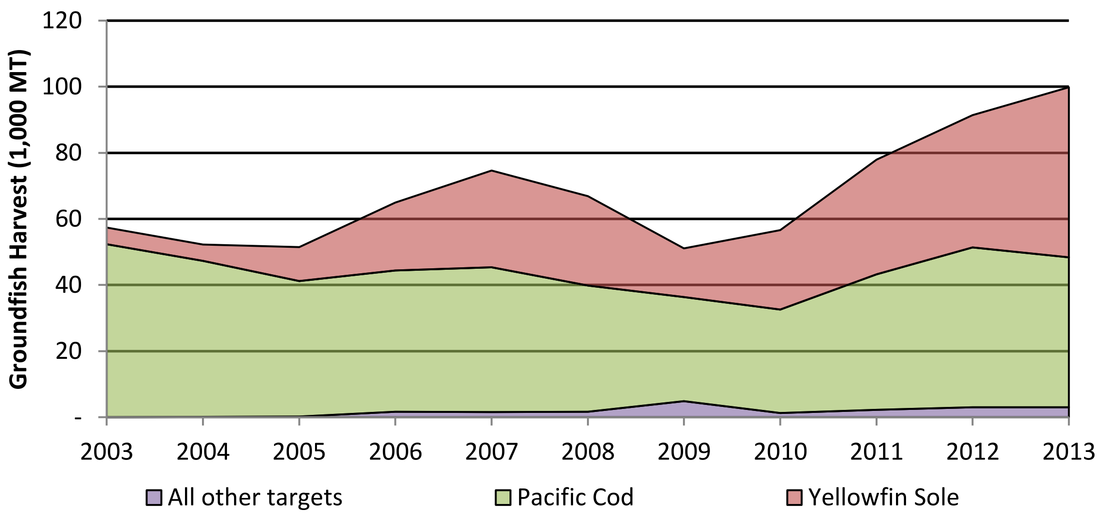
Groundfish harvests in BSAI TLA target fisheries began declining in 2006, falling nearly 50 percent to 780 tons by 2009 (Figure 4-23). The decline in groundfish harvest is largely due to the reduction in pollock TAC that occurred in those years. Overall groundfish harvest rose again in 2011, largely due to increases in the pollock TACs, and has increased gradually each year since. Within the Pollock|Atka Mackerel|Other Species target group, pollock accounted for 99.7 percent of harvest with the remaining 0.3 percent attributed to the Atka mackerel fishery. No BSAI TLA vessels had landings assigned specifically to the "Other Species" category from 2008 to 2013. Therefore, changes within this target group are almost entirely driven by the pollock fishery. From 2008 to 2013, the pollock fishery accounted for 92 percent of the total harvest in BSAI TLA fisheries. Because pollock is so overwhelming within the BSAI TLA fisheries, Figure 4-24, provided below, displays total harvest in the BSAI TLA fishery, excluding pollock. In that figure, the increasing importance of the Yellowfin sole target fishery for some BSAI TLA participants can readily be seen. In 2013, landings of yellowfin sole for BSAI TLA vessels exceeded landings of Pacific cod for the first time. Groundfish harvest in the BSAI TLA fisheries is shown below in Table 4-34.

Figure 4-23 Groundfish Harvests in Target Fisheries of BSAI TLA Vessels, 2003 to 2013



Source: Developed by Northern Economics using AKFIN data (Fey 2014).

Figure 4-24 Non-pollock Groundfish Harvests in Target Fisheries of BSAI TLA Vessels, 2003 to 2013



Source: Figure developed by Northern Economics using AKFIN data (Fey 2014).

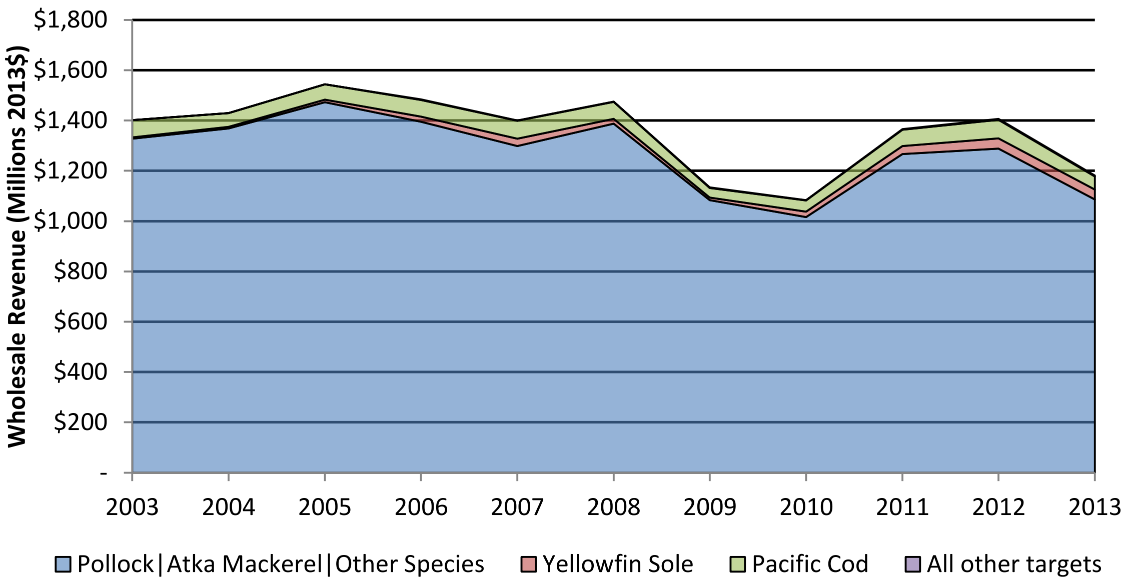
Table 4-34 Groundfish Harvest in Target Fisheries of BSAI TLA Vessels, 2008 to 2013

	2008	2009	2010	2011	2012	2013	Total
Target Group	Groundfish Harvest (1,000 mt)						
Pollock|Atka Mackerel|Other Species	879.55	729.45	723.67	1,084.89	1,084.21	1,119.77	5,621.53
Yellowfin Sole	27.07	14.72	24.10	34.75	39.98	51.49	192.11
Pacific Cod	38.17	31.50	31.29	40.98	48.38	45.33	235.67
All other targets	1.65	4.88	1.24	2.22	3.00	3.00	15.99
All Targets	**946.43**	**780.55**	**780.31**	**1,162.84**	**1,175.57**	**1,219.60**	**6,065.30**

Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

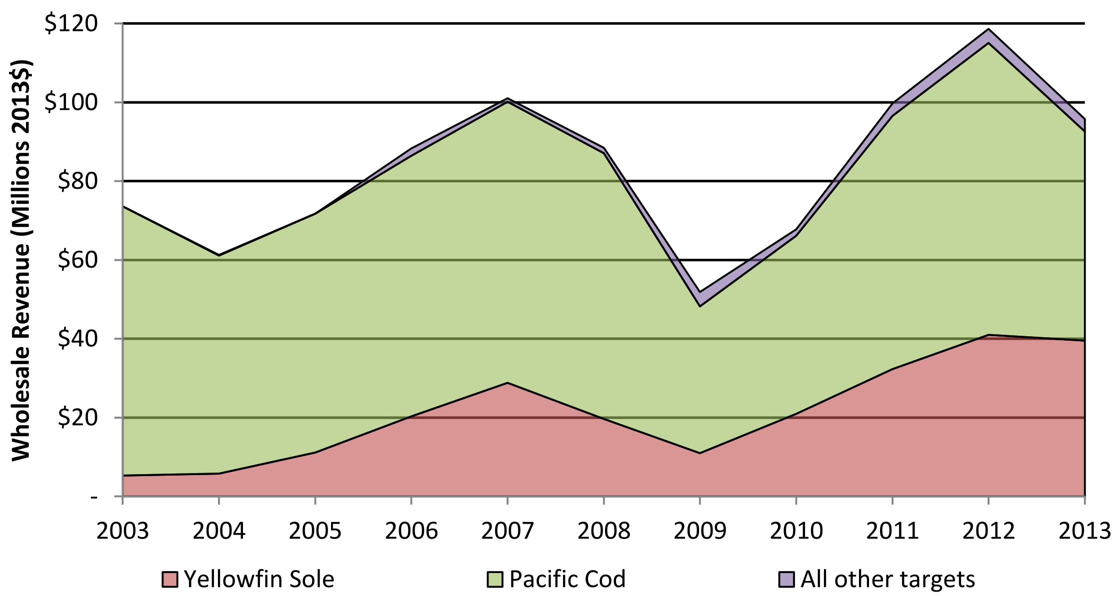
Wholesale revenues in the BSAI TLA groundfish fisheries remained relatively flat from 2006 to 2008, with higher prices in 2008 helping to offset significantly lower pollock harvests (Figure 4-25). The sharp decline in 2009 is attributed to the combination of the second year of low pollock TACs and the global recession. A decline in wholesale revenues in 2013 is seen, despite small increases in total BSAI TLA groundfish harvest. The decline is a function of lower revenues per ton across all major species in 2013 as discussed earlier in Table 4-2 on page 129. Figure 4-26 shows wholesale revenues in the BSAI TLA groundfish fishery, excluding harvests in pollock target fisheries. This graphic clearly shows the effect of low prices in 2009 resulting from the global recession. Despite increases in harvests for all species other than Pacific cod, significant revenue declines occurred in all target fisheries in 2013.

Figure 4-25 Wholesale Revenue in Target Fisheries of BSAI TLA Vessels, 2003 to 2013



Source: Figure developed by Northern Economics using AKFIN data (Fey 2014).

Figure 4-26 Non-pollock Wholesale Revenue in Target Fisheries of BSAI TLA Vessels, 2003 to 2013



Source: Figure developed by Northern Economics using AKFIN data (Fey 2014).

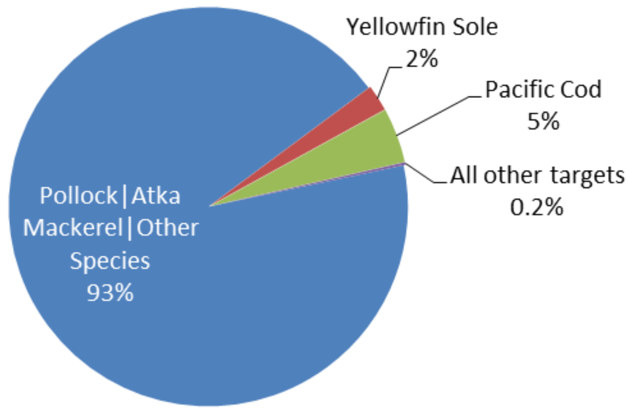
Table 4-35 Real Wholesale Revenue in Target Fisheries of BSAI TLA Vessels, 2008 to 2013

	2008	2009	2010	2011	2012	2013	Total
Target Group	Wholesale Revenue (in millions of 2013 $)						
Pollock|Atka Mackerel|Other Species	$1,386.85	$1,082.94	$1,016.24	$1,266.43	$1,287.58	$1,085.41	$7,125.44
Yellowfin Sole	$19.66	$10.96	$20.98	$32.30	$40.97	$39.49	$164.35
Pacific Cod	$67.41	$37.27	$45.18	$64.27	$74.13	$53.14	$341.40
All other targets	$1.34	$3.65	$1.58	$3.14	$3.56	$3.13	$16.40
All Targets	**$1,475.26**	**$1,134.82**	**$1,083.98**	**$1,366.13**	**$1,406.24**	**$1,181.16**	**$7,647.59**

Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

As documented in Figure 4-27, pollock accounts for 93 percent of total wholesale revenue for BSAI TLA vessels.

Figure 4-27 Average Percentage of Wholesale Revenue by Target Fishery for BSAI TLA Vessels, 2008 to 2013



Source: Figure developed by Northern Economics using AKFIN data (Fey 2014).

4.4.3.3 Distribution of Harvest and Processing between Vessel and Processor Types

Harvests in the BSAI TLA were distributed among the three types of vessels described earlier: AFA-CPs, AFA-CVs, and non-AFA Trawl CVs. Catcher Processors by definition catch fish and process it on board. When they sell their products they generate wholesale revenues. The two groups of CVs deliver their harvests to offshore motherships, shore plants, or inshore floating processors, and in making deliveries receive ex-vessel revenues. The processing facilities then turn the raw fish into products and sell them to generate wholesale revenues. Table 4-36 summarizes the distribution of wholesale revenues between the different processor types. In the table we combine shore plants and floating processors to protect confidential information.[29] AFA-CPs accounted for an average of 42 percent of the wholesale revenues and motherships for 11 percent, while shore plants and inshore floating processors generated an average of 47 percent. It also should be noted that floating processors participated only in the non-pollock target fisheries.

[29] There were a total of five different inshore floating processors that participated in these fisheries over the six-year period, but there were only two years in which three or more participated. It should be noted that the Northern Victor is counted as a shore plant rather than as a floating processor.

Table 4-36 Distribution of Wholesale Revenue among Processors in the BSAI TLA

Processor Type	2008	2009	2010	2011	2012	2013	Average
			Wholesale Revenue ($ millions 2013)				
AFA-CP	$653	$469	$444	$574	$574	$478	$532
Motherships (Offshore)	$153	$97	$119	$167	$160	$133	$138
Shore Plants & Inshore Floating Processors	$669	$569	$521	$625	$672	$570	$604
Total	$1,475	$1,135	$1,084	$1,366	$1,406	$1,181	$1,275
			Wholesale Revenue ($ millions 2013)				
AFA-CP	44%	41%	41%	42%	41%	40%	42%
Motherships (Offshore)	10%	9%	11%	12%	11%	11%	11%
Shore Plants & Inshore Floating Processors	45%	50%	48%	46%	48%	48%	47%
Total	100%	100%	100%	100%	100%	100%	100%

Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

Table 4-37 separates out ex-vessel revenues and processing value added in BSAI TLA fisheries involving CVs. This is important because otherwise it might be inferred that AFA-CVs and non-AFA Trawl CVs capture all of the wholesale revenue generated by their harvest activities. In reality, the CVs deliver to processors and receive ex-vessel payment for their fish. The processors in turn add value to the raw fish they purchase from the CVs by turning it into products such as surimi, fillets, or headed and gutted fish. When these products are sold, the processors generate wholesale revenue.

In Table 4-26 we saw that there were three types of harvesting vessels active in the BSAI TLA: AFA-CPs, AFA-CVs and non-AFA Trawl CVs. Table 4-37 summarizes the ex-revenues generated by AFA-CVs and non-AFA Trawl-CVs in BSAI TLA Fisheries from 2008 to 2013. AFA-CPs are not included because there is no transaction in which ex-vessel revenues are generated. As might be expected by the sheer number of vessels, AFA-CVs (99 vessels) generate much more ex-vessel revenue than do non-AFA Trawl CVs (25 vessels). Between 2008 and 2013, AFA-CVs averaged a total of $241 million in ex-vessel revenues while non-AFA Trawl CVs generated an average of $9 million. Both types of CVs deliver to motherships and to shore-based processors or inshore floating processors. The processors added an average of $492 million in value to the groundfish delivered by CVs in the BSAI TLA from 2008 to 2013.

Table 4-37 Ex-Vessel Revenue and Processing Value Added in BSAI TLA Fisheries

	2008	2009	2010	2011	2012	2013	Average
			Ex-Vessel Revenue ($ millions 2013)				
AFA-CVs	$302	$213	$174	$252	$273	$235	$241
Non-AFA Trawl CVs	$9	$5	$5	$10	$14	$12	$9
Total Ex-Vessel Value	**$311**	**$218**	**$179**	**$262**	**$286**	**$247**	**$251**
			Value Added by Processors ($ millions 2013)				
Mothership Value Added	$102	$59	$81	$114	$105	$86	$91
Shore Plants & Inshore Floating Processors	$409	$388	$380	$416	$440	$370	$401
Total Value Added	**$511**	**$447**	**$461**	**$530**	**$546**	**$457**	**$492**
			Total Wholesale Value of CV Harvests				
CV Based Wholesale Value	**$822**	**$666**	**$640**	**$792**	**$832**	**$703**	**$743**

Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

Table 4-38 summarizes the ex-vessel revenue generated by vessels in the BSAI TLA fisheries by the vessel owner's state of residence. As shown earlier in Table 4-27, a total of 13 of the 124 unique CVs operating in BSAI TLA fisheries have been registered to Alaskans at some point during the six-year period shown, but in any given year no more than 8 vessels were active. As shown in Table 4-38, Alaskan-owned CVs participating in the BSAI TLA fisheries have generated an average $6 million in ex-vessel revenues from 2008 to 2013, or 2.3 percent of the total generated in the fisheries. There is currently one AFA-CP that is listed as being owned by an Alaska firm or individual. The wholesale revenue of that single vessel cannot be reported because of non-disclosure rules, but given that there were 16 AFA-CPs operating, the wholesale revenue of any one vessel may be approximated as the average revenue of the fleet. From 2011 to 2013 (the years when the AFA-CP was reported as "Alaska-owned", the average AFA-CP generated $33.86 million in wholesale revenue.

Table 4-38 Distribution of Ex-Vessel Revenue by Vessel Owners State of Residence

	2008	2009	2010	2011	2012	2013	Average
	Ex-Vessel Revenue ($ millions 2013)						
Alaska	$7	$5	$5	$5	$7	$6	$6
Other States	$304	$213	$174	$257	$279	$241	$245
Total Ex-Vessel Value	**$311**	**$218**	**$179**	**$262**	**$286**	**$247**	**$251**
Alaska Percent of Total	2.2%	2.2%	2.7%	2.0%	2.5%	2.4%	2.3%

Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

4.4.3.4 Halibut PSC Limits and Halibut PSC Mortality in Target Fisheries of BSAI TLA Vessels

Halibut PSC limits by target species in the BSAI TLA fisheries are shown in Table 4-39. Since 2008, total halibut PSC limits for BSAI TLA fisheries have remained unchanged with some variation occurring in the apportionments between target fishery groups. Apportionment of the 875 mt limit is set each year in the Council's harvest specifications process. In 2013, Pacific cod was apportioned the highest amount of halibut PSC mortality, followed by Pollock|Atka Mackerel|Other Species and yellowfin sole.

Table 4-39 Halibut PSC Limits and Apportionment to Target Fisheries for BSAI TLA Vessels, 2008 to 2013

Target Group	2008	2009	2010	2011	2012	2013
	Apportionment of Halibut PSC Limit (in Round Weight mt) to Target Fisheries					
Rockfish	3	5	5	5	5	5
Pollock|Atka Mackerel|Other Species	125	175	250	250	250	250
Yellowfin Sole	162	187	167	167	167	167
Pacific Cod	585	508	453	453	453	453
All targets combined	**875**	**875**	**875**	**875**	**875**	**875**

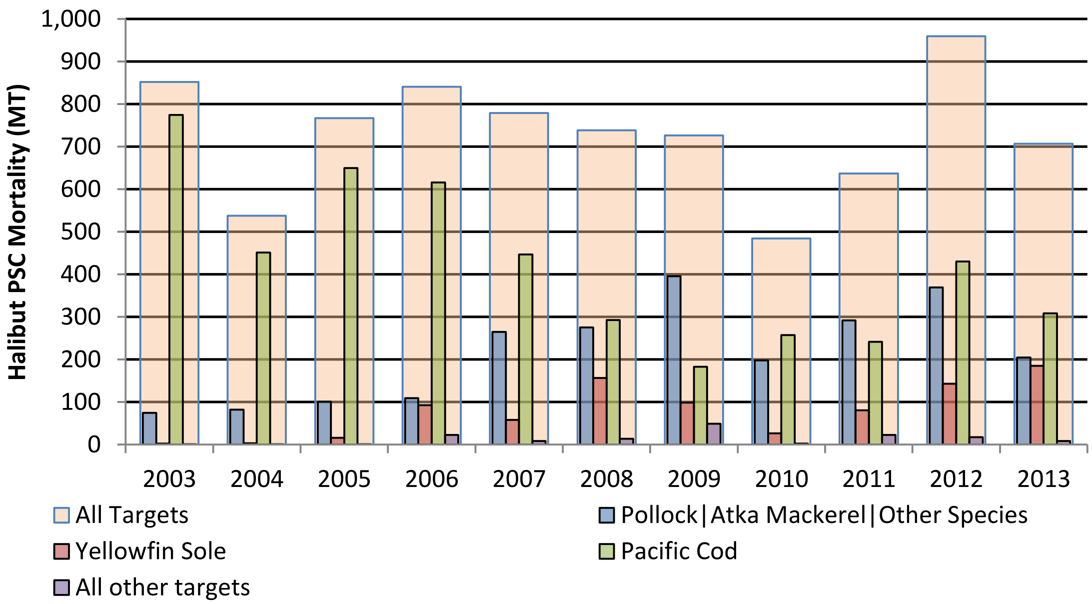
Source: Developed by NEI using data from NMFS' Alaska Groundfish Specification Tables (NMFS 2014f).

Figure 4-28 summarizes halibut PSC mortality in the BSAI TLA fisheries from 2003 to 2013. Actual halibut mortality data are shown in Table 4-40 for 2008 to 2013. In 2003, over 90 percent of halibut mortality in the BSAI TLA target fisheries was caught in the Pacific cod fishery. Halibut PSC mortality in BSAI TLA Pacific cod fisheries has generally declined since then to a low in 2009 of 183 mt. During that same period, halibut mortality in the Pollock|Atka Mackerel|Other Species target group increased steadily to a peak in 2009 of 395 mt. Halibut PSC mortality in BSAI TLA yellowfin sole fisheries generally increased from 2005 to 2008, fell in 2009 and 2010, and increased each year from 2011 to 2013. Total halibut PSC mortality in BSAI TLA fisheries has been relatively volatile—during the 11-year period shown in the figure, there have been 5 years with a year-over-year change in absolute terms of over 200 mt—over 23 percent of the 875 mt PSC limit.

In 2012, the halibut PSC mortality in the BSAI TLA actually exceed the 875 mt limit reaching 960 mt. It should be noted that halibut PSC mortality is not a binding constraint for the BSAI pollock fishery. If the halibut PSC limit for Pollock|Atka Mackerel|Other Species is reached, BSAI TLA may no longer participate in target fisheries for Atka mackerel or "Other Species", but they may continue to fish with mid-water trawl gear for pollock.

As seen in Figure 4-29 at the bottom of the next page, over the six-year period from 2008 to 2013, halibut PSC mortality in target fisheries Pollock|Atka Mackerel|Other Species has averaged 41 percent of the total halibut PSC mortality taken in BSAI TLA fisheries, noting again that 99.7 percent of the groundfish taken in this target fishery group is harvested in pollock target fisheries. During the same period, 40 percent of halibut PSC mortality has been taken in Pacific cod target fisheries and 16 percent has been taken in yellowfin sole target fisheries.

Figure 4-28 Halibut PSC Mortality in BSAI TLA Target Fisheries, 2003 to 2013



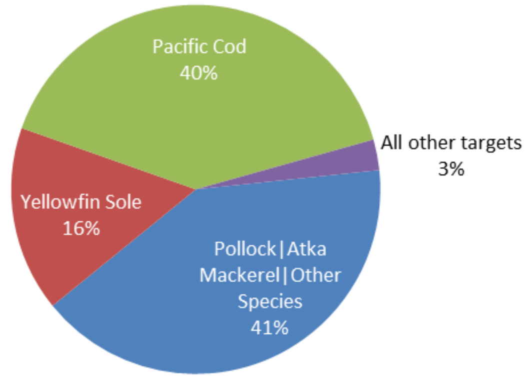
Source: Figure developed by Northern Economics using AKFIN data (Fey 2014).

Table 4-40 Halibut PSC mortality in BSAI TLA Target Fisheries, 2008 to 2013

	2008	2009	2010	2011	2012	2013	Total
Target Group	**Halibut PSC mortality (in Round Weight mt)**						
Pollock|Atka Mackerel|Other Species	275.7	395.9	198.0	291.9	369.4	204.6	1,735.6
Yellowfin Sole	156.7	98.9	26.8	80.8	143.1	185.2	691.5
Pacific Cod	292.6	183.0	257.0	241.4	430.1	308.3	1,712.4
All other targets	13.7	49.0	2.4	23.2	17.4	8.6	114.2
All Targets	**738.6**	**726.9**	**484.2**	**637.3**	**960.0**	**706.8**	**4,253.8**

Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

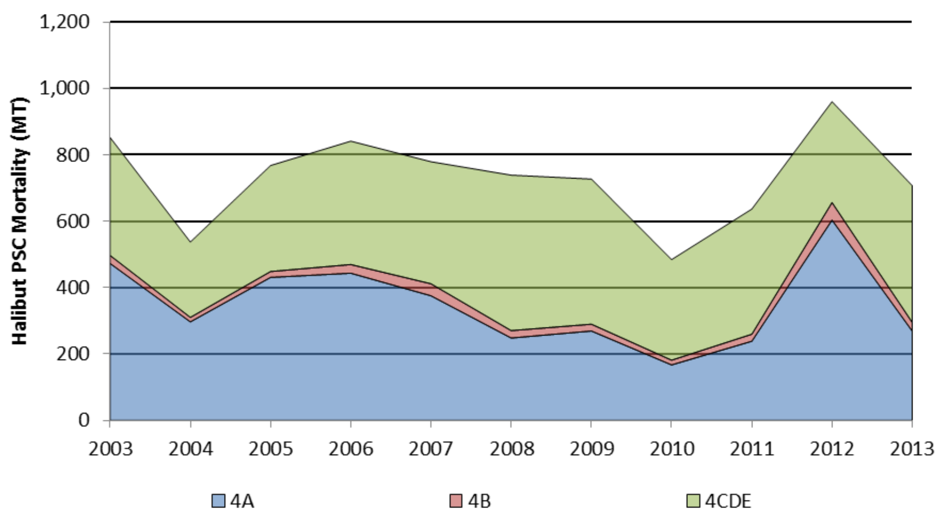
Figure 4-29 Average Percentage of Total Halibut PSC mortality by Target Fishery for BSAI TLA, 2008 to 2013



Source: Figure developed by Northern Economics using AKFIN data (Fey 2014).

Figure 4-30 and
Table 4-41 summarize halibut mortality in BSAI TLA fisheries by IPHC area. Halibut PSC in BSAI TLA fisheries primarily occurs in IPHC areas 4A and 4CDE—only 4 percent of BSAI TLA halibut from 2008 to 2013 has been taken in IPHC 4B. From 2003 to 2007, the majority of halibut PSC mortality occurred in Area 4A, but beginning in 2008, Area 4CDE overtook 4A as the area in which the majority of halibut PSC mortality occurred, with the exception of 2012, when Area 4A experienced a 150 percent increase in halibut PSC mortality driven primarily by PSC increases in the pollock and Pacific cod target fisheries.

Figure 4-30 Halibut PSC Mortality in BSAI TLA Fisheries by IPHC Area



Source: Developed by Northern Economics using AKFIN data (Fey 2014).

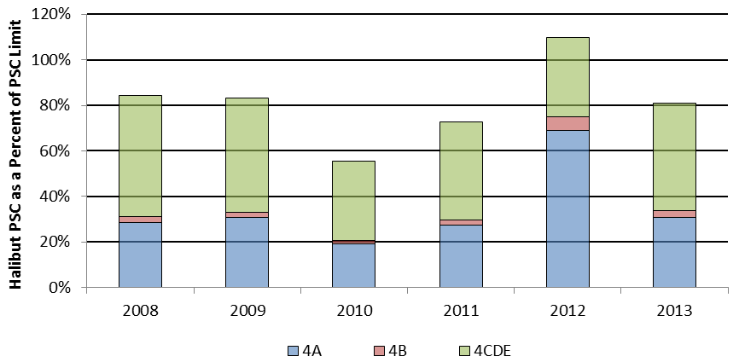
Table 4-41 Halibut PSC Mortality in BSAI TLA Fisheries by IPHC Area, 2008 to 2013

	2008	2009	2010	2011	2012	2013	Total
Target Group	Halibut PSC Mortality (in Round Weight mt)						
IPHC Area 4A	248.1	269.3	167.2	238.4	603.3	268.7	1,795.1
IPHC Area 4B	22.4	20.5	14.3	21.1	53.0	26.1	157.4
IPHC Areas 4CDE	468.1	437.0	302.8	377.0	303.7	411.9	2,300.6
All Areas	**738.6**	**726.9**	**484.2**	**636.6**	**960.0**	**706.8**	**4,253.1**

Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

Figure 4-31 shows the amount of halibut PSC mortality taken by BSAI TLA fisheries as a percentage of the 875 mt PSC limit in effect since 2008. As seen in the figure, the BSAI TLA fisheries exceeded their halibut PSC limit in 2012. In 2012 there was a large increase taken in IPHC Area 4A, and as seen in Table 4-40, there were big increases in halibut PSC mortality in the pollock target fisheries (up nearly 80 mt), in the yellowfin sole target fisheries (up nearly 83 mt), and in the Pacific cod fisheries (up nearly 170 mt).

Figure 4-31 Percentage of the 2014 Halibut PSC Limit Harvested in BSAI TLA fisheries, by IPHC Area



Source: Developed by Northern Economics using AKFIN data (Fey 2014).

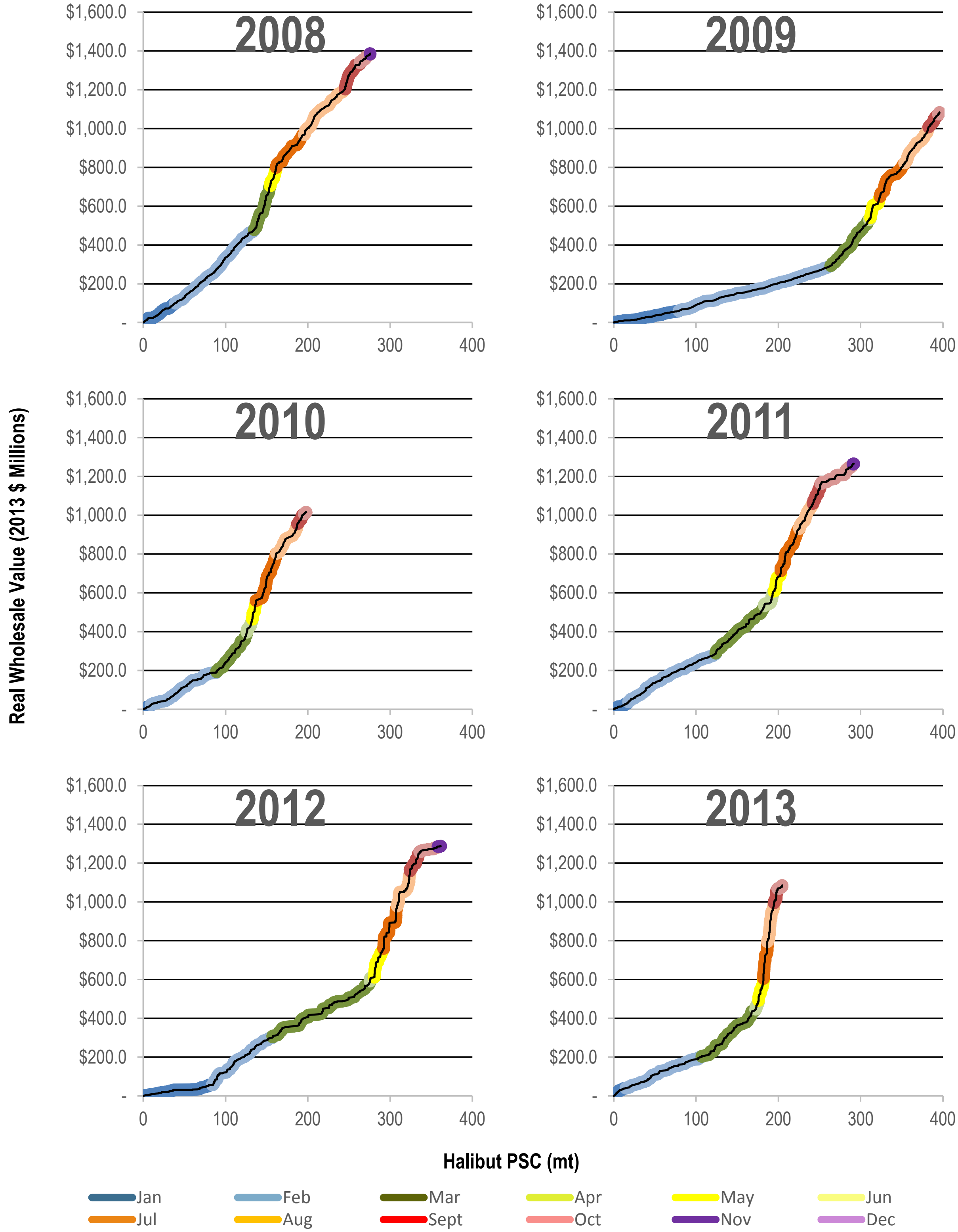
4.4.3.5 Groundfish Wholesale Revenues Generated per Ton of Halibut PSC in BSAI TLA Fisheries

This section summarizes wholesale revenue per halibut PSC for the three major BSAI TLA target fisheries using annual catch progression charts that were initially developed and described in section 4.4.1.4. As previously discussed, as the catch progression lines becomes steeper, more wholesale revenue is being earned per halibut PSC. Conversely, the flatter the line becomes, the less wholesale revenue is earned per halibut PSC. Figure 4-32 and Figure 4-34 provide catch progression lines for the BSAI TLA pollock and Pacific cod target fisheries for each year from 2008 to 2013, while Figure 4-33 shows the six-year average catch progression—the relatively small number of vessels operating in the BSAI TLA yellowfin sole fishery precludes annualized versions of the catch progress lines. All of the figures provided show considerable year-over-year variation and variation across targets.

Figure 4-32 summarizes annual catch progressions for the BSAI TLA pollock target fishery. The pollock fishery appears to earn less wholesale revenue per halibut PSC in the beginning of the year, and progressively gets better in the latter part of the year (as indicated by the steeper line). Both wholesale revenue and halibut PSC appear to remain relatively constant in each year. The fact the catch progression lines for the pollock fishery are relatively flat during the lucrative roe season is undoubtedly an indication that factors other than revenue and halibut PSC contribute to decisions to participate in any given fishery—other factors are likely to include catch per unit of effort and operating costs. Further we also note that in spite of the relative flatness of the lines during January and February, the pollock fishery was generating an average of between $1.1 and $3.5 million in wholesale revenue per ton of halibut PSC during these two months—far more revenue per halibut PSC than any other fishery for which PSC limit reductions are being considered.

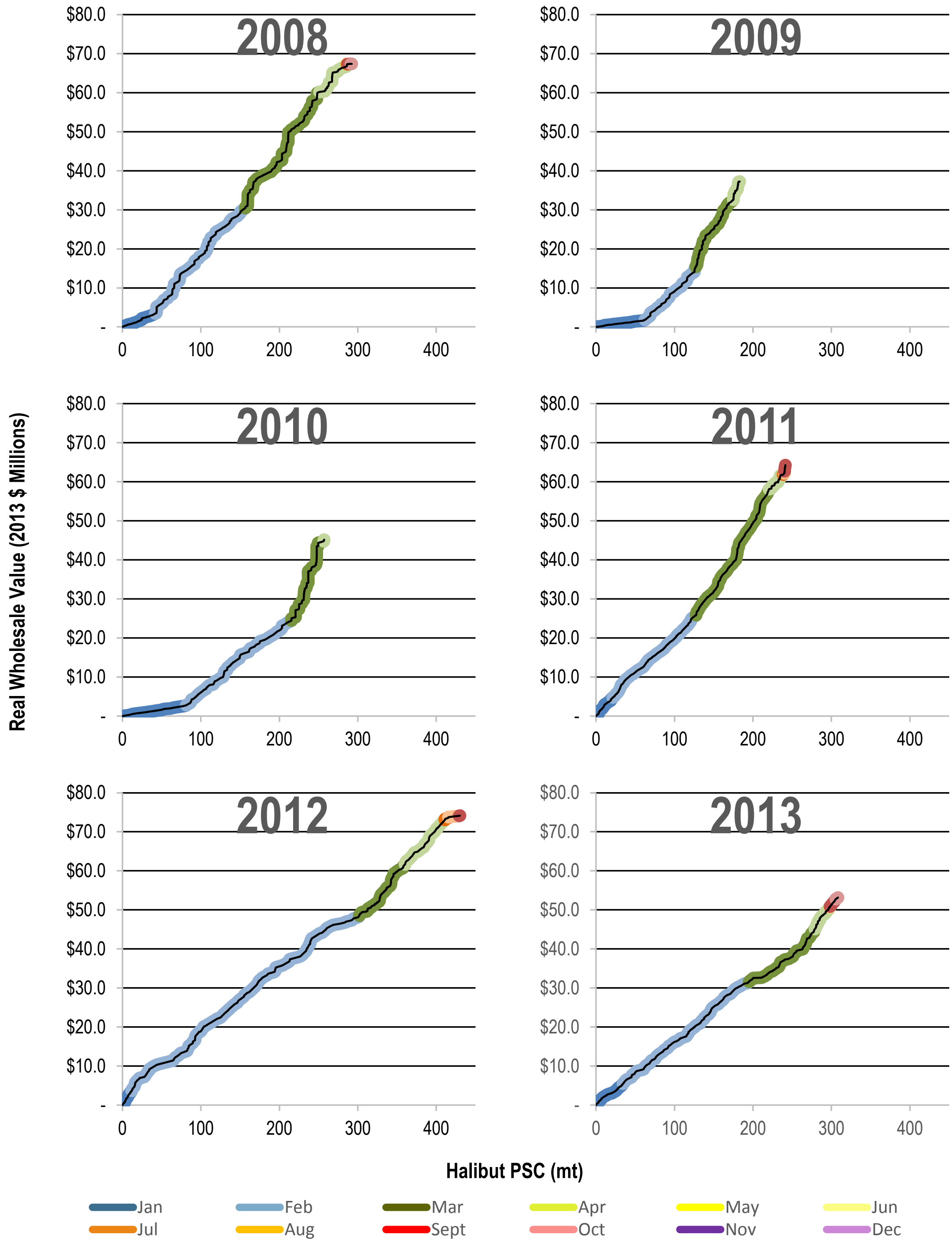
In Figure 4-33, we see that in four of the six years the Pacific cod fishery maintains a relatively consistent slope (the exceptions were in 2009 and 2010), indicating wholesale revenue per halibut PSC stays relatively consistent throughout the year, with most fishing occurring in the early part of the year. In 2009, total wholesale revenue in the Pacific cod target fishery failed to reach $40 million. Total wholesale revenue between 2008 and 2013 ranged from $74 million to $34 million, as previously summarized in Table 4-35. Halibut PSC ranged from a low of 183 mt in 2009 to a high of 430 mt in 2012, as summarized in Table 4-40.

Figure 4-32 Annual Progression of Wholesale Revenues and Halibut PSC in the BSAI TLA Pollock Target Fishery



Source: Developed by Northern Economics using AKFIN data (Fey 2014).

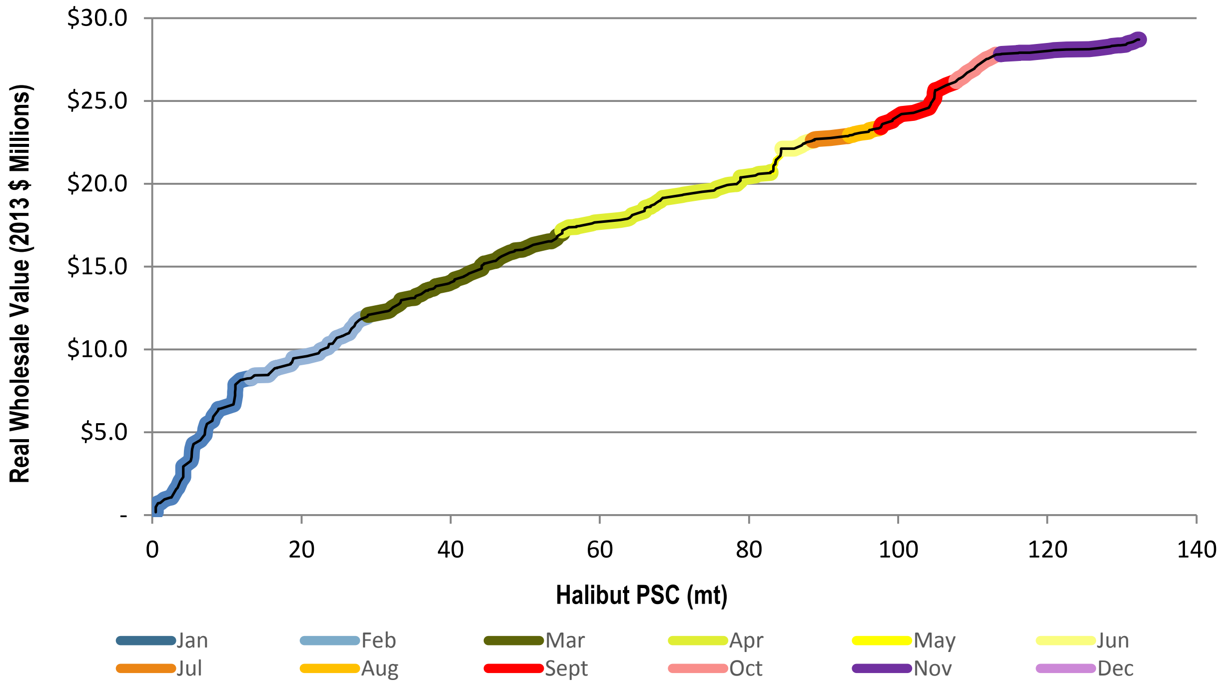
Figure 4-33 Annual Progression of Wholesale Revenues and Halibut PSC in the BSAI TLA Pacific Cod Target Fishery



Source: Developed by Northern Economics using AKFIN data (Fey 2014).

Annual catch progression lines such as those shown for the BSAI TLA target fisheries for pollock and Pacific cod, cannot be provided for the yellowfin sole fishery due to confidentiality constraints. In Figure 4-34, we have created an "annual average" catch progression chart, which combine PSCs and wholesale revenues within each month over the 6-year period from 2008 to 2013. We note that even with all 6-years combined, small adjustments had to be made to protect confidential information in two of the months. While the inter-annual variability is lost, some of the monthly trends with respect to wholesale revenues per halibut are still revealed. In particular, during the month of January, wholesale revenues per halibut PSC are relatively high while in November wholesale revenues per halibut PSC are relatively low.

Figure 4-34 Average Progression of Wholesale Revenues and Halibut PSC in the BSAI TLA Yellowfin Sole Target Fishery by Month from 2008 to 2013



Source: Developed by Northern Economics using AKFIN data (Fey 2014).

Table 4-42 summarizes average wholesale revenue generated per ton of halibut mortality in each of the four target fishery groups for the BSAI TLA fisheries. This measure is an indication of how much wholesale revenue the average participant in the BSAI TLA fisheries would have to give up during an average trip if they were required to reduce halibut mortality by one mt. The numbers shown in the table are calculated by summing the wholesale revenue for the target group and year and then dividing by the halibut morality for the same target group over the entire year. It should be noted that there is significant variability in halibut encounter rates year-over-year and from vessel to vessel. There is also significant variability in the wholesale value generated per halibut PSC in any given fishery.

It is clear that the wholesale revenue generated per ton of halibut mortality in the pollock fisheries (averaging $4.17 million per ton from 2008 to 2013) is significantly higher than is generated in the other BSAI TLA target fisheries. Wholesale revenue per ton of halibut PSC in the BSAI TLA Pacific cod fisheries averaged $250,000 from 2008 to 2013, while the yellowfin sole fishery generated an average $200,000 per ton of halibut mortality. As previously mentioned, using this average value to estimate impacts from halibut PSC reductions could result in significant estimation errors of the impacts PSC limit reduction options.

Table 4-42 Average Wholesale Revenue per Ton of Halibut PSC Mortality in BSAI TLA Target Fisheries, 2008 to 2013

	2008	2009	2010	2011	2012	2013	Average
Target Group	**Average Wholesale Revenue Per Halibut PSC Ton (in millions of 2013 $ per mt)**						
Pollock|Atka Mackerel|Other Species	$5.09	$2.74	$5.13	$4.35	$3.72	$5.30	$4.17
Pacific Cod	$0.13	$0.11	$0.78	$0.40	$0.29	$0.24	$0.25
Yellowfin Sole	$0.23	$0.20	$0.18	$0.27	$0.17	$0.17	$0.20
All Other Targets	$0.10	$0.07	$0.65	$0.14	$0.20	$0.36	$0.14
All Targets	**$2.01**	**$1.56**	**$2.24**	**$2.15**	**$1.50**	**$1.73**	**$1.82**

Source: Developed by Northern Economics using AKFIN data (Fey 2014).

4.4.3.6 Measures of Halibut PSC Mortality and Encounters

Table 4-23 summarizes the key factors that result in the total amount of halibut PSC in the BSAI TLA target fisheries. By changing any one of the factors the sector can change total halibut PSC. It should be reiterated that Total PSC = Groundfish × Halibut Encounter Rate × DMR. Changes in any of the three factors will change total PSC, noting that changes in halibut encounters will change the halibut encounter rate, and thus change total PSC as well.

Table 4-43 Measures of Halibut Mortality and Encounters in A80-CP Target Fisheries and Impacts of a 10 Percent Change in any of the Three Key Factors

Sector and Target	2008	2009	2010	2011	2012	2013
			Total Groundfish (mt)			
All A80-CP Targets	**946,435**	**780,551**	**780,306**	**1,162,839**	**1,175,565**	**1,219,601**
Pollock|Atka Mackerel|Other	879,546	729,446	723,673	1,084,885	1,084,210	1,119,770
Pacific Cod	38,169	31,504	31,294	40,984	48,380	45,335
Yellowfin Sole	28,053	18,555	24,260	35,834	41,883	52,387
			Halibut Encounter (kg)			
All A80-CP Targets	**955,579**	**932,234**	**641,296**	**818,505**	**1,242,433**	**916,359**
Pollock|Atka Mackerel|Other	324,556	485,732	243,010	350,135	438,793	248,476
Pacific Cod	417,976	261,458	362,022	339,936	605,757	434,275
Yellowfin Sole	210,403	182,451	35,720	124,103	197,294	229,334
			Halibut Encounter Rate (kg halibut / mt of Groundfish)			
All A80-CP Targets	1.0	1.2	0.8	0.7	1.1	0.8
Pollock|Atka Mackerel|Other	0.4	0.7	0.3	0.3	0.4	0.2
Pacific Cod	11.0	8.3	11.6	8.3	12.5	9.6
Yellowfin Sole	7.5	9.8	1.5	3.5	4.7	4.4
			Average DMR (percentage)			
All A80-CP Targets	**77**	**78**	**76**	**78**	**77**	**77**
Pollock|Atka Mackerel|Other	85	82	81	83	84	82
Pacific Cod	70	70	71	71	71	71
Yellowfin Sole	80	80	81	81	81	83
Change in Halibut PSC by Target Given a 10 Percent Reduction in Total Groundfish, Halibut Encounter Rates, or DMR (percent)						
All A80-CP Targets	**73.9**	**72.7**	**48.4**	**63.7**	**96.0**	**70.7**
Pollock|Atka Mackerel|Other	27.6	39.6	19.8	29.2	36.9	20.5
Pacific Cod	29.3	18.3	25.7	24.1	43.0	30.8
Yellowfin Sole	16.8	14.6	2.9	10.0	16.0	19.0

Note that Total PSC = Groundfish × Halibut Encounter Rate × DMR.

Source: Developed by NEI based on data from AKFIN (Fey 2014)

4.4.3.7 Reliance of BSAI TLA Vessels on BSAI Groundfish and Diversification of BSAI TLA Vessels into Other Fisheries

Vessels participating in the BSAI TLA fisheries also participate in a relatively limited way in other fisheries throughout the state and on the West Coast. The level of participation in other fisheries is important because it provides context regarding the relative importance of the groundfish fisheries that are affected by the proposed alternatives to reduce halibut PSC Limits. Table 4-44 through Table 4-47 summarize activities in fisheries other than BSAI TLA fisheries in which these vessels are active. Table 4-44 summarizes other fishery activities in Alaska and the U.S. West Coast for all vessels in the BSAI TLA from 2008 to 2013. The other three remaining tables summarize activities for each of the three component fleets.

As shown in Table 4-44, BSAI TLA vessels were active in several other fisheries, and from 2008 to 2013 generate an average of $167 million in wholesale and ex-vessel revenues[30] in these other fisheries. These other revenues increase the total revenue generated by the BSAI TLA vessels by approximately 21 percent over the revenues generated in the BSAI TLA alone. It should be noted that 76 percent of all non-BSAI TLA revenues were generated in BSAI Groundfish CDQ fisheries, which are also subject to change under the proposed halibut PSC limit reductions.

In 2013, AFA-CPs accounted for 74 percent of all additional revenues earned from BSAI TLA vessels in other fisheries. AFA-CPs participate in CDQ Groundfish fisheries and other West Coast fisheries. AFA-CVs' participation rate in other fisheries is the highest of the three fleet components, with 39 vessels participating in the GOA Groundfish and West Coast fisheries in 2013.

Table 4-44 Total BSAI TLA Vessels Participating Other Fisheries, 2008 to 2013

	2008	2009	2010	2011	2012	2013
Number of BSAI TLA Vessels Participating Other Fisheries						
BSAI Pot Groundfish	-	-	1	-	-	-
CDQ Groundfish	19	17	12	17	18	18
All Halibut	3	4	5	2	2	1
All Fixed Gear Sablefish	2	2	2	-	-	-
GOA Groundfish	30	33	29	33	30	28
AK Salmon	1	6	3	2	2	2
All Other AK Fisheries	3	4	4	5	4	4
West Coast Fisheries	35	30	34	31	25	26
Additional Revenue of BSAI TLA Vessels in All Other Fisheries						
All Other Fisheries	$170.1	$124.0	$145.4	$187.9	$197.0	$177.8

Note: For CPs, wholesale revenue is used in the revenue calculations; for CVs ex-vessel revenue is used.
Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

[30] The revenue information in the diversity tables summarizes wholesale revenue if the vessel is a CP and ex-vessel revenue if the vessel is a CV.

Table 4-45 Number of AFA-CPs Participating Other Fisheries, 2008 to 2013

	2008	2009	2010	2011	2012	2013
Number of AFA-CPs Participating Other Fisheries						
BSAI Pot Groundfish	-	-	-	-	-	-
CDQ Groundfish	12	12	12	15	15	15
All Halibut	-	-	-	-	-	-
All Fixed Gear Sablefish	-	-	-	-	-	-
GOA Groundfish	-	-	-	-	-	-
AK Salmon	-	-	-	-	1	-
All Other AK Fisheries	-	-	-	-	-	-
West Coast Fisheries	8	4	6	9	9	9
Wholesale Revenue of AFA-CPs in All Other Fisheries						
All Other Fisheries	$135.5	$94.7	$107.8	$138.5	$149.7	$131.0

Table developed by Northern Economics using AKFIN data (Fey 2014).

Table 4-46 Number Vessels AFA-CVs Participating Other Fisheries, 2008 to 2013

	2008	2009	2010	2011	2012	2013
Number Vessels AFA-CVs Participating Other Fisheries						
BSAI Pot Groundfish	-	-	-	-	-	-
CDQ Groundfish	6	4	-	-	-	-
All Halibut	2	3	3	2	2	1
All Fixed Gear Sablefish	1	1	-	-	-	-
GOA Groundfish	22	24	22	23	23	22
AK Salmon	-	-	-	-	-	-
All Other AK Fisheries	2	2	2	3	3	2
West Coast Fisheries	25	23	26	20	16	17
Ex-Vessel of AFA-CV Revenue in All Other Fisheries						
All Other Fisheries	$29.0	$22.4	$30.6	$38.5	$38.4	$39.8

Table developed by Northern Economics using AKFIN data (Fey 2014).

Table 4-47 Number of Non-AFA Trawl CVs Participating Other Fisheries, 2008 to 2013

	2008	2009	2010	2011	2012	2013
Number of non-AFA Trawl-CVs Participating Other Fisheries						
BSAI Pot Groundfish	-	-	1	-	-	-
CDQ Groundfish	1	1	-	2	3	3
All Halibut	1	1	2	-	-	-
All Fixed Gear Sablefish	1	1	2	-	-	-
GOA Groundfish	8	9	7	10	7	6
AK Salmon	1	6	3	2	1	2
All Other AK Fisheries	1	2	2	2	1	2
West Coast Fisheries	2	3	2	2	-	-
Ex-Vessel Revenue in All Other Fisheries						
All Other Fisheries	$5.7	$6.9	$7.0	$10.9	$9.0	$7.0

Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

4.4.4 Longline Catcher Processors

Longline CPs operating in the BSAI primarily participate in the Pacific cod fishery and are apportioned 48.7 percent of the BSAI Pacific cod TAC, after subtraction of the CDQ reserve. In addition to Pacific cod, few other target species exist, with the exception of the IFQ sablefish fishery.[31] The longline CPs produce higher-value products that compensate for the lower catch volumes compared to trawl vessels.

The BSAI Pacific cod allocation for the longline CP sector in combination with a closed class of license holders, created an opportunity for these license holders to form a voluntary fishing cooperative to divide the sector's allocation of Pacific cod among members of the cooperative through private contractual agreements. The Freezer Longline Conservation Cooperative (FLCC) was incorporated on February 26, 2004. By June 2010, through private negotiations and a federally funded license buyback loan, the owners of all longline CPs endorsed for BSAI Pacific cod had become members of the FLCC (NPFMC 2012, 2013b). It is important to note that FLCC is not regulated by NMFS, with allocations being apportioned to the sector, and not the cooperative. Further details regarding the FLCC are provided in Section 4.4.4.8.

4.4.4.1 Description of Participants in the Longline CP Fisheries

Longline CP Harvesting Vessels in Longline CP Target Fisheries

Table 4-48 summarizes the number of unique vessels fishing in the longline CP fishery. Between 2008 and 2013, 43 unique longline CPs participated in the BSAI Groundfish fishery. To determine unique vessel counts, the study team counted each active vessel in a year once. The number of unique vessels participating in the longline CP fishery has steadily declined from 39 in 2008 to 31 by 2013. A large reduction in the number of participating longline CPs occurred in 2011 across both target species, likely due to the full implementation of the FLCC, and the rationalization that the cooperative enabled.

Table 4-48 Types and Numbers of Vessels Participating in BSAI Target Fisheries of Longline CPs, 2008 to 2013

	2008	2009	2010	2011	2012	2013	2008 to 2013
Pacific Cod	39	38	36	30	31	29	42
All other targets but Sablefish	7	10	13	10	7	7	20
All Targets	**39**	**38**	**38**	**32**	**31**	**31**	**43**

Source: Developed by Northern Economics using AKFIN data (Fey 2014).

Table 4-49 summarizes the longline CP ownership by region. Of the 43 unique vessels participating in the longline CP fishery between 2008 and 2013, 9 were registered to owners in Alaska. Alaskan-owned longline CPs tend to also participate for Pacific cod in the CDQ cod fishery.

Table 4-49 Longline CP Vessel Owner's Place of Residence, 2008 to 2013

	2008	2009	2010	2011	2012	2013	Unique Vessels
Region	Number of Participating Vessels						
NW Alaska	-	-	-	-	-	-	-
SW Alaska	-	-	-	-	-	-	-
Other Alaska	3	3	8	8	7	7	9
Other U.S.	36	35	30	24	24	24	39
Total	39	38	38	32	31	31	43

Source: Developed by Northern Economics using AKFIN data (Fey 2014).

[31] Because the halibut bycatch in the IFQ Sablefish fishery is exempt from PSC limits, this analysis treats the participation in the sablefish fishery differently from participation in the Greenland turbot fishery, for example.

Participation and earnings for vessels and crew in the LGL-CP fisheries are summarized in Table 4-14. As previously discussed, the number of vessels operating in LGL-CP target fisheries declined substantially in 2011, likely due to the implementation of their cooperative, the FLCC. In addition to the decrease in active vessels, the number of months fished by active vessels increased slightly in 2011 and thereafter. On average between 2008 and 2013, LGL-CPs paid out nearly $60 million to an estimated average of 1,278 crew and officers—approximately $43,500 in income per person.

We reiterate here that while estimates of the number of crew members on board vessels each week are reported voluntarily in daily production reports provided to NMFS, the average number of persons in crew rotations is based on data collected in EDRs for the A80-CP fleet. A80-CPs, which operate a similar number of months per year, have similar season lengths. In addition, the estimated crew share percentage (of wholesale revenue) is assumed based on the analysts' experience and expertise—there are no data officially collected regarding payments to crew members. If a 40 percent crew share percentage had been assumed, the average income earned per person would have increased to an average of $49,769 per person. Similarly, if the ratio of crew members on board to the number of persons in crew rotations was lower, the average payments to persons in crew rotation would be higher. Public review comments on these issues would improve the accuracy of the estimates.

Table 4-50 Summary of Participation and Earnings in the BSAI by Vessels and Crew in LGL-CP Fisheries

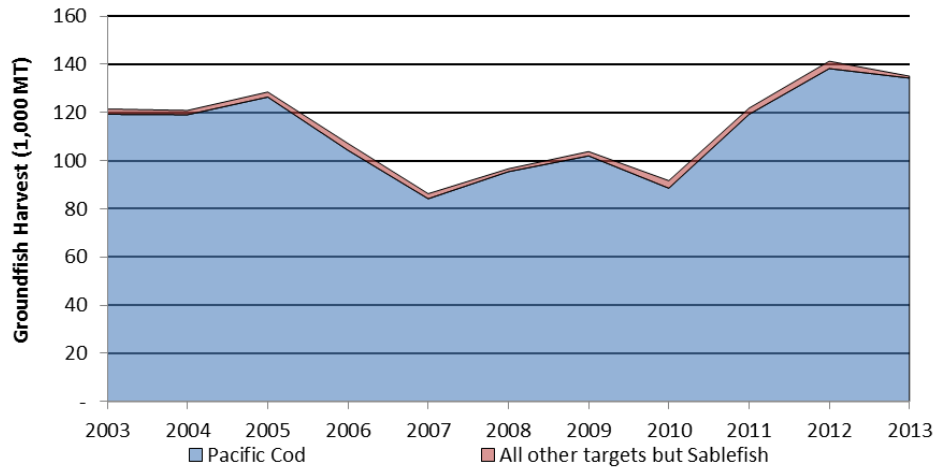
	2008	2009	2010	2011	2012	2013	6-Year Average
Number of Active Vessels	39	38	38	32	31	31	35
Average Crew Size (Incl. Officers)	19.0	18.8	18.6	19.4	19.7	19.9	19.2
Average Operating Months	7.3	7.7	7.2	9.5	9.9	9.3	8.5
Average Persons in Crew Rotation per Vessel	33.4	34.7	30.7	39.3	44.0	40.7	37.1
Total Persons in Crew Rotation in Sector	1,304.4	1,319.7	1,165.0	1,257.9	1,362.8	1,260.2	1,278.3
Crew Share Percentage	35%	35%	35%	35%	35%	35%	35%
Total Payments to Crew and Officers (2013 $ Millions)	$67.5	$46.4	$44.9	$62.6	$65.9	$46.6	$55.7
Average Income Earned per Person (2013 $)	$51,764	$35,186	$38,547	$49,796	$48,370	$36,969	$43,548

Note: Operating Months, Crew Payments and Total Revenues include time spent and revenue generated when fishing CDQ allocations.
Source: Developed by Northern Economics using AKFIN data (Fey 2014 and A80-CP Economic Data Report data (Fissel 2014).

4.4.4.2 Catch and Revenue in Longline CP Target Fisheries

Figure 4-35 and Table 4-51 summarize total harvest in the longline CP fishery. Within the fishery, Pacific cod was targeted 98 percent of the time, with the remaining 2 percent to All Other Targets but Sablefish. Greenland turbot was the primary focus of the "Other Targets", generating 94 percent of the revenue in that group of target fisheries. Total harvest decreased 30 percent in 2006 and 2007, and then remained relatively flat until increasing again in 2011. In 2012, total harvest exceeded 140,000 mt. A five percent decrease in total harvest is seen in 2013. Between 2008 and 2013, the longline CP fishery harvested approximately 25 percent of all of the total non-pollock harvests by volume of all groups affected by the PSC limit reduction alternative.

Figure 4-35 Groundfish Harvests in Target Fisheries of Longline CPs, 2003 to 2013



Source: Figure developed by Northern Economics using AKFIN data (Fey 2014).

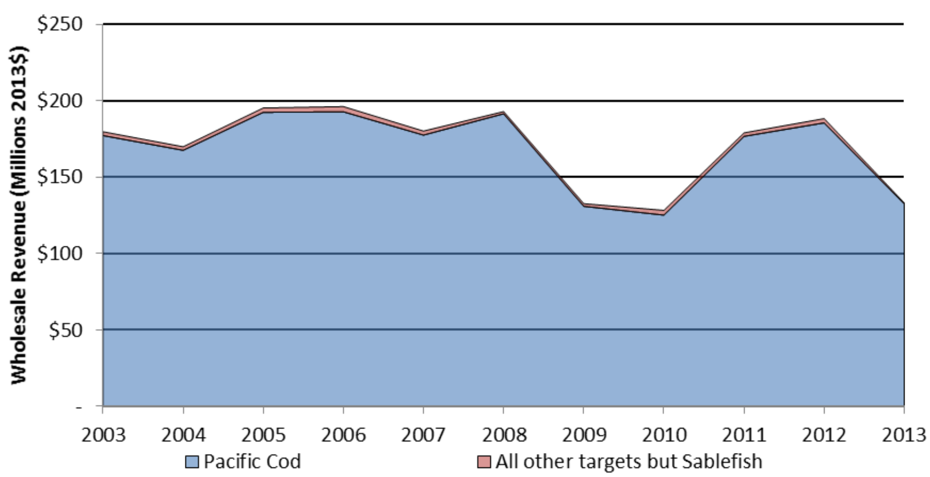
Table 4-51 Groundfish Harvest in Longline CP Target Fisheries, 2008 to 2013

	2008	2009	2010	2011	2012	2013	Total
Target Group	**Metric Tons of Groundfish (of All Species) Harvested in Longline CP Target Fisheries**						
Pacific Cod	95.46	102.00	88.60	119.26	138.26	134.29	677.87
All other targets but Sablefish	1.19	1.77	3.10	2.57	3.07	0.82	12.52
All Targets	**96.66**	**103.78**	**91.70**	**121.83**	**141.33**	**135.11**	**690.41**

Source: Developed by Northern Economics using AKFIN data (Fey 2014).

Figure 4-36 and Table 4-52 summarize total wholesale revenues in the longline CP fishery. As can be seen in the figure, wholesale revenues remained stable from 2005 through 2007, despite declines in total harvest. Wholesale revenues dropped below $130 million in 2009 and 2010, likely due to effects from the global recession. Wholesale revenues recovered in 2011 and 2012 before declining 30 percent in 2013. It is not entirely clear at this point what is causing the sudden drop in wholesale revenues in 2013. We note similar declines have occurred in other fisheries, not just in the longline CP fishery, and not just for Pacific cod.

Figure 4-36 Wholesale Revenue in Target Fisheries of Longline CPs, 2003 to 2013



Source: Figure developed by Northern Economics using AKFIN data (Fey 2014).

Table 4-52 Real Wholesale Revenue in Target Fisheries of Longline CPs, 2008 to 2013

	2008	2009	2010	2011	2012	2013	Total
Target Group	**Wholesale Revenue (in millions of 2013 $)**						
Pacific Cod	$191.45	$130.93	$125.20	$176.72	$185.55	$132.50	$942.36
All other targets but Sablefish	$1.47	$1.74	$3.10	$2.25	$2.78	$0.62	$11.95
All Targets	**$192.92**	**$132.67**	**$128.30**	**$178.97**	**$188.33**	**$133.11**	**$954.31**

Source: Developed by Northern Economics using AKFIN data (Fey 2014).

4.4.4.3 Regional Impacts of Longline CPs

Table 4-53 summarizes the distribution of wholesale revenues generated by longline CPs between Alaska and other states. These data assign revenue to states based on the vessel owner’s address on record in the ADF&G vessel files. In general, the proportion of the amount of Alaska-based revenue has increased. In 2008 and 2009, Alaska-based vessels generated 7.3 percent of the fleet’s wholesale revenue, but from 2010 to 2013 Alaska’s share jumped to 18.4 percent.

Table 4-53 Distribution of Wholesale Revenue from Longline CP Fisheries

	2008	2009	2010	2011	2012	2013	Average
	Wholesale Value by Vessel Owner's Region ($Millions 2013)						
Other States	$179.61	$122.06	$106.71	$145.68	$150.73	$109.77	$135.76
Alaska	$13.31	$10.61	$21.60	$33.29	$37.60	$23.34	$23.29
Total	**$192.92**	**$132.67**	**$128.30**	**$178.97**	**$188.33**	**$133.11**	**$159.05**

Source: Developed by Northern Economics using AKFIN data (Fey 2014).

4.4.4.4 Halibut PSC Limits and Halibut PSC Mortality in Target Fisheries of Longline CPs

Halibut PSC limits in the longline CP fisheries are apportioned to the sector as a whole. This differs from apportionment to A80 cooperatives, which are regulated by NMFS. Under NMFS regulation, apportionment of halibut PSC is directly assigned to each cooperative by NMFS. However, the creation of FLCC allowed for the sector-wide apportionment of halibut PSC mortality to be distributed similarly to A80 cooperatives, in that halibut PSC mortality is apportioned based on the groundfish catch histories of the member vessels. This type of organizational structure potentially presents efficiency gains in managing halibut PSC.

Halibut PSC limits for the longline CP target fisheries are shown in Table 4-54. The PSC limit for the Pacific cod fishery is allocated exclusively to longline CPs, while the PSC limit for all other target fisheries (excluding sablefish) is shared with the longline CPs. While longline CPs have some level of participation in these other target fisheries, longline CVs do not. PSC limits have remained unchanged since 2008.

Table 4-54 Halibut PSC Limits and Apportionment to Longline CP Target Fisheries, 2008 to 2013

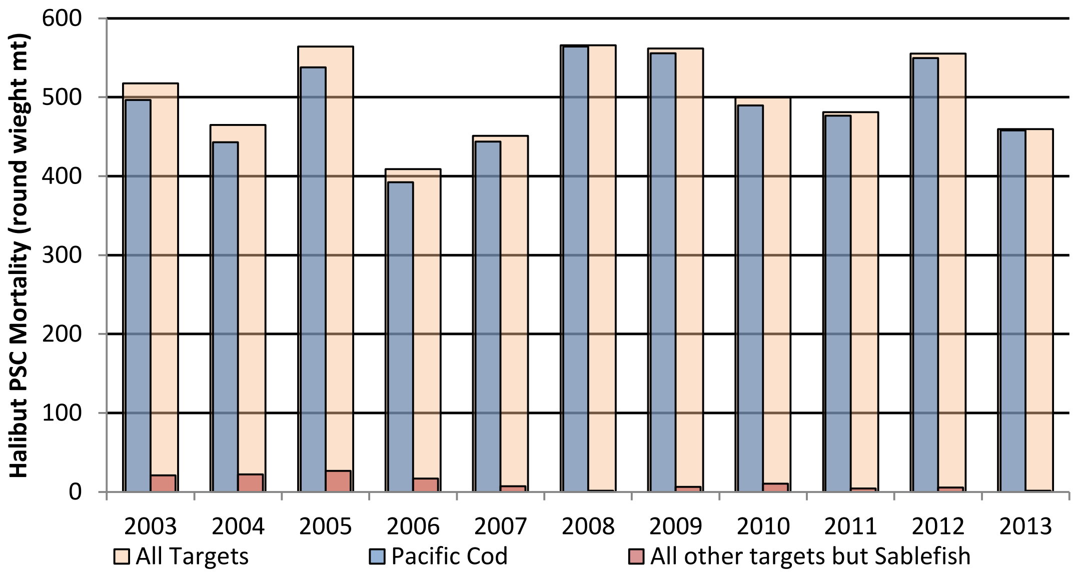
Target Group	2008	2009	2010	2011	2012	2013
	Halibut PSC Limit (in Round Weight mt)					
Pacific Cod	760	760	760	760	760	760
All other Hook and Line Target Fisheries excluding Sablefish	58	58	58	58	58	58

Note: Technically, the PSC limit for all other longline fisheries except sablefish applies to both longline CPs and longline CVs. However, longline CVs have had no recorded activity in these other fisheries from 2008 to 2013.

Source: Developed by Northern Economics using AKFIN data (Fey 2014).

Figure 4-37 and Table 4-55 summarize total halibut mortality in the longline CP target fisheries. Between 2008 and 2013, total halibut mortality remained relatively stable, averaging just over 500 tons annually. Between 2008 and 2013, the longline CP fisheries had 3,100 tons of halibut PSC mortality, almost entirely in the Pacific cod target fishery, as shown in Table 4-55. As aforementioned, the present analysis of halibut mortality excludes participants in the IFQ and CDQ fixed gear fisheries for sablefish, as they are exempt from the PSC limits.

Figure 4-37 Halibut PSC Mortality in Longline CP Target Fisheries, 2003 to 2013



Source: Developed by Northern Economics using AKFIN data (Fey 2014).

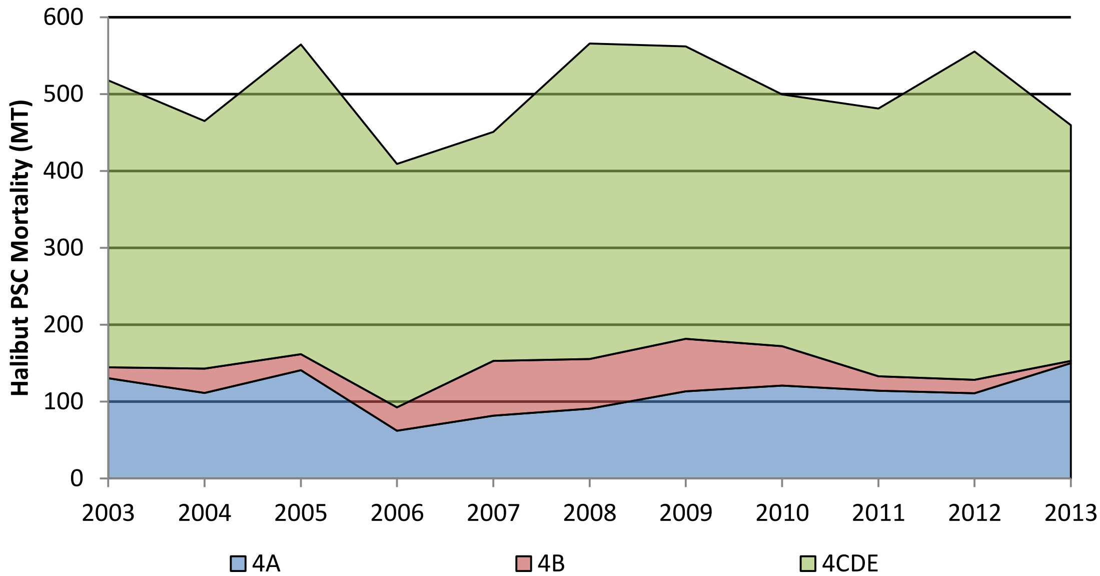
Table 4-55 Halibut PSC Mortality in Longline CP Target Fisheries, 2008 to 2013

	2008	2009	2010	2011	2012	2013	Total
Target Group	**Halibut PSC Mortality (in Round Weight mt)**						
Pacific Cod	564.3	555.6	489.4	476.7	549.5	458.1	3,093.7
All other targets but Sablefish	1.3	6.4	10.3	4.5	5.7	1.4	29.6
All Targets	**565.7**	**562.0**	**499.7**	**481.2**	**555.2**	**459.5**	**3,123.2**

Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

Figure 4-38 and Table 4-56 summarize halibut PSC mortality taken in the longline CP fishery. Between 2008 and 2013, halibut PSC mortality averaged 520 mt—approximately 15 percent of total halibut PSC mortality taken in the all of the fisheries for which reductions in PSC limits are being considered. Over the same time period, 70 percent of halibut PSC mortality was taken from IPHC Area 4CDE, 23 percent from 4A, and 7 percent from 4B. As shown in the figure below, halibut mortality in the longline CP fishery remained relatively constant among IPHC areas.

Figure 4-38 Halibut PSC Mortality in Longline CP Fisheries by IPHC Area



Source: Figure developed by Northern Economics using AKFIN data (Fey 2014).

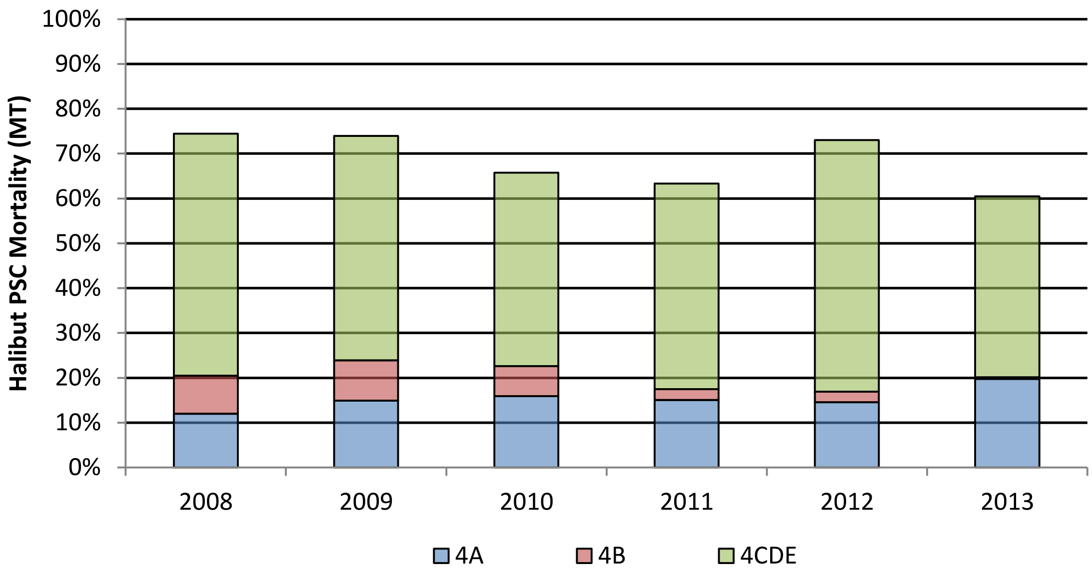
Table 4-56 Halibut PSC Mortality in Longline CP Fisheries, by IPHC Area, 2008 to 2013

	2008	2009	2010	2011	2012	2013	Total
IPHC Area	**Halibut PSC Mortality (in Round Weight mt)**						
IPHC Area 4A	90.8	113.2	121.0	114.2	110.7	149.9	699.9
IPHC Area 4B	64.6	68.4	51.0	18.7	17.7	3.0	223.4
IPHC Areas 4CDE	410.3	380.4	327.7	348.3	426.7	306.5	2,199.9
All Areas	**565.7**	**562.0**	**499.7**	**481.2**	**555.2**	**459.5**	**3,123.2**

Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

The percentage of the halibut PSC limit for the Pacific cod fishery (760 mt) taken from 2008 to 2013 by longline CPs is shown in Figure 4-39. Since 2008, the longline CP fishery has taken an average of 68 percent of its halibut PSC limit. In three of the years (2008, 2009, and 2012) halibut PSC mortality exceeded 70 percent of the limit, while in two of the years, less than 65 percent was taken (2011 and 2013). Reductions in halibut PSC mortality in IPHC areas 4B and 4CDE helped push the percent of halibut taken in 2013 down to just over 61 percent. Any potential halibut PSC limit reductions in the BSAI Groundfish fishery would need to be large to impact the longline CP fishery as their halibut PSC mortality has been consistently below the fishery's halibut PSC apportionment. While not shown in the figure, longline CP halibut PSC mortality in all other target fisheries (excluding sablefish) has been less than 10 percent of the 58 mt PSC limit, with the exception of 2010 when 17.5 percent was taken.

Figure 4-39 Percentage of 2014 Halibut PSC Limits for Pacific Cod Taken by Longline CP, 2008 to 2013

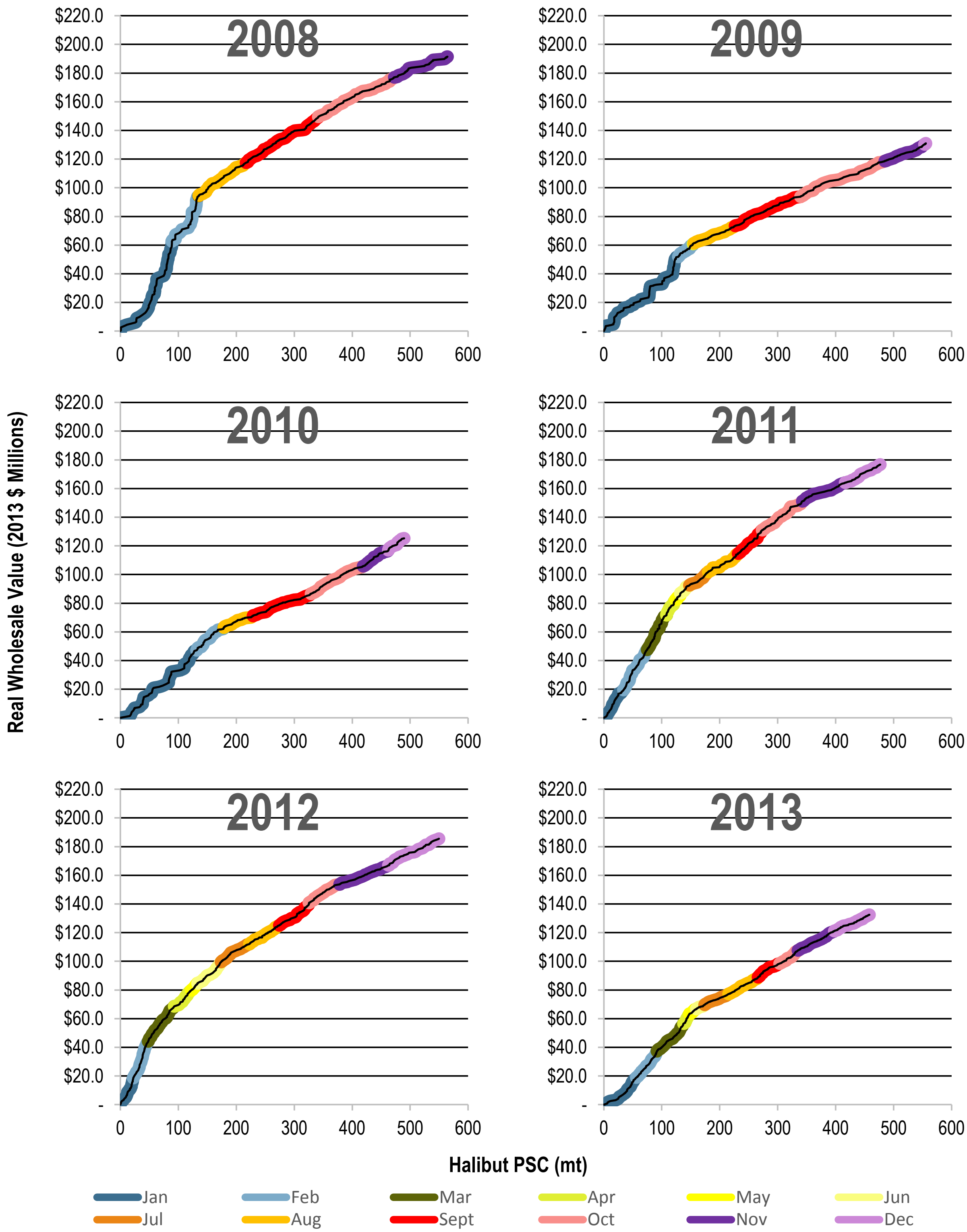


Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

4.4.4.5 Groundfish Wholesale Revenues Generated per Ton of Halibut PSC in LGL-CP Fisheries

As highlighted in section 4.4.4.2, Pacific cod was targeted in 98 percent of the fishery-month-area catch records of LGL-CP from 2008 and 2013. Therefore, catch progression lines for the Pacific cod target fishery are presented in Figure 4-40, but a catch progression line for "all other target fisheries" is not provided. As seen in the figure, the wholesale revenue per halibut PSC remains relatively constant over the years—all exhibit a slightly convex shape indicating that fishing in the beginning of the year typically generates the highest wholesale revenue per halibut PSC. Wholesale revenue and halibut PSC were highest in 2008, at $191 million and 564 mt, respectively. Wholesale revenues and halibut PSC reached their lowest in 2013 at $133 million and 458 mt, respectively. While variations in wholesale revenues from year to year appear to be substantial, the amount of halibut PSC taken in the LGL-CP Pacific cod fishery remains relatively stable year over year.

Figure 4-40 Annual Progression of Wholesale Revenues and Halibut PSC in the LGL-CP Pacific Cod Target Fishery



Source: Developed by Northern Economics using AKFIN data (Fey 2014).

Table 4-57 summarizes the average wholesale revenue per ton of halibut PSC mortality in the longline CP fishery between 2008 and 2013. This measure is an indication of how much wholesale revenue the average participant in the longline CP fishery would have to give up during an average trip if they were required to reduce their halibut PSC mortality by a single mt. The numbers shown in the table are calculated by summing the wholesale revenue for the target group and year and then dividing by the halibut PSC mortality for the same target group and year. It should be noted that because there is significant variability in halibut PSC mortality rates over the course of the year and across vessels, there is also significant variability in the wholesale value generated per ton of halibut mortality in a given fishery.

Wholesale revenue per ton of halibut mortality in the longline CP target fishery for Pacific cod averaged $300,000 between 2008 and 2013, as shown in Table 4-57. Small amounts of halibut PSC mortality taken in the “All other targets but sablefish” group in 2008 resulted in a wholesale revenue per ton of halibut of $1.10 million. However, the overwhelming majority of participation takes place in the Pacific cod target fishery, which drives the average revenue per ton. The lowest average wholesale revenues per ton of halibut PSC mortality occurred in 2009 ($240,000) and 2010 ($260,000), primarily due to decreases in wholesale revenues as a result of a global recession. As previously mentioned, using this average value to estimate impacts from halibut PSC reductions could result in gross overestimation or underestimation of impacts due to different methodologies used under different scenarios. These scenarios are discussed later in affected participant sections.

Table 4-57 Wholesale Revenue per Ton of Halibut PSC Mortality in Longline CP Target Fisheries, 2008 to 2013

	2008	2009	2010	2011	2012	2013	Average
Target Group	**Wholesale Revenue Per Ton of PSC (in millions of 2013 $ per mt)**						
Pacific Cod	$0.34	$0.24	$0.26	$0.37	$0.34	$0.29	$0.30
All other targets but Sablefish	$1.10	$0.27	$0.30	$0.50	$0.49	$0.45	$0.40
All Targets	**$0.34**	**$0.24**	**$0.26**	**$0.37**	**$0.34**	**$0.29**	**$0.31**

Source: Developed by Northern Economics using AKFIN data (Fey 2014)

4.4.4.6 Measures of Halibut PSC Mortality and Encounters

Table 4-58 summarizes key factors that result in the total amount of halibut PSC in the LGL-CP target fisheries. The measures described below all contribute to the PSC total. By changing any one of the factors the sector can change total halibut PSC. From a mathematical perspective and assuming that all PSC halibut is discarded, halibut PSC mortality is the multiplicative product of three factors: 1) Groundfish caught (mt); 2) the halibut encounter rate (kg of halibut ÷ groundfish mt); and 3) the halibut discard mortality rate or DMR (the ratio of the volume of halibut that are dead when discarded to the total volume of halibut that are discarded). In other words: PSC (in kg) = Groundfish (mt) × halibut encounter rate (kg/mt) × DMR. A change in any one of these three factors results in a change in halibut mortality. In the last section of the table we show the impact on total PSC of a 10 percent change in any one of the three key factors, noting that a change in halibut encounters will be manifest as a change in the halibut encounter rate, and thus will also generate a change in total PSC.

Table 4-58 Measures of Halibut Mortality and Encounters in LGL-CP Target Fisheries and Impacts of a 10 Percent Change in the Key Factors on PSC Mortality

Sector and Target	2008	2009	2010	2011	2012	2013
Total Groundfish (mt)						
All LGL-CP Targets	96,656	103,779	91,705	121,830	141,330	135,108
Pacific Cod	95,462	102,004	88,602	119,261	138,262	134,292
Halibut Encounter (kg)						
All LGL-CP Targets	5,140,733	5,100,069	4,988,273	4,808,378	5,546,639	5,100,520
Pacific Cod	5,130,405	5,050,592	4,894,122	4,767,494	5,495,032	5,089,970
Halibut Encounter Rate (kg halibut / mt of Groundfish)						
All LGL-CP Targets	53.2	49.1	54.4	39.5	39.2	37.8
Pacific Cod	53.7	49.5	55.2	40.0	39.7	37.9
Average DMR (%)						
All LGL-CP Targets	0.11	0.11	0.10	0.10	0.10	0.09
Pacific Cod	0.11	0.11	0.10	0.10	0.10	0.09
Change in Halibut PSC by Target Given a 10 Percent Reduction in Total Groundfish, Halibut Encounter Rates, or DMR (percent)						
All LGL-CP Targets	56.6	56.2	50.0	48.1	55.5	45.9
Pacific Cod	56.4	55.6	48.9	47.7	55.0	45.8

Note that Total PSC = Groundfish × Halibut Encounter Rate × DMR, and that changes in halibut encounters will change the halibut encounter rate, and thus change Total PSC.
Source: Developed by NEI based on data from AKFIN (Fey 2014)

4.4.4.7 Reliance of Longline CPs on BSAI Groundfish and Diversification of Longline CPs into Other Fisheries

Table 4-59 summarizes participation and wholesale revenues of longline CPs that participate in fisheries outside of the BSAI groundfish fisheries for Pacific cod and "other groundfish targets excluding sablefish." These other fisheries include the CDQ groundfish fisheries, the pot-gear fishery for Pacific cod, the sablefish and halibut fisheries, and longline groundfish fisheries in the GOA. On average, more than a third of vessels participating in the longline CP BSAI Groundfish fisheries between 2008 and 2013 also participated in the CDQ groundfish fishery, GOA groundfish fishery, and fixed gear sablefish fishery. Vessels participating in the longline CP fishery that also participated in the "other fisheries" generated, on average, $52 million in wholesale revenue per year—or approximately 33 percent of wholesale revenue generated in the BSAI longline CP groundfish fisheries.

Table 4-59 Number of Longline CPs Participating in Other Fisheries, 2008 to 2013

	2008	2009	2010	2011	2012	2013
Number of Longline CPs Participating in Other Fisheries						
BSAI Pot Groundfish	3	1	3	2	1	-
CDQ Groundfish	17	17	15	13	11	13
All Halibut	5	5	5	5	1	1
All fixed Gear Sablefish	12	13	16	13	10	6
GOA Groundfish	18	17	18	13	7	3
AK Salmon	-	1	-	-	-	-
All other AK Fisheries	2	2	2	1	2	2
West Coast Fisheries	-	-	-	-	-	-
Longline CP Wholesale Revenue ($2013 Millions)						
Halibut Fisheries	$0.3	$0.4	$0.6	$1.5	NA	NA
All Other Fisheries	$63.7	$42.2	$55.7	$67.3	$48.3	$35.0
BSAI Longline Groundfish Total	$192.92	$132.67	$128.30	$178.97	$188.33	$133.11
Total Revenue by Longline CPs (excludes halibut)	$256.62	$174.87	$184.00	$246.27	$236.63	$168.11
BSAI Longline Groundfish as a Percent of Total	75.2%	75.9%	69.7%	72.7%	79.6%	79.2%

Source: Developed by Northern Economics using AKFIN data (Fey 2014).

4.4.4.8 Longline CP Cooperative

Since 2003, longline CPs have been required to have a Pacific cod longline catcher processor endorsement on their LLP license to target BSAI Pacific cod with longline gear and process it on board. The Consolidated Appropriations Act of 2005 defined eligibility in the longline CP sector as the holder of an LLP license that is transferable, or becomes transferable, and that is endorsed for BS or AI catcher processor fishing activity, Pacific cod, and longline gear (NPFMC 2012).

Each year a BSAI Pacific cod allocation is made to the longline CP sector through the annual harvest specifications process. A sector-specific allocation, in combination with a closed class of license holders, created an opportunity for these license holders to form a voluntary fishing cooperative to divide the sector’s allocation of Pacific cod among members of the cooperative through private contractual agreements. The Freezer Longline Conservation Cooperative (FLCC) was incorporated on February 26, 2004. By June 2010, through private negotiations and a federally funded license buyback loan, the owners of all longline CPs endorsed for BSAI Pacific cod had become members of the FLCC (NPFMC 2012, 2013b). In December 2010, Congress passed the Longline Catcher Processor Subsector Single Fishery Cooperative Act (Pub. L. 111-335) that established a statutory framework for the formation of the cooperative. Under this Act, NMFS must implement a single, mandatory cooperative with exclusive catch privileges for each LLP license holder if requested to do so by persons holding at least 80 percent of the LLP licenses held by longline CPs eligible to participate in the BSAI Pacific cod fishery. A cooperative implemented under the Act would be authorized by NMFS to collectively harvest the total amount of BSAI Pacific cod allocated to the longline CP sector and utilize the sector’s halibut PSC mortality allocation, less any TAC amount and PSC mortality amount allocated to longline CPs not in the cooperative. The allocation to vessels not in the cooperative would be based on vessel history from 2006 to 2008 (NPFMC 2012). The federal legislation specifies that the cooperative must prohibit any eligible member from harvesting a total of more than 20 percent of the Pacific cod available to be harvested by the longline CP sector.

In addition, the Longline Catcher Processor Subsector Single Fishery Cooperative Act authorizes NMFS to recover reasonable costs related to the implementation and administration of a cooperative approved under the Act, consistent with section 304(d)(2) of the MSA. However, NMFS reports that, to date, it has not received any request from LLP license holders to implement a cooperative under the Act (78 FR 63951

[October 25, 2013]). Moreover, the members of FLCC have argued that their cooperative was not formed under the Act. Nevertheless, NMFS maintains that FLCC members are subject to cost recovery because the Council has limited the longline CP portion of the BSAI Pacific cod fishery to only persons holding an LLP with specific endorsements, those LLP holders have formed a voluntary cooperative, those LLP holders have taken a federal loan as part of a license buyback program, and the Council has set aside a percentage of the TAC for those vessels (NMFS 2013).

In any case, the formation of the FLCC has created a de facto catch share program for the longline CP portion of the BSAI Pacific cod fishery (NMFS 2013). The FLCC apportions the sector's share of the available Pacific cod TAC among its members to eliminate the race for fish that arises under limited access management. FLCC members subdivide the TAC, with each receiving a share for harvest; shares are issued in proportion to historical BSAI Pacific cod fishing activity. FLCC members are free to exchange their shares among themselves, and to stack shares on individual vessels (NPFMC 2013b) Compliance with the agreement is monitored by SeaState, Inc., and the contract, signed by the members, imposes heavy financial penalties for noncompliance. Under the terms of the contract, dissolution of the cooperative requires the agreement of an 85 percent supermajority of LLP license holders (NPFMC 2013b).

In the GOA, the allocation of Pacific cod and apportionment of halibut PSC mortality available to the longline catcher processor sector is at times too small to allow NMFS to open the fishery in the absence of some control of harvest by members of the sector. Consequently, for several years, FLCC members have also organized their GOA Pacific cod harvests, working with participants in the GOA Pacific cod fishery that are not cooperative members. The GOA constituents have not come to an agreement on the terms for a GOA cooperative. This coordination has resulted in sufficient commitments regarding Pacific cod harvests and halibut PSC mortality avoidance to allow NMFS to open the fishery (NPFMC 2013b).

4.4.5 Longline Catcher Vessels

Longline CVs represent the smallest sector among the groups that are potentially affected by the alternative to reduce halibut PSC limits in the BSAI. Among the affected groups, longline CVs account for less than 0.05 percent of total groundfish harvest and 0.1 percent of non-pollock groundfish harvest between 2008 and 2013.

4.4.5.1 Description of Participants in Longline Catcher Vessel Target Fisheries

Longline CV Harvesting Vessels

Between 2008 and 2013, 42 unique vessels participated in the longline CV fishery for Pacific cod, as shown in Table 4-60. The number of vessels operating in the longline CV fishery has mostly decreased since 2008, reaching nine unique vessels in 2011 and 2012. The number of vessels increased in 2013 to 11. From 2010 to 2013 the number of vessels was fairly steady ranging between 11 and 9 vessels. While the actual count of vessels in the longline CV Pacific cod fishery has been relatively flat from 2010 to 2013, participation by individual vessels has varied and there have been a total of 21 different active vessels in the last 4 years. Of these 21 vessels, 3 were active in three of the four years, 4 were active in two years, and the remaining 14 vessels had only one year of activity in the fishery. The lack of steady participation by individual vessels is an indication that the longline CV Pacific cod fishery is a part-time fishery for the participating vessels. This is backed up at the end of the longline CV summary, where the diversity of fisheries in which these vessels participate is summarized.

Table 4-60 Number of Vessels Participating in Longline CV Target Fisheries, 2008 to 2013

	2008	2009	2010	2011	2012	2013	2008 to 2013
Pacific Cod	**20**	**13**	**11**	**9**	**9**	**11**	**42**

Source: Developed by Northern Economics using AKFIN data (Fey 2014).

Table 4-61 summarizes the number of unique longline CVs by region of owner residence. As shown, the majority of unique longline CVs operating between 2008 and 2013 were registered as Alaskan (74 percent). As the number of unique vessels had steadily decreased since 2008, reductions have occurred in nearly every region of residence. The number of vessels registered to Other Alaska and Other States—primarily in Washington and Oregon, have only decreased since 2008, while the NW and SW Alaska regions had small increases in participation in 2012 and 2013.

Table 4-61 Longline CV Vessel Owner's Place of Residence, 2008 to 2013

	2008	2009	2010	2011	2012	2013	Unique Vessels
Region	Number of Participating Vessels						
NW Alaska	-	-	-	-	-	1	1
SW Alaska	6	7	4	4	5	7	14
Other Alaska	8	6	3	2	2	1	16
Other U.S.	6	-	3	3	2	2	11
Total	20	13	10	9	9	11	42

Note: Shaded cells indicate that catch and revenue data for that sub-set of vessels in that year for that target fishery cannot be disclosed due to confidentiality rules.

Source: Developed by Northern Economics using AKFIN data (Fey 2014).

Participation and earnings for LGL-CV vessels and crew are summarized in Table 4-62. On average between 2008 and 2013, LGL-CVs operated for three months of the year with an average crew size of approximately four. Total employment averaged just over 50 people with total payments to crew and officers averaging $0.3 million—an average income per person of $6,218.

Table 4-62 Summary of Participation and Earning in the BSAI by Vessels and Crew in LGL-CV Fisheries

	2008	2009	2010	2011	2012	2013	6-Year Average
Number of Active Vessels	20	13	10	9	10	11	12
Average Crew Size (Incl. Officers)	3.9	3.9	4.5	3.7	3.7	3.7	3.9
Average Operating Months	4.0	3.8	2.3	2.5	2.8	2.8	3.0
Average Persons in Crew Rotation per Vessel	4.5	4.6	4.2	4.1	4.3	4.0	4.3
Total Persons in Crew Rotation in Sector	89.6	60.2	37.5	37.2	34.3	43.5	50.4
Crew Share Percentage	45%	45%	45%	45%	45%	45%	45%
Total Payments to Crew and Officers (2013 $ Millions)	$0.9	$0.2	$0.1	$0.2	$0.2	$0.3	$0.3
Average Income Earned per Person (2013 $)	$9,736	$3,544	$2,648	$4,527	$6,564	$6,924	$6,218

Note: Operating Months, Crew Payments and Total Revenues include time spent and revenue generated when fishing CDQ allocations.

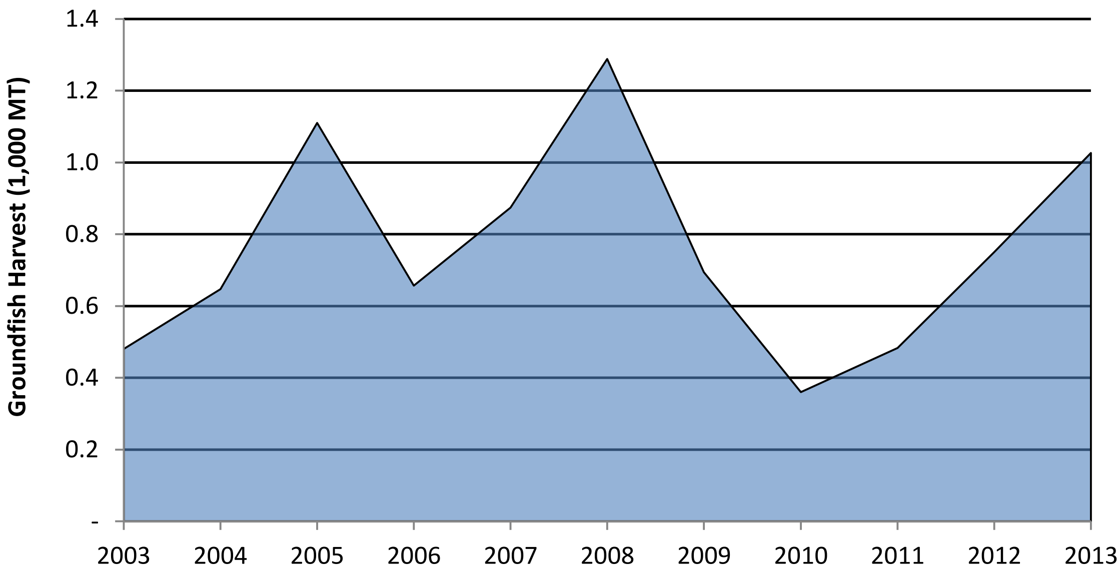
Source: Developed by Northern Economics using AKFIN data (Fey 2014 and A80-CP Economic Data Report data (Fissel 2014).

4.4.5.2 Catch and Revenue in Longline CV Target Fisheries

After subtraction of the CDQ reserve, 2 percent of the BSAI Pacific cod TAC is allocated to longline CVs less than 60 feet length overall, and 0.2 percent is allocated to longline CVs greater than 60 ft. length overall. Vessels greater than 60 feet must have a catcher vessel Pacific cod endorsement to target BSAI Pacific cod.

Figure 4-41 summarizes harvests in the longline CV fishery between 2003 and 2013. As previously noted, the longline CV fishery solely targets Pacific cod with longline gear. Peak harvest in the longline CV Pacific cod fishery occurred in 2008 with nearly 1,300 mt. Steep declines followed in 2009 and 2010, bringing the total harvest to 360 mt in 2010. Since 2010, harvests by longline CVs have steadily increased back to 1,000 mt. Total harvest appears relatively volatile between 2008 and 2013 compared to other Pacific cod fisheries in the BSAI. The fact the most of the vessels operating in the longline CV Pacific cod fishery participate in other fisheries with more revenue potential, as discussed at the end of this section (see Section 4.4.5.5), may indicate that Pacific cod is a "fishery of opportunity" for these participants, but not a fishery upon which they rely heavily.

Figure 4-41 Groundfish Harvests in Longline CV Pacific Cod Fishery, 2003 to 2013



Source: Figure developed by Northern Economics using AKFIN data (Fey 2014).

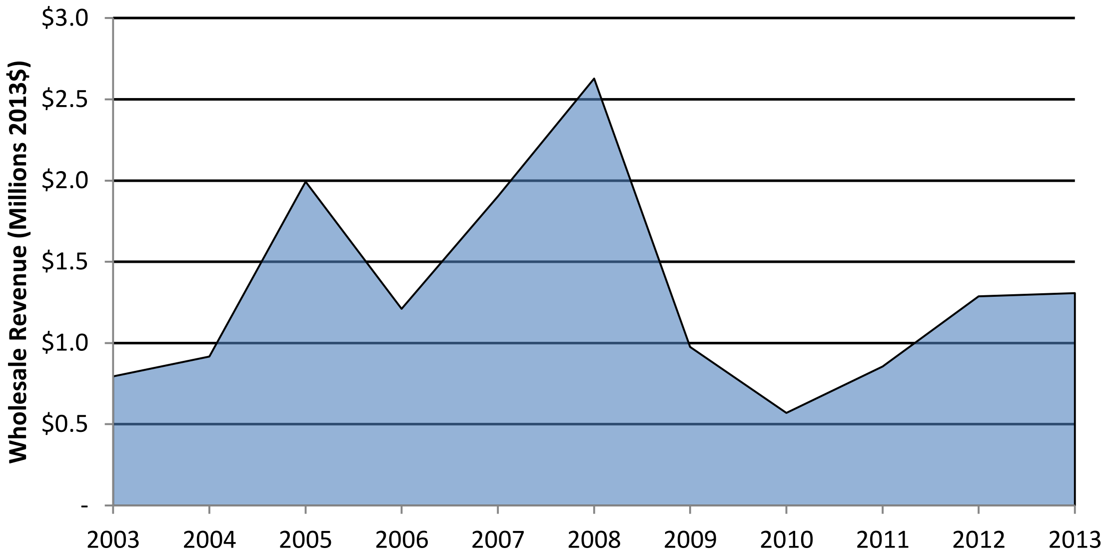
Table 4-63 Groundfish Harvest in Longline CV Pacific Cod Fishery, 2008 to 2013

	2008	2009	2010	2011	2012	2013	Total
Target Group	**Metric Tons of Groundfish Harvested in Pacific cod Target Fishery**						
Pacific Cod	1.29	0.69	0.36	0.48	0.75	1.03	4.60

Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

Figure 4-42 and Table 4-64 summarize historic wholesale revenues in the longline CV fishery for Pacific cod. Overall, changes in wholesale revenue are largely correlated with changes in harvest between 2003 and 2013. Wholesale revenues peaked in 2008 at $2.5 million, followed by sharp declines in 2009 and 2010. Wholesale revenues recovered slightly to $1.29 million by 2012. In 2013, total wholesale revenue remained flat at $1.31 million, despite a 25 percent increase in harvest.

Figure 4-42 Wholesale Revenue in Longline CV Pacific Cod Target Fishery, 2003 to 2013



Source: Figure developed by Northern Economics using AKFIN data (Fey 2014).

Table 4-64 Real Wholesale Revenue in Longline CV Pacific Cod Target Fishery, 2008 to 2013

	2008	2009	2010	2011	2012	2013	Total
Target Group	Wholesale Revenue (in millions of 2013 $)						
Pacific Cod	$2.63	$0.98	$0.57	$0.86	$1.29	$1.31	$7.62

Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

4.4.5.3 Ex-Vessel Revenue, Wholesale Revenue and Processor Value Added

Longline CVs deliver their harvests to either shore plants or inshore floating processors, and in making deliveries receive ex-vessel revenues. The processing facilities then turn the raw fish into products and sell them to generate wholesale revenues. The difference between ex-vessel value and wholesale value is the value added by the processor. Table 4-65 summarizes ex-vessel and wholesale revenues and calculates the value added by processors. In the table we combine processor types to protect confidential information.[32]

Total ex-vessel value in the fishery ranged from a high of $1.95 million in 2008 to a low of just $230,000 in 2010. On average, vessels in the longline CV Pacific cod target fisheries have generated about $60,000 in ex-vessel revenue per year. As seen in Table 4-65, changes in ex-vessel revenues from 2008 to 2013 have tracked closely with wholesale revenues, but processor value added has been much more stable than either of the two revenue measures. Over all six years, the average ex-vessel value generated has been about 56 percent of total revenue, but that figure is heavily influenced by 2008, where ex-vessel value generated was 74 percent of wholesale revenue. From 2009 to 2013, harvesters have received an average of 47 percent of the total value generated.

[32] If there were more vessels participating in the fishery, it would have been possible to discuss revenue impacts by region. But the very low number of participating vessels and confidentiality rules precludes that assessment.

Table 4-65 Ex-Vessel Revenues, Wholesale Revenue and Processor Value Added from the Longline CV Fishery

2008	2009	2010	2011	2012	2013	Average
Ex-Vessel Value ($Millions 2013)						
$1.95	$0.47	$0.23	$0.37	$0.61	$0.67	$0.72
Wholesale Value Generated by Processors ($Millions 2013)						
$2.63	$0.98	$0.57	$0.86	$1.29	$1.31	$1.27
Processor Value Added ($Millions 2013)						
$0.67	$0.50	$0.34	$0.48	$0.68	$0.64	$0.55

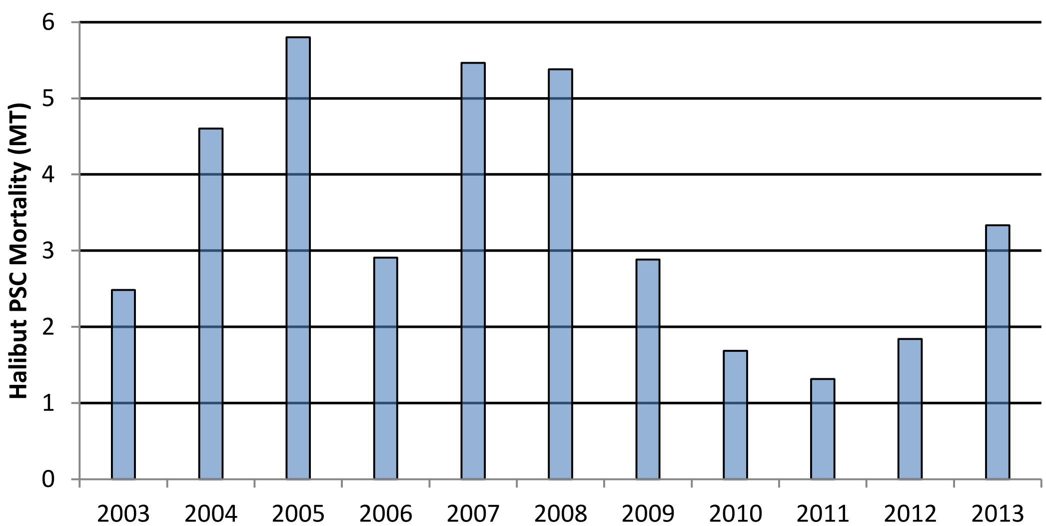
Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

4.4.5.4 Halibut PSC Limits and Halibut PSC Mortality in Longline CV Target Fishery

Halibut PSC limits for the longline CV Pacific cod target fishery have remained stable at 15 mt since 2008 (NMFS 2014f).

Figure 4-43 summarizes halibut PSC mortality in the longline CV fishery from 2003 to 2013. Actual halibut mortality data are shown in Table 4-66 for 2008 to 2013. Total halibut mortality in the longline CV Pacific cod target fishery has varied from a high of 5.8 mt in 2005 to low of 1.3 mt in 2011 during the 11-year period shown in Figure 4-43. Since 2008, the high has been 5.4 mt—just 36 percent of the 15 mt PSC limit for the fishery. Between 2008 and 2013, total halibut PSC mortality in the longline CV fishery averaged 2.7 mt. The decreases in halibut mortality from 2008 to 2011 largely correlate with overall participation in the longline CV fishery, with a few recent upticks in 2012 and 2013.

Figure 4-43 Halibut PSC Mortality in Longline CV Target Fishery, 2003 to 2013



Source: Figure developed by Northern Economics using AKFIN data (Fey 2014).

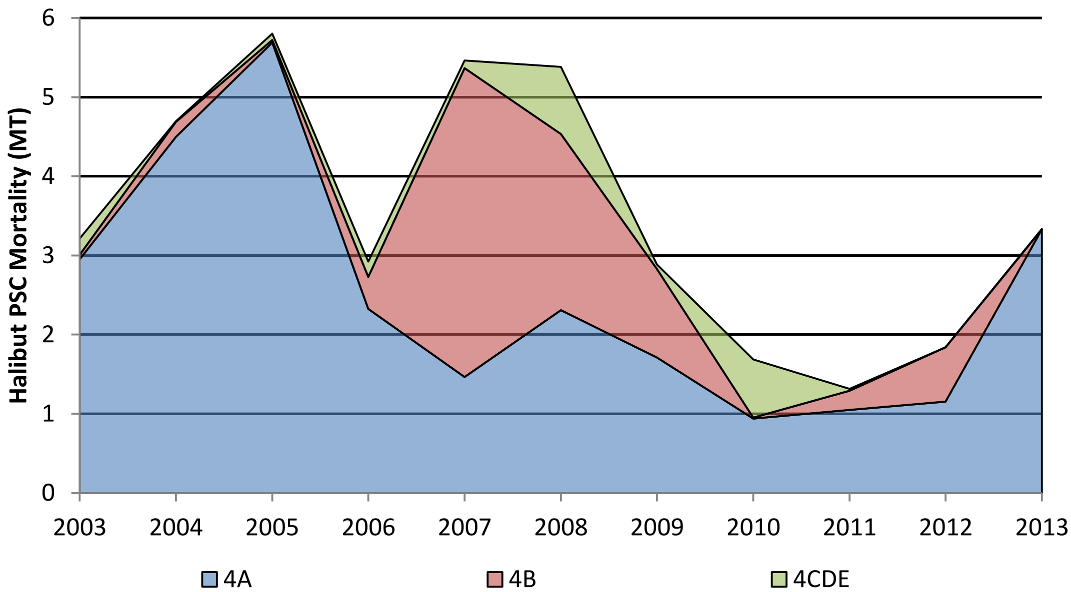
Table 4-66 Halibut PSC Mortality in Longline CV Target Fishery, 2008 to 2013

	2008	2009	2010	2011	2012	2013	Total
Target Group	Halibut PSC Mortality (in round weight mt)						
Pacific Cod	5.4	2.9	1.7	1.3	1.8	3.3	16.4

Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

Figure 4-44 and Table 4-67 summarize halibut mortality in longline CV fishery by IPHC area. Between 2008 and 2013, nearly two-thirds of halibut mortality occurred in IPHC Area 4A. This changed in 2007, when a large spike in halibut mortality occurred in Area 4B, pushing total halibut mortality back above 5 mt in 2007 and 2008—still less than half of the longline CV fishery's total halibut PSC limit. Halibut mortality decreased steadily between 2008 and 2011, where it reached a low of 1.3 mt. By 2013, halibut mortality returned to 3.3 mt, caught entirely in Area 4A.

Figure 4-44 Halibut PSC Mortality in Longline CV Fishery by IPHC Area, 2008 to 2013



Source: Figure developed by Northern Economics using AKFIN data (Fey 2014).

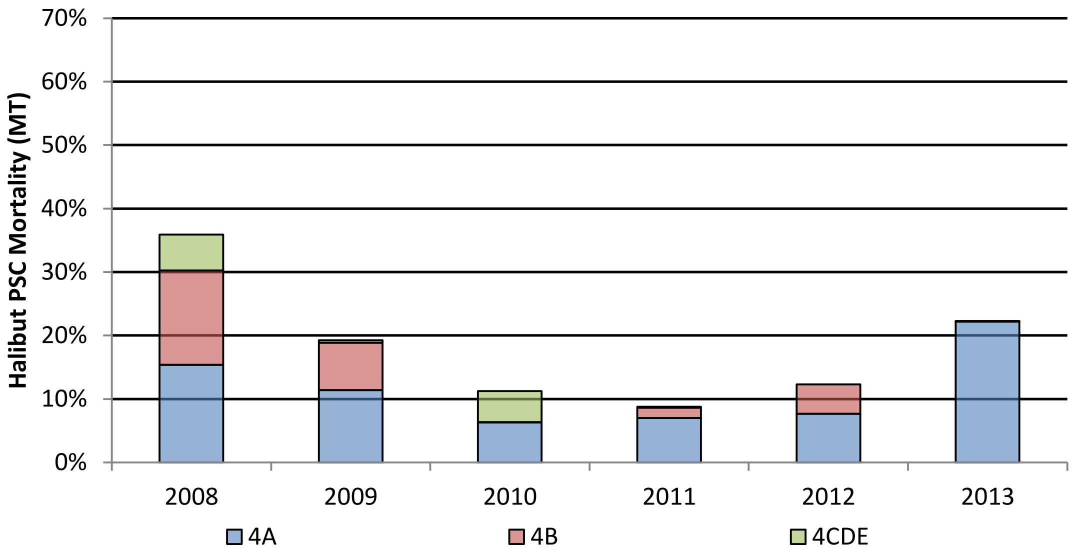
Table 4-67 Halibut PSC Mortality in Longline CV Fishery, by IPHC Area, 2008 to 2013

	2008	2009	2010	2011	2012	2013	Total
Target Group	**Halibut PSC Mortality (in round weight mt)**						
IPHC Area 4A	2.3	1.7	0.9	1.0	1.2	3.3	**10.5**
IPHC Area 4B	2.2	1.1	0.0	0.2	0.7	0.0	4.3
IPHC Areas 4CDE	0.8	0.1	0.7	0.0	-	0.0	1.7
All Areas	**5.4**	**2.9**	**1.7**	**1.3**	**1.8**	**3.3**	**16.4**

Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

Figure 4-45 summarizes the percent of the longline CV Pacific cod halibut PSC limit taken between 2008 and 2013. Within that time frame, the longline CV fishery, on average, harvested 18 percent of its 15 mt halibut PSC limit annually. In order for the longline CV fishery to be materially affected by a reduction, their limit would need to be cut by more than 60 percent. Because most of these vessels also participate in the commercial halibut fishery (see Table 4-69) they are more likely to gain from the reduced halibut PSC limits than they are to be harmed.

Figure 4-45 Percentage of 2014 Halibut PSC Limits taken by Longline CVs, 2008 to 2013



Source: Figure developed by Northern Economics using AKFIN data (Fey 2014).

Table 4-68 summarizes the calculation of the wholesale revenue per ton of halibut PSC mortality in the longline CV Pacific cod fishery. This measure is an indication of how much wholesale revenue the participants (harvesters and processors combined) in the longline CV fishery would have to give up during an average trip if they were required to reduce halibut PSC mortality by one mt. The numbers shown in the table are calculated by summing the wholesale revenue by year and then dividing by the halibut PSC mortality taken in the year in the fishery. It should be noted that because there is significant variability in halibut PSC rates over the course of the year and across vessels, there is also significant variability in the wholesale value generated per ton of halibut PSC mortality in a given fishery.

Between 2008 and 2013, the longline CV Pacific cod fishery (including both harvesters and processors) generated an average of $0.46 million per ton of halibut PSC mortality. The years with the lowest averages of wholesale revenue per ton of halibut PSC mortality occurred in 2009 and 2010, both at $340,000 per ton of halibut PSC mortality, while in 2012, wholesale revenue generated per ton of halibut PSC mortality averaged $700,000.

Table 4-68 Wholesale Revenue per Ton of Halibut PSC Mortality in Longline CV Pacific Cod Fishery, 2008 to 2013

	2008	2009	2010	2011	2012	2013	All Years
Target Group	Wholesale Revenue Per Ton of PSC (in millions of 2013 $ per mt)						
Pacific Cod	$0.49	$0.34	$0.34	$0.65	$0.70	$0.39	$0.46

Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

4.4.5.5 Reliance of Longline CVs on BSAI Groundfish and Diversification of Longline CVs into Other Fisheries

Table 4-69 summarizes the participation and amount of ex-vessel revenues earned in other fisheries by vessels that also participated in the longline CV Pacific cod fishery in the BSAI between 2008 and 2013. There is a noticeable drop-off beginning in 2011 of activity of longline CVs in other fisheries. In 2009 there were 13 active longline CVs targeting Pacific cod in the BSAI. Of these, 9 also participated in the Alaska halibut fisheries, 10 participated in IFQ sablefish fisheries and 4 were active in GOA groundfish fisheries.

Similar levels of participation in other fisheries were seen in 2010. In 2011, longline CVs active in the BSAI Pacific cod fishery dropped by two, but the number that also participated in halibut fisheries fell by four vessels, and the number in sablefish fell by five. Similar declines were seen in 2012. The reasons for this apparent shift are not known.

In the bottom part of the table we summarize the diversity of ex-vessel revenue earned by the longline CVs active the BSAI Pacific cod fishery. Of the other fisheries in which vessels participate, halibut is clearly the most important, and in every year shown, revenues in the halibut fishery have been much higher than revenues in the BSAI Pacific cod fishery. Revenue in the BSAI Pacific cod fishery as a percent of revenue in all fisheries is summarized in the bottom row of the table. In 2008 and 2009, Pacific cod accounted for an average of 10 percent of overall earning. In 2010 and 2011, the average dropped to 5 percent. Then in 2012 and 2013, the relative importance of the BSAI Pacific cod fishery jumped up to an average of 25 percent of total revenue.

Table 4-69 Number of Longline CVs Participating in Other Fisheries, 2008 to 2013

	2008	2009	2010	2011	2012	2013
Number Longline CVs Participating in BSAI Pacific Cod Fishery						
BSAI Longline CV Pacific Cod	20	13	11	9	9	11
Number Longline CVs Participating Other Fisheries						
BSAI Pot Groundfish	-	1	-	-	1	2
CDQ Groundfish	-	-	-	-	-	-
All Halibut	18	9	10	6	5	7
All Fixed Gear Sablefish	13	10	11	6	4	2
GOA Groundfish	14	4	5	3	1	-
AK Salmon	3	3	1	1	1	1
All Other AK Fisheries	2	1	1	-	-	1
West Coast Fisheries	1	-	-	1	-	-
Ex-Vessel Revenue ($2013 Millions)						
Halibut Fisheries	$8.54	$2.36	$5.27	$4.46	$1.67	$1.32
All Other Fisheries	$4.06	$1.35	$2.80	$0.50	$0.44	$0.29
Halibut & Other Fishery Total	**$12.61**	**$3.71**	**$8.08**	**$4.95**	**$2.11**	**$1.61**
BSAI Longline CV Pacific Cod	$1.96	$0.47	$0.23	$0.37	$0.61	$0.67
All Fisheries	**$14.57**	**$4.19**	**$8.31**	**$5.33**	**$2.72**	**$2.28**
BSAI Longline CV Pacific Cod % of Total Ex-vessel revenue	13%	11%	3%	7%	22%	29%

Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

4.4.6 Community Development Quota Fisheries for Groundfish

The CDQ Program was established by the Council in 1992, and in 1996, the program was incorporated into the MSA. The CDQ Program consists of six different CDQ groups representing different geographical regions in Alaska. The CDQ Program receives annual apportionments of TACs for a variety of commercially valuable species in the BSAI Groundfish fishery, which are in turn allocated among six different non-profit managing organizations representing different affiliations of communities (CDQ groups).

The final rule to implement Amendment 80 in 2008 increased the percentage of TAC for directed fisheries (with the exception of pollock and sablefish) that are allocated to the CDQ Program from 7.5 percent to 10.7 percent, modified the percentage of halibut, crab, and non-Chinook salmon PSC mortality allocated to the CDQ Program as PSC mortality quota, and included other provisions necessary to bring A80 and the CDQ Program into compliance with applicable law.

The CDQ groups are provided exclusive access to the CDQ target fisheries and PSC limits. Like allocations made to the two A80 cooperatives, apportionments of halibut PSC mortality are made to each CDQ group, allowing the CDQ group to optimize the distribution of halibut PSC mortality among its groundfish target fisheries. For the purpose of this study, CDQ data were analyzed as a single multi-vessel, multi-gear, multi-target sector.

4.4.6.1 Description of Participants in the CDQ Fisheries

CDQ Harvesting Vessels in CDQ Target Fisheries

Table 4-70 summarizes the number of unique vessels operating in the CDQ fisheries between 2008 and 2013. Sixty unique vessels participated in the CDQ fishery between 2008 and 2013, with nearly 60 percent of vessels operating in the pollock and Pacific cod target fisheries.

Vessels operating in the CDQ fisheries are not regulated by gear type. For this reason, Table 4-70 summarizes participation only by target fisheries. To determine unique vessel counts, the study team counted each active vessel in a year once. However, within each harvest sector, the columns do not sum to the "All Target" total. This is due to the fact that some vessels participate in multiple target fisheries.

Table 4-70 Types and Numbers of Vessels Participating in CDQ Fisheries, 2008 to 2013

	2008	2009	2010	2011	2012	2013	2008 to 2013
Pollock|Atka Mackerel|Other Species	24	21	18	22	22	21	35
Pacific Cod	19	20	17	16	16	23	35
Yellowfin Sole	5	3	5	11	9	8	13
All other targets	7	5	7	10	10	10	16
All Targets	**40**	**40**	**36**	**38**	**36**	**42**	**56**

Source: Developed by Northern Economics using AKFIN data (Fey 2014).

Table 4-71 provides a summary of average annual payments derived from activities in CDQ fisheries, which generated nearly $56 million per year. The table total "vessel-based[33]" revenues generated in CDQ groundfish fisheries by year along with the total value added generated by shore based processing facilities. We note here that because vessels engaged in CDQ groundfish fisheries are primarily participating in the non-CDQ fisheries for similar species, we do not generate estimates of the number of crew members engaged in CDQ groundfish fisheries—doing so would tend to double count participants.

Table 4-71 Summary of Participation and Earnings in the BSAI for Vessels and Crew Participating in CDQ Fisheries

	2008	2009	2010	2011	2012	2013	6-Year Average
Total Payments to Crew and Officers (2013 $ Millions)	$66.7	$45.3	$47.2	$62.2	$61.9	$50.8	$55.7
Total Vessel Based Revenue (2013$ Millions)	$233.3	$157.5	$166.1	$219.2	$219.8	$181.7	$196.3
Total Value Added Revenue Generated by Shore based Processors, Floaters and Motherships ($2013 Millions)	$8.7	$8.7	$1.2	$1.2	$2.7	$0.8	$3.9

Source: Developed by Northern Economics using AKFIN data (Fey 2014 and A80-CP Economic Data Report data (Fissel 2014).

Table 4-72 below summarizes unique vessel participation in CDQ fisheries by vessel type and region of owner residence. Catcher processors represent the majority of vessels participating in CDQ fisheries; largely consisting of longline CPs, AFA-CPs, and A80-CPs. Between 2008 and 2013, 25 percent of vessels operating in the CDQ fishery were Alaskan owned. Some individual CDQ groups have acquired ownership interests in both the at-sea processing sector and in catcher vessels that directly catch the CDQ group's various species allocation. Other CDQ groups lease quota to various harvesting partners, receiving royalty

[33] "Vessel-based" revenue are either wholesale revenues if the vessel is a CP, or ex-vessel revenues if the vessel is a CV.

payments on each allocation harvested. It is important to note that some vessels owned in part by Alaskan CDQ groups may be registered with non-Alaskan addresses.

Table 4-72 CDQ Vessel Owner's Place of Residence, 2008 to 2013

	2008	2009	2010	2011	2012	2013	2008 to 2013
AFA-CPs			Number of Unique Vessels				
NW Alaska	-	-	-	-	-	-	-
SW Alaska	-	-	-	-	-	-	-
Other Alaska	-	-	-	1	1	1	1
Other U.S.	12	12	12	14	14	14	15
Total Unique Vessels	12	12	12	15	15	15	15
AFA-CVs			Number of Unique Vessels				
NW Alaska	-	-	-	-	-	-	-
SW Alaska	1	1	-	-	-	-	1
Other Alaska	-	-	-	-	-	-	-
Other U.S.	5	3	-	-	-	-	5
Total Unique Vessels	6	4	-	-	-	-	6
Non-AFA Trawl CVs			Number of Unique Vessels				
NW Alaska	-	-	-	-	-	-	-
SW Alaska	-	-	-	-	-	-	-
Other Alaska	-	-	-	-	-	-	-
Other U.S.	1	1	2	2	3	3	4
Total Unique Vessels	1	1	2	2	3	3	4
A80-CP			Number of Unique Vessels				
NW Alaska	-	-	-	-	-	-	-
SW Alaska	-	-	-	-	-	-	-
Other Alaska	-	-	-	-	-	-	-
Other U.S.	4	5	7	8	7	6	10
Total Unique Vessels	4	5	7	8	7	6	10
Longline CPs			Number of Unique Vessels				
NW Alaska	-	-	-	-	-	-	-
SW Alaska	-	-	-	-	-	-	-
Other Alaska	3	3	5	5	6	5	6
Other U.S.	14	14	10	8	5	8	16
Total Unique Vessels	17	17	15	13	11	13	19
Longline CVs			Number of Unique Vessels				
NW Alaska	-	1	-	-	-	5	6
SW Alaska	-	-	-	-	-	-	-
Other Alaska	-	-	-	-	-	-	-
Other U.S.	-	-	-	-	-	-	-
Total Unique Vessels	-	1	-	-	-	5	6
All Types			Number of Unique Vessels				
NW Alaska	-	1	-	-	-	5	6
SW Alaska	1	1	-	-	-	-	1
Other Alaska	3	3	5	6	7	6	7
Other U.S.	36	35	31	32	29	31	50
Total Unique Vessels	40	40	36	38	36	42	56

Note: There were a total of six vessels whose owners lived in multiple regions over the six-year period. Also note that shaded cells indicate that catch and revenue data for that sub-set of vessels in that year for that target fishery cannot be disclosed due to confidentiality rules.

Source: Developed by Northern Economics using AKFIN data (Fey 2014).

CDQ Vessel Ownership

Table 4-73 below displays the vessel name, sector, and CDQ ownership group for the groundfish and crab vessels operating in the BSAI. Some vessels owned by more than one CDQ group and in those cases the percent of CDQ ownership (the fifth and last column of the table) displays the sum of all CDQ group ownership.

Table 4-73 CDQ Ownership in Groundfish and Crab Vessels

ADFG	Vessel Name	Sector	CDQ Group(s)	CDQ	ADFG	Vessel Name	Sector	CDQ Group(s)	CDQ
8522	Us Liberator	LGL-CP	APICDA	20%	56987	Ocean Rover	BSAI TLA	CBSFA	10%
35687	Golden Dawn	BSAI TLA	APICDA	25%	57201	Endurance	Inactive	CBSFA	10%
39369	Gulf Prowler	LGL-CP	APICDA	25%	59378	American Dynasty	BSAI TLA	CBSFA	10%
40920	Prowler	LGL-CP	APICDA	25%	59687	Forum Star	BSAI TLA	CBSFA	10%
43570	Ocean Prowler	LGL-CP	APICDA	25%	60202	Northern Jaeger	BSAI TLA	CBSFA	10%
47952	Exceller	BSAI TLA	APICDA	100%	60660	American Triumph	BSAI TLA	CBSFA	10%
57621	Starbound	BSAI TLA	APICDA	20%	62152	American Challenger	Inactive	CBSFA	10%
62424	Farwest Leader	LGL-CP	APICDA	70%	75473	Saint Paul	POT-CV	CBSFA	100%
63333	Bering Prowler	LGL-CP	APICDA	25%	76769	Saint Peter	POT-CV	CBSFA	100%
69625	Konrad	Inactive	APICDA	100%	52	Bering Sea	Inactive	CVRF	100%
77470	Arctic Prowler	Inactive	APICDA	25%	8225	Sea Venture	LGL-CP	CVRF	100%
7	Pacific Mariner	Inactive	BBEDC	40%	36047	North Sea	Inactive	CVRF	100%
14	Judi B	LGL-CV	BBEDC	50%	56016	Deep Pacific	LGL-CP	CVRF	100%
64	Cascade Mariner	Inactive	BBEDC	50%	59376	North Cape	LGL-CP	CVRF	100%
222	Nordic Mariner	Inactive	BBEDC	45%	60795	Northern Hawk	BSAI TLA	CVRF	100%
963	Western Mariner	Inactive	BBEDC	50%	63484	Lilli Ann	LGL-CP	CVRF	100%
1112	Arctic Wind	BSAI TLA	BBEDC	50%	35957	Sea Wolf	BSAI TLA	CVRF, NSEDC	71%
8411	Bristol Mariner	Inactive	BBEDC	45%	37660	Great Pacific	BSAI TLA	CVRF, NSEDC	71%
31792	Arctic Mariner	Inactive	BBEDC	50%	38989	Alaska Rose	BSAI TLA	CVRF, NSEDC	71%
32858	Neahkahnie	Inactive	BBEDC	30%	40638	Bering Rose	BSAI TLA	CVRF, NSEDC	71%
35844	Aleutian Mariner	Inactive	BBEDC	40%	56164	Ms. Amy	BSAI TLA	CVRF, NSEDC	71%
38431	Morning Star	BSAI TLA	BBEDC	50%	60655	Destination	BSAI TLA	CVRF, NSEDC	71%
51672	Bering Defender	BSAI TLA	BBEDC	50%	66196	Mesiah	BSAI TLA	CVRF, NSEDC	71%
52813	Alaska Patriot	LGL-CP	BBEDC	50%	34905	Glacier Bay	LGL-CP	NSEDC	100%
56676	Defender	BSAI TLA	BBEDC	50%	48075	Northern Glacier	BSAI TLA	NSEDC	38%
57450	Arctic Fjord	BSAI TLA	BBEDC	30%	51873	Rebecca Irene	A80-CP	NSEDC	9%
62437	Alaskan Leader	LGL-CP	BBEDC	50%	55921	Cape Horn	A80-CP	NSEDC	9%
70435	Bristol Leader	LGL-CP	BBEDC	100%	56991	Pacific Glacier	BSAI TLA	NSEDC	38%
77393	Northern Leader	LGL-CP	BBEDC	50%	57211	Unimak	A80-CP	NSEDC	9%
103	Early Dawn	Inactive	CBSFA	30%	57228	Arica	A80-CP	NSEDC	9%
34931	Starlite	BSAI TLA	CBSFA	75%	60407	Alaska Ocean	BSAI TLA	NSEDC	38%
39197	Starward	BSAI TLA	CBSFA	75%	52929	Golden Alaska	Mothership	YDFDA	26%
50570	Aleutian Challenger	BSAI TLA	CBSFA	10%	32	Ocean Leader	BSAI TLA	YDFDA	75%
55111	Fierce Allegiance	BSAI TLA	CBSFA	30%	24255	American Beauty	BSAI TLA	YDFDA	75%
55301	Katie Ann	BSAI TLA	CBSFA	10%	34855	Baranof	LGL-CP	YDFDA	41%
56618	Northern Eagle	BSAI TLA	CBSFA	10%	35833	Courageous	LGL-CP	YDFDA	85%

Note: Inactive vessels are vessels that did not show up as active vessels in the groundfish data used for the analysis.

Along with generating revenue in the CDQ sector, vessels that are owned wholly or in part by CDQ organizations also generate revenue in other sectors in the BSAI groundfish fishery. Table 4-74 displays the revenues (in real millions of dollars) generated by vessels with CDQ ownership interests in the four sectors analyzed between 2008 and 2013, noting the revenues reported reflect the CDQ ownership percentage. Thus, if CDQ organizations had a 50 percent ownership share in a vessel, only 50 percent of that vessel's revenue would be reported in Table 4-74. The BSAI TLA sector is the largest source of revenue for CDQ vessels and on average accounts for 56 percent of the total revenues generated by CDQ owned vessels. On average, CDQ-owned vessel assets have generated an estimated $255 million for CDQ organizations from 2008 to 2013.

Table 4-74 Estimated Revenues Generated by CDQ Owned Vessel Assets by Sector (2013 $million)

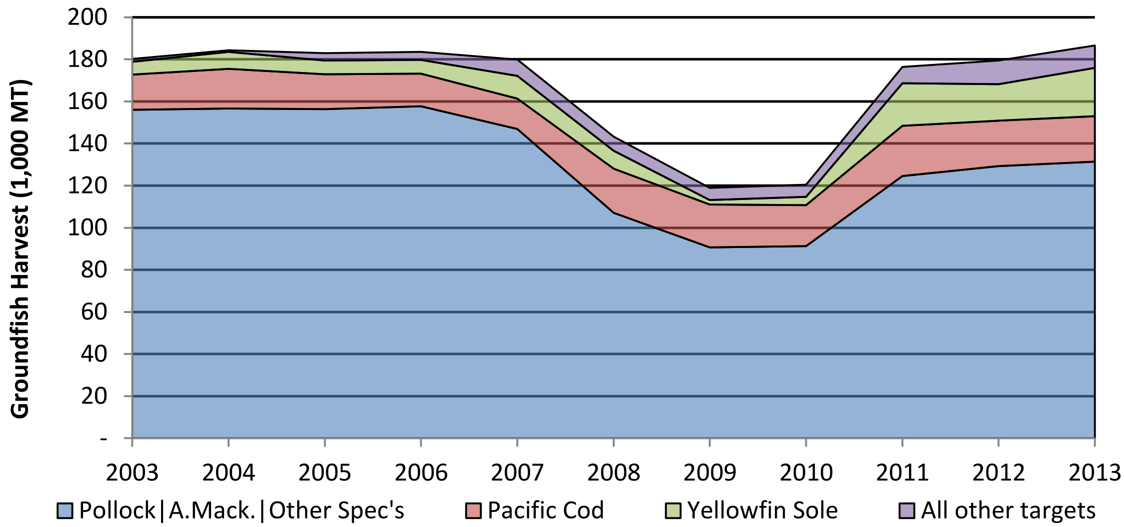
Sector	2008	2009	2010	2011	2012	2013	Average
BSAI TLA	177.55	148.88	111.17	141.76	146.92	127.37	142.27
A80-CP	5.80	4.90	5.95	7.13	7.84	6.00	6.27
LGL-CP	46.49	32.60	33.90	44.64	52.01	36.82	41.08
CDQ	74.60	43.44	41.08	94.75	76.03	62.71	65.43
Total	304.44	229.82	192.10	288.28	282.81	232.90	255.06

4.4.6.2 Catch and Revenue in CDQ Target Fisheries

Figure 4-46 shows total harvest of CDQ fisheries between 2003 and 2013, while Table 4-75 provides actual numbers from 2008 to 2013. Because of reductions in the pollock ABC and TACs, groundfish harvests in CDQ target fisheries declined dramatically in 2008 and again in 2009. CDQ pollock harvests fell nearly 43 percent to 91 mt by 2009. Overall groundfish catch rose again in 2011, largely due to increases in the pollock TACs and an emerging yellowfin sole fishery. Total harvest in the CDQ fishery has increased gradually each year since 2011.

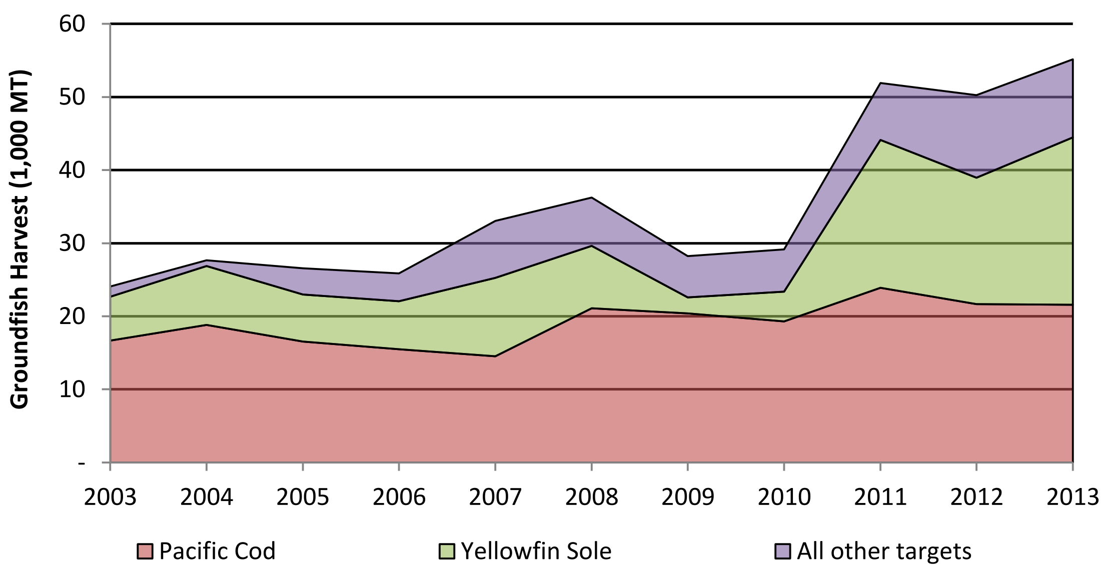
Harvests in the Pollock|Atka Mackerel|Other Species target group are almost entirely driven by pollock, although since 2003, 4 percent of the 1.44 million tons in this target group were assigned as Atka mackerel or “other species” target fisheries. From 2008 to 2013, the pollock fishery accounted for 73 percent of the total harvest in the CDQ fishery. Because pollock is so overwhelming within the CDQ fishery, Figure 4-47 displays total harvest in the CDQ fishery, excluding pollock. In that figure, the increasing importance of the yellowfin sole target fishery can readily be seen. From this “non-pollock” perspective, CDQ harvests increased between 2003 and 2013. A 400 percent year-over-year increase in the harvest of yellowfin sole occurred in 2011, pushing the total non-pollock harvest above 50 mt. In 2013, yellowfin sole harvest reached nearly 23 mt, overtaking Pacific cod as the second largest target fishery (Table 4-75). Note that harvests of “all other targets” include CDQ target fisheries for rock sole (52 percent), rockfish (30 percent), arrowtooth flounder (5 percent), flathead sole (5 percent) and Greenland turbot (>1 percent).

Figure 4-46 Groundfish Harvests in Target Fisheries of CDQ Vessels, 2003 to 2013



Source: Developed by Northern Economics using AKFIN data (Fey 2014).

Figure 4-47 Non-pollock Groundfish Harvests in CDQ Target Fisheries, 2003 to 2013



Source: Developed by Northern Economics using AKFIN data (Fey 2014).

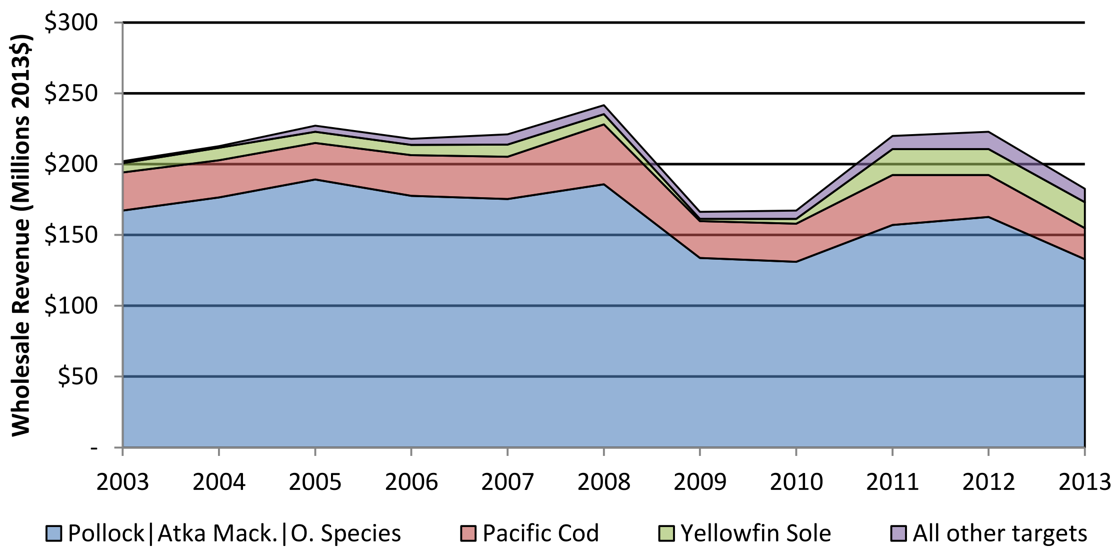
Table 4-75 Groundfish Harvest in CDQ Target Fisheries, 2008 to 2013

	2008	2009	2010	2011	2012	2013	Total
Target Group	**Metric Tons (1,000s) of Groundfish (of All Species) Harvested in CDQ Target Fisheries**						
Pollock|Atka Mackerel|Other Species	107.01	90.62	91.33	124.52	129.21	131.43	674.12
Pacific Cod	21.11	20.38	19.32	23.91	21.66	21.57	127.95
Yellowfin Sole	8.50	2.22	4.04	20.20	17.31	22.90	75.17
All other targets	6.62	5.64	5.80	7.79	11.26	10.66	47.78
All Targets	**143.24**	**118.85**	**120.50**	**176.41**	**179.44**	**186.56**	**925.01**

Source: Developed by Northern Economics using AKFIN data (Fey 2014).

Figure 4-48 and Table 4-76 summarize wholesale revenues in the CDQ groundfish fisheries from 2003 to 2008. As shown, wholesale revenues gradually increased from 2003 through 2008 in spite of a decline in pollock harvest. The sharp decline in 2009 is attributed to primarily to the global recession. Overall groundfish revenues rose again in 2011, largely due to increases in the pollock TACs and an emerging yellowfin sole fishery. In 2013, an 18 percent decrease in total wholesale revenue occurred, despite a gradual increase in total harvest—a phenomenon seen in almost all other fisheries. The decline is a function of lower revenues per ton across all major species in 2013 as discussed in earlier sections.

Figure 4-48 Wholesale Revenue in CDQ Target Fisheries, 2003 to 2013



Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

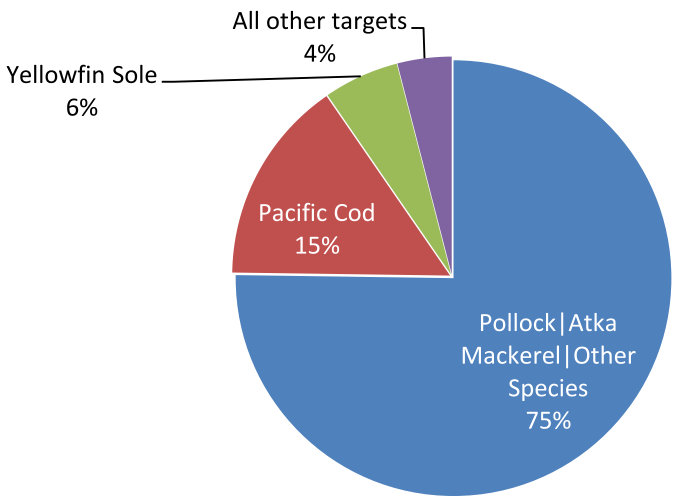
Table 4-76 Real Wholesale Revenue in CDQ Target Fisheries, 2008 to 2013

	2008	2009	2010	2011	2012	2013	Total
Target Group	**Wholesale Revenue (in millions of 2013 $)**						
Pollock|Atka Mackerel|Other Species	$185.80	$133.68	$131.07	$157.03	$162.77	$132.95	$903.29
Pacific Cod	$42.21	$26.06	$27.02	$35.38	$29.62	$21.98	$182.27
Yellowfin Sole	$7.39	$1.70	$3.38	$18.20	$18.18	$18.22	$67.07
All other targets	$6.27	$5.02	$5.85	$9.26	$12.26	$9.53	$48.19
All Targets	**$241.67**	**$166.45**	**$167.32**	**$219.87**	**$222.84**	**$182.68**	**$1,200.83**

Note: All other targets include CDQ target fisheries for rock sole, rockfish, arrowtooth flounder, Greenland turbot, and flathead sole.
Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

Figure 4-49 summarizes wholesale revenue generated by species in the CDQ fisheries. As shown, the pollock fishery accounts for three-quarters of the wholesale revenue generated. Pollock and Pacific cod combined accounted for 90 percent of wholesale revenues in the CDQ fishery between 2008 and 2013.

Figure 4-49 Average Percentage of Wholesale Revenue by CDQ Target Fisheries, 2008 to 2013



Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

4.4.6.3 Regional Impacts of CDQ Groundfish Fisheries

In Table 4-77 we compare the distribution of wholesale revenue between two groups: 1) CPs that are owned by residents of other states, and 2) shore plants in Alaska combined with CPs that are registered to Alaska owners. We note that due to confidentiality restrictions, we cannot provide a similar breakdown for ex-vessel revenues generated by CVs. The share of wholesale revenue from the CDQ groundfish fishery that is attributed to Alaska jumped considerably in 2011, when one of the AFA-CPs switched to Alaska ownership. We also note that the full economic impact of the CDQ groundfish fishery in Alaska is beyond the scope of this analysis, but it is almost certainly greater than the split of wholesale revenues depicted here.

Table 4-77 Distribution of Wholesale Revenue from the BSAI CDQ Fisheries

	2008	2009	2010	2011	2012	2013	Average
			Wholesale Value by Region ($Millions 2013)				
Other States	$235.36	$162.29	$157.29	$170.13	$186.70	$154.93	$177.78
Alaska	$6.31	$4.15	$10.03	$49.74	$36.14	$27.75	$22.35
Total	$241.67	$166.45	$167.32	$219.87	$222.84	$182.68	$200.14

Note: Wholesale value generated by shore plants in Alaska is combined with Alaska-owned CPs.
Source: Developed by Northern Economics using AKFIN data (Fey 2014).

4.4.6.4 Halibut PSC Limits and Halibut PSC Mortality in Target Fisheries of CDQ Vessels

Table 4-78 summarizes halibut PSC limits for the CDQ fishery between 2008 and 2013. Halibut PSC mortality is allocated to CDQ groups initially, allocating 326 mt from the total trawl halibut PSC limit, plus 7.5 percent, or 67 mt, of the non-trawl halibut PSC limit. The increase in the halibut PSC limit in 2010 was a part of the Amendment 80 reapportionment of PSC mortality. Halibut PSC limits have remained at 393 mt since 2010.

Table 4-78 Halibut PSC Limits and Apportionment to CDQ Target Fisheries, 2008 to 2013

Target Group	2008	2009	2010	2011	2012	2013
	Halibut PSC Limit (in Round Weight mt)					
All targets combined	343	343	393	393	393	393

Source: Developed by NEI using data from NMFS' Alaska Groundfish Specification Tables (NMFS 2014f).

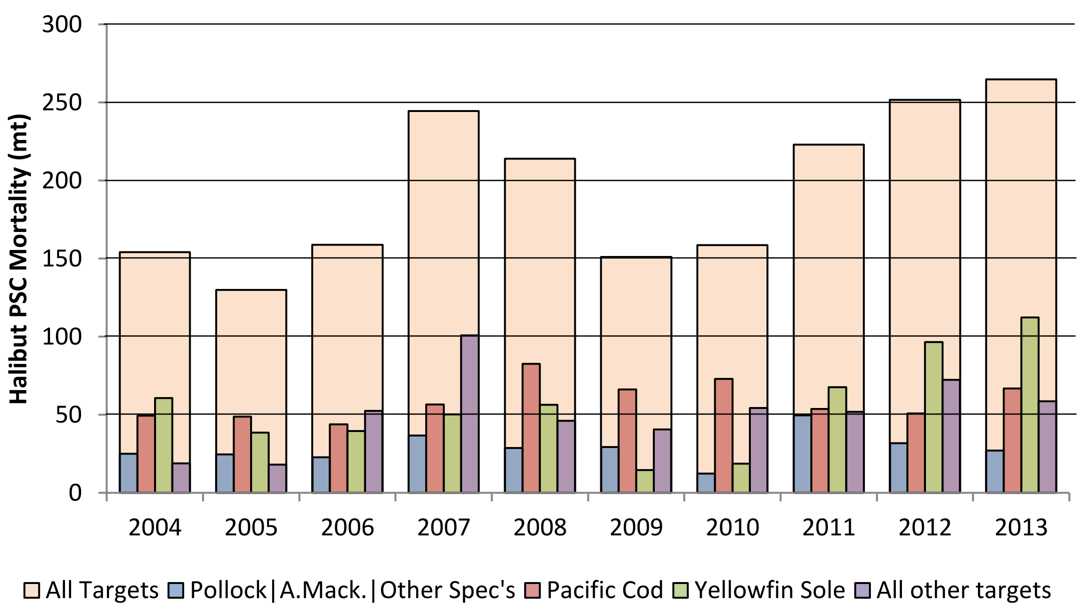
Table 4-79 and Figure 4-50 on the following page summarize halibut mortality in the CDQ target fisheries. Halibut mortality occurs primarily in the non-pollock fisheries, which accounted for 86 percent of halibut PSC mortality in the CDQ fishery (see Figure 4-51). Between 2004 and 2013, halibut PSC mortality in CDQ fisheries closely tracked total harvest of non-pollock harvest, increasing during years of increased harvest in non-pollock fisheries. Halibut PSC mortality fell 29 percent in 2009 and 2010, during which time there was a decrease in total yellowfin sole harvest. Halibut PSC mortality peaked in 2013 at 265 mt, roughly 67 percent of the CDQ Program's total halibut PSC limit. Recent increases in halibut PSC mortality are primarily due to increased CDQ participation in the yellowfin sole fishery.

Table 4-79 Halibut PSC Mortality in CDQ Target Fisheries, 2008 to 2013

Target Group	2008	2009	2010	2011	2012	2013	Average
	Halibut PSC Mortality (in Round Weight mt)						
Pollock|Atka Mackerel|Other Species	28.8	29.3	12.4	49.6	31.9	27.0	29.8
Pacific Cod	82.7	66.3	73.1	53.8	50.9	66.8	65.6
Yellowfin Sole	56.3	14.7	18.7	67.6	96.6	112.3	61.0
All other targets	46.2	40.7	54.4	51.9	72.3	58.7	54.0
All Targets	**214.0**	**151.0**	**158.6**	**223.0**	**251.7**	**264.8**	**210.5**

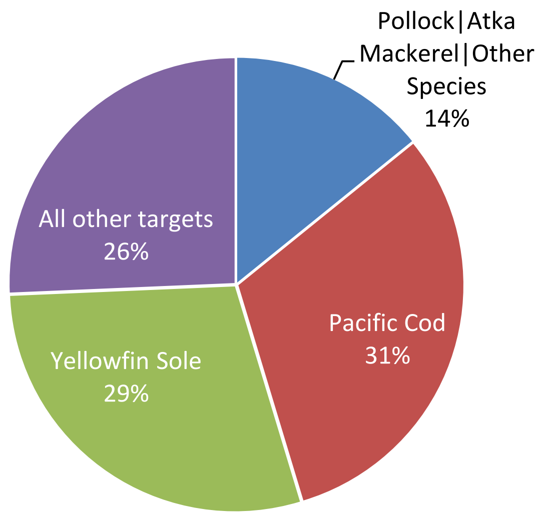
Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

Figure 4-50 Halibut PSC Mortality in CDQ Target Fisheries, 2004 to 2013



Source: Developed by Northern Economics using AKFIN data (Fey 2014).

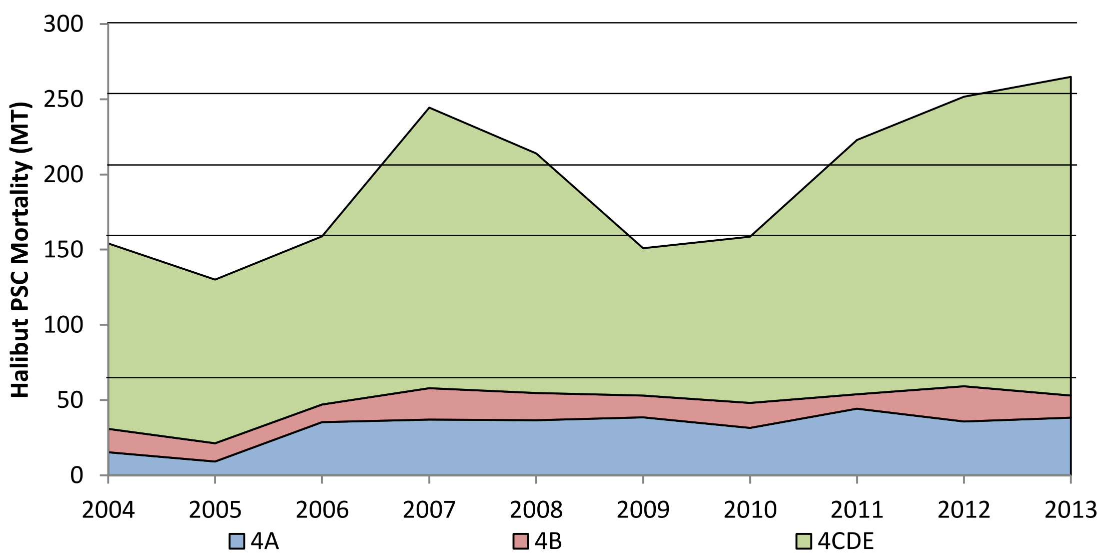
Figure 4-51 Average Percentage of Total Halibut PSC Mortality by CDQ Target Fisheries, 2008 to 2013



Source: Developed by Northern Economics using AKFIN data (Fey 2014).

Figure 4-52 and Table 4-80 summarize halibut mortality in CDQ fisheries by IPHC area. Halibut PSC primarily occurs in IPHC Area 4CDE—75 percent of CDQ halibut PSC mortality 2008 to 2013 was taken in IPHC Area 4CDE.

Figure 4-52 Halibut PSC Mortality in CDQ Fisheries by IPHC Area, 2004 to 2013



Note: Data by IPHC Area were unavailable for CDQ fisheries prior to 2004.
Source: Developed by Northern Economics using AKFIN data (Fey 2014).

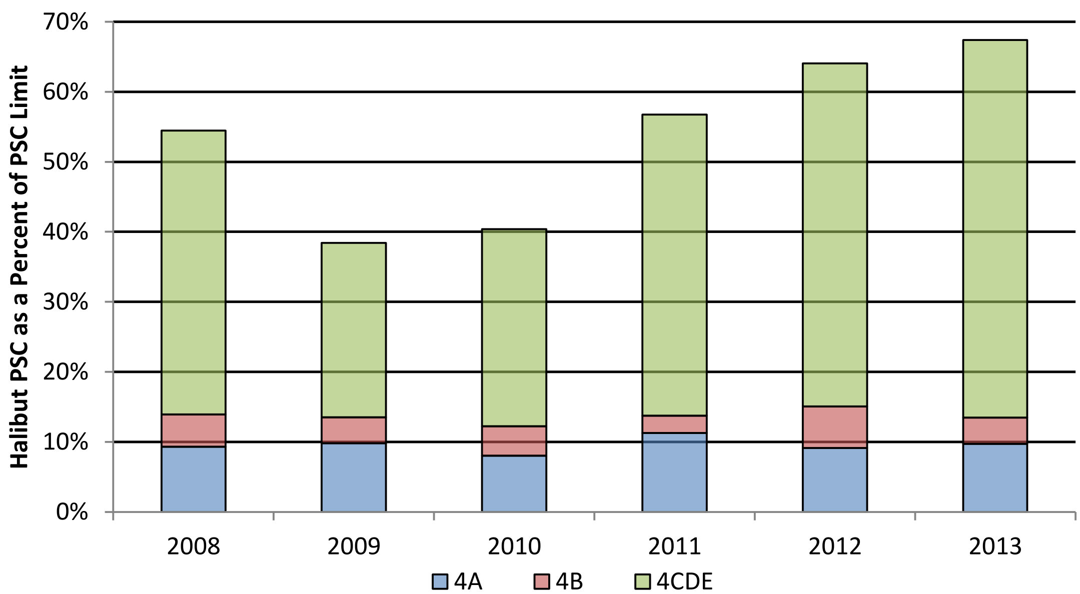
Table 4-80 Halibut PSC Mortality in CDQ Fisheries by IPHC Area, 2008 to 2013

	2008	2009	2010	2011	2012	2013	Total
Target Group	Halibut PSC Mortality (in Round Weight mt)						
IPHC Area 4A	36.6	38.6	31.5	44.3	35.8	38.3	225.1
IPHC Area 4B	18.1	14.5	16.6	9.6	23.5	14.7	96.9
IPHC Areas 4CDE	159.3	97.9	110.5	169.1	192.4	211.9	941.2
All Areas	**214.0**	**151.0**	**158.6**	**223.0**	**251.7**	**264.8**	**1,263.2**

Source: Developed by Northern Economics using AKFIN data (Fey 2014).

Figure 4-53 summarizes the percentage of halibut PSC limits harvested in the CDQ fishery by IPHC area. Between 2008 and 2013, the CDQ fishery harvested 54 percent of its halibut PSC limit, on average. Since 2010, annual percentages of halibut PSC limits harvested has gradually increased in IPHC Area 4CDE, reaching 67 percent of the total halibut PSC limit in 2013. As seen in Table 4-79, there were relatively big increases in halibut mortality in the yellowfin sole target fisheries.

Figure 4-53 Percentage of Current Halibut PSC Limits Harvested in CDQ Fisheries by IPHC, 2008 to 2013



Source: Developed by Northern Economics using AKFIN data (Fey 2014).

4.4.6.5 Groundfish Wholesale Revenues Generated per Ton of Halibut PSC in CDQ Fisheries

Annual catch progression lines for the two largest CDQ target fisheries (pollock and Pacific cod) are shown in Figure 4-54 and Figure 4-55. As shown previously in section 4.4.6.2, the pollock target fishery represents the largest fishery for CDQs, by both value and volume. The annual catch progression for the pollock target fishery is shown in Figure 4-54, and reveals that halibut PSC reached its maximum in 2011 at approximately 50 mt while accruing nearly $160 million in wholesale revenue. The long flat segment of line for 2011, indicated that fishing latter part of the year generated much less wholesale revenue per halibut PSC. Nearly $140 million in wholesale revenue was generated utilizing approximately 25 mt of halibut PSC through September. The flat segment that begin in October shows that to generate the remaining $20 million in wholesale revenues, approximately the same amount of halibut PSC was required as needed to generate the first $140 million. With the exception of 2008 and 2009, all other years exhibit nearly flat portions in their catch progression line, indicating almost zero additional wholesale revenue per halibut PSC.

Figure 4-55 summarizes annual catch progressions for the CDQ Pacific cod target fishery, almost all of which is harvested by longline vessels. As shown and previously discussed in section 4.4.6.2, variation in wholesale revenues and halibut PSC occurs across all years. Wholesale revenue per halibut PSC appears to be the best in 2008, 2011, and 2012, as indicated by the relatively steeper progression lines.

Table 4-81 summarizes calculation of the wholesale revenue generated per ton of halibut PSC mortality in each of the CDQ fisheries. This measure is an indication of how much wholesale revenue the average participant in the CDQ fishery would have to give up during an average trip if they were required to reduce halibut PSC mortality by one mt. The numbers shown in the table are calculated by summing the wholesale revenue for the target group and year and then dividing by the halibut PSC mortality for the same target group and year. It should be noted that because there is significant variability in halibut PSC mortality rates over the course of the year and across vessels, there is also significant variability in the wholesale value generated per ton of halibut PSC mortality in a given fishery.

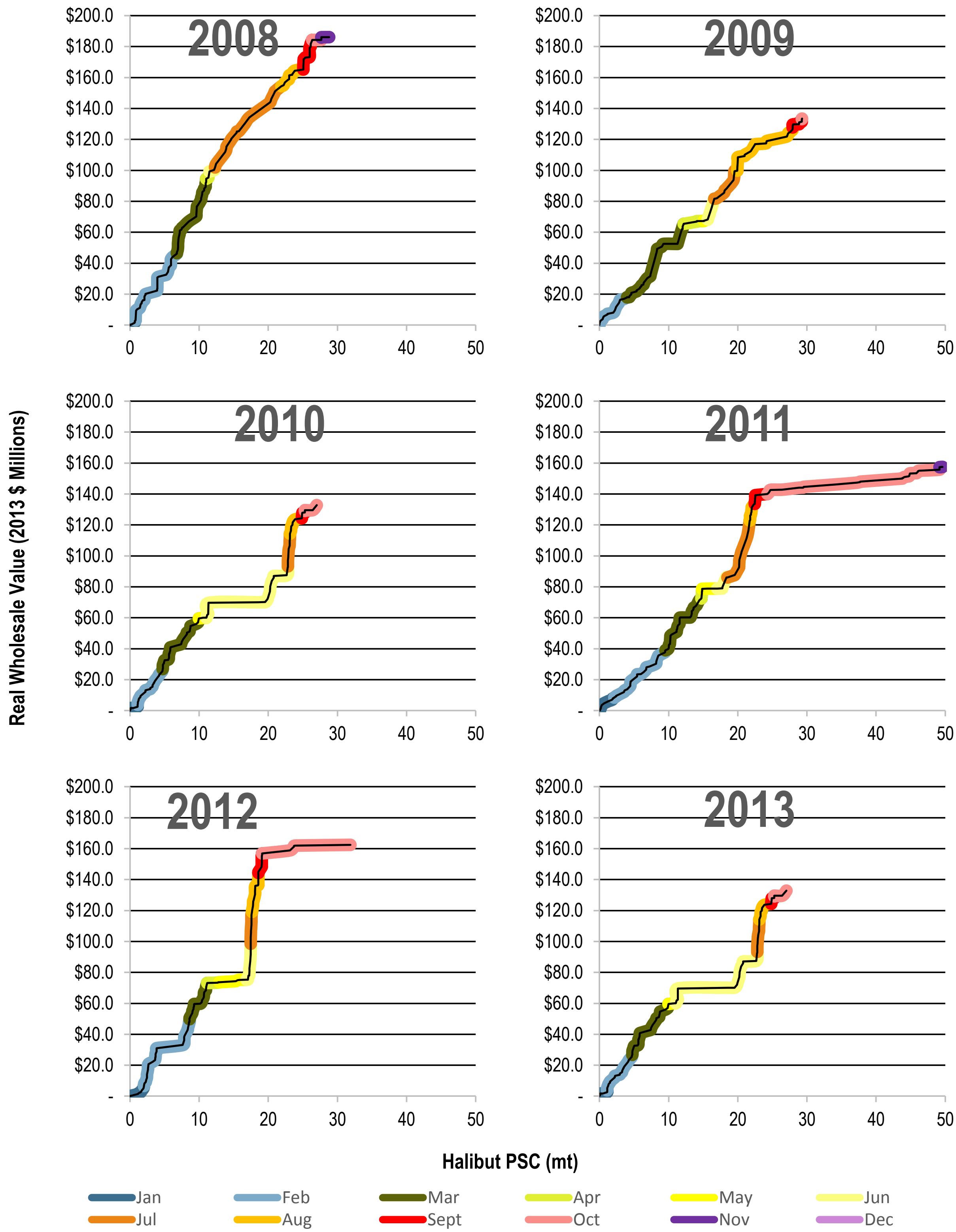
Table 4-81 Wholesale Revenue per Ton of Halibut PSC Mortality in CDQ Target Fisheries, 2008 to 2013

	2008	2009	2010	2011	2012	2013	Average
Target Group	**Wholesale Revenue Per Halibut Ton of PSC Mortality (in millions of 2013 $ per mt)**						
Pollock|Atka Mackerel|Other Species	$6.45	$4.56	$10.58	$3.17	$5.11	$4.92	$5.05
Pacific Cod	$0.51	$0.39	$0.37	$0.66	$0.58	$0.33	$0.46
Yellowfin Sole	$0.13	$0.12	$0.18	$0.27	$0.19	$0.16	$0.18
All other targets	$0.14	$0.12	$0.11	$0.18	$0.17	$0.16	$0.15
All Targets	**$1.13**	**$1.10**	**$1.05**	**$0.99**	**$0.89**	**$0.69**	**$0.95**

Source: Developed by Northern Economics using AKFIN data (Fey 2014).

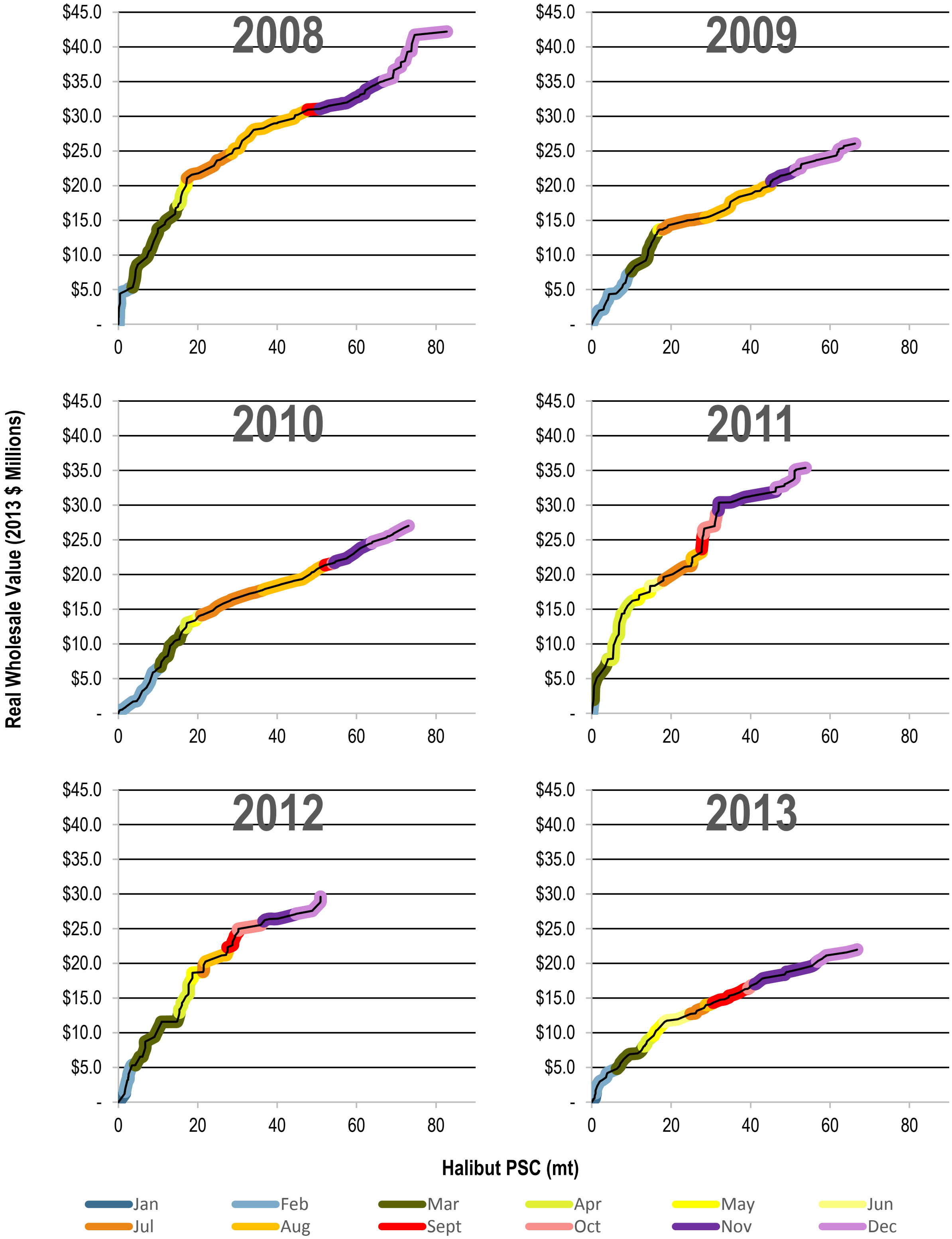
Wholesale revenues per ton of halibut PSC mortality have gradually decreased from $1.13 million in 2008 to $0.69 million in 2013. This is likely due to the combination of decreased wholesale revenues from pollock in 2009 and 2010, and increases in halibut PSC mortality in non-pollock fisheries. It is clear that the wholesale revenue generated per ton of halibut PSC mortality in the pollock fisheries (averaging $5.05 million per ton from 2008 to 2013) is significantly higher than the values generated in the other CDQ target fisheries. This is due to the relatively low levels of halibut PSC mortality taken in the pollock target fishery. Wholesale revenue per ton of halibut PSC mortality in the CDQ Pacific cod fishery averaged $460,000 from 2008 to 2013, while the yellowfin sole fishery averaged a relatively low $18,000 per ton of halibut PSC mortality. As previously mentioned, using this average value to estimate impacts from halibut PSC reductions could result in gross overestimation or underestimation of impacts due to different methodologies used under different scenarios. These scenarios are discussed later in affected participant sections.

Figure 4-54 Annual Progression of Wholesale Revenues and Halibut PSC in the CDQ Pollock Target Fishery



Source: Developed by Northern Economics using AKFIN data (Fey 2014).

Figure 4-55 Annual Progression of Wholesale Revenues and Halibut PSC in the CDQ Pacific Cod Target Fishery



Source: Developed by Northern Economics using AKFIN data (Fey 2014).

4.4.6.6 Measures of Halibut PSC Mortality and Encounters

Table 4-23 summarizes key factors that result in the total amount of halibut PSC in the CDQ target fisheries. The measures described below all contribute to the PSC total. By changing any one of the factors, the sector can change total halibut PSC. For example cutting total groundfish by 10 percent will reduce total halibut PSC by 10 percent if all of the other factors remain constant. Similarly if a sector cuts its halibut encounter rate by 10 percent, total PSC will be reduced by 10 percent.

Table 4-82 Measures of Halibut Mortality and Encounters in CDQ Target Fisheries

Sector and Target	2008	2009	2010	2011	2012	2013
Total Groundfish (mt)						
CDQ Total	143,240	118,853	120,502	176,413	179,442	186,560
Pollock	101,413	82,744	82,728	118,698	123,150	127,835
Pacific Cod	21,110	20,377	19,322	23,906	21,660	21,572
Yellowfin Sole	8,503	2,218	4,043	20,202	17,313	22,896
Halibut Encounters (r.w. kg)						
CDQ Total	**953,977**	**757,806**	**830,762**	**711,259**	**619,805**	**824,411**
Pollock	26,892	23,811	12,151	45,524	15,897	18,054
Pacific Cod	796,250	657,190	729,731	512,738	382,833	593,012
Yellowfin Sole	65,518	17,509	22,021	79,564	113,618	130,566
Encounter Rate (kg of halibut / mt of groundfish)						
CDQ Total	**6.7**	**6.4**	**6.9**	**4.0**	**3.5**	**4.4**
Pollock	0.3	0.3	0.1	0.4	0.1	0.1
Pacific Cod	37.7	32.3	37.8	21.4	17.7	27.5
Yellowfin Sole	7.7	7.9	5.4	3.9	6.6	5.7
Average DMR (percentage)						
CDQ Total	**22**	**20**	**19**	**31**	**41**	**32**
Pollock	90	89	88	89	89	88
Pacific Cod	10	10	10	11	13	11
Yellowfin Sole	86	84	85	85	85	86
Change in Halibut PSC by Target Given a 10 Percent Reduction in Total Groundfish, Halibut Encounter Rates, or DMR (percent)						
CDQ Total	21.4	15.1	15.9	22.3	25.2	26.5
Pollock	2.4	2.1	1.1	4.1	1.4	1.6
Pacific Cod	8.3	6.6	7.3	5.4	5.1	6.7
Yellowfin Sole	5.6	1.5	1.9	6.8	9.7	11.2

Source: Developed by Northern Economics using AKFIN data (Fey 2014).

4.4.6.7 Reliance on BSAI Groundfish and Diversification of CDQ Vessels into Other Fisheries

Vessels participating in the CDQ fisheries are primarily dependent on the other non-CDQ BSAI groundfish fisheries and most participate in the CDQ fisheries on a part-time basis. These vessels also generate revenues in other fisheries throughout the state and on the West Coast. The level of participation in other fisheries is important because it provides context regarding the relative importance of the groundfish fisheries that are affected by the proposed alternatives to reduce halibut PSC Limits. Table 4-83 summarizes activities in fisheries other than CDQ fisheries in which these vessels are active.

Table 4-83 Total CDQ Vessels Participating Other Fisheries, 2008 to 2013

	2008	2009	2010	2011	2012	2013
Number of CDQ Vessels Participating Other Fisheries						
BSAI Pot Groundfish	-	-	-	-	-	-
Non-CDQ BSAI Groundfish	40	39	34	37	35	37
All Halibut	-	1	-	-	-	-
All Fixed Gear Sablefish	4	5	3	2	2	1
GOA Groundfish	13	14	11	10	7	4
AK Salmon	-	-	-	-	1	-
All Other AK Fisheries	1	1	1	1	1	1
West Coast Fisheries	10	3	4	9	9	9
Additional Revenue of Vessels Participating CDQ Fisheries in All Other Fisheries ($2013 millions)						
Non-CDQ BSAI Groundfish	$551.5	$476.1	$531.0	$749.4	$732.3	$678.8
All Other Fisheries	$14.9	$14.1	$15.0	$14.7	$17.5	$13.8

Note: Table developed by Northern Economics using AKFIN data (Fey 2014).

4.4.7 Community Dependence on Groundfish Fisheries

Appendix C includes a detailed analysis of community participation patterns in the BSAI halibut fisheries, for communities in Alaska and elsewhere.

4.5 Pacific Halibut Fisheries in IPHC Area 4

This section provides an overview of the commercial halibut fisheries in Area 4. Within this overview we generally combine the IFQ fishery and the CDQ fishery when discussing IFQ and CDQ harvests and revenue. This is done in part because data precision has not been consistent over all of the years, and also because the proposed reductions in halibut PSC limit will create proportional benefits for both fisheries. In other words, if PSC limit reductions lead to a million pound increase in the FCEY, the two fishery components will share the benefit in direct proportions to their allocations.

4.5.1 Catch and Revenue in the Commercial Fisheries for Pacific Halibut in the BSAI

Over the past ten years there have been substantial reductions in the net weight pounds of halibut IFQ and CDQ harvests in Alaska. Between 2003 and 2013 there was a 60 percent decrease in the reported net weight pounds of halibut harvested in Alaska according to AKFIN data. Roughly 19 percent of the net weight pounds of halibut harvested by IFQs and CDQs in Alaska were harvested in the Area 4 in 2013, a proportion that has stayed relatively stable over the past decade. Between 2012 and 2013 there was a 24 percent decrease in the reported net weight of IFQ and CDQ halibut harvests in Area 4. Harvests within the three regulatory subareas defined by the IPHC (4A, 4B, and 4CDE) are broken out in Table 4-84 below. In 2013 IPHC regulatory Area 4A accounted for 29 percent, Area 4B accounted for 29 percent, and Area 4CDE accounted for 42 percent of the total reported net weight pounds of halibut harvested in the BSAI.

Table 4-84 IFQ and CDQ Harvests of Halibut in Alaska Based on AKFIN Data

	GOA (2C–3B)	4A	4B	4CDE	BSAI (4A–4E)	Alaska Total
Year	Harvests Reported in Net Weight Pounds (1,000s)					
2003	45,428.1	4,899.4	3,836.3	3,023.2	11,758.9	57,188.2
2004	47,992.7	3,372.7	2,631.1	2,810.6	8,814.3	56,807.1
2005	46,192.9	3,291.4	1,884.8	3,384.4	8,560.6	54,753.5
2006	44,412.3	3,230.5	1,577.4	3,145.2	7,953.0	52,365.3
2007	41,951.8	2,760.0	1,403.0	3,758.3	7,921.4	49,873.2
2008	39,655.3	3,011.7	1,725.3	3,777.4	8,514.3	48,169.6
2009	37,188.9	2,536.4	1,536.8	3,306.6	7,379.7	44,568.6
2010	35,598.7	2,350.2	1,818.3	3,296.1	7,464.7	43,063.4
2011	24,580.6	2,275.6	2,027.9	3,497.6	7,801.1	32,381.7
2012	19,720.3	1,596.5	1,717.1	2,322.3	5,636.0	25,356.2
2013	18,242.7	1,247.9	1,221.7	1,779.5	4,249.0	22,491.7
Total	**400,964.2**	**30,572.1**	**21,379.6**	**34,101.3**	**86,053.1**	**487,018.6**

Note: The AKFIN data contained several records that did not report a harvest subarea—with the exception of 1,320 lb of harvests with "Unknown" areas were assigned to IPHC Areas based on processor locations.
Source: Table developed by Northern Economics from data provided by AKFIN (Fey 2014).

This study uses data from AKFIN for analysis, but it should be noted that IPHC also collects and publishes data on the commercial harvest of halibut in Alaska. The IPHC data displayed in Table 4-85 below vary slightly from the harvests reported in Table 4-84 prepared with AKFIN data, because IPHC also includes halibut harvests made for scientific purposes and funding. Although the numbers differ slightly, the IPHC data show a similar reduction in reported net weight pounds of halibut harvested between 2003 and 2013, about 63 percent.

Table 4-85 Commercial Harvests of Halibut in Alaska from IPHC Data

	GOA (2C–3B)	4A	4B	4CDE	BSAI (4A–4E)	Grand Total
Year	Harvests Reported in Net Weight Pounds (1,000s)					
2003	48,389.0	5,024.0	3,863.0	3,258.0	12,145.0	60,534.0
2004	50,861.0	3,562.0	2,719.0	2,923.0	9,204.0	60,065.0
2005	49,829.0	3,404.0	1,975.0	3,481.0	8,860.0	58,689.0
2006	46,998.0	3,332.0	1,590.0	3,227.0	8,149.0	55,147.0
2007	44,215.0	2,828.0	1,416.0	3,850.0	8,094.0	52,309.0
2008	41,475.0	3,015.0	1,763.0	3,876.0	8,654.0	50,129.0
2009	37,491.0	2,528.0	1,593.0	3,310.0	7,431.0	44,922.0
2010	35,102.0	2,325.0	1,829.0	3,315.0	7,469.0	42,571.0
2011	24,444.0	2,351.0	2,054.0	3,429.0	7,834.0	32,278.0
2012	19,771.0	1,583.0	1,738.0	2,341.0	5,662.0	25,433.0
2013	18,203.0	1,233.0	1,237.0	1,775.0	4,245.0	22,448.0
Total	**416,778.0**	**31,185.0**	**21,777.0**	**34,785.0**	**87,747.0**	**504,525.0**

Note: IPHC Commercial Harvest data includes harvests undertaken by IPHC for scientific purposes. All IPHC data are reported in 1,000 of lb.
Source: Table developed by Northern Economics from IPHC Reports (IPHC RARA, 2014).

Table 4-86 displays IFQ and CDQ halibut harvests in thousands of net weight pounds between 2003 and 2013 in Area 4 by subarea. IFQ harvests accounted for over 74 percent of the total net weight pounds of halibut harvested in 2013. The majority of CDQ halibut harvests in the BSAI are reported in regulatory Area 4CDE, and in 2013 about 78 percent of the total harvested net weight pounds of halibut were harvested in this area. Area 4CDE surrounds the western coast of Alaska, within which the majority of CDQ communities are found. The remainder of the CDQ halibut is harvested in Area 4B; there are no CDQ allocations in Area 4A. IFQ harvests are more equally distributed across the three regulatory areas being analyzed in this study, with 39 percent of the 2013 IFQ harvest in Area 4A, 32 percent in Area 4B, and 29 percent in Area 4CDE.

Table 4-86 IFQ and CDQ Harvests of Halibut in the BSAI

	4A	4B	4CDE	IFQ Total	4A	4B	4CDE	CDQ Total
Year	IFQ Fishery in Net Weight Pounds (1,000s)				CDQ Fishery in Net Weight Pounds (1,000s)			
2003	4,899.4	3,836.3	3,023.1	11,758.8	-	-	0.2	0.2
2004	3,372.7	2,631.1	2,810.6	8,814.3	-	-	-	-
2005	3,291.4	1,884.8	3,384.2	8,560.4	-	-	0.1	0.1
2006	3,230.5	1,577.4	3,144.7	7,952.5	-	-	0.5	0.5
2007	2,760.0	1,403.0	3,758.0	7,921.1	-	-	0.3	0.3
2008	3,011.7	1,725.0	3,776.9	8,513.5	-	0.3	0.5	0.8
2009	2,526.5	1,443.8	1,753.7	5,724.0	-	102.8	1,552.9	1,655.7
2010	2,315.3	1,397.7	1,879.4	5,592.4	-	420.6	1,451.6	1,872.2
2011	2,275.6	1,594.9	1,875.3	5,745.8	-	433.0	1,622.4	2,055.3
2012	1,587.1	1,376.4	1,172.9	4,136.4	-	350.1	1,149.5	1,499.6
2013	1,230.2	999.0	930.3	3,159.6	-	222.6	849.2	1,089.5
Total	**30,500.4**	**19,869.5**	**27,509.0**	**77,878.8**	**-**	**1,529.4**	**6,627.2**	**8,174.2**

Note: Prior to 2009, the distinction between CDQ and IFQ harvests was less precise than they are currently.
Source: Table developed by Northern Economics from data provided by AKFIN (Fey 2014)

The net weight pounds of halibut allocated to the BSAI IFQ and CDQ fisheries has steadily declined since 2003. Table 4-87 displays the allocations for the BSAI IFQ and CDQ fisheries broken down by IPHC regulatory area. Since 2003, the total net weight pounds of halibut allocated to IFQ fisheries in the BSAI have declined by 67 percent and CDQ allocations have declined by 56 percent. The IFQ fishery in regulatory Area 4A has historically received the highest allocation—about 38 percent of the total BSAI IFQ allocation in 2013. Area 4CDE typically receives the highest of the CDQ allocation, in 2013 accounting for over 76 percent of the total BSAI CDQ allocations. If IFQ and CDQ allocations were combined, 4A gets 33.3 percent, 4B gets 25.0 percent, and 4CDE gets 41.7 percent.

Table 4-87 IFQ and CDQ Allocations of Halibut in the BSAI (Net Weight Pounds)

	4A	4B	4CDE	IFQ Total	4A	4B	4CDE	CDQ Total
Year	IFQ Fishery in Net Weight Pounds				CDQ Fishery in Net Weight Pounds			
2003	4,970.0	3,344.0	2,436.0	10,750.0	-	836.0	2,014.0	2,850.0
2004	3,470.0	2,248.0	2,064.0	7,782.0	-	562.0	1,721.0	2,283.0
2005	3,440.0	1,808.0	2,178.0	7,426.0	-	452.0	1,811.0	2,263.0
2006	3,350.0	1,336.0	1,932.0	6,618.0	-	334.0	1,618.0	1,952.0
2007	2,890.0	1,152.0	2,239.8	6,281.8	-	288.0	1,860.2	2,148.2
2008	3,100.0	1,488.0	2,122.8	6,710.8	-	372.0	1,767.2	2,139.2
2009	2,550.0	1,496.0	1,882.8	5,928.8	-	374.0	1,577.2	1,951.2
2010	2,330.0	1,728.0	1,950.0	6,008.0	-	432.0	1,630.0	2,062.0
2011	2,410.0	1,744.0	2,028.0	6,182.0	-	436.0	1,692.0	2,128.0
2012	1,567.0	1,495.2	1,328.8	4,391.0	-	373.8	1,136.2	1,510.0
2013	1,330.0	1,160.0	1,030.8	3,520.8	-	290.0	950.7	1,240.7
Total	**31,407.0**	**18,999.2**	**21,193.0**	**71,599.2**	**-**	**4,749.8**	**17,777.5**	**22,527.3**

Source: Table developed by Northern Economics from NMFS data (NMFS 2014f).

Using the information displayed in Table 4-86 and Table 4-87, Table 4-88 below displays the combined IFQ and CDQ harvest as a percentage of the combined BSAI halibut allocation. With the exception of harvests in Area 4A in 2010 and 2012, the combined CDQ and IFQ harvest historically has stayed well under the total allocated amount. In 2013 only 89 percent of the total BSAI halibut allocation was harvested leaving a total of 714,225 pounds of allocated halibut un-harvested.

Table 4-88 IFQ and CDQ Allocations of Halibut in the BSAI (Percent of Allocation)

	4A	4B	4CDE	BSAI Total
Year	Combined IFQ and CDQ Harvests as percent of Allocation			
2003	99%	92%	68%	86%
2004	97%	94%	74%	88%
2005	96%	83%	85%	88%
2006	96%	94%	89%	93%
2007	96%	97%	92%	94%
2008	97%	93%	97%	96%
2009	99%	82%	96%	94%
2010	101%	84%	92%	92%
2011	94%	93%	94%	94%
2012	102%	92%	94%	96%
2013	94%	84%	90%	89%
Total	**97%**	**90%**	**88%**	**91%**

Source: Table developed by Northern Economics from data AKFIN (Fey 2014) and NMFS (2014f).

Table 4-89 below displays the estimated real ex-vessel value of IFQ and CDQ halibut harvest. The estimated real ex-vessel value is the amount that processors paid fishermen for their harvests and has been adjusted for inflation (2013$). Since 2003, the estimated real ex-vessel value of Alaskan IFQ and CDQ halibut harvests has decreased by 55 percent. IFQ and CDQ halibut harvests in the BSAI have decreased by 61 percent and regulatory Area 4A experienced the largest decrease with a 74 percent reduction in real ex-vessel value since 2003.

Table 4-89 Estimated Real Ex-vessel Revenue of IFQ and CDQ Harvests of Halibut in Alaska

	GOA (2C–3B)	4A	4B	4CDE	BSAI (4A–4E)	Alaska Total
Year	Ex-Vessel Value of Harvests (in Millions of 2013 $)					
2003	$202.98	$21.57	$14.90	$10.93	$47.39	$250.37
2004	$210.76	$14.15	$9.99	$10.98	$35.12	$245.88
2005	$191.16	$12.93	$6.61	$11.80	$31.34	$222.50
2006	$212.48	$15.21	$6.85	$14.20	$36.26	$248.74
2007	$227.85	$14.57	$6.75	$18.22	$39.54	$267.39
2008	$204.61	$14.14	$7.38	$16.68	$38.20	$242.81
2009	$140.26	$8.25	$4.92	$9.87	$23.04	$163.30
2010	$188.16	$11.81	$8.50	$15.14	$35.46	$223.62
2011	$165.22	$15.36	$12.76	$21.72	$49.84	$215.06
2012	$120.29	$8.88	$9.02	$12.49	$30.39	$150.69
2013	$94.04	$5.52	$5.15	$7.80	$18.47	$112.52
Total	**$1,957.82**	**$142.39**	**$92.83**	**$149.83**	**$385.05**	**$2,342.87**

Source: Table developed by Northern Economics from data provided by AKFIN (Fey 2014).

One of the factors contributing to the decline in real ex-vessel values of IFQ and CDQ harvests displayed in Table 4-89 is the decrease in harvest pounds discussed earlier (Table 4-86), but falling prices have also contributed. Table 4-90 displays the estimated real ex-vessel value per net weight pound for IFQ and CDQ halibut harvests in Alaska, which has actually increased by 14 percent since 2003. Starting from the peak in 2011, however, there has been a relatively large price decline across all areas—prices were down 11.8 percent in 2012 and 18.8 percent in 2013. Over the two years, prices have declined by a total of 30.5 percent.

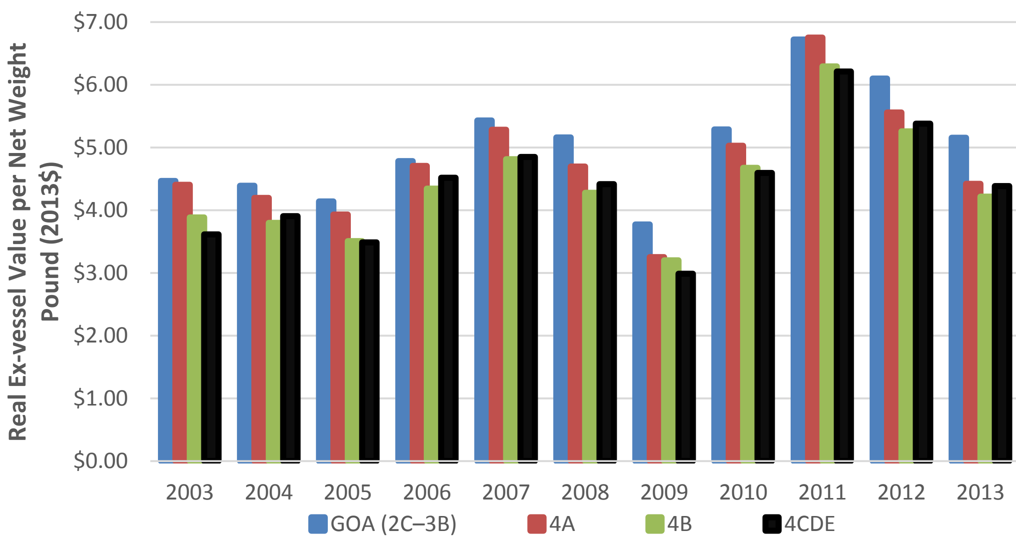
Table 4-90 Estimated Real Ex-vessel Price per Net Weight Pound Harvested

	GOA (2C–3B)	4A	4B	4CDE	BSAI (4A–4E)	Alaska Average
Year	Ex-Vessel Value per Net Weight Pound (2013$)					
2003	$4.47	$4.40	$3.88	$3.61	$4.03	$4.38
2004	$4.39	$4.20	$3.80	$3.91	$3.98	$4.33
2005	$4.14	$3.93	$3.51	$3.49	$3.66	$4.06
2006	$4.78	$4.71	$4.34	$4.52	$4.56	$4.75
2007	$5.43	$5.28	$4.81	$4.85	$4.99	$5.36
2008	$5.16	$4.69	$4.28	$4.42	$4.49	$5.04
2009	$3.77	$3.25	$3.20	$2.99	$3.12	$3.66
2010	$5.29	$5.03	$4.67	$4.59	$4.75	$5.19
2011	$6.72	$6.75	$6.29	$6.21	$6.39	$6.64
2012	$6.10	$5.56	$5.26	$5.38	$5.39	$5.94
2013	$5.16	$4.42	$4.22	$4.39	$4.35	$5.00
Total	**$4.88**	**$4.66**	**$4.34**	**$4.39**	**$4.47**	**$4.81**

Note: Estimates of ex-vessel prices are calculated from the summary data.
Source: Table developed by Northern Economics from data provided by AKFIN (Fey 2014).

Real ex-vessel value of halibut harvests per net weight pound has followed similar trends in both the BSAI and GOA since 2003. As displayed in Figure 4-56, areas 2C-3B (GOA), 4A, 4B and 4CDE all reported the lowest real ex-vessel value per net weight pound in 2009 and the highest real ex-vessel value per net weight pound in 2011. Since 2011, all four of the areas analyzed have experienced decreases in the real ex-vessel value per net weight pound for CDQ and IFQ halibut harvests.

Figure 4-56 Estimated Real Ex-Vessel Value per Net Weight Pound Harvested



Source: Figure developed by Northern Economics from data provided by AKFIN (Fey 2014)

Table 4-91 displays the real wholesale value of IFQ and CDQ halibut harvest in Alaska between 2003 and 2013. The real wholesale value is the value that processors generated from selling processed product to the consumer market, and has been adjusted for inflation (2013$). The real wholesale value of harvests in Alaska has decreased by almost 40 percent since 2003. Real wholesale value of harvests from Area 4 has decreased by over 60 percent, with harvests and products from 4A seeing the largest reductions—a 72 percent decline since 2003.

Table 4-91 Estimated Real Wholesale Value of IFQ and CDQ Harvest of Halibut in Alaska

	GOA (2C–3B)	4A	4B	4CDE	BSAI (4A–4E)	Alaska Total
Year	Wholesale Value of Harvests (in Millions of 2013 $)					
2003	$379.59	$41.22	$32.28	$25.44	$98.94	$478.53
2004	$405.77	$37.07	$28.92	$30.90	$96.89	$502.67
2005	$482.11	$34.23	$19.60	$35.20	$89.04	$571.15
2006	$480.38	$38.61	$18.85	$37.59	$95.05	$575.44
2007	$476.68	$38.59	$19.62	$52.54	$110.74	$587.42
2008	$483.38	$42.15	$24.15	$52.87	$119.17	$602.55
2009	$416.41	$25.75	$15.60	$33.57	$74.92	$491.33
2010	$448.06	$38.00	$29.40	$53.30	$120.71	$568.76
2011	$281.05	$35.99	$32.07	$55.31	$123.37	$404.42
2012	$271.64	$24.75	$26.62	$36.00	$87.38	$359.01
2013	$248.28	$11.44	$11.20	$16.31	$38.94	$287.21
Total	**$4,373.35**	**$367.81**	**$258.31**	**$429.03**	**$1,055.15**	**$5,428.50**

Note: Estimated wholesale values include revenues from ancillary products.
Source: Table developed by Northern Economics from COAR data provided by AKFIN (Fey 2014).

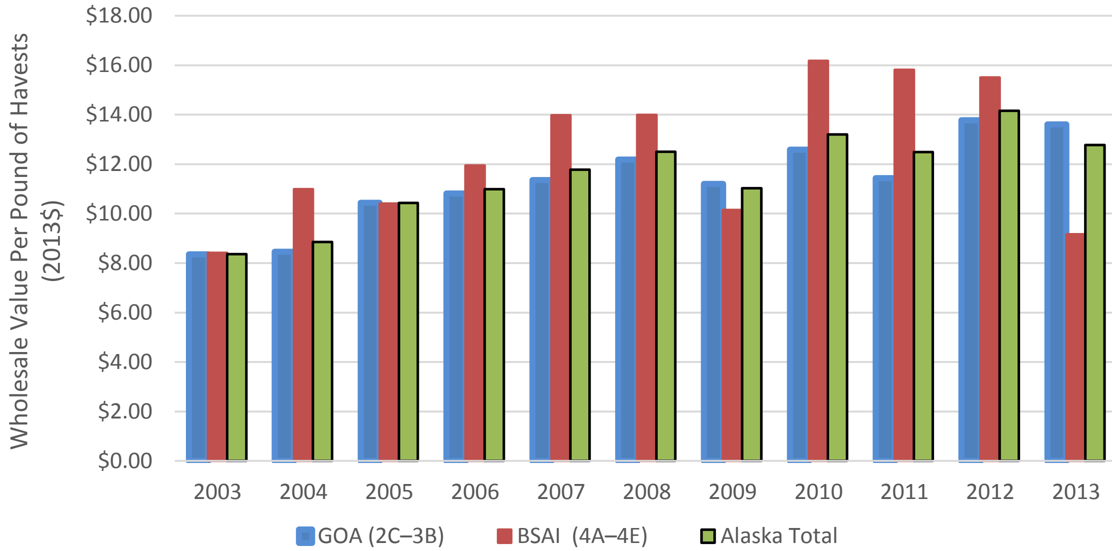
Overall, the real wholesale value generated per net weight pound of IFQ and CDQ halibut harvests in Alaska (displayed in Table 4-92 and Figure 4-57 below) has increased by 52 percent since 2003. Through 2011, real wholesale values per harvested pound in Area 4 increased at a faster rate than increases in the GOA and Alaska as whole. Prices fell across the board in 2009 due primarily to the global recession, then rebounded in 2010. In Area 4, real wholesale values generated per harvested pound were at their highest levels that year, before seeing relatively small declines in 2011 and 2013. Real wholesale prices for the GOA and Alaska as whole hit their high point in the 11-year period in 2012. In 2013, real wholesale value generated per pound for Area 4 halibut fell sharply, while prices in the GOA were flat. The drop in wholesale value per harvested pound in Area 4 amounted to 69.2 percent year-over-year decline. Unusually large and unexplained declines in imputed wholesale prices were also seen in the BSAI groundfish fisheries.

Table 4-92 Estimated Real Wholesale Value per Net Weight Pound Harvested

	GOA (2C–3B)	BSAI (4A–4E)	Alaska Average
Year	Wholesale Value Per Pound of Harvests (2013$)		
2003	$8.36	$8.41	$8.37
2004	$8.45	$10.99	$8.85
2005	$10.44	$10.40	$10.43
2006	$10.82	$11.95	$10.99
2007	$11.36	$13.98	$11.78
2008	$12.19	$14.00	$12.51
2009	$11.20	$10.15	$11.02
2010	$12.59	$16.17	$13.21
2011	$11.43	$15.81	$12.49
2012	$13.77	$15.50	$14.16
2013	$13.61	$9.16	$12.77
Total	**$10.91**	**$12.26**	**$11.15**

Note: Estimates of wholesale values per pound are calculated from the COAR data.
Source: Table developed by Northern Economics from data provided by AKFIN (Fey 2014).

Figure 4-57 Estimated Real Wholesale Value per Net Weight Pound Harvested



Source: Figure developed by Northern Economics from data provided by AKFIN (Fey 2014).

4.5.2 Distribution of Revenue in the BSAI Commercial Halibut Fisheries

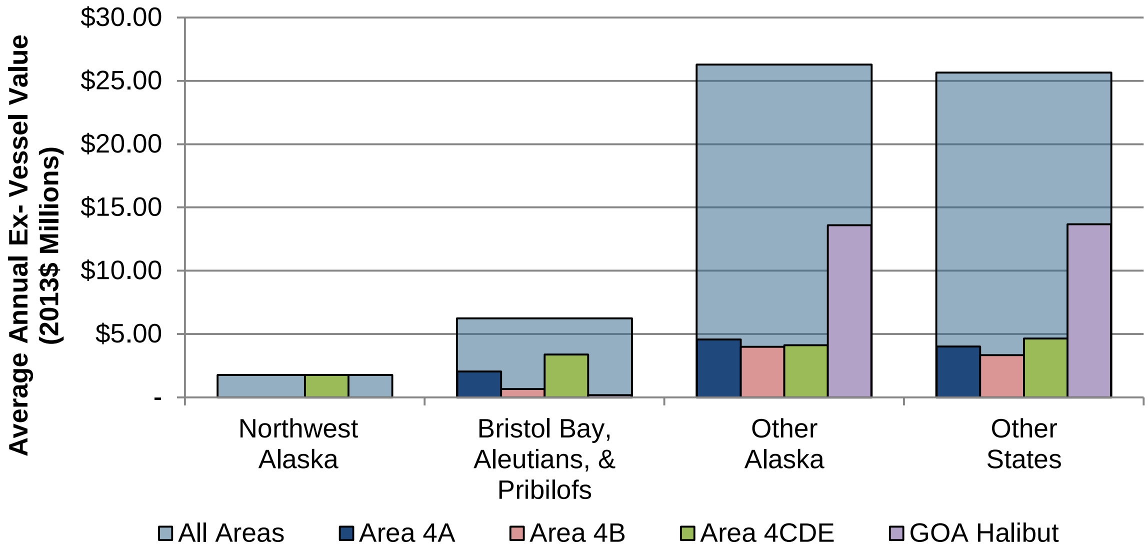
Table 4-93 displays the real ex-vessel value of halibut of participants in Area 4 halibut fisheries by the vessel owner's region of residence. The table also includes ex-vessel revenues generated by those same participants in the GOA halibut fishery. In order to be included in the table, the vessel had to have participated in Area 4 in that year. The regions of residence displayed in this table are:

- **Northwest Alaska**—Includes the Northwest Coast of Alaska from Platinum and Goodnews Bay, Nome and includes the Bethel, Wade Hampton and Nome Census Area;
- **Bristol Bay, Aleutians, and Pribilofs—**Includes Bristol Bay Communities, (excluding communities located on the Gulf of Alaska coast (i.e. the Chigniks, Perryville, and Ivanof Bay). Also included are the Pribilofs and all communities in the Aleutians West Census Area as well as the four communities in the Aleutians East Borough that have direct vessels access to the BSAI. Residents of King Cove, Cold Bay, and Sandpoint are excluded because they are considered Gulf of Alaska Communities;
- **Other Alaska**—Includes all communities on the Gulf of Alaska plus any other Alaska communities in which halibut fishermen reside;
- **Other States**—Includes all other U.S. halibut fishery participants.

Figure 4-58 along with
Table 4-93 show that between 2008 and 2013 all of the vessel owners residing in the Northwest Alaska Communities fished for halibut exclusively in Area 4CDE and generated an average annual real ex-vessel value of $1.77 million. Areas 4C, 4D and 4E are geographically close to the NW AK region, and it should also be noted that a large percent of the vessel owners residing in NW AK participate in CDQ harvest and Area 4E is home to an exclusive CDQ fishery.

Vessel owners from Bristol Bay, the Aleutians, and Pribilofs averaged $2.03 million in halibut revenues from 2008 to 2013 and spread their fishing effort across all IPHC areas in the Bering Sea. This is not surprising given that these communities are located with direct access to all of these areas. Residents of this region had small but regular participation ($0.17 million on average) in the GOA halibut fisheries.

Figure 4-58 Average Ex-vessel Value of Halibut of Active Vessels in Area 4 by Owner Region of Residence



Notes: 1) Only vessels that participated in at least one sub-area in IPHC Area 4 in the year are included in the table.
Source: Developed by Northern Economics based on data from AKFIN (Fey 2014)

Residents of the remainder of the Alaska (Other Alaska) and residents of states other than Alaska had greater levels of participation in Area 4 halibut fisheries than did local residents. Other Alaska residents averaged nearly $12.7 million in annual ex-vessel revenues from Area 4 halibut fisheries while residents of Other U.S. States just under 12.0 million from Area 4 halibut fisheries. These same fishermen also had very significant levels of participation in the GOA halibut fisheries, and here it should be noted that in order to be included in this data table, a vessel must have had halibut landings in Area 4 halibut fisheries during the year. Other Alaska residents that fish in Area 4 also generated an average of 13.6 million per year in GOA halibut fisheries, while residents of other U.S. States that fished in Area 4 averaged $13.7 million in GOA halibut fisheries.

Table 4-93 Ex-vessel Value of Halibut from Area 4 by Owner Region of Residence, 2008 to 2013

Region	Area	2008	2009	2010	2011	2012	2013	Average
		Ex-Vessel Value (2013 $ Millions)						
Northwest Alaska	Area 4A	-	-	-	-	-	-	-
	Area 4B	-	-	-	-	-	-	-
	Area 4CDE	$2.39	$1.43	$1.62	$2.19	$1.61	$1.34	$1.77
	Area 4 Total	$2.39	$1.43	$1.62	$2.19	$1.61	$1.34	$1.77
	GOA Halibut	-	-	-	-	-	-	-
	Halibut Total	$2.39	$1.43	$1.62	$2.19	$1.61	$1.34	$1.77
Bristol Bay, Aleutians & Pribilofs	Area 4A	$2.87	$1.38	$2.25	$2.82	$1.70	$1.18	$2.03
	Area 4B	$0.29	$0.38	$0.66	$1.09	$0.73	$0.74	$0.65
	Area 4CDE	$4.53	$1.70	$3.87	$4.60	$3.36	$2.24	$3.38
	Area 4 Total	$7.68	$3.46	$6.79	$8.50	$5.80	$4.16	$6.06
	GOA Halibut	$0.23	$0.09	$0.61	$0.00	-	$0.09	$0.17
	Halibut Total	$7.91	$3.55	$7.40	$8.50	$5.80	$4.26	$6.24
Other Alaska	Area 4A	$4.88	$3.39	$5.42	$7.28	$4.13	$2.36	$4.58
	Area 4B	$3.86	$2.68	$5.03	$6.00	$4.27	$2.05	$3.98
	Area 4CDE	$3.71	$2.56	$3.69	$8.97	$3.62	$2.12	$4.11
	Area 4 Total	$12.45	$8.64	$14.14	$22.25	$12.02	$6.52	$12.67
	GOA Halibut	$19.81	$12.80	$18.25	$15.58	$8.93	$6.24	$13.60
	Halibut Total	$32.26	$21.44	$32.39	$37.84	$20.95	$12.76	$26.27
Other States	Area 4A	$6.30	$3.43	$4.12	$5.23	$3.03	$1.96	$4.01
	Area 4B	$3.22	$1.85	$2.80	$5.67	$4.01	$2.35	$3.32
	Area 4CDE	$6.03	$4.18	$5.96	$5.95	$3.89	$1.89	$4.65
	Area 4 Total	$15.55	$9.46	$12.87	$16.85	$10.93	$6.20	$11.98
	GOA Halibut	$19.08	$13.50	$17.80	$15.05	$9.35	$7.29	$13.68
	Halibut Total	$34.62	$22.96	$30.67	$31.90	$20.28	$13.49	$25.65
All Regions	Area 4A	$14.04	$8.20	$11.79	$15.33	$8.86	$5.49	$10.62
	Area 4B	$7.36	$4.91	$8.49	$12.76	$9.01	$5.15	$7.95
	Area 4CDE	$16.67	$9.87	$15.14	$21.71	$12.49	$7.59	$13.91
	Area 4 Total	$38.07	$22.99	$35.42	$49.80	$30.36	$18.23	$32.48
	GOA Halibut	$39.12	$26.39	$36.66	$30.63	$18.28	$13.62	$27.45
	Halibut Total	$77.19	$49.38	$72.08	$80.43	$48.63	$31.85	$59.93

Note: Only vessels that participated in at least one sub-area in IPHC Area 4 in the year are included in the table.
Source: Developed by Northern Economics based on data from AKFIN (Fey 2014)

Table 4-94 summarizes vessel and crewmember participation in Area 4 halibut fisheries, by the region of the vessel owner's place of residence. The table provides counts of active vessels by year, and reprises the amount of ex-vessel revenue earned. The latter is duplicated from the previous table because of its direct relationship to crew shares and payments to crew members, estimates of which are shown in the table below. Average crew sizes are based on data provided by AKFIN, but these data are somewhat incomplete and therefore algorithms were developed to estimate missing values. Crew share percentages were developed based on the professional experience and expertise of the analysts. In general, it was assumed that larger vessels (more often owned by non-local fishermen) had somewhat smaller crew shares.

Table 4-94 Number of Active Vessels, Crew Size, Persons working and Payments to Crew Members in Area 4 Halibut Fisheries by Region of Residence

Region	Year	Active Vessels	Ex-Vessel Revenue (2013 $ millions)	Average Crew Size	Estimated Total Persons in Crew Rotations	Average Crew Share Percentage	Crew Payments (2013$ M)	Payments/Person in Crew Rotation (2013 $)
Northwest Alaska	2008	199	$2.39	3.1	617.8	49.9%	$1.17	$1,900
	2009	192	$1.43	3.1	596.8	49.9%	$0.70	$1,167
	2010	177	$1.62	3.1	553.4	49.9%	$0.80	$1,445
	2011	199	$2.19	3.1	623.0	49.9%	$1.08	$1,727
	2012	173	$1.61	3.1	539.3	49.9%	$0.80	$1,475
	2013	194	$1.34	3.1	604.0	49.9%	$0.67	$1,103
	Average	**189**	**$1.77**	**3.1**	**589.1**	**49.9%**	**$0.87**	**$1,470**
Bristol Bay, Aleutians & Pribilofs	2008	60	$7.68	3.3	216.9	48.7%	$3.59	$16,565
	2009	51	$3.46	3.4	185.6	48.4%	$1.62	$8,747
	2010	49	$6.79	3.3	179.6	48.5%	$3.19	$17,754
	2011	53	$8.50	3.3	190.8	48.7%	$4.00	$20,950
	2012	64	$5.80	3.4	228.3	48.8%	$2.74	$11,999
	2013	50	$4.16	3.5	184.5	48.7%	$1.97	$10,691
	Average	**55**	**$6.06**	**3.4**	**197.6**	**48.6%**	**$2.85**	**$14,451**
Other Alaska	2008	56	$12.45	4.2	256.8	45.2%	$5.51	$21,460
	2009	47	$8.64	4.4	213.8	44.8%	$3.84	$17,955
	2010	51	$14.14	4.7	248.2	44.4%	$6.26	$25,223
	2011	52	$22.25	4.5	251.3	44.7%	$9.82	$39,071
	2012	50	$12.02	4.4	226.1	44.8%	$5.32	$23,542
	2013	41	$6.52	4.1	174.0	45.0%	$2.87	$16,509
	Average	**50**	**$12.67**	**4.4**	**228.4**	**44.8%**	**$5.60**	**$23,960**
Other States	2008	42	$15.55	5.1	241.4	43.3%	$6.78	$28,087
	2009	39	$9.46	5.4	213.9	43.1%	$4.10	$19,169
	2010	39	$12.87	5.3	210.7	43.0%	$5.57	$26,449
	2011	37	$16.85	5.4	207.8	42.7%	$7.27	$34,998
	2012	32	$10.93	4.9	160.8	43.4%	$4.73	$29,413
	2013	35	$6.20	4.8	171.1	43.4%	$2.65	$15,488
	Average	**37**	**$11.98**	**5.2**	**201.0**	**43.2%**	**$5.18**	**$25,601**
All Regions	2008	357	$38.07	3.5	1,332.9	44.8%	$17.06	$12,797
	2009	329	$22.99	3.6	1,210.1	44.6%	$10.26	$8,478
	2010	316	$35.42	3.7	1,192.0	44.7%	$15.82	$13,275
	2011	341	$49.80	3.6	1,272.9	44.5%	$22.17	$17,413
	2012	319	$30.36	3.6	1,154.6	44.8%	$13.59	$11,770
	2013	320	$18.23	3.5	1,133.7	44.8%	$8.16	$7,200
	Average	**330**	**$32.48**	**3.3**	**1,216.0**	**44.7%**	**$14.51**	**$11,932**

Note: Only vessels that participated in at least one sub-area in IPHC Area 4 in the year are included in the table.
Source: Developed by Northern Economics based on data from AKFIN (Fey 2014)

Table 4-94 also provides estimates of the total number of persons that worked as crew members on board Area 4 halibut vessels. The estimates assume there is some natural turnover of crew members during the course of the year, and that the longer the vessel is active, the greater the number of persons that will have worked. For example, a vessel with a standard crew of 4 (including the skipper) that was active for 12 weeks during the year is assumed to have utilized 1.5 × the standard crew, or 6 persons. Using this type of calculation it is estimated that on average, slightly more 1,200 persons per year worked on Area 4 halibut vessels from 2008 to 2013. Of this amount, nearly 600 are estimated to have been based on vessels from Northwest Alaska and another 200 persons are estimated to have worked on vessels operating out of communities in the Bristol Bay, Aleutians and Pribilof Region. Overall we estimate that crew members and skippers were paid an average of $14.5 million for their efforts fishing for Area 4 halibut.

Table 4-95 utilizes all the same methodologies for determining average crew sizes, crew share percentages, and natural crew turnover discussed above to summarize participation by IPHC Area. Vessels were assigned to **one area only** based the area in which the majority of ex-vessel revenues were generated, even though some vessels actively fish all areas.

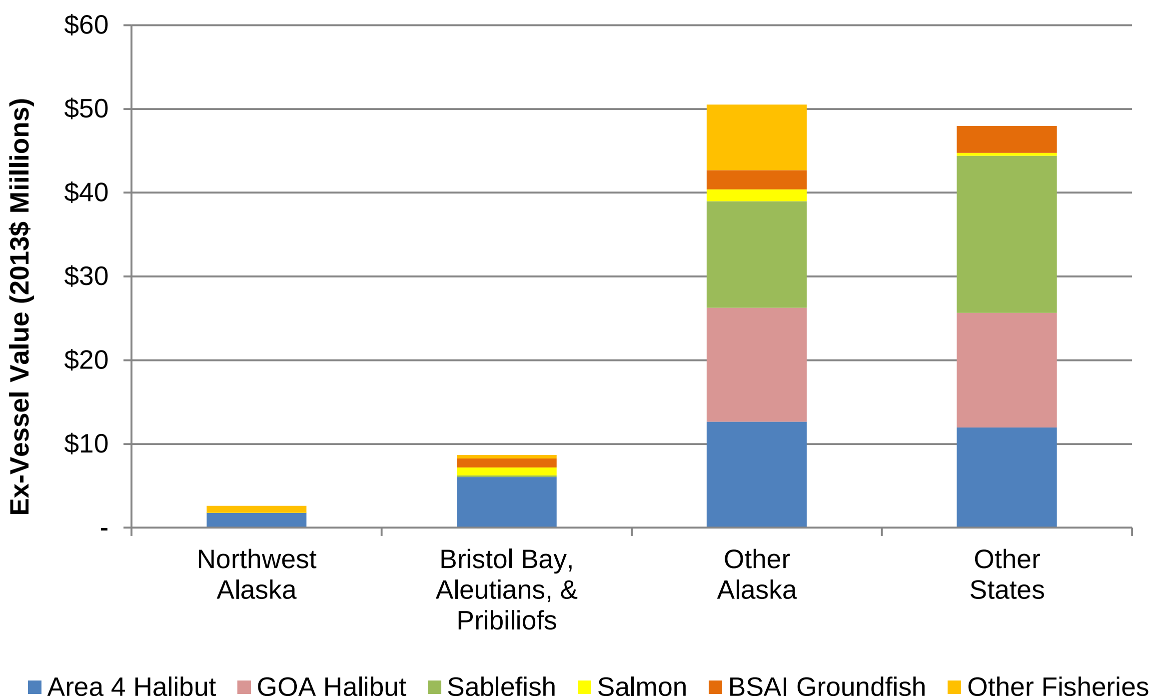
Table 4-95 Number of Active Vessels, Crew Size, Persons working and Payments to Crew Members in Area 4 Halibut Fisheries by IPHC Area 4

Region	Year	Active Vessels	Ex-Vessel Revenue (2013 $ millions)	Average Crew Size	Estimated Total Persons in Crew Rotations	Average Crew Share Percentage	Crew Payments (2013$ M)	Payments/Person in Crew Rotation (2013 $)
Area 4A	2008	68	$11.98	4.4	327.7	44.5%	$5.33	$16,261
	2009	65	$6.87	4.4	292.2	44.3%	$3.04	$10,416
	2010	62	$10.72	4.6	289.7	44.4%	$4.76	$16,425
	2011	55	$14.73	4.3	255.9	44.6%	$6.57	$25,672
	2012	51	$8.50	4.2	216.2	44.6%	$3.79	$17,537
	2013	46	$5.49	3.9	184.0	44.5%	$2.45	$13,290
	Average	**58**	**$9.72**	**4.3**	**261**	**44.5%**	**$4.32**	**16,600**
Area 4B	2008	23	$6.28	4.6	122.3	43.5%	$2.73	$22,360
	2009	18	$4.12	5.1	94.9	43.8%	$1.80	$19,001
	2010	27	$7.72	5.1	142.6	43.6%	$3.37	$23,621
	2011	28	$12.25	4.8	142.9	43.4%	$5.31	$37,194
	2012	30	$8.65	4.3	139.1	43.9%	$3.79	$27,279
	2013	29	$5.15	4.4	135.4	43.4%	$2.23	$16,500
	Average	**26**	**$7.36**	**4.7**	**130**	**43.6%**	**$3.21**	**24,326**
Area 4CDE	2008	266	$14.22	3.2	882.9	45.6%	$6.49	$7,348
	2009	246	$8.27	3.3	823.0	45.3%	$3.75	$4,557
	2010	227	$13.78	3.3	759.6	45.5%	$6.27	$8,253
	2011	258	$20.85	3.3	874.2	45.1%	$9.41	$10,764
	2012	238	$11.98	3.3	799.3	45.5%	$5.45	$6,824
	2013	245	$7.59	3.3	814.3	45.9%	$3.48	$4,278
	Average	**247**	**$12.78**	**3.3**	**826**	**45.5%**	**$5.81**	**7,004**
Area 4A Total	2008	357	$38.07	3.5	1,332.9	44.8%	$17.06	$12,797
	2009	329	$22.99	3.6	1,210.1	44.6%	$10.26	$8,478
	2010	316	$35.42	3.7	1,192.0	44.7%	$15.82	$13,275
	2011	341	$49.80	3.6	1,272.9	44.5%	$22.17	$17,413
	2012	319	$30.36	3.6	1,154.6	44.8%	$13.59	$11,770
	2013	320	$18.23	3.5	1,133.7	44.8%	$8.16	$7,200
	Average	**330**	**$32.48**	**3.3**	**1,216.0**	**44.7%**	**$14.51**	**$11,932**

Note: Only vessels that participated in at least one sub-area in IPHC Area 4 in the year are included in the table.
Source: Developed by Northern Economics based on data from AKFIN (Fey 2014)

Figure 4-59 and Table 4-96 display the ex-vessel revenues from Area 4 Halibut fisheries along with ex-vessel revenues of all other fisheries in which active Area 4 vessels participated, by the region of residence of the vessel owner. Halibut fishers from the Northwest Alaska and the Bristol Bay, Aleutians, & Pribilofs focus their fishing time on Area 4 halibut. Somewhat surprising is the fact that Western Alaska halibut fishermen are not more involved in the salmon fisheries of the region. Non-local halibut fishermen are not only more likely to be engaged in GOA halibut fisheries, but they are also heavily involved in sablefish fisheries and "other fisheries" which include GOA groundfish fisheries, Alaska crab fisheries and herring fisheries.

Figure 4-59 Average Ex-vessel Revenue of All Fisheries of Active Vessels in Area 4 by Owner Region of Residence



Note: Only vessels that participated in at least one sub-area in IPHC Area 4 in the year are included in the table.
Source: Developed by Northern Economics based on data from AKFIN (Fey 2014).

Table 4-96 Ex-Vessel Value in All Fisheries of Active Area 4 Vessels by the Vessel Owner's Region

Region	Area	2008	2009	2010	2011	2012	2013	Average
		Ex-Vessel Value (2013 $ Millions)						
Northwest Alaska	Area 4 Halibut	$2.39	$1.43	$1.62	$2.19	$1.61	$1.34	$1.77
	GOA Halibut	-	-	-	-	-	-	-
	Sablefish	-	-	-	-	-	-	-
	Salmon	$0.04	$0.03	ND	ND	ND	ND	$0.04
	BSAI Groundfish	ND	ND	ND	-	ND	$0.00	$0.00
	Other Fisheries	$0.77	$0.69	$0.94	$0.81	$0.93	$0.65	$0.80
	All Fisheries	$3.21	$2.16	$2.57	$3.00	$2.54	$1.99	$2.58
Bristol Bay, Aleutians & Pribilofs	Area 4 Halibut	$7.68	$3.46	$6.79	$8.50	$5.80	$4.16	$6.06
	GOA Halibut	ND	ND	ND	ND	-	ND	-
	Sablefish	$0.35	$0.13	$0.10	ND	$0.17	ND	$0.19
	Salmon	$1.17	$0.77	$0.73	$0.89	$1.38	$0.81	$0.96
	BSAI Groundfish	$1.34	$0.76	$0.89	$1.29	$0.96	$1.04	$1.05
	Other Fisheries	$1.17	$0.23	$0.12	$0.29	$0.32	$0.36	$0.42
	All Fisheries	$11.71	$5.35	$8.63	$10.96	$8.63	$6.38	$8.67
Other Alaska	Area 4 Halibut	$12.45	$8.64	$14.14	$22.25	$12.02	$6.52	$12.67
	GOA Halibut	$19.81	$12.80	$18.25	$15.58	$8.93	$6.24	$13.60
	Sablefish	$12.27	$10.64	$12.45	$18.90	$13.19	$8.84	$12.71
	Salmon	$1.03	$1.53	$1.96	$1.80	$1.15	$0.99	$1.41
	BSAI Groundfish	$0.65	$0.06	$1.39	$2.15	$6.05	$3.42	$2.29
	Other Fisheries	$9.26	$5.58	$7.60	$8.02	$11.31	$5.37	$7.86
	All Fisheries	$55.46	$39.24	$55.80	$68.70	$52.64	$31.37	$50.54
Other States	Area 4 Halibut	$15.55	$9.46	$12.87	$16.85	$10.93	$6.20	$11.98
	GOA Halibut	$19.08	$13.50	$17.80	$15.05	$9.35	$7.29	$13.68
	Sablefish	$18.83	$16.64	$17.31	$25.92	$19.96	$13.85	$18.75
	Salmon	$0.40	ND	ND	$0.31	ND	ND	$0.35
	BSAI Groundfish	$5.67	$3.22	$3.84	$3.86	$1.90	$0.65	$3.19
	Other Fisheries	$13.89	$10.28	$7.94	$9.47	$9.37	$8.96	-
	All Fisheries	$73.40	$53.10	$59.75	$71.46	$51.51	$36.95	$47.95
All Regions	Area 4 Halibut	$38.07	$22.99	$35.42	$49.80	$30.36	$18.23	$32.48
	GOA Halibut	$38.89	$26.30	$36.05	$30.63	$18.28	$13.52	$27.28
	Sablefish	$31.44	$27.41	$29.86	$44.83	$33.32	$22.69	$31.66
	Salmon	$2.63	$2.33	$2.69	$3.00	$2.53	$1.80	$2.76
	BSAI Groundfish	$7.65	$4.05	$6.12	$7.30	$8.91	$5.12	$6.52
	Other Fisheries	$25.09	$16.78	$16.60	$18.58	$21.92	$15.33	$9.07
	All Fisheries	$143.78	$99.85	$126.74	$154.13	$115.32	$76.69	$109.74

Note: Only vessels that participated in at least one sub-area in IPHC Area 4 in the year are included in the table. Also, ND indicates that the information cannot be disclosed because fewer than three vessels participated. In these cases, amounts have been added to “Other Fisheries.”
Source: Developed by Northern Economics based on data from AKFIN (Fey 2014)

Table 4-97 and Table 4-98 on the following pages provide more detailed information about participants in the Alaska halibut fisheries from Western Alaska whose communities are on the Bering Sea or Aleutian Island Coast.

Table 4-97 shows participation in the Bering Sea halibut fishery by borough or census area for 2008 to 2012. Since the halibut permits are statewide, the analysis assumes that only residents in western or southwestern Alaska with direct access to the Bering Sea would fish in that area. Residents of Kodiak Island Borough and communities with direct access to the Gulf of Alaska are omitted from the table. The table also shows estimates of the landings and ex-vessel value of catch by area. Table 4-98 shows the number of persons fishing by community by year for each of the boroughs and census areas listed in Table 4-97.

Information in the both of the tables comes from the Commercial Fisheries Entry Commission (CFEC) database of "Permit Activity Fishing Activity by Year, State, Census Area, or City" (CFEC 2013). The CFEC database provides fishery participation data at the community level, though community-level landings and revenues data are often confidential due to a limit number of permits being fished. Northern Economics uses a proprietary algorithm to produce landings and revenues estimates wherever the actual data are limited due to confidentiality. The algorithm uses average landings and revenues per active permit holder to fill in missing information, using locations and historical information in the process. These estimates are produced in such a way that the communities properly add up to the total for the boroughs and census areas, and so that those areas add up to the state totals.

The information for 2012 in both tables should be considered preliminary, due to a lag in updating halibut information in the CFEC database.

Table 4-97 Commercial Halibut Fishery Participation of Residents of the Bering Sea Coast by Borough or Census Area, 2008 to 2012

Borough / Census Area	Year 2008	2009	2010	2011	2012
Number of Permits Held					
Aleutians East Borough	10	11	10	12	12
Aleutians West Census Area	54	59	52	58	52
Bethel Census Area	228	230	214	228	206
Bristol Bay Borough	5	4	4	5	5
Dillingham Census Area	44	31	28	24	46
Lake and Peninsula Borough	3	2	2	4	2
Wade Hampton Census Area	25	19	13	22	22
Total Number of Permits Held	**369**	**356**	**323**	**353**	**345**
Number of Permits Fished					
Aleutians East Borough	8	9	10	11	11
Aleutians West Census Area	51	45	48	52	47
Bethel Census Area	178	170	155	176	140
Bristol Bay Borough	0	1	2	0	1
Dillingham Census Area	22	13	9	13	20
Lake and Peninsula Borough	1	1	0	0	0
Wade Hampton Census Area	11	12	9	14	15
Total Number of Permits Fished	**271**	**251**	**233**	**266**	**234**
Number of Persons Fishing					
Aleutians East Borough	8	9	10	11	11
Aleutians West Census Area	51	45	48	52	47
Bethel Census Area	178	170	155	176	140
Bristol Bay Borough	0	1	2	0	1
Dillingham Census Area	22	13	9	13	20
Lake and Peninsula Borough	1	1	0	0	0
Wade Hampton Census Area	11	12	9	14	15
Total Number of Persons Fishing	**271**	**251**	**233**	**266**	**234**
Total Pounds					
Aleutians East Borough	102,989	123,803	122,914	104,921	91,480
Aleutians West Census Area	1,724,762	1,735,302	2,255,639	2,202,811	1,501,449
Bethel Census Area	434,385	469,656	471,975	494,241	354,996
Bristol Bay Borough	0	20,610	36,923	0	395
Dillingham Census Area	29,918	15,603	41,054	48,595	53,382
Lake and Peninsula Borough	11,450	13,609	0	0	0
Wade Hampton Census Area	16,222	66,283	60,235	16,854	9,448
Total Pounds	**2,319,725**	**2,444,865**	**2,988,740**	**2,867,421**	**2,011,149**
Total Revenues					
Aleutians East Borough	438,710	247,578	423,002	516,387	381,143
Aleutians West Census Area	6,190,416	3,158,206	7,331,362	10,041,953	5,670,546
Bethel Census Area	1,564,704	898,784	1,237,342	1,348,518	1,077,006
Bristol Bay Borough	0	41,079	126,720	0	1,152
Dillingham Census Area	91,639	31,417	94,618	198,814	180,523
Lake and Peninsula Borough	46,414	27,883	0	0	0
Wade Hampton Census Area	69,404	133,180	204,518	68,832	28,031
Total Revenues	**8,401,286**	**4,538,127**	**9,417,561**	**12,174,503**	**7,338,402**

Source: Developed by Northern Economics based on data from CFEC (CFEC 2013).

Table 4-98 Active Halibut Permit Holders among Residents of Communities on the Bering Sea Coast, 2008 to 2012

		Year				
Borough / Census Area	**Community**	**2008**	**2009**	**2010**	**2011**	**2012**
Aleutians East Borough	Akutan	5	6	7	8	8
	Cold Bay	1	1	1	1	1
	False Pass	2	2	2	2	2
	Total	**8**	**9**	**10**	**11**	**11**
Aleutians West Census Area	Adak	2	2	1	2	1
	Atka	4	1	4	4	5
	Dutch Harbor	6	6	8	6	5
	Nikolski	1	0	0	0	0
	Saint George Island	6	6	5	7	7
	Saint Paul Island	22	21	21	23	20
	Unalaska	10	9	9	10	9
	Total	**51**	**45**	**48**	**52**	**47**
Bethel Census Area	Akiachak	1	0	0	0	0
	Bethel	0	0	0	0	0
	Chefornak	29	23	25	23	9
	Goodnews Bay	0	4	2	1	2
	Kipnuk	21	24	21	24	19
	Kongiganak	1	0	0	0	1
	Kwigillingok	0	0	0	0	1
	Mekoryuk	32	31	30	31	27
	Newtok	12	8	9	9	10
	Nightmute	8	7	5	9	7
	Platinum	0	1	0	0	0
	Quinhagak	10	7	2	8	9
	Toksook Bay	36	36	33	41	30
	Tuluksak	0	0	0	0	0
	Tuntutuliak	0	1	0	0	0
	Tununak	28	28	28	30	25
	Total	**178**	**170**	**155**	**176**	**140**
Bristol Bay Borough	King Salmon	0	1	1	0	0
	Naknek	0	0	1	0	1
	Total	**0**	**1**	**2**	**0**	**1**
Dillingham Census Area	Clarks Point	0	0	0	0	1
	Dillingham	12	4	0	1	2
	Manokotak	0	0	1	0	0
	Togiak	9	8	8	12	17
	Twin Hills	1	1	0	0	0
	Total	**22**	**13**	**9**	**13**	**20**
Lake and Peninsula Borough	Egegik	0	0	0	0	0
	Pilot Point	0	0	0	0	0
	Port Heiden	1	1	0	0	0
	Total	**1**	**1**	**0**	**0**	**0**
Wade Hampton Census Area	Chevak	2	1	2	5	6
	Hooper Bay	5	10	7	9	9
	Scammon Bay	4	1	0	0	0
	Total	**11**	**12**	**9**	**14**	**15**
Total Number of Persons Fishing		**271**	**251**	**233**	**266**	**234**

Source: Developed by Northern Economics based on data from CFEC (CFEC 2013).

4.5.3 Community Dependence on Halibut Fisheries

Appendix C includes a detailed analysis of community participation patterns in the BSAI halibut fisheries, for communities in the BSAI.

4.6 A Description of the Methodology Used to Assess the Economic Impacts of Alternative 2

In order to estimate the future impacts of reductions in halibut PSC limits in the BSAI Groundfish fishery, a very complicated series of calculations, assumptions, and estimates must be made, most of which include a significant amount of uncertainty and variation. In addition to the uncertainty found in many of the assumptions and estimates, the calculations are dynamic—outcomes, assumptions and calculations made in one year affect the outcomes, assumptions and calculations made in later years. Estimates of future halibut yields further complicated because of the fact that a large portion of the PSC taken in the BSAI groundfish fisheries is made up of small fish that have not yet recruited into the fishery. These fish, which are collectively known as U26 halibut[34] because they are less than 26 inches in length, represent an important component of future halibut biomass. According to IPHC scientists, U26 fish that are "saved" if PSC is reduced will over a period of several years grow, spawn, die of natural causes, be taken as PSC, or recruit into fishery. IPHC scientists estimate that the volume of U26 savings will eventually result in an approximately 1:1 increase in the constant exploitable yield (CEY) for the fishery. In other words if U26 halibut PSC is reduced by 1 round weight mt, over the course of several years 1 net weight mt of O26 fish will be harvested in the commercial halibut fishery.

After a thorough assessment of potential methodologies to assess impact of bycatch reductions, analysts at Northern Economics, Inc. (NEI) have concluded that a multi-year simulation model that is repeated over 10,000 iterations, with random selections of key variables in each iteration, will provide more robust results than a simpler single-year model. Throughout the remainder of this document this "Iterative Multi-year Simulation Model" will be referred to as the IMS Model.

The basic IMS Model concept is introduced here to provide context for the discussions provided in upcoming sections. In general, the IMS Model works on the premise that outcomes in future years under the status quo and under any of the PSC Limit Reduction alternatives, can be assessed by creating a 10-year series of outcomes into the future for both groundfish and halibut fisheries starting with 2014.

For the halibut fishery, the starting point assumes that the coastwide exploitable biomass estimates and area-specific distributions provided by IPHC staff in their 2015 Annual Meeting Blue Book are held constant for each year in the future. Holding the baseline level of exploitable biomass constant allows the model to ascribe any changes in halibut FCEYs and harvests to changes in halibut PSC mortality in the groundfish fishery.

For groundfish under the status quo, we assume that ABCs, TACs, harvests, revenues, prices, and halibut PSC will mirror the years from 2008 to 2013. For each year into the future, the IMS Model will randomly draw one of these six years and the fishery outcomes from that year will be assumed. Each year into the future will be thusly populated and because the model uses years from the recent past, we can be somewhat assured that the harvests, revenues, and PSC levels will both resemble and vary in ways that are realistic.

Once the groundfish years are drawn and populated, the IMS Model will use the PSC levels from each of the assumed future years as inputs into the algorithm that attempts to simulate the calculation used by the

[34] It should be noted that most of the definitions of IPHC management terminology have been taken from an IPHC publication for the 2012 Annual meeting titled "Halibut Terminology – What You May Hear" (IPHC 2012a).

IPHC to calculate FCEYs starting with the assumed exploitable biomass for each subarea in Area 4. The algorithm, which will be explained in much greater detail in the next section, uses PSC amounts taken in Year 1 to adjust TCEYs and FCEYs in Years 2 and 3. Given that the IMS Model assumes a constant baseline exploitable yield, year-over-year variations in halibut PSC are the primary driver of changes in the FCEYs and harvests over the 10-year future period in the IMS Model. Halibut revenues for each future year will use the ex-vessel and wholesale prices from the "basis year" selected for groundfish.

To calculate the impacts of the PSC reduction alternative for this particular, the IMS Model uses the same set of selected basis years but imposes the reduced PSC limit under consideration. For example if the IMS Model is assessing a 30 percent reduction in the limit for the LGL-CPs, the new limit would be imposed on the LGL-CP sector, while all other PSC Limits for all other sectors and fisheries would be held at status quo levels. The IMS Model assumes that when faced with the new limit, each sector will reduce its groundfish harvest and with those harvest reductions also reduce PSC such that amounts of PSC taken fall just below the new constraint. The cuts in groundfish harvests lead not only to lower PSC levels but also reduce ex-vessel and wholesale revenues.

The way that each sector reacts to the new limit will depend on the way that the sector in question is organized and regulated. The LGL-CP sector is organized as a cooperative, and therefore the IMS model assumes that co-op members will work to change their fishing behaviors primarily through changes in the months and areas fished. This will minimize, as much as is practical, the negative impacts of cutting their groundfish harvest. Other sectors and fisheries are organized and regulated differently. The BSAI TLA catcher vessel fishery for Pacific cod is considered a "race for fish," and therefore feasible behavior changes limited. In race-for-fish situations, the IMS Model assumes that groundfish harvests are reduced such that the last fish caught are the first fish that are cut as a result of the reduced limit for halibut PSC.

With the reduced PSC limits imposed, the IMS Model recalculates the area-specific PSC taken in each of the future years, and uses these lower PSC levels to adjust FCEYs for the halibut fishery in each subarea. The IMS Model assumes that the new higher quotas are harvested at the same harvest-to-FCEY ratio as in the status quo. The IMS Models also assumes the same set of prices as used in the status quo and then calculates ex-vessel and wholesale revenue for the halibut fishery.

The IMS Model uses the 11-step process shown below to generate a single set of potential impacts for the proposed the PSC option.

1) assign basis years to each future year from 2014 through 2023
2) calculate groundfish harvests, revenue and PSC under the status quo for the 10-year future
3) calculate new status quo FCEYs for the halibut fishery for each of the 10 future years
4) calculate halibut catch and revenues under the status quo
5) report the status quo outcomes for both groundfish and halibut
6) impose new PSC limits on one particular sector
7) estimate PSC reductions using sector-specific behavioral changes to reduce both groundfish harvests and PSC
8) calculate the "change case" revenues for the groundfish sector
9) calculate new "change case" FCEYs for the halibut fishery for each of the 10 future years
10) calculate halibut catch and revenues under the change case.
11) report the change case outcome for both groundfish and halibut

12) calculate the differences from the status and the change case and report the difference for both the groundfish and halibut fishery

The process described above represents a single iteration of the IMS Model. Because of the relatively high levels of variability in PSC taken in the groundfish fisheries, there is a significant amount of variability in outcomes for the halibut fishery with each set of basis years selected. Therefore, the IMS Model has been designed to repeat the entire process described over thousands of iterations. With each iteration, the variance and standard deviation around estimates of the key measures of impacts are smaller, and there is more certainty that the reported measures accurately reflect the modelled outcomes.

The remainder of Section 4.6 contains the following subsections:

- Section 4.6.1 provides a detailed description of the algorithms used in the IMS Model to generate estimates of for the coming year's FCEY. The algorithms link changes in halibut PSC mortality in the groundfish fisheries to changes in the allowable catch (the FCEY) in the commercial halibut fisheries.
- Section 4.6.2 provides a demonstration of the IMS Model and examples of some of the key indicators that the IMS Model generates.
- Section 4.6.3 recaps the assumption and processes used in the IMS Model.

4.6.1 Description of Algorithms for Calculating Fishery Constant Exploitation Yield

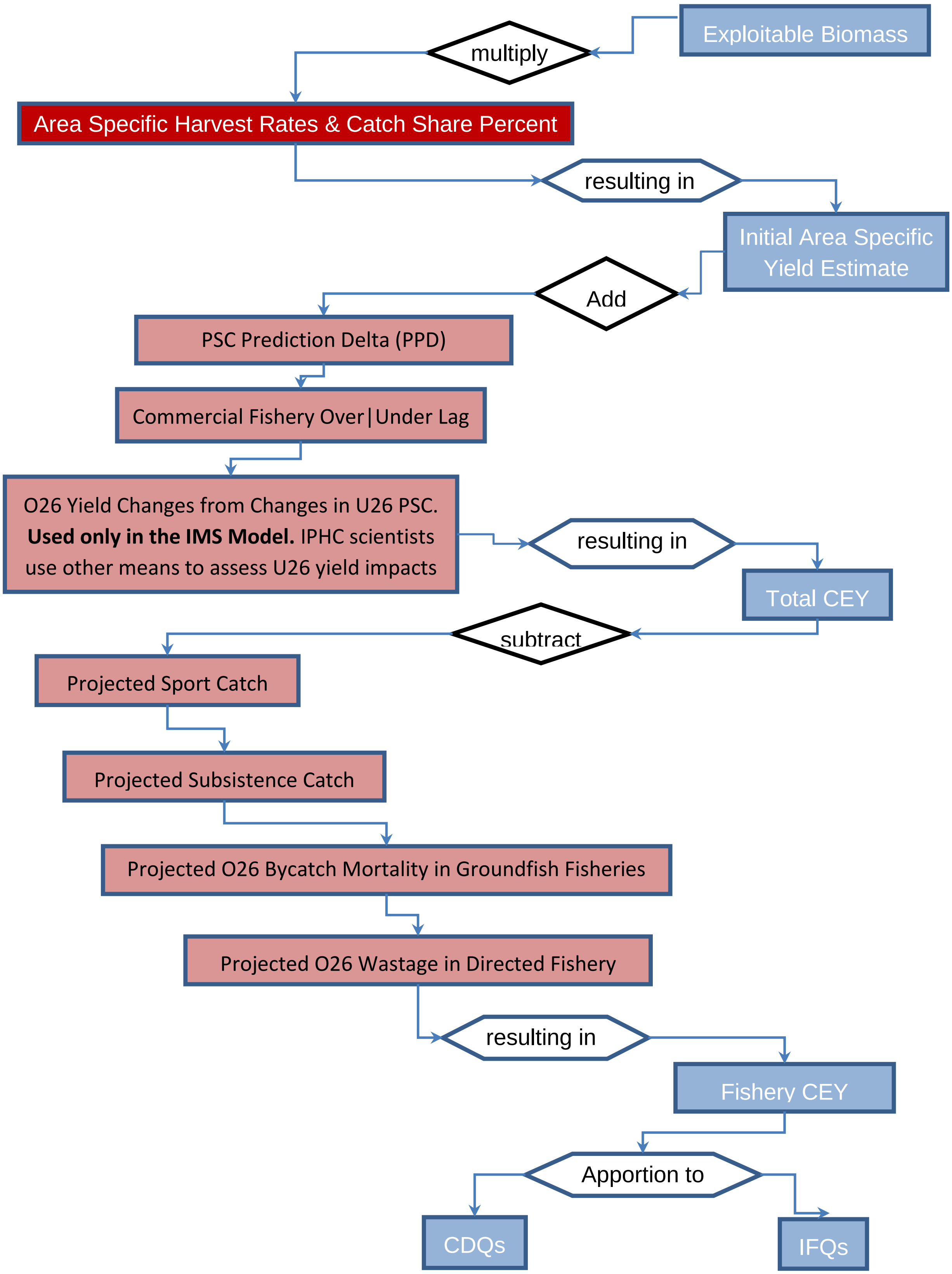
This section provides a description of algorithms used in the IMS Model to generate estimates of FCEYs. The process tries to replicate the process used by the IPHC staff to generate their recommendations[35] to the IPHC Commissioners for FCEY values for the commercial halibut fisheries in each of the three major units of Area 4 including areas 4A, 4B, and 4CDE. While the process described here is believed to be valid and has been discussed in detail with IPHC staff, it is not an exact replica of the IPHC algorithm. The primary reason for differences is the need to create a process that can be used in a forward-looking model such as the IMS Model rather than the IPHC approach, which is geared specifically for the upcoming fishery year.

This section is fairly detailed because the process used to calculate FCEYs and to link change in halibut PSC mortality is complex, and in general does not appear to be well understood by persons who are not directly involved in the process. Figure 4-60 on the following page provides a graphical representation of the IPHC algorithms in the form of flow chart. In the pages that follow the figure, the description of the process works from the top down, and while that is logically straightforward, many of the concepts used in the early parts of the discussion are not fully defined until later parts of the discussion.

In general, the process starts with the estimates of the coastwide exploitable biomass. This is subdivided into area-specific yield estimates, based on estimates of area-specific biomass distributions and target harvest rates. The initial yield estimates are then adjusted by several factors that contribute to the calculation of the Total Constant Exploitation Yield (TCEY). Several sources of removals external to the commercial fishery are then deducted including PSC, sport and subsistence use. The remainder is available for the commercial fishery as the FCEY.

[35] The IPHC staff make a range of recommendations to the Commissioners. The algorithm that is summarized in the section is intended to represent the IPHC Staff's "blue line" recommendation. The Commissioners are not bound by the recommendations and they may set FCEYs using other criteria and input.

Figure 4-60 Flowchart of the Process to Calculate FCEYs for the Directed Halibut Fisheries in the IMS Model



Source: Adapted by NEI from an original flow chart developed by the IPHC (IPHC 2012b).

It is important to note that the FCEY for each IPHC area is more or less the halibut fishery equivalent of the groundfish TACs, or Total Allowable Catches, that are adopted by the Council and NMFS for a particular groundfish species by groundfish management area or reporting areas (e.g., the TAC for sablefish in the BS, or the TAC for Atka Mackerel in Western Aleutian Islands [reporting area 543]). In addition to the differences in terminology it must be noted that, in all of their management processes, the IPHC adjusts all weights to "net-weight" equivalents, including estimates of biomass and bycatch. Further, the IPHC uses pounds rather than metric tons. These issues will be discussed in the first subsection (4.6.1.1).

The remainder of Section 4.6.1 is organized in a manner similar to the process described in Figure 4-60. We start with a summary of the process used to move from estimates of total exploitable biomass to what the IPHC defines as the TCEY or Total Constant Exploitation Yield (Subsection 4.6.1.2). The TCEY is more or less equivalent to the Allowable Biological Catch (ABC) that is developed annually by the Groundfish Plan Team and vetted through the Council's Scientific and Statistical Committee.

After describing the process the IPHC uses to develop area-specific TCEYs, the summary moves on to describe the various estimates of predicted "removal" amounts that are subtracted from the TCEY to arrive at the FCEY. The removals outside of the landings in the directed fishery include predicted amounts of subsistence harvests, recreational harvests, and wastage (halibut mortality) in the directed halibut fisheries. In addition predicted amounts of mortality resulting from PSC in the commercial groundfish fisheries (halibut PSC mortality), and predicted amounts of bycatch mortality, from other Bering Sea fisheries, such as the fisheries for king crab and snow crab are deducted from the TCEY. The Final FCEYs for the Area 4 subareas are then apportioned to the CDQ and IFQ fisheries.

4.6.1.1 Differences in the Unit of Measure used by the IPHC and Unit used by NMFS

The IPHC uses dressed-weight pounds as its basic unit of volume. A dressed halibut is a western cut halibut—i.e. a headed and gutted halibut with the collarbone intact, noting that the collarbone is the bone just behind the gills. In its reports and data tables, the IPHC refers to dressed weight as "net weight", and this analysis will also refer to dressed weights as "net weight". The IPHC uses a standard factor of 75 percent to convert whole fish (round weight) to net weight. NMFS uses round weight metric tons to report total halibut interceptions and halibut PSC mortality, but uses net weight pounds (in 1,000s) when reporting commercial catch in directed fisheries for halibut. The IPHC also typically reports halibut in 1,000s of net weight pounds.

Conversion Rates:

- To convert round weight halibut to net weight multiply the round weight by 0.75. To convert net weight to round weight, divide the net weight by 0.75.[36]
- To convert a metric ton to pounds multiply metric tons by 2,204.6.
- To convert metric tons to 1,000s of pounds multiply by 2.2046.
- To convert a metric ton of round-weight halibut to pounds of net weight halibut multiply by 2,204.6 then multiply the result by 0.75, or simply multiply by 1,653.45 noting that 2,204.6 × 0.75 = 1,653.45.

We also note that in addition to converting halibut PSC mortality to 1,000s of net weight pounds, the IPHC categorizes halibut PSC mortality, and mortality of halibut that are discarded or otherwise killed in the directed halibut fishery as either O26 or U26 halibut. These two size classes (defined below) will be discussed in more detail in subsection 4.6.1.3, which deals with "removals" outside of the directed fishery:

[36] A potential source of error is the tendency by analysts to multiply net weight by 1.33 rather than divide by 0.75.

- U26 halibut are less than 26 inches in length as measured from the tip of the head to inner curve of the tail. U26 halibut are fish that the IPHC considers unlikely to grow long enough in the coming year such that they would be legally retainable in the directed halibut fishery—halibut must be at least 32 inches long to be retained in the directed halibut fishery. U26 halibut are an important component of halibut PSC. If PSC is reduced, IPHC scientist believe that the volume of U26 fish saved will eventually account for a 1:1 increase in the CEY of the fishery. The IMS Model accounts for future increases in CEYs that eventually result from reductions in U26 PSC.
- O26 halibut are greater than or equal to 26 inches. These are fish that already are at least 32 inches, or fish from 26 to 31 inches, which are likely to grow to 32 inches in the coming year and therefore be a part of the exploitable biomass for the directed fishery in the coming year.

4.6.1.2 Total Constant Exploitation Yield Estimation

The IPHC's basic goal when setting FCEYs is to exploit the total halibut biomass at a target harvest rate that is both sustainable in the long run and at a rate that is constant over time. The first step in estimating the "Total Constant Exploitation Yield" or TCEY is to multiply the estimated exploitable biomass by that predetermined rate.[37] For the Area 4 (and for Area 3B) the IPHC has determined that the target harvest rate should be 16.125 percent. For all other areas, the target harvest rate is set at 21.5 percent (Webster 2013a).

The IPHC generates separate estimates of exploitable biomass for Area 4A, 4B, and for 4CDE, noting that exploitable biomass for 4CDE includes biomass in the Closed Area (see Figure 1-1). The IPHC treats 4CDE as a single unit up through the estimation of the Final FCEY. The Final FCEY is then further apportioned to each of the three subareas using the Catch Sharing Plan (CSP) developed by the Council. Table 4-99 shows the process of moving from the total exploitable biomass to its distribution within Area 4 to "Initial Area Specific Yield" estimates.

Table 4-99 Coastwide Biomass, Distribution of Biomass in Area 4, and Area Specific Yield Estimates

Year	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
	Coastwide Biomass (Areas 2, 3, & 4 Combined) in millions of pounds (net weight)											
Spawning Biomass	339.5	299.5	266.7	241.5	224.4	204.6	197.8	195.3	197.2	203.9	208.5	215.1
Exploitable Biomass	403.6	352.6	307.9	266.9	236.3	203.9	186.4	175.6	169.2	168.8	169.7	180.6
	Distribution of Coastwide Biomass Area 4 subareas (as a percent of total)											
4A	8.3%	7.9%	7.1%	6.9%	5.8%	7.8%	8.8%	7.7%	6.6%	7.5%	6.5%	6.7%
4B	3.7%	3.2%	3.5%	4.6%	5.2%	6.1%	6.3%	5.1%	5.6%	3.6%	4.3%	3.8%
4CDE	10.0%	10.4%	8.6%	9.8%	8.5%	8.5%	10.5%	10.9%	10.1%	9.9%	10.8%	11.9%
Area 4 Total	**22.0%**	**21.5%**	**19.2%**	**21.3%**	**19.5%**	**22.4%**	**25.6%**	**23.7%**	**22.3%**	**21.0%**	**21.6%**	**22.4%**
	Initial Area Specific Yield Estimates in Area 4 in millions of pounds (net weight)											
4A	7.94	7.25	4.80	3.65	2.94	2.42	1.99	1.96	1.58	2.12	2.41	2.24
4B	4.73	3.60	2.72	1.76	1.31	0.98	0.98	1.30	1.42	1.66	1.73	1.49
4CDE	5.88	5.29	4.76	3.89	3.54	3.18	2.40	2.78	2.32	2.31	2.88	3.17
Area 4 Total	**18.54**	**16.13**	**12.29**	**9.30**	**7.80**	**6.58**	**5.37**	**6.04**	**5.31**	**6.09**	**7.01**	**6.90**

Notes: The Initial Area Specific Yield Estimates for Area 4 and subareas are calculated by multiplying the coastwide exploitable by the distribution percentages in the second part of the table, and then multiplying that result by the target harvest rate—15.0% from 2004 through 2010 and 16.125% from 2011 forward.

Source: Developed by NEI based of information in Stewart (2015a), and Webster (2015a) augmented through personal communications between the analysts and IHPC scientists.

The final section of Table 4-99 shows the Initial Area Specific Yield Estimates for Area 4 and subareas. The estimates were generated by multiplying the exploitable biomass by the distribution percentages for

[37] The IPHC defines the exploitable biomass as the portion of total biomass can be caught by hook and line gear.

each subarea (in the second section of the table) and then multiplying that result by the target harvest rate—15.0 percent for years prior to 2011, and 16.125 percent for years from 2011 on. As in shown Figure 4-60, we have labeled the result of the first step as the development of Initial Area Specific Yield Estimate.

For purposes of this analysis, it is clear that we need to mirror as close as is reasonable the IPHC's algorithms to establish TCEYs and catch limits (FCEYs). However, there are and will be differences in the methods we describe here, and historical data that may be found in other sources. For example the IPHC's conservation mission, is to manage the Pacific halibut in waters coastwide, and while it develops area-specific estimates for setting catch limits, its ultimate responsibility is conservation at the coastwide level. As a result, the Area 4 TCEY and the FCEY estimates that result using the algorithm described above, may not be exactly equal to the TCEY and catch limits that are ultimately adopted by the commission. In the absence of more information regarding intent, this appears to be the most appropriate basis for assessing impacts of PSC limit reductions at this time.

Adjustments to the Initial Area Specific Yield Estimates

In this section we describe three specific adjustments that are made to Initial Area Specific Yield Estimates: We have labelled these three adjustments as follows:

- PSC Prediction Delta
- Commercial Fishery Over|Under Lag
- O26 Yield Changes from Changes U26 PSC

The PSC Prediction Delta

A major issue for the IPHC when setting TCEYs and FCEYs for the directed fishery is the fact that halibut PSC mortality varies from year to year, and because the IPHC is creating the TCEY and FCEYs for the coming year, it needs to project (or forecast) what halibut PSC mortality will be in the coming year. If the groundfish fisheries are always constrained by the PSC limits, then it is very easy to project halibut PSC mortality in the coming year—i.e., it will be equal to the PSC limit.

If, on the other hand, halibut PSC mortality is not constrained by the PSC limit, and varies from year to year at levels that may be well below the cap, then using the PSC Limit as the projected PSC mortality for the coming year is likely to create an FCEY that is noticeably lower than it would have been, if a better projection were available.

The IPHC does have options for projecting the halibut PSC mortality in the coming year,[38] but in its current algorithm, it has chosen to use the estimated PSC mortality in the year that has just been completed for the projected amount in setting the FCEY in the coming year.[39] In other words, the FCEY for fishing year 2015 ($FCEY_{2015}$) uses the halibut PSC mortality from fishing year 2014 (PSC_{2014}) as its projected halibut PSC mortality, or more generally $FCEY_y$ uses PSC_{y-1}, where y = the year for which the FCEY is being set.

If the there is a difference between the predicted PSC amount (PSC_{y-1}) and the actual amount (PSC_y), then the difference, (i.e. the PSC Prediction Delta [PPD]) is used to adjust the Initial Area Specific Yield Estimate in the next year (y+1). We note here, as will be discussed more detail later, that the PPD is based only on O26 PSC. In the current year (y) the PPD_y equals the actual amount of O26PSC from last year (or

[38] For example, it could use a two-year average of halibut PSC mortality or even a three-year average.

[39] In reality the IPHC staff produces its initial estimates of TCEY, halibut PSC mortality, other removals, and FCEY in November in time for interim meetings that take place in December. With rationalization of many of the groundfish fisheries, it is more and more common that groundfish fisheries are operating (and generating halibut PSC mortality) in November and December. This makes it even more difficult for the IPHC staff to utilize actual halibut PSC mortality for the current year in the FCEY recommendations for the coming year. Instead it is forced to forecast halibut PSC mortality for the last few months of the current year fishery.

$O26PSC_{y-1}$) subtracted from predicted amount from last year (which in reality was the actual O26 amount from two years ago (or $O26PSC_{y-2}$). In other words, $PPD_y = O26PSC_{y-2} - O26PSC_{y-1}$.

PPD_y is then added to the Initial Yield Estimate.[40] If halibut PSC mortality is declining, then the PPD is positive and the resulting TCEY will be higher than the Initial Yield Estimate. In this case, the directed fishery is "compensated" for the higher-than-necessary projection of halibut PSC mortality that was used in the previous year and which resulted in a lower-than-necessary TCEY in the previous year.

If we look back to the BSAI groundfish fishery, and in particular to the A80-CP fishery for the years 2007 through 2011 (see Figure 4-7) PSC mortality declined by 900 mt in a 4-year period or 225 mt per year. During this period predicted O26PSC amounts would have overestimated actual O26PSC, and PPDs would have been positive in 2009, 2010, 2011, and 2012.

If, however, halibut PSC mortality is increasing, the PPD is negative and the TCEY for the current year will be lower than the Initial Yield Estimate. In this case, the directed fishery is "penalized" for the lower-than-necessary projection of halibut PSC mortality in the previous year, which therefore resulted in a higher-than-necessary TCEY in the previous year.

During the course of the development of the IMS model, the analysts noted that similar but smaller differences in the projections of other non-market removals and actual non-market removals were not being accounted for in the models. In this case, "other non-market removals" include sport and personal use and "O26 wastage" in the commercial halibut fishery. These lagged differences have been included in the PSC Projection Delta.

The Commercial Fishery Over|Under Lag

The Commercial Fishery Over|Under Lag (CFOL) is similar in concept to the PPD, but is based on differences between the $FCEY_y$ and the actual commercial harvest ($Catch_y$). The Commercial Fishery Over|Under Lag is somewhat hypothetical in nature, but its development is necessary for use in the IMS Model to assess impacts of PSC Limit reductions. Assume, for example, that the IPHC calculates a very low FCEY for a given area, and that because the FCEY is so low, the IPHC and NMFS determine that no fishery can take place that year. In this case, the fishery would be under harvested for that year. When it comes time to look at TCEYs in the coming year, the under-harvested amount could in theory be added back into the Initial Yield Estimate. In mathematical terms, the $CFOL_y = FCEY_{y-1} - Catch_{y-1.}$

An inverse situation can also be imagined, particularly for Area 4CDE with current biomass levels and current PSC amounts. Since, as will be discussed in more detail later in the section, FCEY is calculated as the amount of the TCEY remaining after predicted amounts of O26 PSC and other removals are subtracted, it is possible that the FCEY becomes negative. If the predicted O26 PSC and other removals are greater than the TCEY, then the FCEY will be negative and no commercial harvest will occur. In this case the Commercial Fishery Over|Under Lag for the next year ($CFOL_{y+1}$) is negative and the commercial fishery will have a lower FCEY than it might have had even if $TCEY_{y+1}$ increases. Because the Commercial Fishery Over|Under Lag utilizes the same principles as the PSC Prediction Delta, the Commercial Fishery Over|Under Lag adjustment is subtracted from the Initial Area Specific Yield prior to determination of the TCEY.[41]

[40] During the review of the initial draft of this document IPHC scientists indicated that the PPD adjustment (which was at the time described as the "bycatch project delta or BPD") is most appropriately made prior to the establishment of the TCEY.
[41] We note that for purposes of establishing real world TCEYs and FCEYs and managing the fishery, it may be important that both the PPD and the CFOL adjustments are made prior to establishment of the TCEYs. In theory, if more fish are available than expected, then those fish can be taken either as PSC or in the commercial halibut fishery. However, for purposes of modeling the effects of PSC limit reduction options, the order in which the adjustments are made is immaterial, because it is assumed in the IMS Model that PSC is not directly influenced by the size of the TCEY or of the Initial Area Specific Yield.

For purposes of modelling the halibut fishery into the future we also include in the Commercial Fishery Over|Under Lag the difference between the FCEY and the actual harvest. In Area 4 in general, commercial harvests average about 95 percent of the FCEY, although the rates do vary over time and area.

O26 Yield Changes from Changes in U26 PSC

The final adjustment to the Initial Yield Estimate is one that functionally occurs only when one is trying to model future yield changes from change in PSC. In other words, the IPHC staff does not explicitly add or subtract estimated changes from historical U26 savings to its area-specific estimates of yield. Instead, the IPHC relies on its internal processes to assess the exploitable biomass through setline surveys, tagging studies, fishery data, and other mathematical models. However, because the mission of this analysis is to estimate future impact of PSC changes, the IMS Model needs to account for these changes, and it has been determined that the appropriate place to do this accounting is prior to the specification of the TCEY—in other word as an adjustment to the Initial Area Specific Yields.[42]

As indicated earlier, U26 PSC is believed to have a meaningful impact on future halibut yields. IPHC scientists estimate that for every ton of U26 PSC taken, a ton of O26 yield is lost over the course of several years in the future. If PSC is reduced, **O26** fish that are not taken are available for harvest in the next year or two, while **U26** fish will more gradually make their way into the fishery.

In consultation with Dr. Ian Stewart of the IPHC, analysts have augmented the IMS Model to account for the changes in yield that result from changes in the amount of U26 halibut taken as PSC. For purposes of the IMS Model it is assumed that U26 halibut that were predicted to have been taken in Year 0 but were not, will begin to make their way into the commercial halibut fishery in Year 5. These fish will continue to add to the O26 yield for a period of 7 years. As an example, assume that at the beginning of 2008 it was predicted that PSC in the A80-CP fishery would be 2,525 mt (the PSC limit for the first year of program). It turns out the A80 PSC in 2008 was actually 1,969 mt, a difference of 556 mt. If we assume that 40 percent of this PSC savings was U26 fish, then 222 round weight mt of U26 halibut PSC were saved in 2008 (Year 0). The model assumes that some portion of these U26 fish will begin to show up as O26 fish in 2013 (2008+5), and that they will continue to add to the yield for a total of 7 years (i.e. through 2019). Further, it is assumed the yield increases will be in successively higher amounts through the first four years (i.e. through 2016) and then in successively lower amounts the last three years.

The model assumes a relatively simple formula to approximate the increasing then decreasing amounts of added yield, noting that the 222 mt of savings were reported in round weight terms and that yield in the halibut fishery is reported in terms of net weight (i.e. 75 percent of round weight) or 166.5 net weight mt:

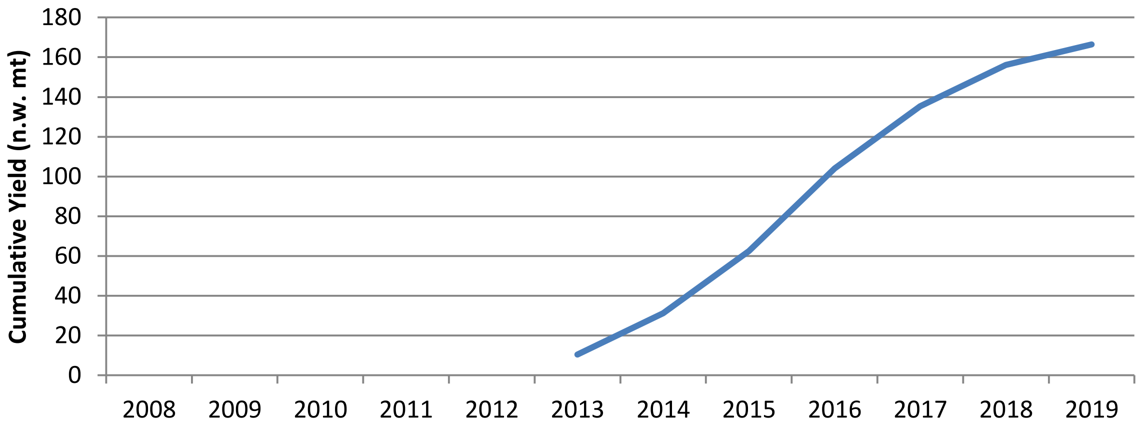
- In year 5 (2013) we assume that 1/16th of the saved U26 are added to the yield, i.e. 10.406 mt.
- In year 6 (2014) we assume that 2/16th of the saved U26 are added to the yield, i.e. 20.812 mt.
- In year 7 (2015) we assume that 3/16th of the saved U26 are added to the yield, i.e. 31.219 mt.
- In year 8 (2016) we assume that 4/16th of the saved U26 are added to the yield, i.e. 41.625 mt. This is the peak year for additions to yield from the e26 fish saved in 2008.
- In year 9 (2017) we assume that 3/16th of the saved U26 are added to the yield, i.e. 31.219 mt.
- In year 10 (2018) we assume that 2/16th of the saved U26 are added to the yield, i.e. 20.812 mt.

[42] As with the PPD and CFOL the IMS Model assumes that PSC levels do not change in response to the additional yield that may be realized because of U26 savings in previous years. Therefore, the order in which adjustments to yield are made within the IMS Model is immaterial, and the commercial halibut fishery eventually realizes a 1 to 1 yield increase for each mt of U26 savings.

- In year 11 (2019) we assume that the final 1/16th of the saved U26 are added to the yield, i.e. 10.406 mt.

Altogether a total of 166.5 net mt of O26 fish have been added to the yield. The cumulative yield curve is shown in Figure 4-61.

Figure 4-61 Example of the Cumulative Added Yield of 222 round weight mt of U26 PSC Savings From 2008



Source: Developed by NEI with consultation from Dr. Ian Stewart of the IPHC.

According to IPHC scientists, the added yield from U26 savings will be distributed coastwide in proportion to the exploitable biomass. Therefore, a relatively small percentage of increased yield from the U26 savings will to be harvested in Area 4 as O26 fish, and other regions will receive the majority of the increased yield. The coastwide distribution of the halibut stock by IPHC regulatory area is shown in below. The IMS Model will use the proportions in basis year to distribute U26 yields in each future year.

Table 4-100 Estimated Distribution of Coastwide Stock in Each IPHC Regulatory Area by Year

Year	2A	2B	2C	3A	3B	4A	4B	4CDE
2004	1.20%	6.20%	9.00%	38.50%	23.10%	8.30%	3.70%	10.00%
2005	1.40%	6.61%	6.61%	42.04%	21.82%	7.91%	3.20%	10.41%
2006	2.20%	7.10%	8.00%	45.20%	18.30%	7.10%	3.50%	8.60%
2007	1.30%	7.31%	7.61%	42.44%	20.02%	6.91%	4.60%	9.81%
2008	1.30%	7.19%	8.09%	43.26%	20.68%	5.79%	5.19%	8.49%
2009	1.50%	8.39%	7.09%	41.16%	19.48%	7.79%	6.09%	8.49%
2010	1.00%	10.61%	7.01%	35.54%	20.22%	8.81%	6.31%	10.51%
2011	2.60%	13.10%	7.70%	34.70%	18.20%	7.70%	5.10%	10.90%
2012	2.30%	13.40%	10.30%	35.60%	16.10%	6.60%	5.60%	10.10%
2013	2.00%	13.13%	12.02%	37.58%	14.23%	7.52%	3.61%	9.92%
2014	2.10%	15.48%	14.29%	32.97%	13.59%	6.49%	4.30%	10.79%
2015	2.20%	14.79%	15.08%	33.47%	12.09%	6.69%	3.80%	11.89%

Source: Data from the 2015 IPHC Meeting Book (Stewart, 2015) adjusted by NEI to correct for rounding errors.

As mentioned earlier and as described above, the IPHC's algorithm is somewhat circular in nature. Up to the point of the initial estimates of area specific yields, the algorithm uses exogenous information. However, in order to get to the point of adjusting the estimated yields to arrive at the TCEY, the IPHC uses fishery-related information from previous years. In order to provide details on the actual TCEYs after the adjustments described in this section, we need first to delve into information regarding the specific removal components alluded to in Figure 4-60. These are described in the section that follows.

4.6.1.3 Halibut Removals that are Not Reported in the Directed Halibut Fishery

For purposes of this part of the discussion it is assumed that the adjustments to area-specific yields have been made and that the IPHC has estimated its TCEYs. The next step in the IPHC process for generating a FCEY is to reduce the TCEY by removals that are not sold as part of the directed halibut fisheries. These "non-market" removals include:

- Removals for subsistence/personal use and recreational use
- Wastage from the directed halibut fisheries
- Halibut PSC mortality from groundfish fisheries

In the current IPHC algorithm—as used to set FCEYs for fishing year 2014—the IPHC generates projections of O26 and U26 halibut for wastage and for halibut PSC mortality and deducts only the O26 portion from the TCEY. As indicated above, the U26 fish from these two sources of mortality are included by the IPHC in its biomass estimates, but are not deducted from the TCEYs. The IMS Model—because it is looking out into the future—accounts for the future yield increases from U26 fish.

<u>Halibut Removals for Subsistence/Personal Use, Recreation Use and Wastage in Directed Halibut Fisheries</u>

Table 4-101 (which is reproduced from Table 3-27) summarizes IPHC estimates of subsistence/personal use removals, and removals by recreational users in Area 4.

Table 4-101 IPHC data on Area 4 halibut harvest history for sport fishers, subsistence/personal use, and retention of halibut under 32 inches in CDQ fisheries in Areas 4D and 4E, in thousands of pounds, net weight.

	Sport (n.w. lb, 1,000s)	Subsistence and Personal Use (n.w. pounds 1,000s)						
	4A	4A	4B	4C	4D	4E	4DE CDQ Use	4CDE Total
2005	50	36	1	8	6	54	23	91
2006	46	27	3	9	8	71	20	108
2007	44	15	2	15	3	52	19	89
2008	40	20	5	6	3	16	22	47
2009	24	34	1	6	1	9	11	27
2010	16	15	1	11	1	10	10	32
2011	17	14	1	2	1	6	17	26
2012	28	10	2	1	1	8	20	30
2013*	9	10	2	1	1	8	10	20
2014*	23	10	2	1	1	8	6	16

* Preliminary: all 2014 data, and subsistence catches for 2013
Source: Kaimmer 2014 for subsistence, Gilroy and Williams 2015 for personal use, Williams 2015 for U32.

A third source of removals deducted from the TCEY is "Wastage" in the directed halibut fisheries. The IPHC defines wastage of halibut that are killed in the directed fishery but which are not landed. There are two primary sources of wastage: 1) discards in the directed fishery—primarily undersized fish (less than 32 inches [U32]), and 2) halibut that are estimated to have been killed by lost or abandoned gear.

Table 3-25, in Section 3.1.4.2, shows IPHC estimates of halibut discard mortality in the commercial halibut fishery in Area 4, 1995 to 2014, in net pounds (1,000s) For completeness and ease of use, that table is reproduced here for the year 2005 through 2014 as Table 4-102.

Table 4-102 IPHC estimates of halibut discard mortality in the commercial halibut fishery in Area 4, 2005 to 2014, in net pounds (thousands).

Year	Wastage from estimated U32 mortality						Wastage from U32 mortality plus lost gear
	4A	4B	4C	4D	4E	Total – Area 4	Total – Area 4
2005	127	11	5	25	4	172	203
2006	95	9	6	31	5	146	164
2007	127	19	9	45	10	210	234
2008	138	18	18	63	15	252	285
2009	145	11	15	50	10	231	265
2010	130	30	20	53	10	243	270
2011	134	35	41	112	24	346	378
2012	90	35	17	44	11	197	208
2013	62	32	15	29	9	147	161
2014	33	46	16	28	6	129	138

Source: Gilroy and Stewart 2015.

Removals due to Halibut PSC Mortality in Groundfish Fisheries

The largest source of non-market removals in Area 4 is due to halibut PSC mortality in the groundfish fisheries. Table 4-103 shows halibut PSC estimates from NMFS. Data on the left-hand side of the table summarize total halibut PSC mortality of fisheries to which the PSC mortality Reduction Alternatives apply. Pot and jig fisheries for Pacific cod and IFQ sablefish fisheries are exempt from halibut PSC limits, and were not included in the PSC mortality Reduction Alternatives. Data on the right-side show additional halibut PSC mortality taken in the exempt fisheries—pot and jig fisheries for Pacific cod and the IFQ sablefish fisheries. As seen in the table, the latter contribute a minimal amount of additional halibut mortality. It should be noted that NMFS generates its estimates of halibut PSC mortality using kilograms (round weight) as the basic unit, but it generally reports halibut PSC mortality in metric tons (round weight). The estimates shown in this table have been converted to millions of net weight pounds.

Table 4-103 NMFS Alaska Region Estimates of Halibut PSC mortality, 2003 to 2013

	Trawl and Longline Fisheries except IFQ Sablefish				Exempt Fisheries (Pot/Jig Fisheries & IFQ Sablefish) plus AKFIN Records with Unspecified Areas				Area 4 Total – All Fisheries
	4A	4B	4CDE	Area 4 Sub-total	4A	4B	4CDE	Unspecified Area 4	
Year	NMFS Estimates of Halibut PSC mortality (Converted from Round weight mt to Net Weight lb – Millions)								
2003	1.775	0.247	4.629	6.651	0.009	0.026	0.001	0.309	6.960
2004	2.142	0.235	4.124	6.501	0.008	0.011	0.001	0.028	6.529
2005	1.775	0.214	4.900	6.888	0.006	0.011	0.001	0.029	6.917
2006	1.429	0.282	4.821	6.533	0.012	0.028	0.001	0.016	6.549
2007	1.558	0.432	4.695	6.685	0.005	0.021	0.000	0.001	6.686
2008	1.196	0.322	4.258	5.775	0.008	0.028	0.002	0.000	5.775
2009	1.527	0.418	3.869	5.814	0.005	0.046	0.002	0.006	5.820
2010	1.028	0.472	4.118	5.618	0.008	0.042	0.000	0.006	5.624
2011	1.096	0.455	3.662	5.213	0.016	0.016	0.002	0.033	5.246
2012	1.739	0.589	3.813	6.141	0.007	0.020	0.003	0.045	6.186
2013	1.251	0.413	4.292	5.957	0.003	0.012	0.002	0.000	5.957

Source: Developed by Northern Economics using AKFIN data (Fey 2014).

A comparison of halibut PSC mortality as estimated by NMFS (Table 4-103) and halibut PSC mortality as estimated by the IPHC is shown in Table 4-104. In the average year from 2003 to 2013, IPHC estimates are higher than NMFS estimates by 344,000 lb (net weight), but there is a fair amount of variability. In 2013, the NMFS estimate was 747,000 net-weight lb, greater than the IPHC estimate, while in 2006 the IHPC estimate of halibut PSC mortality exceeded the estimate of NMFS by 957,000 net-weight lb. Overall Area 4B, of the three IPHC subareas, has had the largest average discrepancy. But if we look just at the magnitude of differences (ignoring which agency's estimate was higher), all three areas had an average difference of over 200,000 lb per year, with the difference in Area 4B exceeding 300,000 lb.

Table 4-104 Comparison of Agency Estimates of Halibut PSC mortality in Groundfish Fisheries, 2003 to 2013

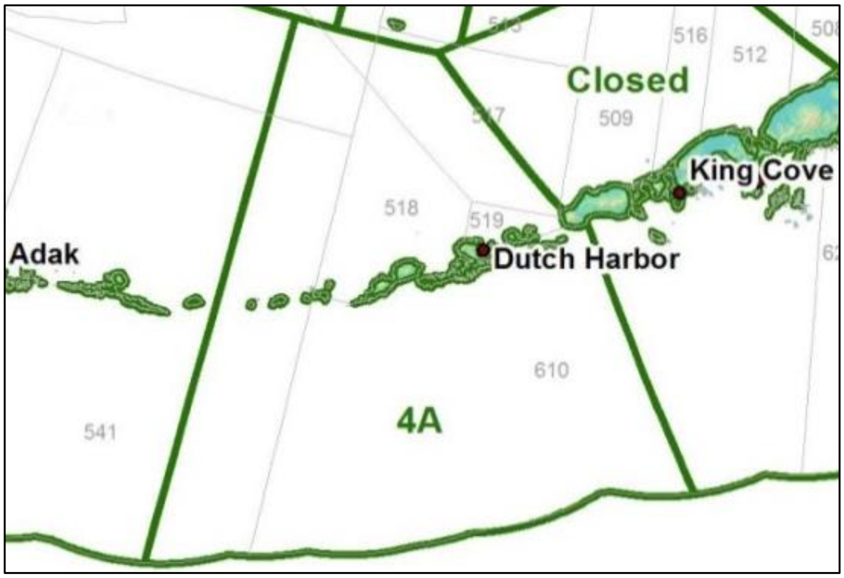
	4A	4B	4CDE	Area 4 Total	4A	4B	4CDE	Area 4 Total
Year	NMFS Estimates of Halibut PSC mortality (Net Weight lb – Millions)				IPHC Estimates of Halibut PSC mortality (Net Weight lb – Millions)			
2003	1.78	0.27	4.63	6.96	1.58	0.75	4.49	6.82
2004	2.15	0.25	4.13	6.53	1.56	0.74	4.44	6.74
2005	1.78	0.23	4.90	6.93	1.78	0.84	5.07	7.69
2006	1.44	0.31	4.82	6.53	1.74	0.82	4.94	7.49
2007	1.56	0.45	4.70	6.67	1.68	0.8	4.78	7.26
2008	1.20	0.35	4.26	5.78	1.52	0.72	4.32	6.56
2009	1.53	0.46	3.87	5.82	1.46	0.69	4.15	6.30
2010	1.04	0.51	4.12	5.62	1.41	0.67	4.01	6.08
2011	1.11	0.47	3.66	5.25	1.19	0.56	3.38	5.14
2012	1.75	0.61	3.82	6.19	1.78	0.63	3.86	6.27
2013	1.25	0.43	4.29	5.96	1.10	0.46	3.65	5.21

Source: Adapted from Stewart (2014c)

There are several potential explanations for these differences between NMFS PSC estimates and the IPHC's. One potential explanation is that NMFS and AKFIN are continually updating and correcting data when there is sufficient evidence to do so. Unless the IPHC regularly updates the historic data that it has received from NMFS, any changes NMFS makes will not necessarily be reflected in IPHC data. Other potential sources of divergence include the following:

- The use of differing Halibut Discard Mortality Rates by gear, target fishery or year. These rates are part of the Annual Specification Process, and will be discussed in detail later in this section.
- The use of differing assumptions with respect to halibut PSC mortality taken in groundfish fisheries that are technically in IPHC Area 4A, but which are actually harvested south of the Aleutian Islands. Groundfish fisheries that occur in this portion of Area 4A are managed as part of the Gulf of Alaska and would be reported as part of the Western Gulf or NMFS Zone # 610 (see Figure 4-62). It is assumed by the analysts that all halibut PSC mortality that is taken in Area 610 is assigned to Area 3B rather than Area 4A.
- Inconsistent inclusion or exclusion of PSC mortality from groundfish fisheries that are exempt from halibut PSC limits. As mentioned in the discussion of Table 4-103, pot and jig fisheries for Pacific cod and IFQ sablefish and non-trawl CDQ sablefish fisheries are all exempt from halibut PSC limits. However, these fisheries do generate halibut PSC mortality and inevitably will induce some level of halibut PSC mortality.
- The inclusion or exclusion of halibut bycatch that occurs in Western Alaska Crab fisheries. The current analysis does not examine whether or how much halibut bycatch is taken in crab fisheries, but if there is halibut mortality in these fisheries, then it presumed that IPHC would try to account for it.

Figure 4-62 IPHC Area 4A with NMFS Reporting Areas



Source: Adapted from NMFS Alaska Region map by Northern Economics Inc.

The bulleted list above addresses potential reasons for overall differences in Area 4 total estimates of halibut PSC mortality. In addition to the Area 4 total, estimates of halibut PSC mortality by IPHC Subareas between NMFS and the IPHC are also likely to differ. One source of these differences is the “mismatch” between IPHC subareas and NMFS reporting areas (3-digit management areas). Looking back to the regulatory area map in Figure 1-1, it is clear that while many of NMFS reporting areas would be unambiguously assigned to one and only one IPHC subarea, others could fall within two subareas and one (Area 523) falls into three subareas (4A, 4B, and 4D). Table 4-105 shows the translation table that is currently used by IPHC to map NMFS reporting areas to IPHC Subareas. It should also be noted that NMFS reporting areas that correspond **primarily** to the “closed area” are assigned, for PSC mortality accounting purposes, to IPHC Area 4CDE.

Table 4-105 Standard Translation of NMFS Reporting Areas into IPHC Subareas

NMFS Area	IPHC Area	NMFS Area	IPHC Area
517	4A	508	4CDE
518	4A	509	4CDE
519	4A	512	4CDE
NMFS Area	**IPHC Area**	513	4CDE
541	4B	514	4CDE
542	4B	516	4CDE
543	4B	521	4CDE
530	4B	523	4CDE
550	4B	524	4CDE

Source: Developed by NEI based on personal communication with IPHC staff (Stewart 2014d)

Table 4-106 shows the halibut discard mortality rates as specified by NMFS for 2003 to 2014. These rates are applied to the estimated PSC mortality of halibut to generate the estimates of mortality in each CDQ or Non-CDQ target fishery by gear.

Table 4-106 Pacific Halibut Discard Mortality Rates (Percentages) for the BSAI, 2003 to 2014

Gear	Target Fishery	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Non-CDQ hook-and-line	Greenland turbot	18	15	15	15	13	13	13	11	11	11	13
	Other species	12	11	11	11	11	11	11	10	10	10	9
	Pacific cod	12	11	11	11	11	11	11	10	10	10	9
	Rockfish	25	16	16	16	17	17	17	9	9	9	4
Non-CDQ trawl	Arrowtooth flounder					75	75	75	76	76	76	76
	Atka mackerel	75	78	78	78	76	76	76	76	76	76	77
	Flathead sole	67	67	67	67	70	70	70	74	74	74	73
	Greenland turbot	70	72	72	72	70	70	70	67	67	67	64
	Non-pelagic pollock	76	76	76	76	74	74	74	73	73	73	77
	Pelagic pollock	84	85	85	85	88	88	88	89	89	89	88
	Other flatfish	71	71	71	71	74	74	74	72	72	72	71
	Other species	67	67	67	67	70	70	70	71	71	71	71
	Pacific cod	67	68	68	68	70	70	70	71	71	71	71
	Rockfish	69	74	74	74	76	76	76	81	81	81	79
	Rock sole	76	77	77	77	80	80	80	82	82	82	85
	Sablefish	50	49	49	49	75	75	75	75	75	75	75
	Yellowfin sole	81	78	78	78	80	80	80	81	81	81	83
Non-CDQ Pot	Other species	8	8	8	8	7	7	7	8	8	8	8
	Pacific cod	8	8	8	8	7	7	7	8	8	8	8
CDQ trawl	Atka mackerel	80	85	85	86	86	85	85	85	85	85	86
	Greenland turbot								88	88	88	89
	Flathead sole	90	90	67	67	70	87	87	84	84	84	79
	Non-pelagic pollock	90	85	85	85	85	86	86	85	85	85	83
	Pacific cod								90	90	90	90
	Pelagic pollock	89	89	90	89	90	90	90	90	90	90	90
	Rockfish	90	90	74	74	76	82	82	84	84	84	80
	Rock sole						86	86	87	87	87	88
	Yellowfin sole	83	82	84	85	86	86	84	85	85	85	86
CDQ hook-and-line	Greenland turbot	4	4	15	15	13	4	4	4	4	4	4
	Pacific cod	11	11	10	10	10	10	10	10	10	10	10
CDQ pot	Pacific cod	2	2	8	8	7	7	7	8	8	8	8
	Sablefish	46	36	33	30	34	34	35	32	32	32	34

Source: Developed by NEI based on data from NMFS (2014f)

In general, the halibut discard mortality rates are recalculated and re-specified every three years—in Table 4-106 the shaded bars indicate the three-year update period. Rates are generated through an analysis of observer data on the viability ratings of discarded halibut. The most recent specification began in 2013 and is expected to run through 2015. As is readily evident in Table 4-106, discard mortality rates for trawl fisheries are much higher than for non-trawl fisheries. Less obvious is the fact that CDQ trawl fisheries are assigned higher discard mortality rates than non-CDQ trawl fisheries for the same target fisheries. For example, in 2013 the discard mortality rate in the non-CDQ trawl fishery for Atka mackerel is 76 percent, while the rate is 86 percent in the CDQ Atka mackerel fishery. CDQ discard mortality rates for longline (hook and line) gear are lower than rates for non-CDQ fisheries.

The analysts note that as discussed in Section 4.4.1.5, if the halibut discard mortality rate can be measurably reduced, the effect on the halibut FCEY and the long-term exploitable biomass is the same as a reduction in actual halibut PSC of the same percentage. Assume, for example, that a fishery has a total PSC of 400 mt and the fishery is assigned a 60 percent halibut discard mortality rate. The halibut PSC mortality for the fishery is calculated to be 240 mt (400 mt × 60% = 240 mt). Now assume that participants in the fishery are able reduce their halibut PSC by 10 percent to 360 mt. If the halibut discard mortality rate remains at 60 percent, then the halibut PSC mortality is reduced by 10 percent to 216 mt (360 mt × 60% = 216 mt).

Alternatively, if the participants implement a mortality reduction policy involving perhaps shorter tows, deck sorting, and careful release, etc., and they are able to reduce their halibut discard rate by 10 percent (i.e., to 54 percent), the same amount of halibut would be saved, without the potential for reducing groundfish catch and revenues—i.e. 400 × 54% = 216 mt).

Estimates of O26 and U26 Halibut PSC Mortality and Their Application in the FCEY Process

Once the IPHC comes up with its projection of total halibut PSC mortality (which it sets equal to PSC_{y-1}), it explicitly recognizes that halibut caught as PSC mortality are often smaller than halibut caught in the directed fishery. While the legal size limit for retaining halibut in the directed fishery is 32 inches, the IPHC biologists focus on halibut that are over 26 inches (O26), because as fish that are 26 to 31 inches in length grow, most will be of legal size (O32) at some point during the fishing year (y) for which the FCEY is being set. From this perspective, all O26 halibut killed as PSC in the previous year (y-1) would have been a part of the $FCEY_y$ had they not been killed. Halibut killed as PSC mortality that are U26, will become a factor in the FCEY in later years, but under the current IPHC policy, only as a reduction in exploitable biomass.[43]

Because of the increasing importance of the split between O26 and U26 halibut PSC mortality, and increasing evidence that the ratio of O26 to U26 varies significantly between fisheries, the IPHC staff indicates that starting with the 2015 FCEY setting process they will move away from a fixed ratio of 60 percent. Instead they will use fishery-specific O26/U26 ratios based on data from the observer program (Stewart 2014d). Because of the delay in getting all of the observer data for a given year, IPHC staff indicates that they will use the O26/U26 split for the most recent full year of data. This means that for setting the $FCEY_{2015}$ they will multiply PSC $mortality_{2014}$ in each fishery by the O26/U26 percentages from 2013 observer data.

Table 4-107 summarizes O26/U26 percentages for each of the three major BSAI participant groups for which observer data are available. There is a fair amount of variability both within each participant group, and across participant groups. Some of the more obvious trends are listed below.

- BSAI TLA O26 percentages are generally the lowest of the three groups.
- Longline CPs most often have the highest O26 percentage of the three groups.
- The O26 percentage of both longline CPs and BSAI TLA vessels had a steady downward trend from 2008 to 2012, but saw increases in 2013.
- A80-CPs have had the lowest O26 percentage (2010), and the highest (2011 to 2013) of the three groups when comparing same year percentages.

[43] This is the case under the “staff recommendation policy” that was in place for setting FCEYs for the 2014 fishing year. The IPHC is considering a change in this policy. If the “staff recommendation policy” changes to a “Full Accounting Policy”, U26 halibut PSC mortality from the projection year (y-1) will be explicitly considered when the IPHC sets $FCEY_y$.

Table 4-107 Estimated O26/U26 Percentages by Major Participant Group, 2008 to 2013

	A80-CPs		BSAI TLA		Longline CPs	
	O26	U26	O26	U26	O26	U26
Year	Percent of Halibut PSC Mortality by Year					
2008	61.8%	38.2%	68.6%	31.4%	75.2%	24.8%
2009	61.2%	38.8%	57.9%	42.1%	68.3%	31.7%
2010	56.4%	43.6%	59.0%	41.0%	69.8%	30.2%
2011	65.6%	34.4%	51.5%	48.5%	63.4%	36.6%
2012	64.7%	35.3%	43.9%	56.1%	61.5%	38.5%
2013	64.1%	35.9%	52.8%	47.2%	63.5%	36.5%
Weighted Average	61.6%	38.4%	56.2%	43.8%	66.6%	33.4%

Source: Developed by Northern Economics using AKFIN data (Fey 2014).

Baseline Estimates of Area 4 FCEYs, Removals from Halibut PSC Mortality and Other Sources, and Imputed TCEYs

In this section we provide the baseline estimates for each of the Area 4 subareas that will be used in the IMS model and throughout the remainder of the analysis. Table 4-108, Table 4-109, and Table 4-110 show for Area 4A, 4B, and 4CDE respectively, initial area specific yield estimates, the PPD, CFOL and U26 adjustments that are used in to create the "modelled TCEY. We then show and subtract the projected non-market removals to arrive what we call the Model Blue Line FCEY. We note here that these Modelled Blue Line FCEYs are not equal to the FCEYs that were actually adopted by the IPHC or the TACs eventually adopted by the NPFMC and NMFS. The reason for this difference is twofold as described in the bullets.

- The IPHC does not always adopt the blue line estimates of its staff.
- IPHC Scientists have made it very clear that the stock assessment models used in the past have had a retrospective bias that overestimated biomass, and which led to TCEYs that were too high.

Table 4-108, Table 4-109, and Table 4-110 show the derivation of FCEYs for Area 4A, Area 4B and Area CDE. The initial area-specific yield estimates along with the resulting TCEYs and FCEYs used in this analysis rely on the "current" (2015) estimates of historic exploitable biomass levels, rather than on the exploitable biomass levels and area-specific distributions that were assumed to have been correct at the time the original FCEYs were set. Therefore, the Modelled FCEYs in the tables that follow are noticeably lower than FCEYs and TACs that were actually adopted and implemented historically. The numbers in the far right column of the table are the Modelled Catches in each Area 4 Subarea. These, like the FCEYs, are less than the catch that actually occurred. Because of the reasons noted in the bullets above, the catches shown in the table are significantly lower than actual harvest reported in Section 4.5.1. These differences will be discussed summarized in greater detail in Table 4-111.

Finally we note that the numbers of 2014 are shaded because 2014 is the first year of the IMS Model Projections, and therefore the Initial Area Specific Yield Estimates shown will be the starting point for TCEY and FCEY estimates for the years 2015 through 2023.

In Table 4-108, the significant downward trend in Area 4A yield estimates is clearly seen—from 2005 to 2009 the initial yield estimate falls from 3,287 net weight mt to 1,097 net weight mt, a 60 percent decline from 2005 levels. The PPD for 2007 can be calculated as the difference between the projected non-market removals in 2005 and the projected non-market removals in 2006, while the CFOL reflects the difference in the previous year FCEY and actual catch.

Table 4-108 Modelled Estimates of Area Specific Yields, Adjustments to TCEYs, TCEY Removals and FCEYs for Area 4A

Year	Initial Area Specific Yield Estimate	Adjustments to Initial Yield Estimates: PPD	Adjustments to Initial Yield Estimates: CFOL	Adjustments to Initial Yield Estimates: U26 Based Added Yield	Modelled Estimate of TCEY	Projected Non-Market Removals Deducted from TCEY in Year: Sport & Personal Use	Projected Non-Market Removals Deducted from TCEY in Year: Halibut Fishery O26 Wastage	Projected Non-Market Removals Deducted from TCEY in Year: All Groundfish O26 PSC	Modelled FCEY	Modelled Area 4A Catch
All volumes are shown in net weight metric tons (n.w. mt)										
2006	2,179	-	-	-	2,179	39	68	558	1,514	1,438
2007	1,654	165	76	-	1,895	33	48	419	1,395	1,325
2008	1,334	-56	70	-	1,348	27	64	465	792	753
2009	1,097	129	40	-	1,265	27	71	329	838	796
2010	900	-136	42	-	806	26	75	462	243	231
2011	887	189	12	0.4	1,088	14	66	295	714	678
2012	717	-12	36	0.6	741	14	66	306	355	337
2013	962	-128	18	2.2	854	17	43	454	339	322
2014	1,093	155	17	3.3	1,269	9	31	320	909	864

Source: Developed by NEI based on information from IPHC, and NMFS.

Notes: PPD is the PSC Prediction Delta; CFOL is the Commercial Fishery Over|Under Lag. All groundfish O26 PSC includes PSC taken in the groundfish fisheries that are exempted PSC limits—IFQ sablefish and the Pacific cod pot and jig fisheries.

Table 4-109 Modelled Estimates of Area Specific Yields, Adjustments to TCEYs, TCEY Removals and FCEYs for Area 4B

Year	Initial Area Specific Yield Estimate	Adjustments to Initial Yield Estimates: PPD	Adjustments to Initial Yield Estimates: CFOL	Adjustments to Initial Yield Estimates: U26 Based Added Yield	Modelled Estimate of TCEY	Projected Non-Market Removals Deducted from TCEY: Sport & Personal Use	Projected Non-Market Removals Deducted from TCEY: Halibut Fishery O26 Wastage	Projected Non-Market Removals Deducted from TCEY: All Groundfish O26 PSC	Modelled FCEY	Modelled Area 4B Catch
All volumes are shown in net weight metric tons (n.w. mt)										
2006	1,236	-	-	-	1,236	17	6	66	1,147	1,090
2007	800	-32	57	-	825	14	5	103	703	668
2008	595	-58	35	-	572	8	10	162	392	372
2009	444	63	20	-	527	11	9	96	410	389
2010	444	-45	20	-	420	16	6	140	258	246
2011	591	-10	13	0.3	594	7	15	149	422	401
2012	643	20	21	0.5	685	7	17	128	533	506
2013	752	-42	27	1.1	738	5	17	172	543	516
2014	783	53	27	2.9	865	5	16	120	724	688

Source: Developed by NEI based on information from IPHC, and NMFS.

Table 4-110 Modelled Estimates of Area Specific Yields, Adjustments to TCEYs, TCEYs Removals and FCEYs for Area 4CDE

		Adjustments to Initial Yield Estimates				Projected Non-Market Removals Deducted from TCEY				
Year	Initial Area Specific Yield Estimate	PPD	CFOL	U26 Based Added Yield	Modelled Estimate of TCEY	Sport & Personal Use	Halibut Fishery O26 Wastage	All Groundfish O26 PSC	Modelled FCEY	Modelled Area 4CDE Catch
All volumes are shown in net weight metric tons (n.w. mt)										
2006	2,158	-	-	-	2,158	4	18	1,572	563	535
2007	1,763	66	28	-	1,857	5	21	1,502	329	312
2008	1,608	32	16	-	1,656	8	32	1,456	160	152
2009	1,444	255	8	-	1,708	5	49	1,187	466	443
2010	1,091	30	23	-	1,144	3	39	1,169	-68	0
2011	1,260	-18	-68	0.6	1,175	5	42	1,182	-54	0
2012	1,051	139	-54	0.9	1,137	1	88	1,001	47	44
2013	1,048	-54	2	2.9	1,000	1	34	1,108	-144	0
2014	1,305	-55	-144	4.8	1,111	1	26	1,171	-88	0

Source: Developed by NEI based on information from IPHC, and NMFS.

One of the important findings to note from the three area-specific tables is that the U26-based added yields are all relatively small, even when relatively significant PSC reductions were realized in 2008, for example, with the implementation of A80. It is important to reiterate that U26-based added yield accruing to Area 4 from a given PSC reduction event will never exceed 25 percent of the net weight mt savings. This is because the added yield is assumed to be distributed in proportion to the distribution of the overall biomass. Thus, if there is a 100 net weight mt U26 PSC reduction event, approximately 75 percent or more of the added O26 yield will accrue to halibut fisheries in the Gulf of Alaska, in British Columbia and on the U.S. West Coast.

The darkly shaded cells in Table 4-110 indicate that negative FCEYs have been generated, which in turn are assumed to lead to a "closure" of the fishery for that year. The negative FCEYs illustrate a combination of factors:

1) PSC in Area 4CDE represents a very large portion of currently estimated yield for the area.
2) The IPHC's finding of a "retrospective bias" has led the IPHC to respecify historic exploitable biomass estimates. These respecified estimates are the levels reported in Table 4-99 on page 233.
3) The incorrectly specified historic TCEYs led to FCEYs and harvests that were higher than would have been justified by the current estimates.

It should also be noted that because the FCEY for Area 4CDE is negative for the 2014 fishing year, it will be negative in all iterations of the IMS Model. This is because all of the adjustments that will be made to the yields for the 2014 fishing yield have occurred in the past, or with the specification of the Initial Area Specific Yield. While 2014 is considered to be the first of the "future years" because any PSC limit reductions are assumed to be implemented in that year, the FCEYs for 2014 will not see any benefit from those reductions, and thus will remain at levels shown in Table 4-108 through Table 4-110.

In Table 4-111 we compare the modelled catches reported in Table 4-108 through Table 4-110 to actual IFQ and CDQ harvests as reported by NMFS in Table 4-86 on page 214.As seen in Table 4-111, actual historic harvests exceed "modelled catches" in all but three instances. Interestingly, as reported in Table 4-88, harvests exceeded the official allocations in only 2 of the 24 area-year combinations, both times in

Area 4A in 2010 and 2012. According to Table 4-88, harvests as a percent of allocation averaged just 97, 90, and 88 percent in the three areas from 2003 to 2013, and were at 90 percent over the three areas combined. However, the fact that the historic catches exceed the "modelled FCEY" and "modelled catches" is a clear demonstration of the impact of the IPHC's respecification of historic exploitable biomass levels. Regardless of the causes for what would now be considered overages, the modelled Yields, TCEYs, FCEYs as well as the Modelled Catches are all used in the IMS Model to assess the impacts of the alternatives to reduce PSC Limits for the groundfish fisheries.

Table 4-111 Comparison of Modelled Catches Developed Using Current Biomass Estimates to Actual IFQ and CDQ Harvests.

Year	Area 4A			Area 4B			Area 4CDE		
	Modelled	Actual	Difference	Modelled	Actual	Difference	Modelled	Actual	Difference
	All Volumes are Shown in (n.w. mt)								
2006	1,438	1,465	-27	1,090	716	374	535	1,427	-892
2007	1,325	1,252	73	668	636	32	312	1,705	-1,392
2008	753	1,366	-613	372	783	-410	152	1,713	-1,561
2009	796	1,146	-350	389	702	-312	443	1,500	-1,057
2010	231	1,050	-819	246	825	-579	0	1,511	-1,511
2011	678	1,032	-354	401	920	-519	0	1,587	-1,587
2012	337	720	-383	506	783	-277	44	1,053	-1,009
2013	322	558	-236	516	554	-38	0	807	-807

Note: Differences are calculated by subtracting the actual catch from the modelled catch.
Source: Developed by NEI using actual catch estimates from NMFS.

4.6.2 Specification of the IMS Model

In this section we summarize the primary reasons for which it was deemed necessary to develop the IMS Model, and then we go on to describe the specifications of the Model. Finally, we demonstrate some of the model's processes and provide examples of some the key measures and outputs of the IMS Model.

4.6.2.1 Demonstration of the Need to Use a Multi-Year Simulation Model

The need for a multi-year model arises from three primary factors:

1) As described in the previous section, the changes in FCEYs that would develop if there were O26 PSC reductions would only be fully realized over a three-year period because of the lags involved in the FCEY setting process.
2) In order to account for increased yields resulting from U26-based savings, a long-term, multi-year model is required.
3) There have been and presumably will continue to be large variations in the amount of halibut PSC mortality in any given year, and there is not a reliable method of predicting halibut PSC mortality in the coming year.
4) Because multiple years are necessary to capture the full range of impacts of halibut PSC mortality reductions on FCEY and total harvest in the commercial fishery, discounted present value calculations, which reduce values of future year revenue streams, should be used.

The year-over-year variability of halibut PSC mortality in the Groundfish fisheries means there is no obvious choice of a single year to use for projecting halibut PSC mortality. Choosing any one of the previous years from 2008 to 2013 will result in very different FCEYs when compared to FCEY that would result if the use a different year were used. To demonstrate this issue, in Table 4-112 we hold the Initial Area Specific Yield for Area 4A at 2014 levels for the years 2006 through 2013—this is similar to what would be done in the IMS Model except that the IMS Model holds future year Yields constant at 2014 levels. In the table, we then recalculate TCEYs and FCEYs while holding all estimates of 4A removals constant. Even with a **constant** Initial Area Yield (1,093 net weight mt), the FCEY varies from a low of 2.50 to high of 3.85 million net weight lb—i.e., the highest FCEY is 54 percent higher than the lowest FCEY. The variability is likely to be even more extreme when the halibut PSC mortality amounts are broken down to individual sectors, as will be done in the actual modeling process.

Table 4-112 Demonstration of the Impact of the Variability of Halibut PSC Mortality on FCEYs

Year	Initial Area Specific Yield Estimate	Adjustments to Initial Yield Estimates: PPD	CFOL	U26 Based Added Yield	Modelled Estimate of TCEY	Projected Non-Market Removals Deducted from TCEY in Year: Sport & Personal Use	Halibut Fishery O26 Wastage	All Groundfish O26 PSC	Hypothetical FCEY with Constant Initial Yield	FCEY Change from Table 4-108
All volumes are shown in net weight metric tons (n.w. mt)										
2006	**1,093**	-	-	-	**1,093**	39	68	558	**428**	-1,085
2007	**1,093**	165	76	-	**1,334**	33	48	419	**834**	-561
2008	**1,093**	-56	70	-	**1,107**	27	64	465	**551**	-241
2009	**1,093**	129	40	-	**1,262**	27	71	329	**834**	-4
2010	**1,093**	-136	42	-	**999**	26	75	462	**436**	+193
2011	**1,093**	189	12	0.4	**1,295**	14	66	295	**920**	+206
2012	**1,093**	-12	36	0.6	**1,118**	14	66	306	**731**	+376
2013	**1,093**	-128	18	2.2	**985**	17	43	454	**470**	+131
2014	**1,093**	155	17	3.3	**1,269**	9	31	320	**909**	-

Note: Numbers shown in bold have changed from Table 4-108. The initial area specific yield estimate for all years was set equal to 2014 value. FCEYs are IMS Model algorithm described in Figure 4-60.

Source: Developed by NEI for analytical purposes using data from AKFIN (Fey 2014) and NMFS (2014f).

The variability of halibut PSC mortality is also critically important when determining whether a reduced PSC limit will have an effect in a given year. Table 4-113 shows the impact of a hypothetical reduction in halibut PSC limits that results in Area 4A PSCs being constrained at 1,000 r.w. mt. To see how this hypothetical cap affects the Area 4A FCEYs, the round weight PSC is first converted to net weight and then to O26 PSC removals—the result is that a hypothetical cap limits O26 harvests in this example to be less than or equal to 450 net weight mt. In the column labeled "All Groundfish O26 PSC", we see that only four of the nine years shown were directly affected by the new limits. However, because of the dynamic multi-year FCEY setting process, FCEYs were affected in all nine years one way or the other. The total effect summed over all years adds 140 net weight mt to FCEYs over the period shown. Of this increase 139 mt is due to O26 PSC reductions with one additional net weight mt accruing through U26 based yields impacts.

Table 4-113 Demonstration of the Impacts on Modelled FCEYs of a Hypothetical Reduction in PSC Limits

		Adjustments to Initial Yield Estimates				Projected Non-Market Removals Deducted from TCEY in Year				
Year	Initial Area Specific Yield Estimate	PPD	CFOL	U26 Based Added Yield	Modelled Estimate of TCEY	Sport & Personal Use	Halibut Fishery O26 Wastage	All Groundfish O26 PSC	Hypothetical FCEY with Constant Initial Yield	FCEY Change from the previous table
All volumes are shown in net weight metric tons (n.w. mt)										
2006	1,093	**108**	-	-	1,201	39	68	**450**	**644**	+216
2007	1,093	**57**	76	-	1,226	33	48	419	**726**	-108
2008	1,093	**-41**	70	-	1,122	27	64	**450**	**581**	+30
2009	1,093	**114**	40	-	1,247	27	71	329	**819**	-15
2010	1,093	**-124**	42	-	1,011	26	75	**450**	**459**	+23
2011	1,093	**177**	12	**0.7**	1,283	14	66	295	**909**	-11
2012	1,093	**-12**	36	**0.7**	1,118	14	66	306	**731**	+0
2013	1,093	**-124**	18	**2.4**	990	17	43	**450**	**479**	+9
2014	1,093	**151**	17	**3.6**	1,265	9	31	320	**905**	-4

Source: Developed by NEI for analytical purposes using data from AKFIN (Fey 2014) and NMFS (2014f).

4.6.2.2 Specification of the IMS Model for the Status Quo Case

As described above, the analysts have determined that the best modelling approach is to use an iterated multi-year model to simulate the impacts of reduction in PSC limit alternatives. The model looks out into the future starting with 2014 and runs through 2023, noting that 2014 is considered a “future year” because of the fact that at the time much of the analysis took place, available fishery data were complete only through 2013.

As the starting point the for halibut harvests, the Status Quo Case of the IMS model will use the estimates of exploitable biomass presented at the IPHC’s 2015 Annual Meeting and the distribution across IPHC areas (see Table 4-99) to generate Initial Area Specific Yield Estimates. These Initial Yield Estimates were also used for 2014 in Table 4-108 through Table 4-110 above. The Yield estimates will be combined with halibut PSC mortality estimates from groundfish fisheries from 2008 to 2013, along with estimates of personal and subsistence use and wastage in the commercial halibut fishery to impute future TCEYs, FCEYs and commercial halibut fishery harvest from 2014 to 2023. In order to focus the model on changes in PSC resulting from reductions in PSC limits, the model assumes that in all future years personal and subsistence use and wastage in the commercial halibut fishery are held constant at levels from the 2014 fishery. (See Table 4-101 and Table 4-102).

Halibut PSC mortality for each of the future years in all subareas will be simultaneously determined via a random selection of Basis Years from 2008 to 2013. The same set of selected years will be used in a status quo calculation of impacts, and then to calculate the impacts under the particular PSC limit reduction option. The set of selected years will be used for all subareas during an iteration of the IMS Model. The primary results of the IMS Model are the net changes in catch and revenue relative to the status quo under the PSC Limit Reduction Options for each IPHC subarea. The selection of a set of Basis Years and the calculation of impacts will be repeated 10,000 times for each of the seven reduction options for each affected participant group.[44]

Table 4-114 shows an example of two iterations of the section of the IMS Model that determines halibut catches for Area 4A under the Status Quo. For each iteration, the upper unshaded portion corresponds to

[44] As will be discussed later in the analysis, some of the proposed options will have no material impact on particular groups. For example, LGL-CVs attained their maximum PSC level in 2008 at 36 percent of their limit and thus are unaffected by the options.

"existing conditions" from 2008 to 2013 noting that the all of the yield estimates for the existing conditions are based on the IPHCs estimates of exploitable yield provided to the IPHC's 2015 Annual Meeting (see Table 4-99). The lower, shaded, portion for each iteration shows the projected outcomes for future years from 2014 to 2023—all future years use the IPHC's estimate of biomass for 2014.

The left-most column shows the basis years that are used to populate the projected amounts of groundfish O26 PSC in the future years. In both iterations, the year 2008 is shaded along with the O26 PSC amounts taken in 2008. In Iteration Number 1, 2008 is selected as the basis year in 3 of the 10 future years (2014, 2018, and 2021). As seen the third column labelled "Total O26 taken in Model Year", the amount 329 shows up four times, first in 2008 and again each time 2008 is selected as the basis year. Notice that the O26 PSC taken when 2008 is the basis year also shows up four times in the column labelled from "All Groundfish O26 PSC"—in this case, because the number is being used as the projected amount of PSC for the upcoming fishing year, the model years are one year later (2009, 2015, 2019, and 2022). In Iteration Number 2, the year 2008 as a Basis Year shows up only once (for model year 2019).

An important assumption, but relatively minor in terms of impacts, is that catch in future years is assumed to equal 95 percent of the modelled FCEYs. These catch rates approximate the catch rates seen in Table 4-88.

Table 4-114 Two Example Iterations of the Status Quo Halibut Catch Portion of the IMS Model for Area 4A

Basis Year	Model Year	Total O26 PSC taken in Model Year	Initial Area Specific Yield Estimate	Adjustments to Initial Yield Estimates: PPD	CFOL	U26 Based Added Yield	Modelled Estimate of TCEY	Projected Non-Market Removals Deducted from TCEY in Year: Sport & Personal Use	Halibut Fishery O26 Wastage	All Groundfish O26 PSC	Modelled FCEY	Modelled Catch	Actual Catch 2008–13. Modelled Catch from 2014–23
Iteration Number 1													
		All volumes are shown in net weight metric tons (n.w. mt)											
2007	2007	465	1,654	165	76	-	1,895	33	48	419	1,395	1,325	1,252
2008	2008	329	1,334	-56	70	-	1,348	27	64	465	792	753	1,366
2009	2009	462	1,097	129	40	-	1,265	27	71	329	838	796	1,146
2010	2010	295	900	-136	42	-	806	26	75	462	243	231	1,050
2011	2011	306	887	189	12	0.4	1,088	14	66	295	714	678	1,032
2012	2012	454	717	-12	36	0.6	741	14	66	306	355	337	720
2013	2013	320	962	-128	18	2.2	854	17	43	454	339	322	558
2008	2014	329	1,093	155	17	3.3	1,269	9	31	320	909	864	864
2011	2015	306	1,093	-1	45	5.3	1,143	15	16	329	783	744	744
2012	2016	454	1,093	23	39	5.6	1,162	15	16	306	825	783	783
2013	2017	320	1,093	-149	41	4.4	991	15	16	454	505	480	480
2008	2018	329	1,093	134	25	1.3	1,254	15	16	320	903	858	858
2012	2019	454	1,093	-9	45	0.2	1,130	15	16	329	769	731	731
2010	2020	295	1,093	-125	38	-1.4	1,005	15	16	454	520	494	494
2008	2021	329	1,093	160	26	-0.7	1,278	15	16	295	952	905	905
2013	2022	320	1,093	-34	48	-0.1	1,106	15	16	329	746	709	709
2008	2023	329	1,093	9	37	0.0	1,140	15	16	320	789	749	749
Iteration Number 2													
		All volumes are shown in net weight metric tons (n.w. mt)											
2007	2007	465	1,654	165	76	-	1,895	33	48	419	1,395	1,325	1,252
2008	2008	329	1,334	-56	70	-	1,348	27	64	465	792	753	1,366
2009	2009	462	1,097	129	40	-	1,265	27	71	329	838	796	1,146
2010	2010	295	900	-136	42	-	806	26	75	462	243	231	1,050
2011	2011	306	887	189	12	0	1,088	14	66	295	714	678	1,032
2012	2012	454	717	-12	36	1	741	14	66	306	355	337	720
2013	2013	320	962	-128	18	2	854	17	43	454	339	322	558
2012	2014	454	1,093	155	17	4	1,269	9	31	320	910	864	864
2012	2015	454	1,093	-126	45	5	1,017	15	16	454	532	505	505
2010	2016	295	1,093	-	27	7	1,127	15	16	454	642	610	610
2012	2017	454	1,093	160	32	4	1,289	15	16	295	963	915	915
2009	2018	462	1,093	-160	48	2	984	15	16	454	498	473	473
2008	2019	329	1,093	-7	25	-0	1,111	15	16	462	619	588	588
2011	2020	306	1,093	132	31	-2	1,254	15	16	329	894	849	849
2012	2021	454	1,093	23	45	-1	1,160	15	16	306	823	782	782
2013	2022	320	1,093	-149	41	-1	985	15	16	454	500	475	475
2011	2023	306	1,093	134	25	-1	1,253	15	16	320	902	857	857

The discussion and tables above are generally limited to halibut yields, non-market removals and catches. We also note that from the perspective of the groundfish fishery, when a given basis year is selected as a future year, the IMS Model assumes that all ABCs, TACs, ITACs, etc. that were in place during the basis year are imposed in the future year.[45] Also, in the status quo case, all groundfish harvests, and PSC mortality amounts from the basis year are applied to the future years whenever the basis year is selected. The IMS model also assumes that future-year revenues in both the halibut fishery and in the groundfish fisheries use ex-vessel prices and estimated wholesale revenues per ton from the basis year. When used in future years, all basis-year ex-vessel prices and wholesale revenues per ton are discounted at a five percent nominal rate per year. Table 4-115 shows the discount factor for each future year and applies these factors to halibut wholesale revenues per ton for each of the basis years noting that the basis year revenues per ton are taken from Table 4-92. The same discount factors are used to discount wholesale revenues in the groundfish fishery.

Table 4-115 Wholesale Revenues per Net Weight Ton in Basis Years and Discounted Present Value per Ton when Basis Years are Used in Future Model Years

	Basis Year	2008	2009	2010	2011	2012	2013
	2013$ per n.w. lb	$14.00	$10.15	$16.17	$15.81	$15.50	$9.16
	2013$ per n.w. mt	$30,857	$22,383	$35,650	$34,863	$34,179	$20,203
Future Model Year	**Discount Factor**	**Discounted Present Value of Wholesale Halibut Revenue Per Ton When the Basis Year (in the Column) is use in a Future Model Year (row)**					
2014	100.0%	$30,857	$22,383	$35,650	$34,863	$34,179	$20,203
2015	95.0%	$29,314	$21,263	$33,867	$33,120	$32,470	$19,193
2016	90.3%	$27,848	$20,200	$32,174	$31,464	$30,847	$18,233
2017	85.7%	$26,456	$19,190	$30,565	$29,891	$29,304	$17,322
2018	81.5%	$25,133	$18,231	$29,037	$28,397	$27,839	$16,456
2019	77.4%	$23,876	$17,319	$27,585	$26,977	$26,447	$15,633
2020	73.5%	$22,683	$16,453	$26,206	$25,628	$25,125	$14,851
2021	69.8%	$21,549	$15,631	$24,895	$24,346	$23,868	$14,109
2022	66.3%	$20,471	$14,849	$23,651	$23,129	$22,675	$13,403
2023	63.0%	$19,448	$14,107	$22,468	$21,973	$21,541	$12,733

Source: Developed by NEI based on AKFIN data (Fey 2014).

4.6.2.3 Initial Specification of the IMS Model for the Change Case

The "Change Case" is defined as the outcome under a particular suboption—the change case is the intermediate step between the status quo case and impacts of the action. The "impacts" are technically the difference that is calculated by subtracting the Status Quo case from the Change case. In the change case, the IMS Model includes predetermined estimates of reductions of PSC in the affected groundfish sectors that would be caused by reductions in PSC Limits. The PSC reductions lead to new higher levels of TCEYs and FCEYs for the commercial halibut fishery. In the change case for halibut, the IMS model uses the same Initial Area Specific Yield Estimates as used in the Status Quo case, and uses the same algorithm to move from initial yields to TCEY, FCEYs, and total catch. Each iteration in the change case also uses the same set of basis years used in the status quo case. The only driver of change in the change case is the predetermined reductions in PSC caused by reductions in PSC limits.

[45] We reiterate here that since 2008, the PSC limit for the BSAI TLA has been divided into four separate target fishery apportionments for Pacific cod, rockfish, yellowfin sole, and Pollock|Atka Mackerel|Other species. The IMS model uses the apportionment amounts and percentages that were in place in the basis year.

In the change case for groundfish, it is assumed that all PSC reductions occur via reductions in groundfish harvests, which in turn reduce the output of products, and wholesale revenues generated in the fishery. While no "costless" behavioral changes[46] are included directly in the IMS Model, the model does include significant levels of behavioral change in the affected fisheries that exhibit characteristics of rationalized fisheries. Behavioral changes in groundfish fisheries that are characterized as a "race for fish" are not explicitly modelled, and in these fisheries, the reductions in groundfish necessary to reduce PSC to appropriate levels are assumed to occur in a "last-caught, first-cut" process that will be described in more detail below.

Behavioral changes, or the lack of behavioral changes, are captured in the IMS Model in the two scenarios that are developed for each affected fishery—in all cases Scenario A is developed so that it portrays a relatively "low-impact" outcome for the groundfish fisheries. Scenario B is developed so that it portrays a relatively "high-impact" outcome for the groundfish fisheries. While Scenario B summarizes a relatively high-impact outcome, specific impact sections for each rationalized fishery demonstrate that the last-caught, first-cut PSC reduction methodology would lead to an even higher-impact outcome—i.e. an outcome where groundfish harvest reductions and foregone wholesale revenue would be even higher. Similarly, specific impact sections demonstrate that any behavioral change modelled under Scenario A still leads to a "less than optimal" outcome. The actual form of the behavioral changes modelled for each sector will be discussed in the "impact" section that pertains to that sector.

Overall the scenarios will have similar outcomes for the commercial halibut fisheries in Area 4 as whole. However, in many cases the different scenarios will have a differential impact on the amount of halibut PSC that is reduced from an individual sub-area. As an example, Scenario A for the A80-CPs create larger reduction of halibut PSC in Area 4CDE while Scenario A generate larger halibut PSC reduction in Area 4B and 4A and smaller reductions in Area 4CDE—the primary reason for this is that Scenario B forces relatively greater amounts of cuts in the A80-CP Atka Mackerel fishery.

Based on discussions with industry and fishery managers, the groundfish fisheries affected by the proposed PSC reduction alternatives are described below from the perspective of whether each can be characterized as rationalized or whether it should be considered a "race for fish."

- **A80-CPs** when operating under **cooperatives**: Because these fisheries are all currently operating under cooperatives, all A80-CP fisheries are considered rationalized and behavioral changes are assumed to mitigate some of the groundfish harvest reductions that would otherwise be associated with PSC limit reductions.
- **A80-CPs** when operating in **Limited Access** fisheries: Amendment 80 allows vessels to choose between joining cooperatives and operating in an A80 Limited Access Fishery. Since 2011 all A80-CPs have been a part of one of two cooperatives. It is possible however that some vessels could choose to drop out of cooperatives in the future. In fact the Council, mindful of that possibility, added an additional PSC Limit Reduction Suboption that would reduce PSC Limits in an A80 Limited Access Fishery by 60 percent. An A80 Limited Access Fishery would be considered a "race for fish"; no behavioral changes would be assumed; and PSC reductions would be modelled using a "last-caught, first cut" process.
- **LGL-CPs fisheries**: Since 2011, LGL-CPs have been operating under a cooperative structure. While the cooperative was not implemented through a regulatory process, the fishery is considered to be rationalized and behavioral changes are assumed to mitigate some of the groundfish harvest reductions associated with PSC limit reductions.

[46] A costless behavioral change is defined in this situations as a change in behavior that resulted in less halibut PSC without also reducing the amount of groundfish harvested.

- **CDQ fisheries**. Because each CDQ organization controls its own CDQ allocations of both groundfish and halibut PSC, the fishery is considered to be rationalized and behavioral changes are assumed to mitigate some of the groundfish harvest reductions associated with PSC limit reductions.
- **BSAI TLA** fisheries for **Pollock**: The AFA pollock fisheries are considered to be rationalized. However, halibut PSC for the pollock fishery is non-binding—there is a PSC Apportionment (currently 250 mt) that is set each year by the Council and NMFS, but because the Pollock Apportionment is non-binding, it does not have the same behavior-forcing impact that a binding constraint would have. For this reason, the IMS Model does not explicitly assume any reductions in PSC by AFA pollock fisheries vessels. It is believed to be likely that AFA pollock vessels will work to reduce their halibut PSC regardless of whether their PSC Apportionment is binding. These potential “unforced” changes will be examined outside of the IMS Model.
- **BSAI TLA** fishery for **Atka mackerel**: While the BSAI TLA fishery for Atka mackerel cannot be considered fully rationalized, it does have some characteristics that allow its participants to have some control of their outcomes—most important is the fact that there are very few participants in the fishery. Thus, under Scenario A the fishery is considered to be partially rationalized, but under Scenario B it is treated as a race for fish.
- **BSAI TLA** fishery for **Yellowfin Sole**: The BSAI TLA fishery for yellowfin sole is prosecuted primarily by AFA CPs and by a small number of CVs delivering to motherships or floaters. (See Table 4-26 in Section 4.4.3.1.) Because of the small number of participants, and the fact that the majority of the processors are members of an AFA cooperative, it is assumed that while not fully rationalized, there are enough characteristics to treat the fishery as rationalized under Scenario A. Under Scenario B the fishery is treated as a race for fish.
- **BSAI TLA** fishery for **Pacific Cod**: The BSAI TLA fishery for Pacific cod is characterized by a relatively large number of relatively diverse participants. Based on Table 4-26, from 2008 to 2013 the number of active AFA-CPs has ranged from one to four. During the same period there have been as many as 52 AFA-CVs involved in the fishery in a given year and a total of 56 over all the six-year period. In addition, from 11 to 16 non-AFA Trawl CVs have participated in the cod fishery. It can be argued that given the large number of AFA vessels involved in the fishery, the BSAI TLA Pacific cod could be considered at least partially rationalized. However, the fact that there are a large number of non-AFA trawl CVs that are actively engaged in the fishery means that even if the AFA vessels agree to behavioral changes, it is unlikely that the non-AFA trawlers, who have few other fishing options, would agree to cooperate. For this reason, the IMS Model considers the BSAI TLA fishery for Pacific Cod to be a “race for fish” under both Scenario A and Scenario B.

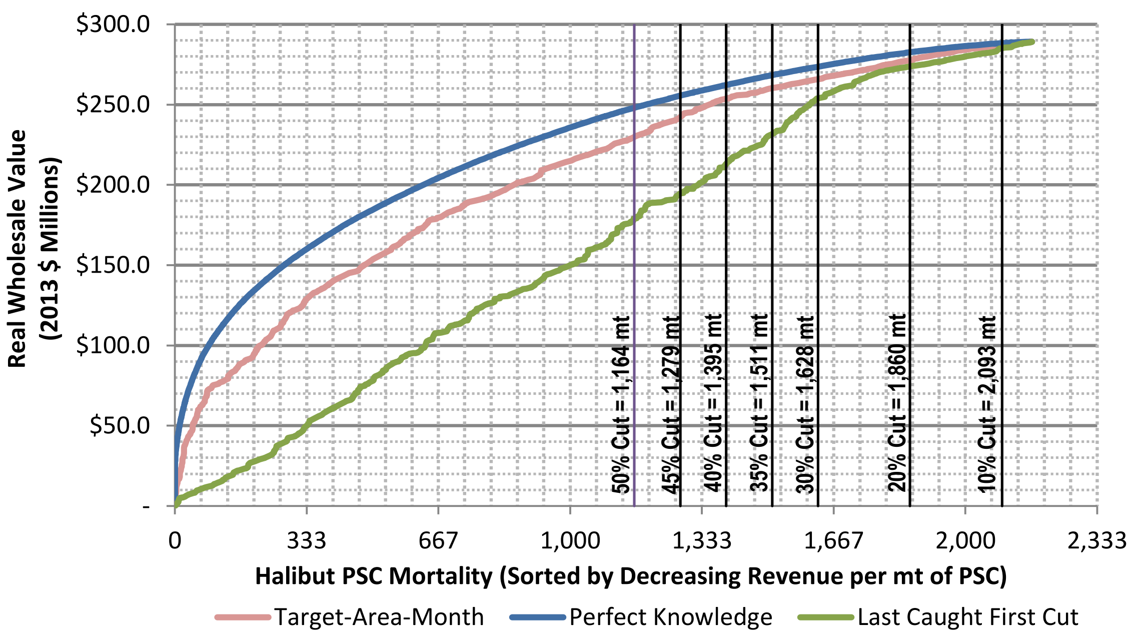
As indicated before the bulleted list, determinations of the PSC reductions under each reduction option for each fishery and sector are made for each basis year, prior to its inclusion in the IMS Model. The process to determine the level of groundfish cuts is done through the systematic sorting of data records. In a last-caught, first-cut scenario, data records for the fishery are sorted by the date of the record from the beginning of the year to the end of the year. If records have the same date, they are further sorted after assigning a unique and fixed random number to each record. The catch progression figures that are contained throughout Section 4.4 (see Figure 4-10 for an example) demonstrate the sorting process that would be used in a non-rationalized fishery which uses a last-caught, first-cut methodology to reduce groundfish harvests and halibut PSC.

Figure 4-63, on the following page, demonstrates three of the potential catch-record sorting methodologies that could be used. This particular figure looks at the 2013 A80-CP fishery and shows halibut PSC mortality on the horizontal or x-axis and wholesale revenue on the vertical or y-axis. The three catch progression lines all start at the origin and moving left-to right and up before they converge at the end of the year with

2,165 mt of PSC mortality and $287.9 million in wholesale revenue. The three lines represent different sorting methods of the same set of catch records. The green, line, which is lowest, shows the progression of the fishery by date—i.e. as it actually occurred. The blue line that is highest shows a hypothetical progression of the fishery if it were possible to prosecute the fishery with perfect knowledge of how much PSC would be taken in each trip and how much revenue would be generated. In this case, the records that generate the most wholesale revenue per halibut PSC are placed at the beginning and records that generate successively lower wholesale revenue per halibut PSC show up later in the progression—this line represents a theoretically optimal set of behaviors by the A80-CPs within the IMS Model constraint that there are no "costless" behavioral changes. The pink middle line represents a sorting of A80-CP catch records that, in theory, could be approximated by behavioral changes by the A80-CPs. In this case, records are sorted based on a fleet-wide ranking of historical wholesale value generated per PSC ton by target fishery, NMFS Area and by month. This line represents in fact the catch progression for Scenario A as used in the IMS Model for A80-CPs when 2013 is selected as the basis year.

In the figure, the vertical lines represent the proposed PSC limit reductions—the right-most vertical line represents 2,093 mt of halibut PSC—the PSC limit proposed under sub-option 1a) with a 10 percent cut from the current 2,325 mt limit. As seen in the figure, this option would cut about 72 mt of PSC with relatively minor impacts to wholesale revenue. Alternatively, if a 35 percent cut in the PSC limit were adopted, the PSC limit would be set at 1,511 mt, and the fleet would need to cut 654 mt of PSC. If the fishery were managed as a race for fish, wholesale revenues would be cut by roughly $57 million to $230 million for the year. If, however, the fleet is able to organize itself by determining to make behavioral changes that avoid particular target-area-month combinations, the revenue impact of the 654 mt of cuts in PSC could be mitigated down to a $29 million revenue cut, with the fleet generating $258 million in revenues—this is still a significant cut, but not nearly as bad as might have occurred under a race for fish.

Figure 4-63 Three Potential Methods to Sort Catch-Records for use in the IMS Model



Note: The minor vertical gridlines are placed at 66.6 mt intervals, while the minor horizontal gridlines are placed at $10 million intervals

Source: Developed by NEI.

The process described above generates lower PSC levels that are run through FCEY algorithm for the commercial halibut fishery, all of which represents the "Change Case". Table 4-116 shows an example iteration of the Change Case noting that the basis years and selected future years are the same in this table as they were for the Status Quo Case shown in Table 4-114 for Iteration Number 1. The numbers that have changed from the Status Quo are bolded.

Table 4-116 An Example Iteration of Halibut Catch in the Change Case Portion of the IMS Model for Area 4A under Alternative 1d) Which Cuts the PSC limit for the A80-CPs by 35%

Basis Year	Model Year	Total O26 PSC taken in Model Year	Initial Area Specific Yield Estimate	Adjustments to Initial Yield Estimates: PPD	CFOL	U26 Based Added Yield	Modelled Estimate of TCEY	Projected Non-Market Removals Deducted from TCEY in Year: Sport & Personal Use	Halibut Fishery O26 Wastage	All Groundfish O26 PSC	Modelled FCEY	Modelled Catch	Actual Catch 2008–13. Modelled Catch from 2014–23
Iteration Number 1													
		All volumes are shown in net weight metric tons (n.w. mt)											
2007	2007	465	1,654	165	76	-	1,895	33	48	419	1,395	1,325	1,252
2008	2008	329	1,334	-56	70	-	1,348	27	64	465	792	753	1,366
2009	2009	462	1,097	129	40	-	1,265	27	71	329	838	796	1,146
2010	2010	295	900	-136	42	-	806	26	75	462	243	231	1,050
2011	2011	306	887	189	12	0.4	1,088	14	66	295	714	678	1,032
2012	2012	454	717	-12	36	0.6	741	14	66	306	355	337	720
2013	2013	320	962	-128	18	2.2	854	17	43	454	339	322	558
2008	2014	**262**	1,093	**155**	**17**	3.3	1,269	9	31	320	909	864	864
2011	2015	**261**	1,093	**159**	**45**	5.3	**1,303**	15	16	**170**	**1,102**	**1,047**	**1,047**
2012	2016	**361**	1,093	**-24**	**55**	5.6	**1,130**	15	16	**194**	**905**	**860**	**860**
2013	2017	**239**	1,093	**-112**	**45**	4.4	**1,031**	15	16	**306**	**693**	**659**	**659**
2008	2018	**262**	1,093	**130**	**35**	1.3	**1,260**	15	16	**176**	**1,052**	**1,000**	**1,000**
2012	2019	**361**	1,093	**6**	**53**	**1.1**	**1,153**	15	16	**170**	**952**	**905**	**905**
2010	2020	**226**	1,093	**-136**	**48**	**1.8**	**1,006**	15	16	**306**	**669**	**636**	**636**
2008	2021	**262**	1,093	**150**	**33**	**3.5**	**1,280**	15	16	**157**	**1,093**	**1,038**	**1,038**
2013	2022	**239**	1,093	**-13**	**55**	**9.0**	**1,144**	15	16	**170**	**943**	**895**	**895**
2008	2023	**262**	1,093	**-6**	**47**	**9.1**	**1,143**	15	16	**176**	**936**	**889**	**889**

The impact of the proposed option for this particular iteration is calculated as the difference from the Status Quo. Mathematically, we subtract the Status Quo from the Change Case to arrive at the Impact for the iteration. The impact case for this particular option, for this particular iteration, with this particular combination of basis years used as future years is shown in Table 4-117. In the table we note an annual average impact of 155 net weight mt to the FCEY in Area 4A. In portions of the IMS Model that are not shown, the discounted present value of the wholesale value of the impact for the iteration is calculated.

Table 4-117 An Example Iteration of Halibut Catch in the Impact Portion of the IMS Model for Area 4A under Alternative 1d) Which Cuts the PSC limit for the A80-CPs by 35%

Basis Year	Model Year	Total O26 PSC taken in Model Year	Initial Area Specific Yield Estimate	Adjustments to Initial Yield Estimates: PPD	CFOL	U26 Based Added Yield	Modelled Estimate of TCEY	Projected Non-Market Removals Deducted from TCEY in Year: Sport & Personal Use	Halibut Fishery O26 Wastage	All Groundfish O26 PSC	Modelled FCEY	Modelled Catch	Actual Catch 2008–13. Modelled Catch from 2014–23
Iteration Number 1													
		All volumes are shown in net weight metric tons (n.w. mt)											
2007	2007	-	-	-	-	-	-	-	-	-	-	-	-
2008	2008	-	-	-	-	-	-	-	-	-	-	-	-
2009	2009	-	-	-	-	-	-	-	-	-	-	-	-
2010	2010	-	-	-	-	-	-	-	-	-	-	-	-
2011	2011	-	-	-	-	-	-	-	-	-	-	-	-
2012	2012	-	-	-	-	-	-	-	-	-	-	-	-
2013	2013	-	-	-	-	-	-	-	-	-	-	-	-
2008	2014	-159	-	-	-	-	1,269	-	-	-	-	-	-
2011	2015	-112	-	159.4	-	-	1,303	-	-	170	319	303	303
2012	2016	-148	-	-47.4	15.9	-	1,130	-	-	194	81	77	77
2013	2017	-144	-	36.0	4.0	-	1,031	-	-	306	188	179	179
2008	2018	-159	-	-4.1	9.4	-	1,260	-	-	176	149	142	142
2012	2019	-148	-	15.5	7.5	0.9	1,153	-	-	170	183	174	174
2010	2020	-138	-	-11.3	9.2	3.3	1,006	-	-	306	149	142	142
2008	2021	-159	-	-9.7	7.5	4.1	1,280	-	-	157	140	133	133
2013	2022	-144	-	21.0	7.0	9.1	1,144	-	-	170	197	187	187
2008	2023	-159	-	-15.5	9.8	9.1	1,143	-	-	176	147	140	140

Note: Cells with a “-“indicate that there is no difference in the change case from the status quo.

In combination with discounted present value calculations, the upper portion of Table 4-114, along with Table 4-116, and Table 4-117 compose a single iteration of the IMS Model for Area 4A. Similar tables are used for the same basis years to calculate the status quo, the change case, and the impacts for Area 4B and Area 4CDE. A single iteration of the IMS Model comprises the status quo, the change case, and the impact calculations for all three IPHC areas. The single iteration also includes the status quo, the change case, and the impacts for the groundfish sector under consideration. With the completion of each iteration, the primary model results are captured and stored and the entire process is repeated. A total of 10,000 iterations of the IMS Model are run for each scenario for each proposed PSC Limit reduction.

4.6.2.4 Key Measures of Impacts Developed in the IMS Model

The assessment of the impacts of the PSC limit reduction options are described in terms of changes from the status quo over a 10-year period in the future—specifically, from 2014 to 2023. The impact of each option will be estimated through the use of the IMS Model, which, as discussed above, simulates the groundfish and halibut fishery over the 10-year future period. The focus of the impacts assessment and the primary output of the IMS Model are four key measures:

- The annual average change, relative to the status quo, in halibut PSC mortality (in round weight mt) by IPHC area over the 10-year period by affected groundfish fisheries;

- The annual average change, relative to the status quo, in halibut harvests (in net weight mt) of the commercial halibut fishery by IPHC area over the 10-year period;
- The average change relative to the status quo in the discounted present value of wholesale revenues over the 10-year period for the affected groundfish fisheries;
- The average change relative to the status quo in the discounted present value of wholesale revenues over the 10-year period for the commercial halibut fisheries.

We define each of these four key measures in more detail below, and also describe several additional measures that are used to assess the impacts of the proposed options to reduce PSC limits.

Annual Average Change in Halibut Mortality in Groundfish Fisheries over the 10-Year Future Period

Each Basis Year selected will bring with it the halibut PSC pattern from the affected groundfish fishery for that year, by vessel, month, area, and target. Under the status quo, the pattern is unchanged. Under the option assessed, halibut PSC mortality is cut on a record-by-record basis until the halibut PSC mortality falls below the new PSC limit. The order in which records are cut is defined by the "Scenario" being run—these scenarios define the shape of the catch progression line from which halibut PSC will be reduced. The difference in halibut PSC mortality for each Basis Year between the status quo and under the option is calculated for each IPHC Area (Change Case PSC – Status Quo PSC = PSC Impact). In each iteration of the simulation, these calculations are reported over all 10 of the Basis Years for each IPHC Area. The IMS Model is run for 10,000 iterations for each Scenario, so there are a total of 100,000 estimates of PSC Difference for each IPHC Area and Scenario. The average of these differences is the "Annual Average Change in PSC" in the groundfish fishery over the 10-year future period.

Annual Average Change in Harvests in the Commercial Halibut Fishery over the 10-Year Future Period

The amount of halibut available for harvest in the commercial halibut fishery changes over time with differences in halibut PSC mortality, but with a lag of over 2 years for O26 PSC and a lag of from 5 to 11 years for U26 PSC. The algorithm used to determine the change in halibut harvest that results from a change in halibut PSC mortality was described in Figure 4-60. The IMS Model incorporates not only changes from savings in O26 halibut, but also calculates increases in future yield due to savings in U26 halibut. The total impact to halibut harvest for each year and IPHC area during the 10-year simulation period is reported. For each iteration, there are 10 years of predicted harvests for each area under both the status quo and the option. The model reports the difference between the two (calculated as Harvest under the Change Case – Harvest under the Status Quo) each year. The IMS Model runs 10,000 iterations, so the Annual Average Change in Harvest is an average calculated over 100,000 data points for each IPHC area and scenario.

The Average Change from the Status Quo of Discounted Present Value of Wholesale Revenue over the 10-year Future Period for the Affected Groundfish Fisheries

Each groundfish record used in the analysis was supplied by AKFIN (Fey 2014) and reports the total weight of groundfish, the total halibut PSC mortality, the total estimated nominal ex-vessel value of the groundfish harvested and the total estimated nominal wholesale value of the groundfish harvested for each vessel in each month in each target fishery in each NMFS reporting area. Prior to undertaking the analysis, we adjusted all of the nominal ex-vessel and wholesale values for inflation to 2013$ using the Producer Price Index for Unprocessed and Packaged Fish (BLS 2014). The sum over all of the AKFIN records for all vessels in a given sector for a given year equals the status quo estimate of groundfish harvest, halibut PSC mortality, ex-vessel value, and wholesale value. The sum of wholesale value of the records that were cut to get the sector under the PSC limit specified by the Option under each scenario equals the change in wholesale value from the status quo for that basis year.

The discounted changes in wholesale values for each of the 10 years in the simulation are summed and the result is the present value of the change from the status quo in wholesale revenue for that iteration. The

IMS model is iterated 10,000 times for each Scenario, and the average of the 10,000 reported values is the average change from the status quo of discounted wholesale revenues for the affected groundfish fishery for that Scenario under that option. Tables in the impact summary sections not only show the impact over the 10-year future period, but also report the discounted annual average wholesale revenues.

The Average Change from the Status Quo of the Discounted Present Value of Wholesale Revenue over the 10-year Future Period for the Commercial Halibut Fisheries

Under the status quo for a given basis year, the wholesale revenue generated in the commercial halibut fishery is calculated by summing the wholesale value for each processor that was active during the fishing year. AKFIN provided these data to the analysts by processor and year. They estimate the wholesale values using Commercial Operator Annual Report data submitted by all of the processors each year. After adjusting for inflation to 2013$, we calculate the real wholesale value per harvested net ton for each year. These values were calculated in Table 4-92 on a net-weight pound basis. These real values of wholesale of revenue per net weight ton were multiplied by the change from the status quo in halibut harvests for each of the 10 future years in each IMS Model iteration, and then discounted based on the future year in which the change occurred. The discounted change in wholesale values over all 10 years in the model is summed and the result is the discounted present value of changes in wholesale value for that iteration. Each run of the IMS Model comprises 10,000 iterations, and the average over all 10,000 iterations is the average change from the status quo of the present value wholesale revenue over the 10-year future period for the commercial halibut fisheries. Tables in the impact summary sections not only show the impact over the 10-year future period, but also report the discounted annual average wholesale revenues.

Additional Measures Used to Assess Impacts of the PSC Limit Reduction Options

In addition to the measures described above, the IMS Model outputs allow the analysis to assess several other key impacts as described below:

- Additional Halibut Yield and Discounted Present Value of Revenues from PSC Savings of U26 Halibut: As described in Section 4.6.1.2, the IMS Model includes estimates of additional halibut yield due to savings of U26 halibut when overall PSC mortality in the BSAI is reduced. The increased yield is assumed to accrue coastwide to all IPHC Areas in proportion to the distribution of the exploitable biomass. This means that PSC reductions in the BSAI will not only generate benefits to the commercial halibut fishery in Area 4, but will also increases halibut yields in the Gulf of Alaska, in British Columbia, and on the U.S. West Coast. The IMS Model calculates the increased yield in these areas during the 10-year future period and estimates the discounted present value of increases in wholesale revenue.

- Measures of Implicit Behavioral Changes that Mitigate Impacts of PSC Reductions in Groundfish Fisheries: PSC reductions in the affected groundfish fisheries are assumed to be accomplished through reductions in groundfish harvests. While the IMS Model does not assume that costless behavioral changes occur, the IMS Model explicitly includes behavioral changes in rationalized fisheries as participants seek to mitigate the impacts of the reduced PSC limits. Measures of these behavioral changes are provided in terms of changes in halibut encounters (HE), and halibut encounter rates (HER).

- Changes in Payments to Vessel-based Crew Members and Changes in Annual Crew Member Earnings: The summaries of existing conditions for both groundfish and halibut include estimates of crew payments, estimates of the total persons in crew member rotations, and estimates of average payments per employed crew member. The impact sections will include estimates of the changes in total crew payments as a result of the proposed PSC limit reductions. The impact sections will also provide estimate of the changes in crew payments per person under the assumption that the number of persons employed in the crew member rotations remains constant. Finally, the impact sections will include estimates of the changes in the number of persons in crew member rotations that would be necessary in order to keep the payments per person at the same level seen in the status quo.

- Changes in Total Groundfish Harvested over All Species and by Target Fishery and by Individual Species: The IMS Model utilizes expected changes in target fishery harvests as a means to accomplish PSC reductions. Summing these changes over all target fisheries for each sector allows the analysis to assess impact to the overall yield of the BSAI groundfish fishery. Additionally, AKFIN data showing the average species-level catch composition of target fisheries by gear and year makes it possible to generate estimates of changes in total catch on a species-by-species basis for managed species.

4.6.2.5 An Example of the Results Generated with the IMS Model

Figure 4-65, Figure 4-64, and Table 4-118 on the following pages provide an example of IMS Model results. In this case, the results shown are for Option 1c, which would reduce A80-CP halibut PSC limits by 30 percent to 70 percent of the Status Quo levels.

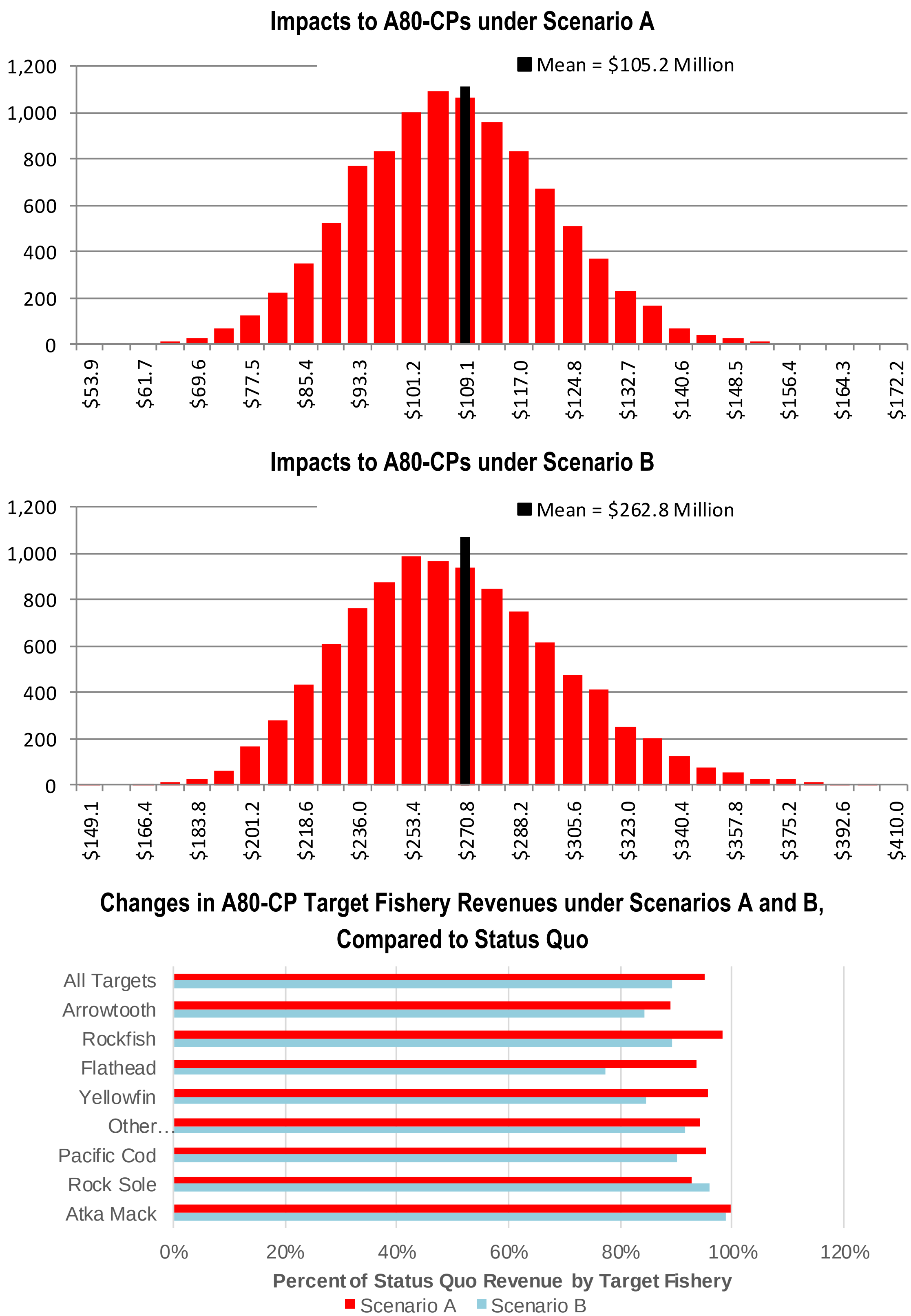
Results from two Scenarios, A and B, are presented. The two scenarios are discussed in greater detail in the methodological discussion of Section 4.8. The two Scenarios for A80-CPs, described below, have been designed specifically for each of the affected sectors, and were intentionally developed to provide reasonable estimates for a lower impact outcome (Scenario A) and a higher impact outcome (Scenario B). It is the presumed that actual outcomes of the specific PSC Limit Reduction Options will fall within the range created by Scenario A and B.

Because the A80-CP fisheries are rationalized, it is assumed that participants are able to change their behaviors to mitigate the potential negative catch and revenue outcomes of the action relative to a last-caught, first-cut scenario which would be expected if the fishery were a race for fish. In Scenario A, it is assumed that the A80-CP cooperatives review detailed fleet-wide records of catch, revenues, and PSC for each target fishery, and develop a ranked list of target fisheries by month and area that will be off limits if the cooperative is going to reduce its PSC to the new limit. In this scenario it is assumed that transfers of PSC and groundfish among all A80-CPs and cooperative are optimally efficient.

In Scenario B for the A80-CPs, we assume that transfers of PSCs across companies are not fully efficient, and that companies with surplus PSC do not trade up to five percent of any surplus PSC. It is also assumed that each company makes its own determination of the months or parts of months in which it will participate. The months will be ranked by the companies from high to low in terms of the wholesale revenues per halibut PSC that are generated. For analytical purposes, all vessels in the company are assumed to operate during the same set of months, even though it might be more efficient for companies with multiple vessels to consolidate their effort onto fewer vessels. The analysts do not believe there is sufficient publically available information to make the types of operational decisions that would hold individual vessels out for the entire year.

Figure 4-64 on page 261 focuses on the groundfish fishery and comprises three separate graphics. The first two show the distribution over 10,000 model iterations of the discounted present value of changes in wholesale revenue relative to the status quo for Scenario A and Scenario B—it is important to note that the horizontal axes of the two figures are not the same and the negative impacts are higher under Scenario B. The graphic at the bottom summarizes the impact of the PSC limit reduction options as a percent of wholesale revenues under the two scenarios with respect to specific target fisheries of A80-CPs.

Figure 4-64 Impacts to A80-CPs under Option 1c): 30 Percent Reduction of PSC Limits



Source: Developed by Northern Economics based on AKFIN data (Fey 2014)

The histograms above serve to demonstrate the level of uncertainty with respect to the foregone revenue outcomes for A80-CPs under the proposed option. While the estimated mean values of foregone discounted present value of wholesale revenues of the two scenarios differ by nearly $160 million over the 10-year future period, there is also a considerable amount of variability within each scenario. Table 4-118 provides additional statistical details regarding the changes generated in the 10,000 iterations of the IMS Model for Option 1c. The table includes outcomes for both the commercial halibut fishery and the groundfish fisheries, with Groundfish impact in the right-most two columns. In the table we see that the standard deviation of estimates outcomes for Scenario A is $14.49 million while for Scenario B the standard deviation of foregone revenues is $35.14 million. Also included in the table are estimates of the reductions in PSC (in round weight mt) under each scenario by the A80-CPs.

For the commercial halibut fishery, Table 4-118 provides statistical details on the increases in the discounted present value of wholesale revenues over the 10-year future period in each IPHC area under the two scenarios. The table also reports the mean annual change in halibut catches by IPHC area in net weight mt, as well as the round weight PSC savings by IPHC area.

Table 4-118 Statistical Details of the IMS Model Runs for Option 1c): 30 Percent Reduction of PSC Limits for A80-CPs

	Directed Halibut Fishery Impacts								Groundfish	
	Scenario A				Scenario B				Scenario A	Scenario B
	4A	4B	4CDE	Area 4	4A	4B	4CDE	Area 4	All Areas	
Iterations with No Change in Discounted Present Value (DPV)	-	-	-	-	-	-	-	-	-	-
Net Change in the Discounted Present Value of Wholesale Revenue from the Status Quo Over All Iterations ($2013 Millions)										
Minimum Change in Magnitude of DPV	$14.49	$0.10	$16.20	$33.73	$8.00	$0.39	$23.26	$33.76	($53.86)	($149.05)
Maximum Change in Magnitude of DPV	$24.04	$1.11	$54.85	$78.26	$13.65	$4.22	$60.24	$75.23	($168.23)	($401.27)
Mean Change in DPV	$19.56	$0.43	$30.27	$50.25	$10.52	$1.62	$40.56	$52.69	($105.23)	($262.77)
Standard Deviation of Changes in DPV	$1.34	$0.15	$5.29	$5.93	$0.79	$0.62	$4.88	$5.50	$14.49	$35.14
Median Change in DPV	$19.56	$0.42	$29.85	$49.80	$10.51	$1.55	$40.43	$52.48	($104.98)	($260.48)
Change in Average Annual Halibut (mt) from the Status Quo										
Mean Annual Change in Halibut PSC mortality (Round Weight mt)	-139.6	-1.8	-272.8	-414.2	-57.2	-12.4	-364.9	-434.5	-414.2	-434.5
Mean Annual Change in Directed Catch (Net Weight mt)	79.8	2.0	128.6	210.4	41.5	7.0	171.9	220.4	-	-
Mean Change in DPV (2013$ million) per annual change in halibut (mt)	$0.25	$0.21	$0.24	$0.24	$0.25	$0.23	$0.24	$0.24	$0.25	$0.60

The ranges of potential impacts of Option 1c) for the commercial halibut fishery are shown graphically in histograms of the 10,000 IMS Model iterations in Figure 4-65 and Figure 4-66. The histograms shown in Figure 4-65 show the range of outcomes over the IMS Model iterations in terms of increases in annual average harvests (in net weight mt) over the 10-year future period. The left-hand column of figures shows outcomes under Scenario A, while the right side shows the range of outcomes under Scenario B. The impacts in the three IPHC subareas are seen moving down the tableaux, with overall impacts in Area 4 is shown at the bottom. Figure 4-65 show the distribution of IMS Model outcomes for changes in 10-year sum of the discounted present value of wholesale revenues in the commercial halibut fishery under option 1c for Scenarios A and B. It should be noted that while there is some variation between the two scenarios, that magnitude of the range across scenarios is much smaller for the commercial halibut fishery than it is for the groundfish fisheries.

Figure 4-65 Annual Average Increases in Commercial Halibut Harvest Relative to Status Quo under Option 1c): 30 Percent Reduction of PSC Limits for A80-CPs

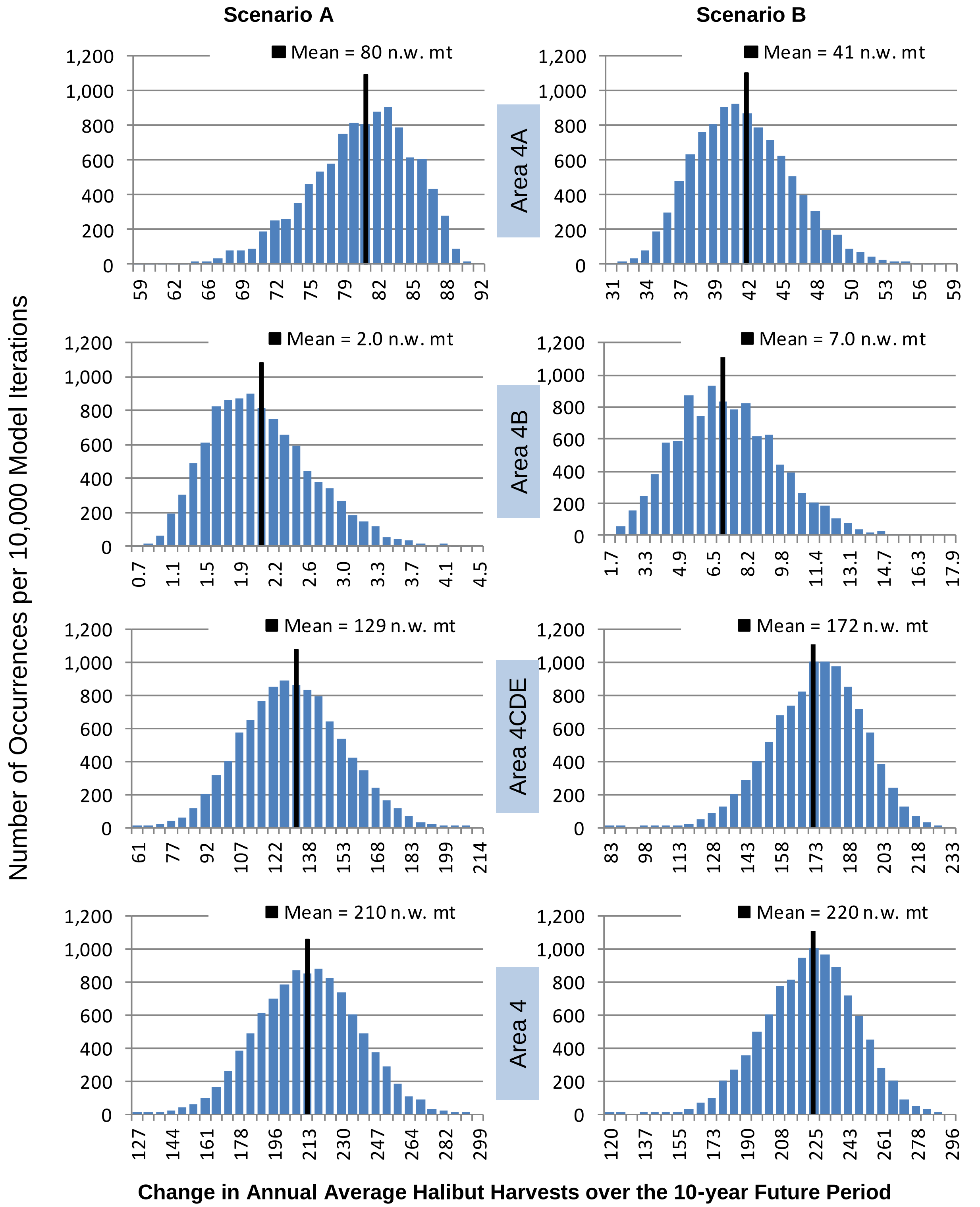
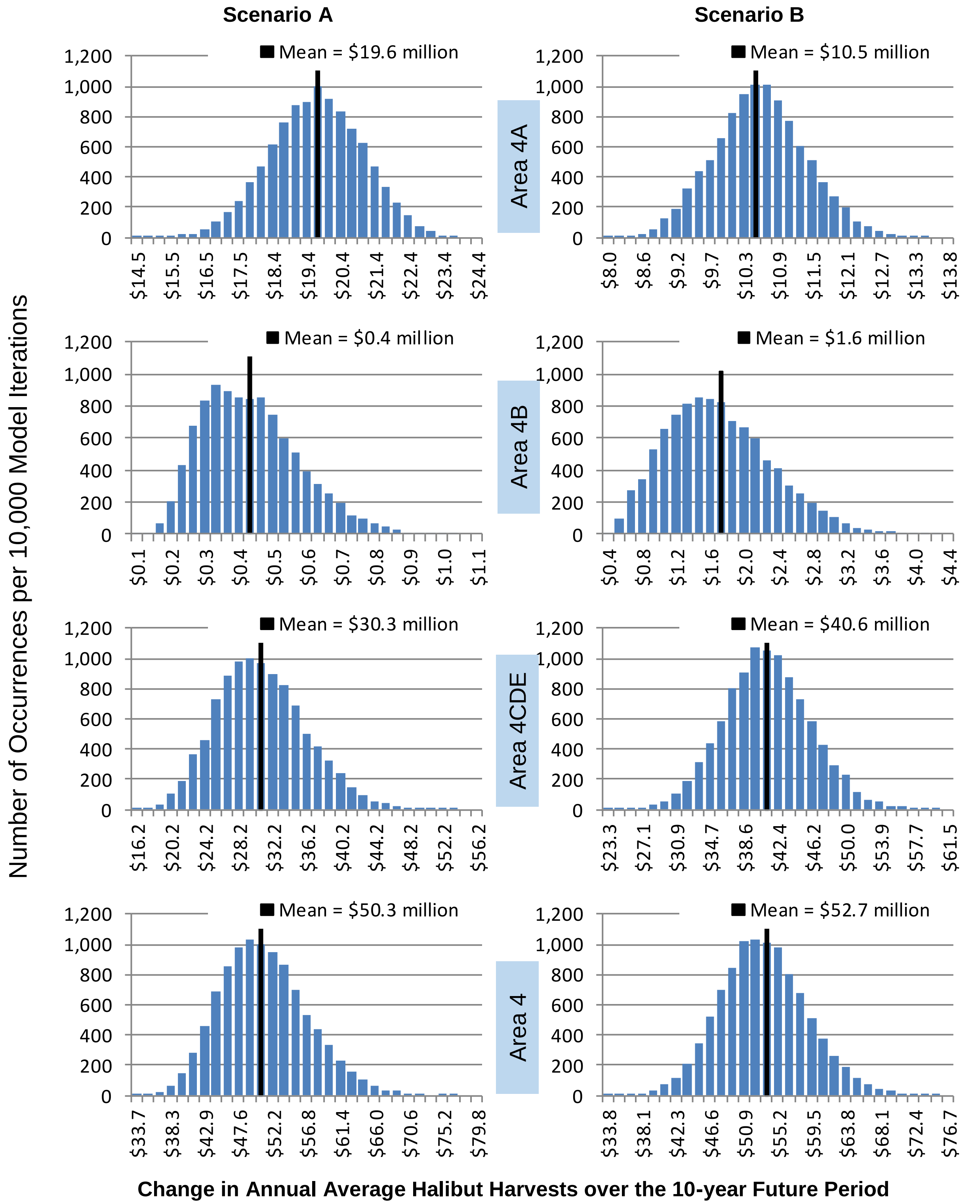


Figure 4-66 Discounted Present Value of Increases in Wholesale Revenue to Commercial Halibut Fisheries Relative to Status Quo under Option 1c): 30 Percent Reduction of PSC Limits for A80-CPs



While the histograms and the table summarizing the statistical details of the PSC limit reduction options are important as a means to describe and summarize the range of potential outcomes under the options, the large number of options under consideration (42) forces these model results to be relegated to a technical appendix (Appendix D). It is highly recommended that decision makers, stakeholders, and members of the public at large review the information in Appendix D in order to gain a better understanding of the overall level of uncertainty in the estimates of the impacts of the options.

4.6.3 A Recap of Key Assumptions Used in the IMS Model

This section contains a recap of the assumptions and specifications of the IMS Model that is used to assess the impacts of the PSC limit reductions proposed for non-exempt BSAI groundfish fisheries. The recap is drawn from earlier parts of this Section and therefore additional details on the assumption can generally be found above. It is the analysts' intention that this section be as concise and as precise as feasible, but that it follow a logical progression. Because of the need for precision, combined with brevity, some readers may perceive the language as overly technical.

General Assumptions Regarding the IMS Model

1) Impacts resulting from reductions to existing PSC limits to affected groundfish sectors can be reasonably assessed by using data from 2008 to 2013 as basis years for measuring impacts. PSC would be cut from each of the basis years along with groundfish harvests and the consequent revenues. The cuts in PSC levels will serve as the inputs for future adjustments to yields and harvests in the commercial halibut fishery.
2) Impacts resulting from reductions to the existing PSC limits on the commercial halibut fishery can be reasonably assessed by using the reduced PSC estimates to adjust future halibut yields and harvests along accepted protocols.
3) Impacts to both the groundfish fisheries and the commercial halibut fishery will be assessed over a 10-year future period that is assumed to begin in 2014 and end in 2023.
4) The reduced PSC limits are assumed to be imposed on the groundfish fisheries in 2014 and the first impacts to yields and harvest in the commercial halibut fishery will be felt in 2015.
5) Future yields for the halibut fishery for the years 2014 to 2023 are projected based on biomass levels from 2014 and adjusted by non-market removals that consist of PSC, harvests in sport, personal use, and subsistence fisheries, and wastage in the commercial halibut fishery.
6) Future year harvests for sport, personal and subsistence use, as well as wastage in the commercial halibut fishery are assumed to be constant at 2014 levels, regardless of changes in future yield levels.
7) PSC levels in future years are determined in the IMS Model through the selection of basis years that are drawn at random from the 2008 to 2013 period.
8) PSC levels in future years, by assumption, do not vary with changes in the halibut biomass.
9) Under the change case, PSC levels are assumed to be reduced by reductions in PSC limits if the PSC level that actually occurred in the basis year exceeded the new (reduced) PSC limit.
10) For each iteration of the IMS Model, basis years are drawn independently for each future year for 2014 through 2023. A single basis year can be selected for any or all future years (the latter is an extremely unlikely outcome).
11) For each iteration of the IMS Model, estimates of outcomes under the future-year status quo (i.e. with no reduction in PSC limits) are subtracted from the estimates of outcomes of the future-year

change case (i.e. with the reductions in PSC limits) These differences are the impacts of the limit reductions option for that particular iteration of the IMS Model.

12) 10,000 iterations of the IMS Model are run for two different scenarios (A and B) for each PSC limit reduction option. Specific A and B Scenarios for each sector will be described later in this recap.
    a. In all cases Scenario A represents a relatively high-impact outcome for the affected groundfish sector in terms of the amount of groundfish harvested and revenue generated.
    b. In all cases Scenario B represents a relatively low-impact outcome for the affected groundfish sector in terms of the amount of groundfish harvested and revenue generated.
    c. Under both Scenario A and B, PSC is reduced to levels at or below the PSC limit.
13) Each 10,000 iteration run of the IMS Model is independent of any other IMS Model runs.

Assumptions Regarding the Future Yield and Harvests in the Halibut Fishery

14) Adjustments to future yields for social or political reasons are explicitly precluded by assumption.
15) If the Fishery Constant Exploitation Yield (FCEY) in a future year is determined to be negative, then the fishery for that year is closed (i.e. harvest is set to zero).
16) It is assumed that the commercial halibut fishery takes place in an area in all years in which the FCEY is greater than zero even if the FCEY is a very small i.e. less than 50 net weight mt.
17) For 2014 and each subsequent year through 2023, the coastwide exploitable biomass of Pacific halibut and the area-specific distribution percentages of that biomass will be taken from estimates for 2014 developed by the IPHC in its 2015 Annual Meeting Bluebook (see Table 4-99).
18) The area-specific target harvest rates in effect in 2014 will be applied to each future year. For Area 4, the target harvest rate is 16.125 percent.
19) The multiplicative product of the exploitable biomass, the area specific distribution percentage, and the target harvest rates combine to create the Initial Area Specific Yield estimate for each sub-area for all of the future years. In other words, the estimated Initial Area Specific Yields are fixed at 2014 levels for each IPHC sub area.
20) Three types of adjustments are made to the Initial Area Specific Yield—the PSC Prediction Delta (PPD), the Commercial Fishery Over|Under Lag (CFOL), and O26 yield changes from U26 PSC savings. These three adjustments are described in the next three assumptions.
21) The PSC Prediction Delta (PPD) is the difference from PSC levels that were predicted prior to the beginning of the previous fishing year and the actual PSC levels that occurred during the previous fishing year. It should be noted that in a later step in the process, TCEYs are adjusted downward by the predicted PSC levels; the PPD is intended to correct for any errors between the prediction and actual PSC levels.
    a. The Predicted PSC for any year ($PPSC_y$) is assumed to be the Actual PSC taken in the groundfish fisheries in the previous year ($APSC_{y-1}$), i.e. $PPSC_y = APSC_{y-1}$.
    b. The Predicted PSC for the previous year ($PPSC_{y-1}$) is therefore assumed to be the Actual PSC taken in the groundfish fisheries two years prior ($APSC_{y-2}$), i.e. $PPSC_{y-1} = APSC_{y-2}$.
    c. Since the PSC Prediction Delta equals the Predicted PSC for the previous year reduced by Actual PSC for the previous year, the PSC Prediction Delta used in fishing year "y" can be restated as $PPD_y = APSC_{y-2} – APSC_{y-1}$.

22) The Commercial Fishery Over|Under Lag (CFOL) serves a similar purpose as the PSC Prediction Delta—it adjusts the yield for the upcoming fishing year (y) by subtracting the actual harvest (H) in the previous year (H_{y-1}) from the FCEY for the previous year ($FCEY_{y-1}$). Typically the Commercial Fishery Over|Under Lag is quite small because it consists only of the un-harvested IFQ and CDQ left on the table from the previous year. If, however, the predicted non-market removals (see Assumption 5) from the TCEY exceed the TCEY, then the FCEY will be negative and the fishery will be closed (as stated in Assumption 15), and the Commercial Fishery Over|Under Lag for the next year will equal the negative FCEY from the previous year.

23) O26 yield increases due to U26 PSC savings are assumed to augment the coastwide commercial halibut fishery yields in volumes that, over the course of seven future years, are exactly equal to the volume of the U26 savings.

    a. The distribution of yield increases to IPHC subareas are determined in the IMS Model by the distribution of biomass that was estimated by the IPHC (see Table 4-100) for the basis year in which the yield increase was realized.[47]

    b. The increases in O26 yield are delayed for a period of five years from the year in which the savings occurred. Thus if the savings actually occurred in 2014, the yield increases will be in realized as coastwide yields increase over the seven-year period from 2019 to 2024.

    c. The coastwide yield increases take following pattern so that over the course of seven years 100 percent of the U26 saving from Year 0 have been realized:

        i. Year 5 coastwide O26 yield increase = U26 savings × 1 ÷ 16

        ii. Year 6 coastwide O26 yield increase = U26 savings × 2 ÷ 16

        iii. Year 7 coastwide O26 yield increase = U26 savings × 3 ÷ 16

        iv. Year 8 coastwide O26 yield increase = U26 savings × 4 ÷ 16

        v. Year 9 coastwide O26 yield increase = U26 savings × 3 ÷ 16

        vi. Year 10 coastwide O26 yield increase = U26 savings × 2 ÷ 16

        vii. Year 11 coastwide O26 yield increase = U26 savings × 1 ÷ 16

24) The IMS Model uses the term Total Constant Exploitation Yield (TCEY) as the halibut yield for the upcoming fishing year for specific subareas, from which all predicted non-market removals are subtracted. The amount left after subtracting non-market removals is the FCEY. In the IMS Model, TCEY is calculated as the Initial Area Specific Yield + the PSC Prediction Delta + the Commercial Fishery Over|Under Lag + the U26-based yield increases.

25) The predicted levels of non-market removal for the upcoming fishing year are always set equal to the actual amount of non-market removals used in the previous fishing year. Actual non-market removals for future years in the IMS Model were described above (see Assumptions 6 through 9) and include PSC, predicted sport, personal and subsistence use, and wastage in the commercial halibut fishery.

26) The FCEY is assumed to equal the TCEY – predicted non-market removals.

27) Harvests in future years are assumed to equal the FCEY × assumed harvest to allocation ratio of 95 percent.

[47] In retrospect, linking the O26 yield increases to the biomass distribution of the basis year in which yield was realized was determined to be unnecessary; instead they should have been distributed using the percentage from 2014. This causes what the analysts believe to be relatively minor change in the distribution of future U26 savings based harvests—adding to the harvests in Areas 3A, 3B, 4A, and 4B, and reducing harvesting in 4CDE, 2C, 2B, and 2A.

28) Future revenues that result from the future year harvests are assumed to use the ex-vessel prices net weight per pound and the wholesale values generated per net weight mt from the basis year used to determine halibut PSC within that particular future year.

29) All future year revenues for both halibut and groundfish are discounted by a factor of 0.95. For halibut, future year wholesale values and discount factors were shown earlier in Table 4-115.

Additional Assumptions Used in the IMS Model with Respect to the Affected Groundfish Fisheries

30) The IMS Model assumes that each basis year can independently be used to represent the groundfish fishery for any of the future years, and that there are no linkages between years. The implied assumption here is that ABCs, TACs, harvests and prices in one year do not impact any other year.

31) All ex-vessel prices and wholesale revenues from the basis year remain intact when the basis year is used as a future year.

32) Each individual record of a vessel's harvest in a NMFS area, in a month, in a target fishery, and processed by a processor (if the vessel was a catcher vessel) remains unchanged under all scenarios and iterations. Along with this comes the implicit assumption that for that particular record the catch per unit of effort is unchanged, the amount of PSC is unchanged, the revenue generated is unchanged and the number of crew members is unchanged.

33) Individual vessel records as described in the previous assumption may be cut (but only in their entirety) in order to reduce PSC for the sector in a given year under a given PSC reduction option.

34) The assumption that all individual vessel records are either used in their entirety or cut from the fishery to reduce PSC limits, precludes any behavioral changes that alter the halibut encounters within a given record or that increase the amount of groundfish harvested with the same amount of PSC. These types of cost-free behavioral changes are not part of the IMS Model. (A minor exception to this assumption is described in part c of assumption 46).

35) The IMS Model does assume that sectors or specific target fisheries within a sector may be "rationalized" and therefore do not exhibit the characteristics of a race for fish.

36) Sectors that are rationalized or target fisheries within a broader group of fisheries (such as the pollock fishery within the BSAI TLA fisheries) are assumed to be able to have some control of the way their fishery is prosecuted during the fishing year. This control is assumed to allow the sector (or target fishery) to mitigate to at least some extent the negative consequences of the PSC limit reductions.

37) For sectors or target fisheries that are not rationalized, the IMS model assumes that the sector (or fishery) progresses over the course of the fishing year in exactly the same way it progress during the basis year. Once the reduced PSC limit is hit, all further groundfish harvests—including the harvests of the individual record that exceeded limit (the last straw as it were)—are cut, and the fishery is assumed to be closed for the year. This methodology is referred to as the last-caught, first-cut PSC reduction methodology.

We note here that for purposes of the ordering of records to simulate the progression of catch over the course of a year, all records have been assigned a unique, randomly selected, but permanent, record identifier. Given that the IMS model uses individual harvest vessel records that report monthly totals by target fishery, NMFS area, and processor, there are often hundreds of records for a given month and year. Therefore, the random record ID is used to sort records within a given month. In a last-caught, first-cut methodology, records in a given month with a larger record ID will be cut prior to records in the same month with a lower record ID.

38) The IMS Model assumes that the following sectors (or fisheries) are rationalized: a) A80-CPs when operating in cooperatives; b) LGL-CPs; c) all groundfish CDQ fisheries; and d) AFA pollock fisheries in the BSAI TLA.

39) The LGL-CV fishery is not considered to be rationalized; however, even with a 50 percent reduction in its PSC, PSC in the LGL-CV fishery has been low enough that it would not have been affected during the basis years, and therefore there are no material impacts for this sector.

40) The analysts have concluded that the Pacific cod fishery within the BSAI TLA fishery is not rationalized, and therefore that fishery is treated as a "race for fish" when cutting individual vessel records to bring the fishery within the PSC limits presumed by the options.

41) The analysts have concluded that while the yellowfin sole fishery within the BSAI TLA fishery is situated somewhat similarly to the Pacific cod fishery, there are so many fewer vessels and ownership entities involved that the fishery could be treated either as a rationalized fishery or as a race for fish. Under Scenario A the yellowfin sole fishery is treated as a rationalized fishery and under Scenario B (the higher impact case) it is treated as a race for fish.

42) For rationalized sectors that are operating in cooperatives (A80-CPs and LGL-CP), the IMS model assumes two different methods to mitigate the negative revenue consequences of PSC reductions under Scenario A and B.

    a. Under Scenario A it is assumed that the cooperatives can, using historic fleet-wide data from the basis years, determine which fisheries must be off limits in order for the cooperative to remain below the PSC limit, while cutting the groundfish harvests with high levels of halibut encounters and relatively low amounts of wholesale revenue generated. This process can create significantly lower revenue impacts than would be realized under a last-caught, first-cut reduction process. Scenario A assumes that there are no barriers or friction that limit transfers of PSC and groundfish quotas among cooperative members or across cooperatives.

    b. Under Scenario B it is assumed that some of PSC transfers occur, but that each company retains up to five percent more PSC than they need as a buffer for unexpected bycatch events if they have a surplus. If companies do not have a surplus, then it is assumed that they use all of their available PSC during the year. The companies are also assumed to make individual decisions (using only their own historical data) to determine the months that all of the companies' vessels will operate. The IMS Model does not make any assumptions regarding the de-activation of individual vessels.[48]

43) The groundfish CDQ fisheries are assumed to be rationalized.

    a. Under Scenario A, it is assumed that the organizations make a joint decision to determine which fisheries must be off limits in order for CDQs as a whole to remain below the PSC limit, while cutting the groundfish harvests with high levels of halibut encounters and relatively low amounts of wholesale revenue generated.

    b. Under Scenario B, it is assumed that the organizations make a joint decision to rank target fisheries to determine the fisheries in which all CDQs will participate, and those that will be avoided in order for all CDQ groups to stay under the limit. The ranking is done in terms of the overall wholesale revenue per PSC for each fishery.

44) The IMS Model assumes that target fishery apportionments of the PSC limit for BSAI TLA fisheries that are currently utilized will continue to be used in the future. Apportionments are made for: a) Pacific cod; b) Yellowfin sole; c) Rockfish; and d) Pollock|AtkaM|Other. The IMS

[48] In the initial draft of the analysis, the IMS Model did in fact make assumptions about which vessel's operations would be cut under the PSC limit reductions.

model also assumes that the pollock target fishery remains exempt from closure due to attainment of the PSC limit, but that the Atka mackerel fishery within the Pollock|AtkaM|Other is constrained by the PSC Limit.

45) The groundfish CDQ fisheries are assumed to be rationalized.

   a. Under Scenario A, it is assumed that the organizations make a joint decision to rank fisheries by target, area, and month to determine the fisheries that must be avoided in order for all CDQ groups to stay under the limit. The ranking is done in terms of the overall wholesale revenue per PSC.

   b. Under Scenario B, it is assumed that the organizations make a joint decision to determine which fisheries must be off limits in order for CDQs as a whole to remain below the PSC limit, while cutting the groundfish target fisheries with high levels of halibut encounters and relatively low amounts of wholesale revenue generated.

46) Under Scenario A in the BSAI TLA fisheries it is assumed that PSC apportionments for yellowfin sole, Pacific cod, and Pollock|AtkaM|Other are all reduced in proportion to the apportionment each was assigned during the basis year.

   a. Under Scenario A, the Pacific cod fishery is assumed be a race for fish, and PSC reductions are achieved in a last-caught, first-cut methodology (see Assumption 37).

   b. Under Scenario A, the yellowfin sole fishery is assumed to be rationalized. Participants are assumed to use an independent contractor to help them determine the order in which months and NMFS areas should be placed off limits in order for the vessels in the target fishery to reduce their PSC to the new lower limit, while mitigating as much as possible the negative revenue impacts of the cuts in groundfish harvests.

   c. Under Scenario A, vessels that target Atka mackerel within the PSC apportionment for Pollock|AtkaM|Other are assumed to continue to be constrained by time/area closures[49]. In the A-Season, the IMS Model assumes they monitor the accumulating levels PSC in the pollock target fishery and time their fishing efforts so as not to be constrained by A-season PSC in the pollock fishery. At beginning of the B-season, if the pollock fishery has not yet reached its PSC limit, the IMS model assumes that Atka mackerel vessels fish as soon as possible to avoid being closed out by PSC in the pollock fishery. We note that the assumption that Atka mackerel vessels are able to potentially change the timing of their effort is violation of the earlier assumption (# 33) that records are either in or out.

47) Under Scenario B in the BSAI TLA fisheries, it is assumed that because the pollock fishery is not constrained by the Pollock|AtkaM|Other PSC apportionment, the industry and the Council agree to keep the Pollock|AtkaM|Other at existing levels and increase the PSC reductions for yellowfin sole, Pacific cod.

   a. Under Scenario B, the Pacific cod and yellowfin sole fisheries are assumed to operate under race-for-fish conditions, and therefore PSC reductions are accomplished using the last-caught, first-cut methodology.

48) Once the PSC reduction for groundfish harvests and PSC have been determined for each of the affected groundfish sectors under Scenarios A and B under each of the PSC reduction options,

[49] In a conversation with NMFS in May 2015 (Furuness 2015), it was determined that the assertion that "if the PSC limit for Pollock|Atka Mackerel|Other is reached, fishing for Atka mackerel and "Other species" is prohibited, but vessels may continue to fish for mid-water pollock" is not correct. According to NMFS the only action that would be taken by NMFS with attainment of the Pollock|Atka Mackerel|Other PSC apportionment is a closure of pollock fishery to bottom trawl gear. However, NMFS already prohibits use of any non-pelagic gear in the BSAI pollock fishery, and therefore no action at all is taken when Pollock|Atka Mackerel|Other apportionment is reached

estimates of groundfish harvests, and wholesale revenues that remain are stored until they are drawn as inputs for the change case with iterations of the IMS Model.

49) The IMS Model assumes that all PSC limits are strictly enforced by NMFS. There are no within-year transfers of the PSC limits from one sector to another, or from one target fishery to another within a sector. While the IMS Model strictly enforces overall PSC limits as well as target-specific apportionments, the IMS Model does allow the mid-water pollock fishery to continue, even after the Pollock|Atka Mackerel|Other Species PSC apportionment has been taken.

4.7 Alternative 1: An Assessment of the Status Quo and the Potential Impacts of Differing Levels of Halibut PSC

In this section we examine the Status Quo and develop the baseline estimates of the key measures described in the previous section. For the groundfish fishery, the key measures can be estimated by using either a) the averages from the Basis Years, or b) the IMS Model. However, realistic estimates of the future halibut FCEYs, and thus harvests and revenues in the commercial halibut fishery, can only be estimated (within this analysis) with the use of the IMS Model as described in Section 4.6. This is because future FCEYs and harvests depend on the O26 and U26 halibut PSC mortality taken in the previous years. Because halibut PSC mortality varies significantly from year to year, there is not a single set of estimates that will produce realistic numbers. Therefore, we have run the IMS Model for the Status Quo Baseline. In the remainder of this section we summarize the Status Quo Baseline and provide the key measures against which changes to the Status Quo will be judged.

4.7.1 Summaries of Key Measures from the Status Quo Baseline

Annual Average Halibut PSC Mortality in Groundfish Fisheries under the Status Quo

Halibut PSC mortality for each of the affected groundfish fisheries and sectors during the Basis Years (2008 to 2013) is a key component of the status quo baseline for Alternative 2 and the assessment of impacts of the various options under Alternative 2. Table 4-119 summarizes halibut PSC mortality as used for the Status Quo Baseline. We note that for the BSAI TLA, the amounts of halibut PSC mortality under the status quo have been reduced by a total of 51.9 mt from what was actually realized during the fishing years from 2008 to 2013. This is a result of the assumption that PSC Limits are strictly enforced. In the IMS Model, Basis Years are randomly drawn to represent the 10 future years in the fishery. Over the 10,000 iterations in the IMS Model for the Status Quo Baseline, the average halibut PSC mortality over the 10-year future period is within 1/10th of 1 percent of the amount shown in the table. Table 4-120 shows the same halibut PSC mortality taken during the Basis Years in the Status Quo Baseline by IPHC sub-area and for Area 4 as a whole.

Table 4-119 Halibut PSC Mortality in the Basis Years, by Groundfish Fishery, 2008 to 2013

Basis Years	2008	2009	2010	2011	2012	2013	Status Quo Average
Groundfish Fishery	**Halibut PSC Mortality (round weight mt)**						
A80-CPs in all target fisheries	1,969.0	2,073.7	2,253.6	1,810.2	1,945.4	2,168.3	**2,036.7**
BSAI TLA in all target fisheries	735.3	726.5	484.2	636.7	936.3	682.9	**700.3**
Longline CPs in Pacific cod fisheries	564.3	555.6	489.4	476.7	549.5	458.1	**515.6**
Longline CVs & CPs in Other Targets	1.3	6.4	10.3	4.5	5.7	1.4	**4.9**
Longline CVs in Pacific cod fisheries	5.4	2.9	1.7	1.3	1.8	3.3	**2.7**
CDQs in all groundfish fisheries	214.0	151.0	158.6	223.0	251.7	264.8	**210.5**
All Affected Groundfish Fisheries	**3,489.4**	**3,516.0**	**3,397.9**	**3,152.4**	**3,690.5**	**3,578.8**	**3,470.8**

Source: Developed by Northern Economics based on data from AKFIN (2014) and NMFS (2014f)

Table 4-120 Halibut PSC Mortality in the Basis Years by IPHC Area, 2008 to 2013

	2008	2009	2010	2011	2012	2013	Status Quo Average
IPHC Area	**Total Halibut PSC Mortality (round weight mt)**						
4A	723.1	923.4	621.9	662.9	1,052.0	756.8	**790.0**
4B	191.2	252.7	285.4	274.6	332.3	250.1	**264.4**
4CDE	2,575.1	2,339.9	2,490.6	2,214.9	2,306.2	2,571.9	**2,416.4**
Area 4 Total	3,489.4	3,516.0	3,397.9	3,152.4	3,690.5	3,578.8	**3,470.8**

Source: Developed by Northern Economics from the IMS Model.

Discounted Present Value of Wholesale Revenues in the Groundfish Fisheries over the 10-year Future Period

Table 4-121 and Table 4-122 summarize wholesale revenues in the Basis Year and in the IMS Model Run for the Status Quo Baseline. Table 4-121 summarizes real wholesale revenues (in 2013$ millions) generated by each of the affected groundfish fisheries during the Basis Years. On average, the groundfish fisheries have generated $1.958 billion in wholesale revenues from 2008 to 2013. Table 4-122 shows IMS Model results for the Status Quo Baseline. The first row of data shows the nominal (pre-discounted) average wholesale values for each of the 10 future years. The average nominal wholesale value in the model over 100,000 iterations (10,000 × 10 years) was $1,959.1 million, which is within 1/20th of 1 percent of the average value shown in Table 4-121. In the second row of Table 4-122, the discounted average values for the future years are shown. The sum of these discounted future values equals the discounted present value of the groundfish fisheries in the Status Quo Baseline—the discounted present value over the 10-year period modelled is $15.723 billion.

Table 4-121 Wholesale Value of Groundfish Fisheries in the Status Quo Basis Year

Groundfish Fishery	2008	2009	2010	2011	2012	2013	Status Quo Average
	Wholesale Value (2013$ Millions)						
BSAI TLA in all target fisheries	$1,475.22	$1,134.72	$1,083.98	$1,363.58	$1,399.22	$1,179.86	**$1,272.76**
A80-CPs in all target fisheries	$320.65	$284.78	$323.90	$357.31	$375.56	$289.04	**$325.21**
Longline CVs in Pacific cod fisheries	$2.63	$0.98	$0.57	$0.86	$1.29	$1.31	**$1.27**
Longline CPs in Pacific cod fisheries	$192.92	$132.67	$128.30	$178.97	$188.33	$133.11	**$159.05**
CDQs in all groundfish fisheries	$241.67	$166.45	$167.32	$219.87	$222.84	$182.68	**$200.14**
Longline CVs & CPs in Other Target Fisheries	$1.47	$1.74	$3.10	$2.25	$2.78	$0.62	$1.99
All Affected Groundfish Fisheries	**$2,233.09**	**$1,719.59**	**$1,704.07**	**$2,120.58**	**$2,187.24**	**$1,786.00**	**$1,958.43**

Note: Wholesale Revenue for the BSAI TLA under the Status Quo baseline has been reduced by $11.2 million from amounts actually generated in the fishery from 2008 to 2013. The reduction is necessary because there were some PSC overages found in the data, and in the Status Quo Baseline and in the IMS Model we assume that PSC Limits are strictly enforced.

Source: Developed by Northern Economics based on data from AKFIN (2014) and NMFS (2014f)

Table 4-122 Nominal and Discounted Future Wholesale Revenue in Groundfish Fisheries under the Status Quo Baseline Model

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	DPV
	Average Groundfish Wholesale Revenue ($ Millions) over 10,000 iterations of the IMS Model										
Nominal Value ($ 2013)	$1,957.8	$1,961.4	$1,960.9	$1,959.4	$1,958.3	$1,958.5	$1,958.5	$1,960.1	$1,957.2	$1,959.4	**#N/A**
Discounted Value	$1,957.8	$1,863.3	$1,769.7	$1,679.9	$1,595.0	$1,515.4	$1,439.7	$1,368.8	$1,298.4	$1,234.9	**$15,723.0**

NPV = Net Present Value

Source: Developed by Northern Economics from the IMS Model.

Annual Average Halibut Yields and Harvests in the Commercial Halibut Fishery under the Status Quo

The IMS Model uses metric tons (mt) as its base unit, and when dealing with halibut yield, the IMS Model operates in net weight mt. Because of this, it may be difficult to translate from data provided by the IPHC and data developed in the analysis. Table 4-123 below shows the three of the primary yield elements developed for the commercial halibut fishery using the algorithm summarized in the flowchart in Figure 4-60. Estimates are provided for Area 4A, 4B, 4CDE and for Area 4 as a whole. The table shows the status quo estimates for:

- Initial Area Specific Yield as reported in Table 4-99
- Average Fishery Constant Exploitation Yield (FCEY) as estimated in the IMS Model for each future year.
- Estimated annual average harvest assumed to be 95 percent of FCEY when FCEY is greater than zero.

A key result within the IMS Model runs for the status quo is that the FCEY in Area 4CDE was determined to be a negative number in slightly more than 20 percent of estimates made. Recall that in each full run of the IMS Model, a total of 100,000 FCEYs are generated for each IPHC area—FCEYs are calculated for each of the 10 future years in each iteration, and 10,000 iterations compose each full model run. For Area 4CDE there were 20,489 instances that the FCEY was a negative number, including all 10,000 of the FCEYs for 2014.[50] There were also 1,639 negative FCEYs in 4CDE calculated for 2015, while in the remaining eight years an there were an average of 1,100 negative FCEYs.

Whenever a negative FCEY is calculated, the IMS model automatically closes the fishery and carries the negative balance into the next year's FCEY calculations as part of the Commercial Fishery Over/Under Lag (CFOL) that was introduced in Figure 4-60. We also note that if the FCEY in Area 4CDE was a positive number of any size, the fishery was assumed to occur. This is in line with a primary assumption in the IMS Model that there are no adjustments made to FCEYs after they are calculated. It should also be noted that even if the IMS Model did allow for exceptions for low or negative FCEYs—in these exceptions the fishery would be allowed to occur in spite of a lack available yield—the Commercial Fishery Over/Under Lag, assuming it also remained in place, would serve to balance out these exceptions.

It is important to reiterate that the future FCEYs and future harvests in Area 4CDE are quite low relative to actual FCEYs and actual harvests seen in Area 4CDE from 2004 to 2013. During the previous 10-year period, FCEYs in 4CDE (as allocated by NMFS in the form of IFQs and CDQs) averaged 1,565 net weight mt, while harvests averaged 1,411 net weight mt (see Table 4-86 and Table 4-87 on page 214.) The primary reason for the significant decline in FCEYs, as modelled into the future, is due to revisions by the IPHC in its retrospective estimates of historic biomass levels. This was discussed in more detail in Section 3.1.1.1, and also on pages 246–247 and demonstrated in Table 4-110 and Table 4-111.

[50] As explained in the discussion on page 228 regarding Table 4-110, the FCEYs for 2014 do not change in any of the iterations because 2014 is assumed as the first year in which the PSC limit reductions are imposed.

Table 4-123 Commercial Halibut Yields and Harvests as Modelled for the Status Quo Baseline

	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Status Quo Average
IPHC Area	**Initial Area Specific Yield in net weight mt**										
4A	1,093	1,093	1,093	1,093	1,093	1,093	1,093	1,093	1,093	1,093	1,093
4B	783	783	783	783	783	783	783	783	783	783	783
4CDE	1,305	1,305	1,305	1,305	1,305	1,305	1,305	1,305	1,305	1,305	1,305
Area 4 Total	3,181	3,181	3,181	3,181	3,181	3,181	3,181	3,181	3,181	3,181	3,181
IPHC Area	**Average Annual Fishery Constant Exploitation Yield (FCEY) in net weight mt**										
4A	767.0	712.2	743.4	744.4	738.9	739.3	736.2	737.1	738.3	737.6	739.4
4B	639.9	657.8	657.2	654.3	653.3	652.6	652.5	653.6	653.6	639.9	659.9
4CDE	-87.1	99.9	155.2	148.6	148.1	146.8	140.3	144.3	145.1	143.6	118.5
Area 4 Total	1,403.9	1,452.0	1,556.4	1,550.3	1,541.3	1,539.4	1,529.1	1,533.8	1,537.1	1,534.7	1,517.8
	Number of Occurrences in the 10,000 Model Iterations										
4CDE FCEY < 0 mt	10,000	1,639	1,142	1,128	1,090	1,116	1,133	1,076	1,073	1,094	2,049
4CDE FCEYs from 0 to 50 mt	0	5,017	564	900	843	921	1,015	1,051	980	936	1,223
IPHC Area	**Average Annual Harvest in net weight mt**										
4A	855	677	706	707	702	702	699	700	701	701	715
4B	688	608	625	624	622	621	620	620	621	621	627
4CDE	0	95	153	146	146	145	139	143	143	142	125
Area 4 Total	1,542	1,380	1,484	1,478	1,469	1,468	1,459	1,463	1,466	1,464	1,467

Source: Developed by Northern Economics from the IMS Model.

Projected Discounted Present Values of Wholesale Revenue in the Halibut Fishery over the 10-year Future Period

Table 4-124 shows the undiscounted and discounted average wholesale revenues for the commercial halibut fishery by IPHC Area resulting from the 10,000 iterations of the Status Quo Baseline IMS Model for each future year. Nominal revenues are not discounted to reflect their value in 2103$. The average nominal wholesale revenue was $435 million, with 48 percent coming from Area 4CDE, 43 percent projected as coming from Area 4B and only 9 percent coming from Area 4A.

The second part of Table 4-124 shows the discounted averages of the wholesale revenues generated in each of the future years over the 10,000 iterations of the IMS Model. The IMS Model assumes a 5 percent discount rate (95 percent of the original value remains after each year). The sum of the discounted values over the 10-year period equals the estimated Net Present Value of the commercial halibut fishery for the Status Quo Baseline. Overall, the sum of the average annual discounted values is approximately 80 percent of the undiscounted values. The discounted future values have essentially the same distribution across IPHC areas.

Table 4-124 Commercial Halibut Harvests as Modelled in the Status Quo Baseline

IPHC Area	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	Sum over 10-year Future Period
	Average Nominal Wholesale Revenues (2013$ millions) over 10,000 iterations of the IMS Model										
4A	$25.37	$20.07	$20.98	$20.97	$20.85	$20.86	$20.77	$20.79	$20.82	$20.78	$212.27
4B	$20.46	$18.04	$18.57	$18.54	$18.46	$18.43	$18.41	$18.41	$18.43	$18.40	$186.15
4CDE	-	$2.84	$4.54	$4.34	$4.34	$4.31	$4.13	$4.25	$4.26	$4.20	$37.21
Area 4 Total	$45.83	$40.95	$44.09	$43.85	$43.65	$43.60	$43.31	$43.45	$43.51	$43.39	$435.64
	Average Discounted (@ 95%/year) Wholesale Revenues over 10,000 iterations of the IMS Model										DPV over 10-Year Future
4A	$25.37	$19.07	$18.93	$17.98	$16.99	$16.14	$15.26	$14.52	$13.81	$13.10	$171.18
4B	$20.46	$17.14	$16.76	$15.89	$15.04	$14.26	$13.54	$12.86	$12.23	$11.60	$149.76
4CDE	-	$2.70	$4.10	$3.72	$3.53	$3.33	$3.04	$2.96	$2.83	$2.65	$28.87
Area 4 Total	$45.83	$38.91	$39.79	$37.59	$35.56	$33.74	$31.84	$30.34	$28.87	$27.35	$349.81

Note: DPV = discounted present value
Source: Developed by Northern Economics from the IMS Model.

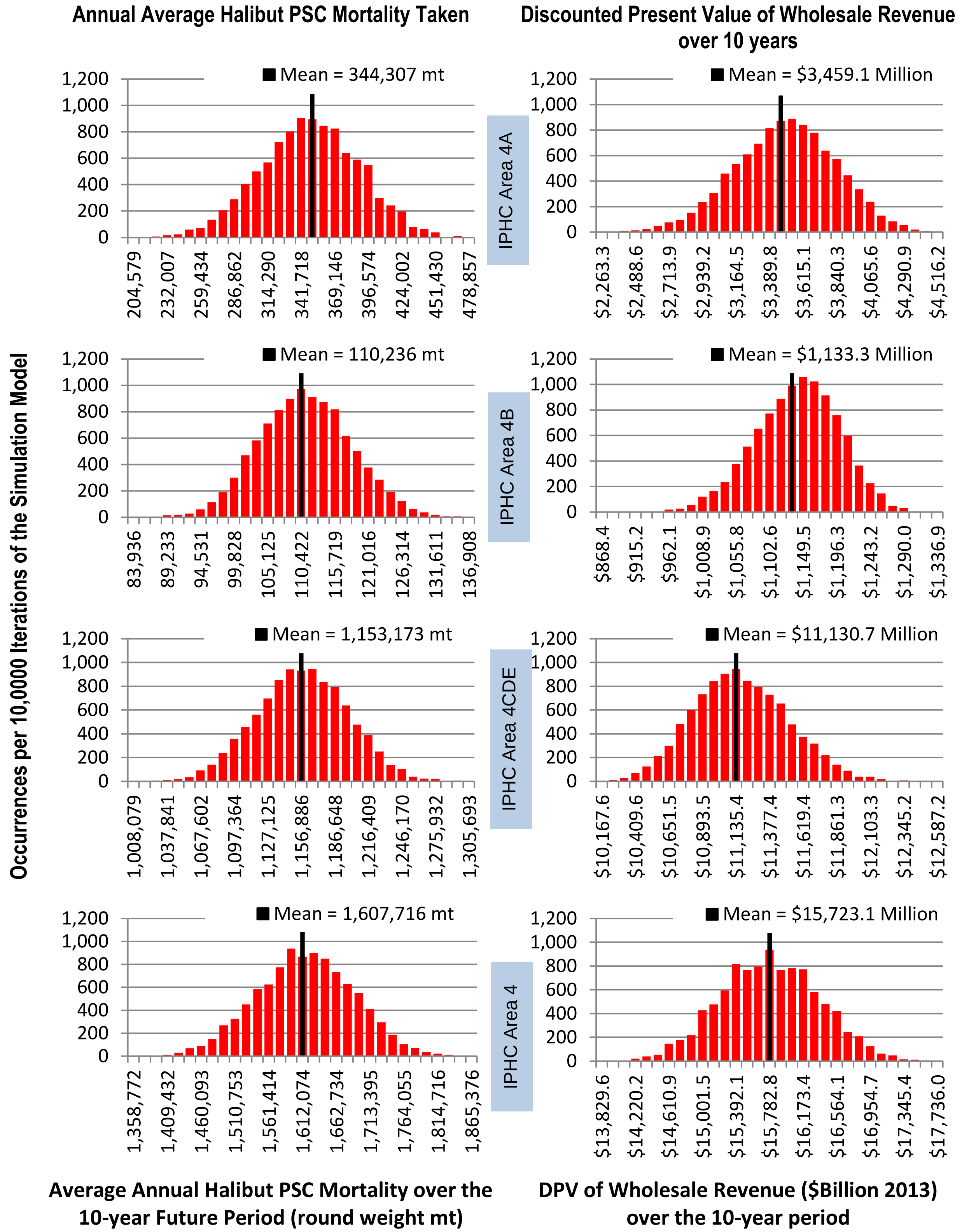
Distributions Halibut PSC, Harvests, and Revenues in the Groundfish and Halibut Fisheries under the Status Quo

On the following pages are two tableaux showing the distributions, in the form of histograms, of the four key measures for the groundfish and commercial halibut fisheries that result from the IMS Model Runs for the Status Quo.

- The histograms on the left-side of Figure 4-67 summarize the projected distribution of the annual average of halibut PSC mortality in the groundfish fisheries, by IPHC area.
- The histograms on the right-side summarize the distribution of the discounted present value of wholesale revenue in the groundfish fisheries over the 10-year future period.
- The histograms on the left-side of Figure 4-68 summarize the projected distribution of the annual average of harvests in the commercial halibut fishery, by IPHC area.
- The histograms on the right-side summarize the distribution of the discounted present value of wholesale revenue in the halibut fishery over the 10-year future period.

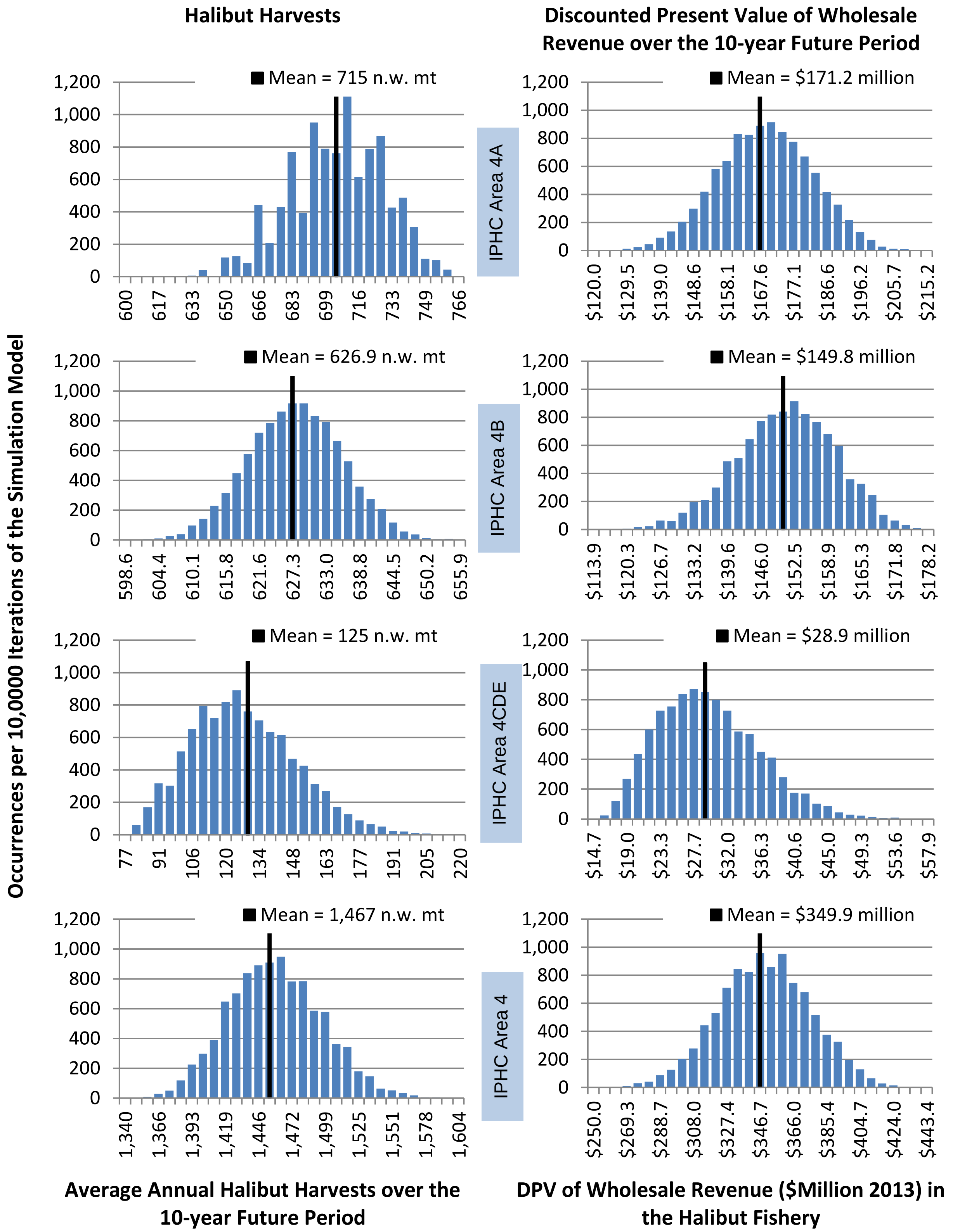
We note here that in spite of all of the instances of negative FCEYs and fishery closures described earlier for IPHC Area 4CDE, the histogram of annual average halibut harvests indicate that none of the 10,000 iterations resulted in a zero average harvest. This is a result of the fact that the histograms summarize the average annual harvest for the area over the 10-year future period for each iteration, and that in at least one the years the estimated FCEY is positive and thus the average harvest is positive.

Figure 4-67 Distributions of Halibut PSC Mortality and the Discounted Present Value of Revenue in Groundfish Fisheries, under the Status Quo Baseline



Source: Developed by Northern Economics from the IMS Model.

Figure 4-68 Distributions of Halibut Catch and the Discounted Present Value of Revenue in the Commercial Halibut Fisheries, under the Status Quo Baseline



Source: Developed by Northern Economics from the IMS Model.

A Qualitative Assessment of Behavior Changes Possible under the Status Quo

Impacts if Current PSC Limits were Fully Taken

The specter of increases in halibut PSC mortality in the BSAI groundfish fishery has long been a concern, not only for participants and managers in the halibut fishery, but also for members of the groundfish industry, consumers of halibut, and many other stakeholders. These concerns have increased due to retrospective revisions to the halibut biomass undertaken by the IPHC in recent years and the implications those revisions have had on yields, FCEYs, and harvests into the future. Concerns for the commercial halibut fishery are undoubtedly exacerbated by the fact that there currently exists a significant amount of slack between the existing PSC limits in groundfish fisheries and the recent amounts of halibut PSC mortality that have been taken.

In this section, we examine the issue from an analytical perspective, and ask the question: what would happen to the FCEYs and halibut harvests if the BSAI groundfish fishery, for some unexplained reason, increased the amount of PSC they take, up to the maximum allowed by their combined PSC limits?

This was primarily an exercise in working through the FCEY-setting algorithm that has been used extensively in this analysis, and in making assumptions about the areas in which halibut PSC increases would occur. Our simplistic approach assumes that the Initial Area Specific Yields from 2014 for each IPHC Area remain constant at 2014 levels. We also assume that each sector's PSC increases proportionally in the Basis Years in the IPHC areas in which they participate, up to that sector's existing PSC limit. In cases where halibut PSC in the BSAI TLA pollock fishery pushed the BSAI TLA over its 875 mt limit for a Basis Year, no additional increases were made.

If we systematically examine the unused PSC limits for each sector and where these sectors have used their PSC in the past, we see from Table 4-125 that 70 percent would be taken from Area 4CDE. This assumes that all sectors expand their use proportionally and simultaneously up to their limits.

Table 4-125 Average Un-Used PSC by Sector and Its Potential Distribution If Used in the Future

	Area 4	4A	4B	4CDE	4A	4B	4CDE
	Average Un-used PSC (n.w. mt)	Current Use as a Percent of Total			Un-Used PSC if Distributed to IPHC Areas (n.w. mt)		
A80-CP	288.3	17%	10%	74%	48.0	28.4	211.9
BSAI TLA	180.2	36%	3%	61%	64.8	5.7	109.8
LGL-CP	297.5	21%	7%	72%	61.5	20.5	215.4
LGL-CV	12.3	67%	22%	11%	8.3	2.7	1.3
CDQ	182.5	19%	8%	72%	35.2	15.1	132.2
All Sectors	**960.7**	**23%**	**8%**	**70%**	**217.8**	**72.3**	**670.6**

Behavior Changes, Innovation and Flexibility in Reducing PSC Mortality

While it is possible that halibut mortality could increase in the future, it is also possible that, under the status quo, halibut mortality could decrease without action forcing changes to the PSC limits. See Section 3.1.3.6 for an additional discussion of voluntary reductions in PSC.

In general, the groundfish fisheries in the BSAI can be characterized as having become more rationalized over time. The A80-CP fishery was rationalized with the implementation of Amendment 80 in 2008, and the formation of cooperatives. Similarly, the longline CP fishery has become rationalized with its cooperative. The following discussion, excerpted from the *Five-year Review of the Effects of Amendment 80*, (Northern Economics 2014), summarizes the increased flexibility that participants in rationalized fisheries are experiencing.

Although not entirely unexpected, rationalization under A80 appears to have led to behavioral changes, innovation and increased flexibility on the part of A80 operators as they work to optimize revenues under the constraints of halibut and crab PSCs.

During interviews with A80 vessel owners and operators it was noted several times that the fleet is no longer trying to maximize revenue per day, and instead is trying to maximize total catch and revenue per pound while staying within their PSC apportionments and other constraints. This change in their primary motivation means they are much less averse to trying new gear configurations, to moving when they hit high levels of bycatch and reducing night-time trawling when halibut are abundant. They are also more willing to test bycatch reduction tools and methods like experimental halibut excluder devices, and to push for deck sorting of halibut to reduce mortality rates.

The following discussion, which summarizes the findings of Abbott, Haynie, and Reimer in their paper, *Hidden Flexibilities: Institutions, Incentives, and the Margins of Selectivity in Fishing* (Abbot et al. 2014), provides some insights into the theoretical underpinning of these changes.

In their analysis of the BSAI non-pollock groundfish trawl fishery, Abbott et al. conclude that behavioral—rather than strictly technical—considerations are significant in explaining changes in catch composition in the fishery following implementation in 2008 of A80. The authors apply multiple statistical measures and econometric modeling techniques to two primary data sources to estimate the significance of various factors in predicting pre- and post-A80 bycatch. These data sources include: confidential observer data on the location and catch of each vessel from the North Pacific Groundfish Observer Program (NPGOP); and vessel-level data on the production weight of final products for each target species, as well as estimates of the initial catch weight embodied in the final products. The authors focus their analysis on three margins of behavioral change, concluding that each has proved significant in explaining reduced bycatch rates: large-scale adjustments to fishing grounds away from areas with traditionally high rates of halibut and cod bycatch; smaller-scale movements away from bycatch hotspots; and reductions in night fishing, particularly during the first third of the year.

The authors also point out that A80 represented a major policy shift away from a system under which the catch of all species, including bycatch species, was regulated by the common-pool assignment of multiple TACs for each species to one under which individual vessels operate under a multispecies catch share system with individual accountability for catch of both target and bycatch species. In addition to granting a defined share of the total A80 TAC for the six primary target species to each vessel in the previous limited-entry program according to its catch history, A80 allows vessels to vest their shares in either a cooperative formed by participating members, or in the limited-access common pool fishery. The regulations afford cooperatives considerable flexibility with regard to the internal allocation of catch entitlements. The authors point out that groups of A80 CPs operating under cooperatives have avoided reaching their collective halibut and cod allocations every year since A80 implementation. The authors also point out that halibut bycatch rates in the non-cooperative portion of the A80 fishery remained unchanged in 2008 and reached historically high levels in 2009 and 2010.

4.8 Option 1, Alternative 2: Analysis of Impacts of Options Affecting the Amendment 80 Catcher Processors

In this section we summarize the impacts of reductions of halibut PSC limits for the A80-CPs as proposed under Option 1. Seven suboptions are specified as follows.

- Option 1.a: Reduce A80-CP Halibut PSC Limits by 10 percent
- Option 1.b: Reduce A80-CP Halibut PSC Limits by 20 percent
- Option 1.c: Reduce A80-CP Halibut PSC Limits by 30 percent
- Option 1.d: Reduce A80-CP Halibut PSC Limits by 35 percent
- Option 1.e: Reduce A80-CP Halibut PSC Limits by 40 percent
- Option 1.f: Reduce A80-CP Halibut PSC Limits by 45 percent
- Option 1.g: Reduce A80-CP Halibut PSC Limits by 50 percent

In a separate section (4.8.2) the Option to reduce PSC limits for vessels that choose to operate in an A80 limited access fishery is described and assessed in a qualitative manner.

A summary of methodological issues relevant to these options is provided below. The methodology discussion is followed by an overview of impacts to both the groundfish participants and the commercial halibut fishery. The overview is followed by two separate sections that describe in more detail the impacts to the groundfish fisheries, and the impacts to the commercial halibut fishery.

Methodological Issues Relevant to the Options to Reduce PSC Limits for A80-CPs

The PSC limit for the A80 fisheries is allocated to two A80 cooperatives based on the catch histories of the A80-CPs included as members. Within each cooperative, PSC mortality is apportioned to companies based on their vessels' catch histories and allocation percentages set forth in the regulations implementing Amendment 80. Within each cooperative, quota for target fisheries as well as quota for PSCs may be transferred from company to company, and of course each company can re-assign quota for groundfish or PSC among its own vessels however it wishes during the year. In addition, groundfish and PSC quota may be transferred from one cooperative to another. The halibut PSC limit for A80-CPs is not subdivided by target fishery—each cooperative and company may use its halibut PSC apportionment in whichever target fishery it chooses.

The assessment of impacts of the proposed reductions in PSC limits is accomplished through the use of the IMS Model, which is described in considerable detail in Section 4.6. For each suboption, the IMS Model is run under two different scenarios that represent a low-impact case (Scenario A) and a high-impact case (Scenario B). These scenarios are described below:

- Scenario A: Under Scenario A it is assumed that operators of A80-CPs, using sector-wide fishery data for the years 2008 to 2013, and ranking each target in each month and each NMFS management area based on the amount of wholesale revenue generated per ton of PSC, determine how much PSC they must cut from their fishing year based on the new limits. It is then assumed that they agree to avoid fishing in target-area-month combinations with the lowest wholesale revenue per PSC, to the extent necessary to reduce their PSC and meet their PSC limit. For analytical purposes it is assumed that operators can estimate, based on historical fishery data, how much halibut savings will be created by dropping these target-area-month combinations from their repertoire. Under this scenario it is also assumed that there are no barriers or any friction that limit transfers of PSC and groundfish quotas among cooperative members or across cooperatives.

- Scenario B: Under Scenario B it is explicitly recognized that transfers of groundfish and PSC quotas may not be as "friction-less" as assumed under Scenario A. It is assumed that companies that have excess PSC apportionments transfer it to companies that don't have enough PSC quota. It is also assumed, however, that each company with excess PSC apportionment holds back five percent of its halibut in case it needs it later in the year. Finally, it is assumed that if transfers of halibut are not available, then companies will cut back operations of all vessels based on the months in which they have historically generated the highest PSC mortality and/or lowest amounts of wholesale revenue per PSC. The IMS Model does not make any assumptions regarding the de-activation of individual vessels under this Scenario,[51] and instead assumes that all vessels within each company cut back their fishing year proportionally.

By design, Scenario A has a lower impact than Scenario B, in part because of the assumption that the A80 fleet knows in advance how many "target-area-months" in low-value fisheries they need to avoid to stay under the fleet-wide cap, and in part because of the assumed stickiness in the transfers in Scenario B.

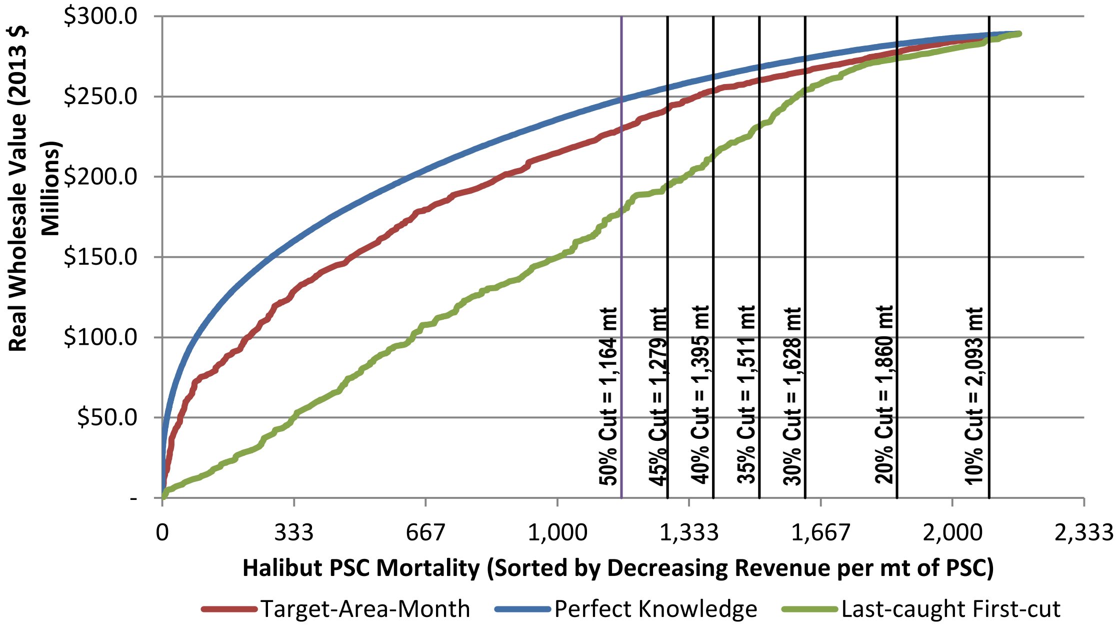
The impacts to the A80 fleet in the 2013 base year under Scenario A are represented graphically in Figure 4-69 as the "target-area-month" line. These catch progression lines are similar to Figure 4-20 in Section 4.4.2.5, with PSC measured along the horizontal axis and wholesale revenues shown on the vertical axis. For comparison purposes, Figure 4-69 displays two additional catch progression lines representing "perfect knowledge" and the actual catch progression from 2013. From a PSC reduction perspective, the catch progression line from 2013 is the equivalent of a last-caught, first-cut PSC reduction methodology, because it implicitly assumes that participants are unable to make behavioral changes that will mitigate potential revenue losses. The "Perfect Knowledge" case represents the best possible optimization of wholesale revenue per halibut PSC. This case implicitly assumes that all vessels in cooperatives know in advance exactly how much catch, revenue, and PSC they will take in each trip, and that they can determine in advance whether or not take or avoid those trips so as to maximize their total revenue relative to their PSC. Figure 4-69 also contains vertical lines that correspond to the new PSC limits that are proposed.

As can be seen in the figure, relatively large differences exist for the same PSC limit reduction option depending on the assumption being made about annual progression. For instance, in 2013, under the perfect knowledge case, the 50 percent halibut PSC reduction (suboption g) would reduce the A80 fleet revenues to approximately $250 million. Under a last-caught, first-cut reduction methodology—which, as stated above, uses that actual catch progression line from 2013—the 50 percent halibut PSC reduction would reduce wholesale revenues for A80-CPs to approximately $180 million. Under Scenario A (which uses the target-area-month ranking process), the 50 percent PSC limit reduction is accomplished with a wholesale revenue reduction down to $227 million. The revenue impacts to the A80-CPs when 2013 is selected as a basis year for each of the other PSC limit reduction options under Scenario A, can also be approximated from the figure. It is important to note that under the status quo with no reductions in the PSC limits, the A80-CPs generated $288 million.

As indicated above, Scenario B is not as optimistic with respect to the sector's ability to organize and change its behaviors on a fleet-wide basis. Instead, Scenario B assumes that individual companies make their own determinations about the months in which their vessels will fish so as to maximize their revenue within the constraints of their PSC apportionments. While the scenario assumes that companies willingly transfer excess PSC, it also assumes that they are somewhat risk averse and hold back up to five percent of any excess they have. To determine which groundfish harvests to cut, the IMS Model uses a catch progression methodology similar to that used in Scenario A. In this case, the methodology was applied to each individual company under Scenario B.

[51] In the initial draft of the analysis, the IMS Model did, in fact, make assumptions about which vessels operations would be cut under the PSC limit reductions. After further discussions with industry, there was not a clear consensus among managers on how they might proceed. Much would depend on vessels' specific operating characteristics and the demands of the market.

Figure 4-69 Proposed Scenario A PSC Limit Reduction for A80-CPs, 2013



Because of data confidentiality issues, we cannot provide specific details on how much was cut from each company. However, we demonstrate the process using three hypothetical "companies" that comprise all of the actual A80 vessels using data from 2012 as an example.

- Company 1 controls 794 mt of PSC or 34 percent of the total, and in 2012 used 818 mt of PSC.
- Company 2 controls 825 mt of PSC (35 percent) and in 2012 used only 569 mt.
- Company 3 controls 706 mt of PSC (or 30 percent) and in 2012 used 558 mt.

Under the status quo during the basis year 2012, Company 1 exceeded its PSC apportionments and had to acquire 24 mt of PSC from either Company 2 or Company 3, both of which had a surplus.

With a 10 percent cut in PSC limit, the following occurs:

- With the 10 percent PSC cut, Company 2 now controls 742 mt of PSC (35 percent) and in 2012 used only 569 mt and, after holding back 5 percent, has 136 mt available.
- With the 10 percent PSC cut, Company 3 now controls 635 mt of PSC, but in 2012 it used 558 mt and (also holding back 5 percent) has 45 mt available for trade.
- With the 10 percent cut, Company 1 controls only 715 mt of PSC (still 34 percent of the total), but now needs to acquire 103 mt to meet its 2012 usage of 818 mt. Because Companies 2 and 3 have surplus available, Company 1 is able to acquire sufficient PSC, and no cuts occur under this option.

With a 20 percent cut in PSC limit, the follow occurs:

- With the 20 percent cut, Company 2 controls 660 mt of PSC and in 2012 used only 569 mt and after holding back 5 percent has 57 mt of PSC available.
- With the cut, Company 3 controls only 565 mt of PSC, and needs all but 7 mt to make it through 2012. Being risk averse, Company 3 holds onto its 7 mt surplus.

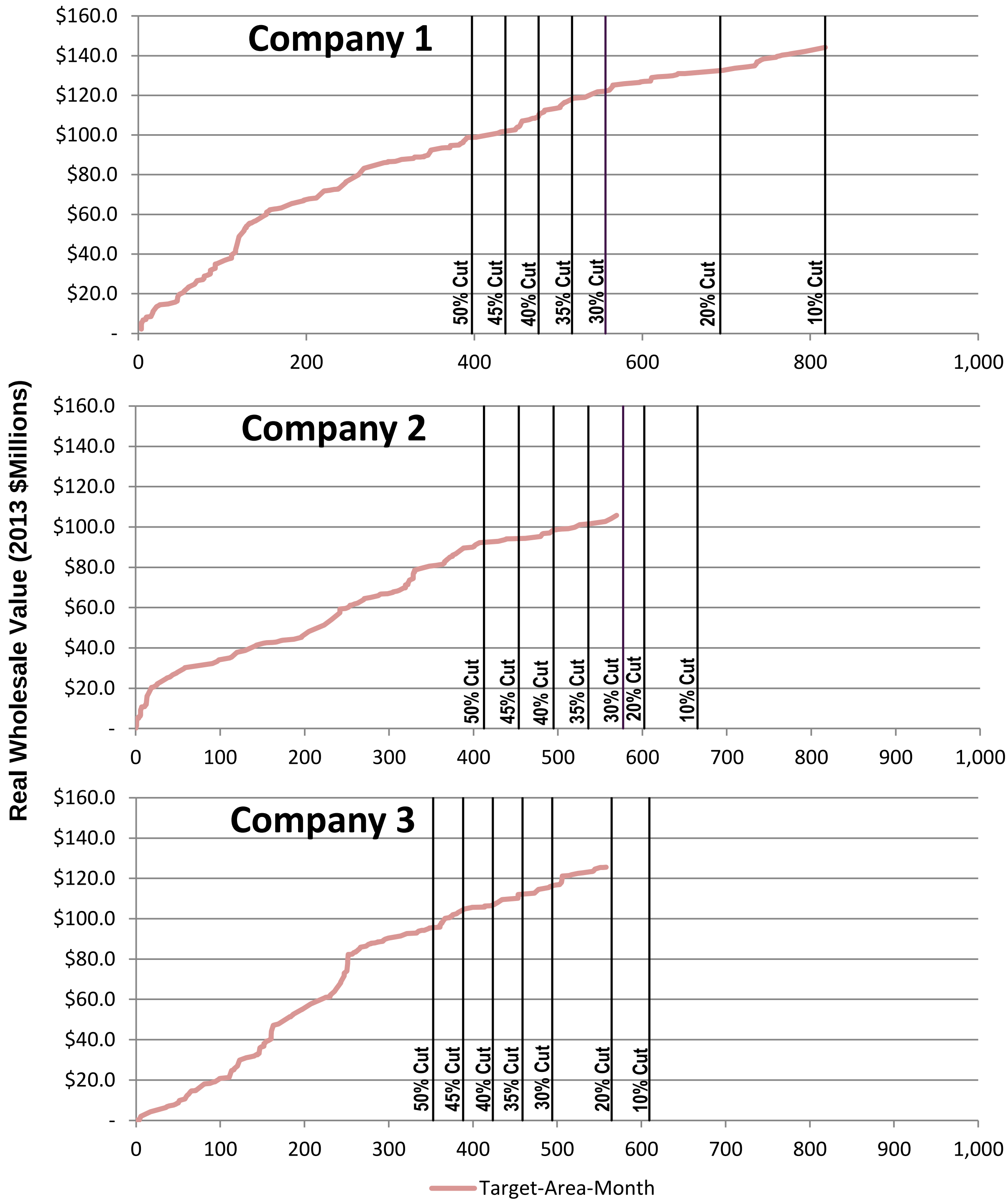
- With the 20 percent cut, Company 1 controls only 636 mt of PSC, but now needs to acquire 182 mt to meet its 2012 usage of 818 mt. However, there are only 57 mt available, so Company 3 has to cut its PSC usage by reducing the amount of groundfish it harvests.

The IMS Model assumes that Company 1 realizes in advance that it will need to cut its use of PSC under the 20 percent PSC limit reduction. After reviewing its company historic harvest data, it determines that all of its vessels will drop all fishing in December, and then fish cautiously in November until the company's vessels hit their limit. Overall, it cuts 167 mt, and generates a total of $13 million less in revenues.

With the 30 percent cut, Company 2 is also no longer willing to trade PSC, although it still has a 19 mt surplus, because of the IMS Model assumption that companies are risk averse. Both Company 1 and Company 3 must cut PSC and they do so by organizing their fleets' monthly fishing patterns to most efficiently utilize their available PSC. Over all of its vessels, Company 1 reduces its PSC usage down to 547 mt and generates $121 million in wholesale revenues ($23 million less than under the status quo.) Company 3 also cuts its PSC by ranking the months in which its vessels have historically generated the most wholesale revenues per halibut PSC. Overall Company 3 cuts 61 mt of PSC and generates $10 million less in revenue than it would have under the status quo.

The process described above is demonstrated graphically in Figure 4-70. For all but the 10 percent PSC limit reduction option, Scenario B generates lower levels of groundfish harvest and wholesale revenue reductions than would occur under a last-caught, first-cut methodology as described earlier and shown in Figure 4-69—on average 30 percent lower. Under Option 1a, foregone revenue under Scenario B is higher than it would have been with the last-caught, first-cut methodology.

Figure 4-70 Proposed Scenario B PSC Limit Reduction for A80-CPs, 2013



Note: Specific company data are not reported. Above figures are for explanatory purposes only.

Table 4-126 details the cuts in PSC and wholesale revenues under each scenario that are made for each Basis Year (2008 through 2013) for each suboption. As discussed in Section 4.6, the IMS Model randomly selects basis years to represent each of the ten future years used in the model iterations. Actual impacts to the fleet are summarized in the next section. It is clear from the table that impacts vary significantly by year. The low levels of PSC in 2011 mean that neither option 1a or 1b will have had an impact when 2011 is drawn to represent a future year in the IMS Model. It is also worth pointing out that in 2009, suboption 1a would have affected the A80 fleet under Scenario B, but not under Scenario A. This is primarily because of the assumption that companies with surplus PSC hold back five percent of that surplus, and is one of the reasons that, as stated in the previous paragraph, a last-caught first-cut methodology in the IMS Model would have generated lower impacts for Option 1a.

Table 4-126 Halibut PSC and Wholesale Revenue Cut in Each Basis Year from A80-CP Target Fisheries by Suboption and Scenario

		2008	2009	2010	2011	2012	2013
Alternative	**Scenario**	**mt Halibut PSC Cut in Each Basis Year**					
Status Quo	Scenario A	-	-	-	-	-	-
	Scenario B	-	-	33	-	-	-
1a: -10%	Scenario A	-	-	163	-	-	78
	Scenario B	-	57	204	-	-	126
1b: -20%	Scenario A	111	224	419	-	89	310
	Scenario B	168	249	429	-	137	349
1c: -30%	Scenario A	342	448	627	197	318	555
	Scenario B	397	495	640	197	353	561
1d: -35%	Scenario A	462	578	743	309	437	667
	Scenario B	501	613	786	351	473	683
1e: -40%	Scenario A	581	679	860	431	555	774
	Scenario B	613	699	898	449	569	789
1f: -45%	Scenario A	693	811	986	534	669	890
	Scenario B	712	808	1,000	584	681	907
1g: -50%	Scenario A	807	911	1,093	648	799	1,007
	Scenario B	840	926	1,114	674	799	1,041
		Real Wholesale Revenues ($2013 millions) Cut in Each Basis Year					
Status Quo	Scenario A	-	-	-	-	-	-
	Scenario B	-	-	$0.7	-	-	-
1a: -10%	Scenario A	-	-	$1.6	-	-	$1.9
	Scenario B	-	$3.4	$14.3	-	-	$6.8
1b: -20%	Scenario A	$2.6	$4.2	$7.0	-	$1.7	$11.4
	Scenario B	$8.1	$16.7	$37.8	-	$10.4	$19.0
1c: -30%	Scenario A	$12.5	$10.7	$17.1	$4.7	$10.9	$22.5
	Scenario B	$24.6	$31.7	$61.0	$16.8	$27.3	$35.1
1d: -35%	Scenario A	$21.5	$17.0	$27.2	$8.6	$18.8	$28.8
	Scenario B	$33.8	$40.0	$76.1	$30.8	$39.8	$52.8
1e: -40%	Scenario A	$28.4	$25.7	$37.7	$18.0	$25.6	$34.9
	Scenario B	$49.4	$52.8	$84.7	$45.8	$52.3	$64.6
1f: -45%	Scenario A	$33.2	$34.3	$46.6	$25.2	$34.6	$44.1
	Scenario B	$61.0	$60.7	$96.6	$62.2	$71.7	$76.6
1g: -50%	Scenario A	$39.8	$40.0	$59.4	$40.4	$41.6	$58.0
	Scenario B	$80.4	$74.3	$106.8	$75.1	$86.1	$98.7

Source: Developed by NEI using data from AKFIN (Fey 2014).

4.8.1 Overview of Groundfish and Halibut Impacts under Option 1 Suboption 1, Addressing Amendment 80 Cooperatives

This section contains tables and figures that summarize the impacts of options to reduce halibut PSC limits for A80-CPs fisheries, along with the resulting increased harvests in the commercial halibut fishery. The section begins with Table 4-127, which summarizes revenue and harvest impacts for both groundfish and commercial halibut fisheries across all suboptions. Subsequent sections provide details for both fisheries, first for groundfish then for the commercial halibut fisheries. The additional details covered for groundfish include estimates of annual average revenue, annual average harvest impacts to each A80-CP target fishery, impacts to crew, and a summary of modelled behavior changes. Additional details provided for the halibut fishery include annual average revenue and harvest impacts to each subarea and to Area 4 as a whole (both in tables and graphically). Finally, future U26-based yield impacts in Area 4, and in other areas outside of Area 4 are summarized for all options. We note that statistical details and histograms summarizing future revenue and harvest impacts pertaining to each individual halibut PSC limit reduction can be found in Appendix D, and that summaries of impacts to communities and regions in Alaska and for regions outside the state are found in Sections 4.13.1.3, 4.13.2.3 and 4.13.2.4.

Table 4-127 is organized into four basic quadrants—upper and lower, left and right. The upper half focuses on projected impacts to wholesale revenues, while the lower half focuses on PSC and harvests. The left side of the table summarizes the negative impacts on the affected groundfish sectors while the right summarizes the positive impacts for the commercial halibut fishery. Each row in the table summarizes the impact for a particular limit reduction percentage. As discussed in the methodology section above, Scenario A is intended to serve as a lower impact case and Scenario B is intended to serve as a higher impact case—for the groundfish fishery, the difference between Scenario A and Scenario B can be quite large, while the differences between the two scenarios for the commercial halibut fishery are relatively small. It should also be noted that the scenarios do not represent a decision point—the Council and NMFS have no immediate control over whether Scenario A or Scenario B is closer to reality.

Table 4-127 Summary of Impacts Over All Reduction Options Affecting A80-CPs

	Groundfish Impacts				Commercial Halibut Fishery Impacts							
	Scenario A	Scenario B	Scenario A	Scenario B	Scenario A				Scenario B			
Option	All Areas		All Areas		4A	4B	4CDE	Area 4	4A	4B	4CDE	Area 4
	PSC Limit (r,w. mt)		10-year Sum of Changes to the DPV Wholesale Revenues (2013 $Millions) Relative to the Status Quo									
Status Quo	2,325		$2,609.87	$2,608.91	$171.2	$149.8	$28.9	$349.8	$171.2	$149.8	$29.5	$350.5
1.a: -10%	2,093		($4.71)	($31.98)	$5.9	$0.0	$2.4	$8.3	$5.0	$0.2	$5.3	$10.5
1.b: -20%	1,860		($36.33)	($122.71)	$12.6	$0.1	$12.7	$25.4	$6.7	$0.8	$20.9	$28.3
1.c: -30%	1,628		($105.23)	($262.77)	$19.6	$0.4	$30.3	$50.3	$10.5	$1.6	$40.6	$52.7
1.d: -35%	1,511		($163.73)	($365.86)	$22.2	$0.5	$40.8	$63.5	$12.3	$3.3	$51.3	$66.8
1.e: -40%	1,395		($228.63)	($468.58)	$23.8	$0.6	$51.9	$76.2	$13.8	$3.7	$60.9	$78.4
1.f: -45%	1,279		($292.98)	($574.78)	$28.5	$0.7	$60.3	$89.5	$15.8	$4.6	$70.4	$90.7
1.g: -50%	1,163		($374.88)	($699.45)	$32.7	$0.8	$68.8	$102.3	$17.9	$5.9	$80.2	$103.9
	Groundfish Impacts				Commercial Halibut Fishery Impacts (net weight mt)							
	Scenario A	Scenario B	Scenario A	Scenario B	Scenario A				Scenario B			
Option	PSC taken (r,w. mt)		Groundfish (1,000s r,w. mt)		4A	4B	4CDE	Area 4	4A	4B	4CDE	Area 4
	Average Annual Change from Status Quo											
Status Quo	2,036.7	2,031.2	0.3	0.3	714.9	626.9	125.2	1,467.1	715.2	627.2	128.2	1,470.6
1.a: -10%	-40.1	-59.0	-0.7	-4.4	21.7	0.1	10.2	32.0	17.8	0.7	22.6	41.1
1.b: -20%	-192.1	-216.7	-5.7	-16.7	50.1	0.6	54.0	104.7	25.2	3.3	88.5	116.9
1.c: -30%	-414.2	-434.5	-15.5	-35.2	79.8	2.0	128.6	210.4	41.5	7.0	171.9	220.4
1.d: -35%	-532.3	-562.5	-23.4	-48.7	90.9	2.4	173.1	266.4	49.0	14.1	217.7	280.9
1.e: -40%	-646.7	-663.9	-32.5	-61.8	97.9	2.7	220.1	320.7	55.3	16.1	257.8	329.1
1.f: -45%	-764.4	-776.9	-41.7	-75.5	117.6	3.3	255.8	376.7	64.1	19.6	298.7	382.5
1.g: -50%	-877.5	-893.6	-53.3	-92.3	135.4	3.6	291.2	430.2	72.9	25.3	340.1	438.2

As can be seen in the upper left quadrant of Table 4-127, each successive suboption represents a bigger cut in the existing PSC limits and a correspondingly greater level of foregone wholesale revenues discounted to present values over the 10-year future period. With a 10 percent cut in limits, A80-CPs are projected to realize between $5 and $32 million in foregone discounted future revenue. With the 50 percent cut in the current PSC limits A80-CPs are projected to generate between $375 and $700 million less wholesale revenues over the 10-year future period discounted to present value.

In the upper right quadrant we see that the commercial halibut fishery can be expected to gain between $8 and $10 million in discounted present value wholesale revenues under Option 1a. With a 50 percent cut in PSC limits, the overall discounted present value wholesale revenue gains jump up to around $100 million. With each successively higher cut, revenues accruing to Area 4CDE comprise a greater proportion of the total—with a 20 PSC limit cut, Area 4CDE is projected to realize approximately 10 to 15 percent of the overall gains, while with a 40 percent cut, Area 4CDE is projected to see roughly 40 percent of the gains.

The lower right quadrant summarizes the annual average changes in commercial halibut harvest (in net weight mt) that are projected under the options, while the lower left quadrant summarizes the expected average changes in PSC taken by A80-CPs, and the projected annual average cuts in groundfish harvests. It should be noted that PSC reductions are shown in round weight mt, and the reductions in groundfish harvests are shown in 1,000s of round weight mt. One of the key points is the fact the halibut PSC reductions in the BSAI are significantly larger than gains to the halibut fishery in Area 4. There are several reasons for this: first PSC are reported in round weight mt and data for the halibut fishery are reported in net weight mt—to convert to net weight mt, multiply the round weight mt by 0.75. Next, most of the gains in Area 4 halibut due to PSC reductions result from savings of O26 halibut. The “rule of thumb” is that 60 percent of the PSC are O26 fish and the remaining 40 percent are U26. It is assumed that on average U26 fish taken as PSC do not recruit into the fishery for another five years. To convert PSC in round weight mt to O26 net weight mt, multiply by 0.75 then multiply by 0.6. The result is a number much closer to the Area 4 harvest increases. The difference is primarily due to the way yield gains from U26 savings are estimated and by slight inter-annual variations in the ratio of O26 to U26 fish.

4.8.1.1 Impacts of Option 1 on Amendment 80 Catcher Processors

In this section we examine in more detail the impacts of the PSC limit reduction options affecting A80-CPs. The section contains three parts that focus on: a) projected impacts to wholesale revenues for A80-CPs; b) projected impacts on groundfish harvests for A80-CPs; and c) behavioral changes of A80-CPs while meeting the reduced PSC limits.

Revenue Impacts for A80-CPs

This section provides additional details on the impacts to revenues and earning projected for A80-CPs resulting from options to reduce PSC Limits. The following figures and tables are used to summarize these additional details.

- Figure 4-71 Annual Average Discounted Present Value of Wholesale Revenue and Halibut PSC under the PSC Limit Reduction Options for A80-CPs
- Table 4-128 Annual Average Future Revenue Impacts of PSC Reduction Options for A80-CPs
- Table 4-129 Average Annual Impacts of PSC Limits to Crew Members on All A80 Vessels
- Table 4-130 Average Annual Impacts of PSC Limits to Crew Members on A80-CPs with Significant Participation in Atka Mackerel Fisheries
- Table 4-131 Average Annual Impacts of PSC Limits to Crew Members on Flatfish Focused Vessels

Figure 4-71 provides a summary of the annual average PSC reductions by A80-CPs that are needed to meet the lower PSC limits under all options, along with the projections of the discounted annual average wholesale revenues they are expected to forego. The figure shows the annual average catch progression lines under Scenarios A and B, along with alternative catch progression lines that could have been used had the IMS Model assumed the A80-CPs had perfect knowledge about their upcoming harvests, or conversely that the A80 fishery did not make behavioral changes and instead reduced its PSC using a last-caught first-cut reduction methodology. In the figure it is clear that outcomes under Scenario A and Scenario B fall between the two more extreme ways that PSC reduction could be projected.

The bolded ✚ markers on the Scenario A and B catch progression lines indicate the spot at which PSC cuts occur under each option. The color coded segments of the line indicate the incremental amounts by which both annual average wholesale revenues (discounted to present values) and PSC are projected to change with each incremental change in the PSC limits. For example, the dark blue line segment from the origin to the first ✚ marker is the portion of the average year that is expected to remain "open" under all options. The entire portion of the line to the right of the first ✚ marker is the projected cuts in annual average discounted present value of wholesale revenue and PSC with a 50 percent reduction in the limit. The lighter blue colored segments between the first ✚ on the left and the second ✚ from the left represent the incremental cuts expected when moving between a 45 percent reduction in the PSC limit to a 50 percent reduction. Each subsequent shaded segment represents incremental cuts for the corresponding option.

Figure 4-71 Annual Average Discounted Present Value of Wholesale Revenue and Halibut PSC under the PSC Limit Reduction Options for A80-CPs

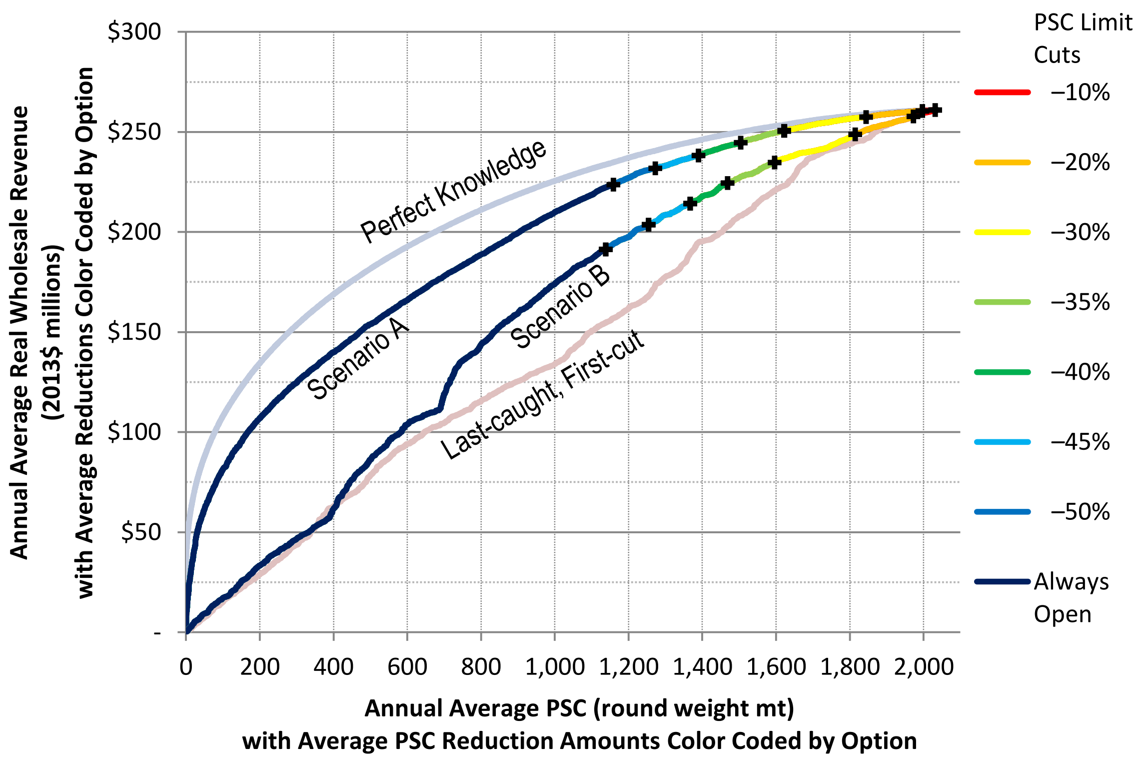


Table 4-128 summarizes the annual average impacts to wholesale revenues (discounted to present values) for A80-CPs projected for each future year resulting from potential halibut PSC limit reductions. The first column of the table shows the range between Scenarios A and B of expected average future values under the status quo, while the columns to the right show the range of projected future values under PSC limit reduction options. Also included at the bottom of the table are the discounted present value of annual average impacts of wholesale revenues over all years during the 10-year future period. The latter set of annual average revenue impacts mirrors the revenue impacts shown in the figure above.

Table 4-128 Annual Average Future Revenue Impacts of PSC Reduction Options for A80-CPs

Year	DPV of Wholesale Revenue Under the Status Quo	1a: -10%	1b: -20%	1c: -30%	1d: -35%	1e: -40%	1f: -45%	1g: -50%
		Forgone Annual Average Discounted Present Value of Wholesale Revenue Under the Alternatives						
	Scen. A - B	Scen. A - B	Scen. A - B	Scen. A - B	Scen. A - B	Scen. A - B	Scen. A - B	Scen. A - B
2014	$325.2 - $325.1	$0.6 - $4.0	$4.5 - $15.2	$13.1 - $32.6	$20.3 - $45.4	$28.4 - $58.1	$36.3 - $71.3	$46.5 - $86.8
2015	$308.9 - $308.8	$0.6 - $3.8	$4.3 - $14.5	$12.4 - $31.0	$19.3 - $43.2	$27.0 - $55.2	$34.5 - $67.8	$44.2 - $82.4
2016	$293.5 - $293.4	$0.5 - $3.6	$4.1 - $13.7	$11.8 - $29.4	$18.3 - $41.0	$25.6 - $52.5	$32.8 - $64.4	$42.0 - $78.3
2017	$278.8 - $278.7	$0.5 - $3.4	$3.9 - $13.0	$11.2 - $28.0	$17.4 - $39.0	$24.3 - $49.8	$31.1 - $61.2	$39.9 - $74.4
2018	$264.9 - $264.8	$0.5 - $3.2	$3.7 - $12.4	$10.6 - $26.6	$16.6 - $37.0	$23.1 - $47.3	$29.6 - $58.1	$37.9 - $70.7
2019	$251.6 - $251.5	$0.5 - $3.1	$3.5 - $11.8	$10.1 - $25.2	$15.7 - $35.2	$22.0 - $45.0	$28.1 - $55.2	$36.0 - $67.1
2020	$239.1 - $239.0	$0.4 - $2.9	$3.3 - $11.2	$9.6 - $24.0	$14.9 - $33.4	$20.9 - $42.7	$26.7 - $52.4	$34.2 - $63.8
2021	$227.1 - $227.0	$0.4 - $2.8	$3.1 - $10.6	$9.1 - $22.8	$14.2 - $31.7	$19.8 - $40.6	$25.4 - $49.8	$32.5 - $60.6
2022	$215.7 - $215.7	$0.4 - $2.6	$3.0 - $10.1	$8.7 - $21.6	$13.5 - $30.1	$18.8 - $38.6	$24.1 - $47.3	$30.9 - $57.6
2023	$205.0 - $204.9	$0.4 - $2.5	$2.8 - $9.6	$8.2 - $20.6	$12.8 - $28.6	$17.9 - $36.6	$22.9 - $45.0	$29.3 - $54.7
Average	$261.0 - $260.9	$0.5 - $3.2	$3.6 - $12.2	$10.5 - $26.2	$16.3 - $36.5	$22.8 - $46.7	$29.2 - $57.2	$37.3 - $69.6

Table 4-129 summarizes the impacts of the PSC limit reduction options to crew members and payments to crew members under Scenarios A and B. Similar tables were generated for the existing conditions in Section 4.4.2.1 on page 145, although it should be noted that the earlier tables included estimates of crew payments generated in CDQ groundfish fisheries, while the table below includes only crew payments from non-CDQ effort. It should also be noted that dollar values shown in the table are discounted out over the 10-year future period to reflect present values of future payments—the discounting results in dollar values that are approximately 20 percent less than values that are not discounted to reflect the present value of the payments. The first row of data shows the annual average discounted present value of payments to crew under the status quo ($71 million) over the future period, and then shows the projected reductions in the annual average present value of crew payments under the options. Two alternative ways to deal with the reductions are shown: companies can keep the same number of crew employees as under the status quo (estimated at 1,806), and reduce everyone's compensation proportionally (as shown in the second row of numbers for each scenario); or they can cut the number of persons employed and maintain the same level of payments per person (estimated at $39,336 under the status quo), as shown in the third row of numbers. Most likely the end result will be a combination of both.

Table 4-129 Average Annual Impacts of PSC Limits to Crew Members on All A80 Vessels

	Status Quo	1a: –10%	1b: –20%	1c: –30%	1d: –35%	1e: –40%	1f: –45%	1g: –50%
Scenario A	**SQ**	**Impacts relative to the Status Quo Under Scenario A**						
DPV of Average Payments to Crew (2013 $millions)	$71.05	($0.13)	($0.98)	($2.85)	($4.44)	($6.20)	($7.94)	($10.16)
Which can be achieved by either reducing payments per person or reducing the number of persons employed:								
Payments Per Person (DPV) in (2013 $)	$39,336	($70)	($545)	($1,579)	($2,458)	($3,433)	($4,395)	($5,628)
Employee Cuts to Maintain SQ Income/person	1,806.1	-3.2	-25.0	-72.5	-112.9	-157.6	-201.8	-258.4
Scenario B	**SQ**	**Impacts relative to the Status Quo Under Scenario B**						
DPV of Average Payments to Crew (2013 $millions)	$71.02	($0.87)	($3.32)	($7.13)	($9.93)	($12.70)	($15.58)	($18.96)
Which can be achieved by either reducing payments per person or reducing the number of persons employed:								
Payments Per Person (DPV) in (2013 $)	$39,321	($480)	($1,840)	($3,945)	($5,496)	($7,032)	($8,628)	($10,497)
Employee Cuts to Maintain SQ Income/person	1,806.1	-22.1	-84.5	-181.2	-252.4	-323.0	-396.3	-482.1

Note: Payments to Crew Members described in the existing conditions included incomes from CDQ fisheries. (see Table 4-16).

Table 4-130 and Table 4-131 serve to highlight differences in projected crew and revenue impacts that are expected to be realized between two separate components of the A80 fleet: 1) vessels with significant participation in Atka mackerel fisheries; and 2) flatfish-focused vessels. The Atka mackerel CPs include all of the vessels owned by Fishing Company of Alaska, the two vessels owned by Ocean Peace Inc. (the Ocean Peace and the Seafisher) and Seafreeze Alaska, which is owned by U.S. Seafoods. Flatfish-focused vessels include the remaining CPs operated by U.S. Seafoods, and all of the CPs operated by Iquique Inc., O'Hara, and Fishermen's Finest. In general, the Atka mackerel CPs and their crews are projected to experience smaller negative consequences on a percentage basis than CPs and crews that focus on flatfish. This finding is demonstrated by examining the employee cuts that would be necessary to maintain status quo incomes per crew person under Scenario B. Atka mackerel CPs are projected to have to cut 169 of the estimated 842 persons employed under the status quo if they hope to maintain the level of payments to individual crew members—this represents a 20 percent cut in overall employees. CPs that focus on flatfish would need to cut 310 persons from their crew rolls to maintain payment per crew member at status quo levels—a 32 percent cut from their estimated status quo workforce of 964 persons. The primary reason for the differential impact is that in general, the Atka mackerel fishery has much lower halibut encounter rates than in the average flatfish target fishery.

Table 4-130 Average Annual Impacts of PSC Limits to Crew Members on A80-CPs with Significant Participation in Atka Mackerel Fisheries

	Status Quo	1a: –10%	1b: –20%	1c: –30%	1d: –35%	1e: –40%	1f: –45%	1g: –50%
Scenario A	**SQ**			**Impacts relative to the Status Quo Under Scenario A**				
DPV of Average Payments to Crew (2013 $millions)	$32.17	($0.08)	($0.35)	($0.95)	($1.50)	($1.90)	($2.64)	($3.25)
Which can be achieved by either reducing payments per person or reducing the number of persons employed:								
Payments Per Person (DPV) in (2013 $)	$38,207	($98)	($410)	($1,126)	($1,776)	($2,255)	($3,138)	($3,856)
Employee Cuts to Maintain SQ Income/person	841.9	-2.2	-9.0	-24.8	-39.1	-49.7	-69.2	-85.0
Scenario B	**SQ**			**Impacts relative to the Status Quo Under Scenario B**				
DPV of Average Payments to Crew (2013 $millions)	$32.17	($0.16)	($0.62)	($1.89)	($2.97)	($4.10)	($5.09)	($6.45)
Which can be achieved by either reducing payments per person or reducing the number of persons employed:								
Payments Per Person (DPV) in (2013 $)	$38,207	($185)	($736)	($2,248)	($3,533)	($4,865)	($6,045)	($7,663)
Employee Cuts to Maintain SQ Income/person	841.9	-4.1	-16.2	-49.5	-77.9	-107.2	-133.2	-168.9

Note: Payments to crew members described in the existing conditions included incomes from CDQ fisheries. (see Table 4-15).

Table 4-131 Average Annual Impacts of PSC Limits to Crew Members on Flatfish Focused Vessels

	Status Quo	1a: –10%	1b: –20%	1c: –30%	1d: –35%	1e: –40%	1f: –45%	1g: –50%
Scenario A	**SQ**			**Impacts relative to the Status Quo Under Scenario A**				
DPV of Average Payments to Crew (2013 $millions)	$38.88	($0.04)	($0.64)	($1.90)	($2.94)	($4.30)	($5.30)	($6.92)
Which can be achieved by either reducing payments per person or reducing the number of persons employed:								
Payments Per Person (DPV) in (2013 $)	$40,322	($47)	($662)	($1,975)	($3,054)	($4,462)	($5,492)	($7,175)
Employee Cuts to Maintain SQ Income/person	964.2	-1.1	-15.8	-47.2	-73.0	-106.7	-131.3	-171.6
Scenario B	**SQ**			**Impacts relative to the Status Quo Under Scenario B**				
DPV of Average Payments to Crew (2013 $millions)	$38.85	($0.71)	($2.70)	($5.23)	($6.95)	($8.60)	($10.49)	($12.51)
Which can be achieved by either reducing payments per person or reducing the number of persons employed:								
Payments Per Person (DPV) in (2013 $)	$40,295	($739)	($2,804)	($5,427)	($7,210)	($8,924)	($10,884)	($12,971)
Employee Cuts to Maintain SQ Income/person	964.2	-17.7	-67.1	-129.9	-172.5	-213.5	-260.4	-310.4

Note: Payments to Crew Members described in the existing conditions included incomes from CDQ fisheries. (see Table 4-14).

Harvest Impacts for A80-CPs

This section provides additional details on the harvest and PSC impacts to A80-CPs from options to reduce PSC Limits. The following figures and tables are used to summarize these additional details.

- Figure 4-72 Impacts to Total Groundfish Harvests by A80-CPs under Option 1
- Table 4-132 Annual Average Impacts of Option 1 to Future Harvests for A-80 CPs by Target Fishery
- Figure 4-73 Percentage Change from Status Quo in A80-CP Target Harvests under Option 1

Figure 4-72 provides an overall picture of the projected annual average impacts on groundfish harvests that are expected with the PSC limit reduction percentages under Option 1. There are two pies representing harvest impacts under Scenario A and Scenario B. The large portions of the pies represent the percentage of the total harvest that remains uncut under all of the options—under Scenario A (which uses a target-area-month ranking to determine which fisheries to avoid) a minimum of 84 percent of overall groundfish harvests are expected to remain uncut regardless of the option chosen. Under Scenario B (which relies more on individual company choices and assumes greater friction in transfers of quota), a minimum average of 72 percent of overall harvests is expected to remain under Option 1g with the largest of the proposed PSC limit cuts. It should be noted that the individual slices of the pie charts represent the incremental amount of groundfish that are expected to be cut under the different limit reduction percentages. The labels for each suboption indicate the cumulative amount cut, and include amounts from all of preceding cuts (i.e. moving back in a counter-clockwise manner).

Figure 4-72 Impacts to Total Groundfish Harvests by A80-CPs under Option 1

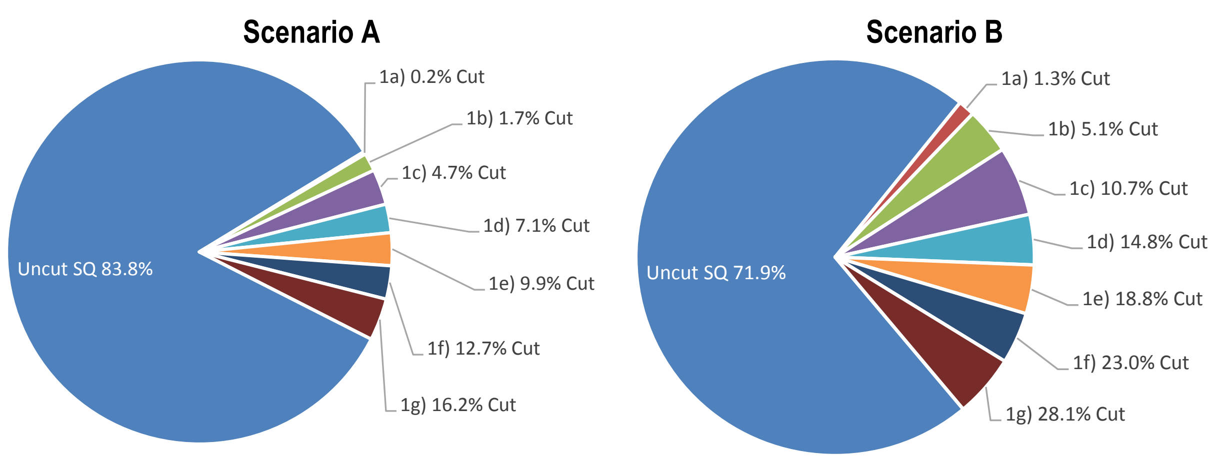


Table 4-132 summarizes annual average impacts from the PSC limit reduction options on future harvest levels for seven specific A80 target fisheries, and for all targets combined. The same impacts as a percent of the status quo are represented graphically in Figure 4-69, but only for the four biggest target fisheries. In both the table and the figure, the differential impacts between Scenarios A and B are shown. The following list, which is sorted by the volume of harvests, shows the range of percentage impacts under Option 1g, which would reduce PSC limits by 50 percent.

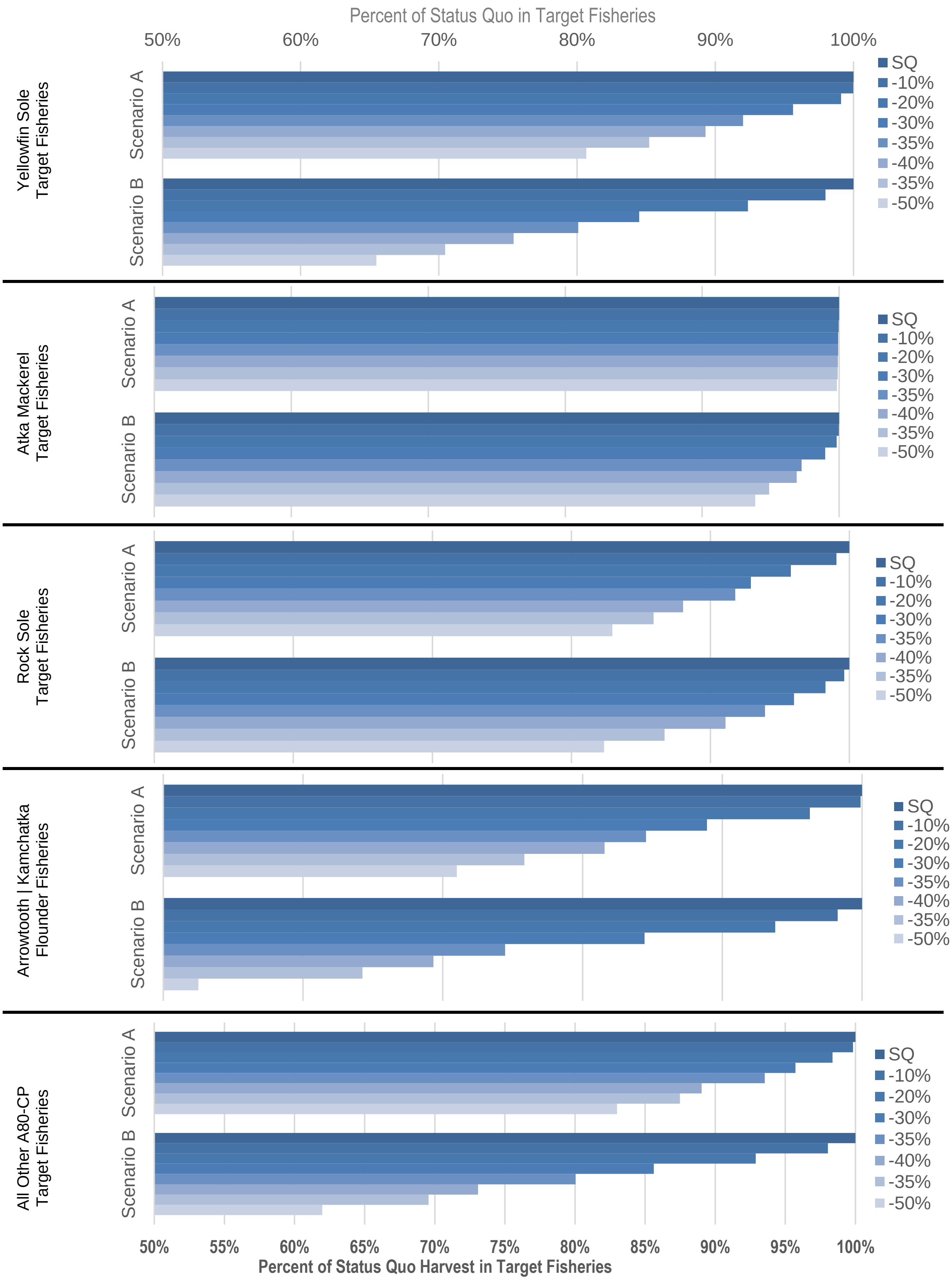
- Yellowfin sole: Under Option 1g cuts range from 19 percent under Scenario A to 35 percent under Scenario B.
- Atka mackerel: Under Option 1g cuts range from 0.2 percent under Scenario A to 24 percent under Scenario B.

- Rock sole: Cuts range from 17 to 18 percent under Scenarios A and B.
- Arrowtooth and Kamchatka Flounder: Under Option 1g cuts range from 29 percent under Scenario A up to 48 percent under Scenario B.
- Flathead sole: Cuts range from 29 percent under Scenario A to 57 percent under Scenario B.
- Rockfish: Cuts range from 4 percent under Scenario A to 28 percent under Scenario B. The very large range is a function of the fact that the rockfish fishery is primarily prosecuted by the Atka mackerel vessels and under Scenario B they are assumed to make blanket cuts over an entire month of effort. Because rockfish is typically a small portion of effort within a month, the relatively high wholesale value generated per halibut PSC is not enough under the strictly applied assumptions to keep those months in the fishery.
- Pacific cod: Cuts range from 20 to 25 percent under Scenarios A and B.
- All other target fisheries: Cuts range from 21 to 29 percent under Scenarios A and B.
- All A80-CP Groundfish: Under Option 1g overall harvest cuts range from 16 percent under Scenario A up to 28 percent under Scenario B.

Table 4-132 Annual Average Impacts of Option 1 to Future Harvests for A-80 CPs by Target Fishery

	Status Quo	1a: – 10 %	1b: – 30 %	1c: – 30%	1d: – 35%	1e: – 40%	1f: – 45%	1g: – 50%
Annual Average Harvests (mt) in the Yellowfin Sole Target Fishery								
Scenario A	139,194	139,170	137,940	133,118	128,078	124,297	118,636	112,280
Scenario B	139,058	136,245	128,447	117,493	111,364	104,863	97,960	91,048
Annual Average Harvests (mt) in the Rock Sole Target Fishery								
Scenario A	65,808	65,195	63,040	61,147	60,401	57,941	56,545	54,588
Scenario B	65,808	65,567	64,672	63,189	61,817	59,948	57,062	54,197
Annual Average Harvests (mt) in the Atka Mackerel Target Fishery								
Scenario A	52,319	52,319	52,299	52,277	52,277	52,266	52,257	52,232
Scenario B	52,319	52,310	52,220	51,790	50,882	50,701	49,642	49,114
Annual Average Harvests (mt) in the Arrowtooth & Kamchatka Flounder Target Fisheries								
Scenario A	25,088	25,062	24,152	22,304	21,210	20,466	19,028	17,812
Scenario B	25,088	24,653	23,532	21,186	18,682	17,391	16,119	13,174
Annual Average Harvests (mt) in the Flathead Sole Target Fishery								
Scenario A	16,124	16,122	15,691	15,095	14,626	13,126	12,608	11,395
Scenario B	16,124	15,949	14,351	12,493	10,680	9,443	8,570	6,913
Annual Average Harvests (mt) in the Rockfish Target Fishery								
Scenario A	17,828	17,822	17,822	17,526	17,502	17,491	17,429	17,162
Scenario B	17,828	17,322	16,843	15,926	15,423	14,150	13,771	12,782
Annual Average Harvests (mt) in the Pacific Cod Target Fishery								
Scenario A	5,232	5,212	5,166	4,988	4,664	4,492	4,476	4,210
Scenario B	5,232	5,059	4,946	4,721	4,654	4,423	4,272	3,933
Annual Average Harvests (mt) in All Other Target Fisheries								
Scenario A	6,823	6,768	6,580	6,429	6,240	5,853	5,739	5,415
Scenario B	6,820	6,774	6,591	6,247	6,067	5,603	5,387	4,885
Annual Average Harvests (mt) in All A80-CP Target Fisheries								
Scenario A	328,417	327,671	322,690	312,885	304,998	295,932	286,717	275,095
Scenario B	328,277	323,878	311,603	293,045	279,569	266,522	252,784	236,046

Figure 4-73 Percentage Change from Status Quo in A80-CP Target Harvests under Option 1



Behavioral Changes of A80-CP in Response to the Options

As discussed in section 4.4.1.5 for all groundfish sectors and in 4.4.2.6 for A80-CPs, changes in halibut PSC are a function of changes in three separate factors: halibut encounter rates, the discard mortality rate (which can be reviewed in Table 4-106 on page 242), and the total volume of groundfish harvested. Here we summarize the behavioral changes that are both explicitly and implicitly modeled in the analysis. For example, there may be a common perception that reducing total groundfish harvest will reduce the amount of halibut encounters proportionately, and this may be true in certain fisheries. However, as seen in Table 4-133, which summarizes the total change in groundfish harvest and halibut PSC as estimated in the analysis, the percentage changes in halibut encounters are much larger than changes in total groundfish, and this change decreases the overall halibut encounter rates. This is an outcome of the methodology used under both scenarios for A80-CPs, but it makes intuitive sense given the fleet's ability to mitigate negative harvest impacts by prioritizing fishing operations from best to worst target-area-month combinations under Scenario A and best to worst month under Scenario B. These assumed mitigating practices are behavioral changes that reduce the overall impact of the options relative to "worst-case" scenarios such as the last-caught, first-cut PSC reduction methodology.

Table 4-133 is split into two halves for Scenario A and B. For each Scenario, the table shows status quo totals for the annual average estimates groundfish harvests, halibut encounters, halibut encounter rates (HER) and total PSC. Also shown are the change (or deltas [Δ]) from the status quo that are expected under the suboptions. The lower part of section shows the percentage changes relative to the status quo.

Table 4-133 Groundfish Harvest Changes and Resulting Changes in Halibut Encounters, Halibut Encounter Rates (HER), and PSC for A80-CPs

	Scenario A							
	SQ	**1a: -10%**	**1b: -20%**	**1c: -30%**	**1d: -35%**	**1e: -40%**	**1f: -45%**	**1g: -50%**
Variable	**Status Quo and Changes (Δ) in Annual Average Outcomes under the Suboptions**							
Groundfish (mt)	328,417	-746	-5,727	-15,532	-23,418	-32,485	-41,700	-53,322
Encounters (mt)	2,575	-49	-243	-525	-675	-821	-968	-1,112
HER (kg/mt)	7.84	-0.13	-0.61	-1.29	-1.61	-1.91	-2.24	-2.52
PSC (r.w. mt)	2,037	-40	-192	-414	-533	-647	-764	-878
	Percentage Change from SQ Under the Suboptions							
Groundfish (Δ %)	-	-0.2%	-1.7%	-4.7%	-7.1%	-9.9%	-12.7%	-16.2%
Encounters (Δ %)	-	-1.9%	-9.4%	-20.4%	-26.2%	-31.9%	-37.6%	-43.2%
HER (Δ %)	-	-1.7%	-7.8%	-16.4%	-20.6%	-24.4%	-28.5%	-32.2%
PSC (Δ %)	-	-2.0%	-9.4%	-20.3%	-26.2%	-31.8%	-37.5%	-43.1%
	Scenario B							
	SQ	**1a: -10%**	**1b: -20%**	**1c: -30%**	**1d: -35%**	**1e: -40%**	**1f: -45%**	**1g: -50%**
Variable	**Status Quo and Changes (Δ) in Annual Average Outcomes under the Suboptions**							
Groundfish (mt)	328,277	-4,399	-16,674	-35,232	-48,708	-61,755	-75,493	-92,231
Encounters (mt)	2,568	-74	-272	-548	-711	-840	-982	-1,131
HER (kg/mt)	7.82	-0.12	-0.45	-0.93	-1.18	-1.34	-1.55	-1.74
PSC (r.w. mt)	2,031	-59	-217	-435	-562	-664	-776	-893
	Percentage Change from SQ Under the Suboptions							
Groundfish (Δ %)	-	-1.3%	-5.1%	-10.7%	-14.8%	-18.8%	-23.0%	-28.1%
Encounters (Δ %)	-	-2.9%	-10.6%	-21.4%	-27.7%	-32.7%	-38.2%	-44.0%
HER (Δ %)	-	-1.6%	-5.8%	-11.9%	-15.1%	-17.1%	-19.8%	-22.2%
PSC (Δ %)	-	-2.9%	-10.7%	-21.4%	-27.7%	-32.7%	-38.2%	-44.0%

As an example, look at Scenario A with a 10 percent reduction in halibut PSC limits. Under this suboption, groundfish harvests are cut by only 0.2 percent but halibut PSC is reduced by 2.0 percent. The majority of the change in halibut PSC is a result of a 1.7 percent decrease in the halibut encounter rate—the change in the halibut encounter rate occurs because of the target-area-month ranking that led to groundfish cuts with relatively high halibut encounters per ton of groundfish. Under the 50 percent reduction option with Scenario A, groundfish harvests are cut by 16.2 percent, and halibut PSC is reduced by 43.1 percent. Under this option, a 32.2 percent reduction in the halibut encounter rate accounts for a large proportion of the overall reduction in halibut PSC. This indicates that by having the ability to optimize fishing, relatively small decreases in groundfish harvested can lead to larger reductions in PSC.

4.8.1.2 Impacts of Option 1 on the Commercial Halibut Fishery

This section provides a summary of impacts on the commercial halibut fishery of proposed options to reduce PSC limit for A80-CPs, and is divided into three parts:

- Harvest Impacts to the Commercial Halibut Fishery
- Revenue Impacts to the Commercial Halibut Fishery
- Yield Increases to Commercial Halibut Fishery Resulting from U26 Savings

Harvest Impacts to the Commercial Halibut Fishery

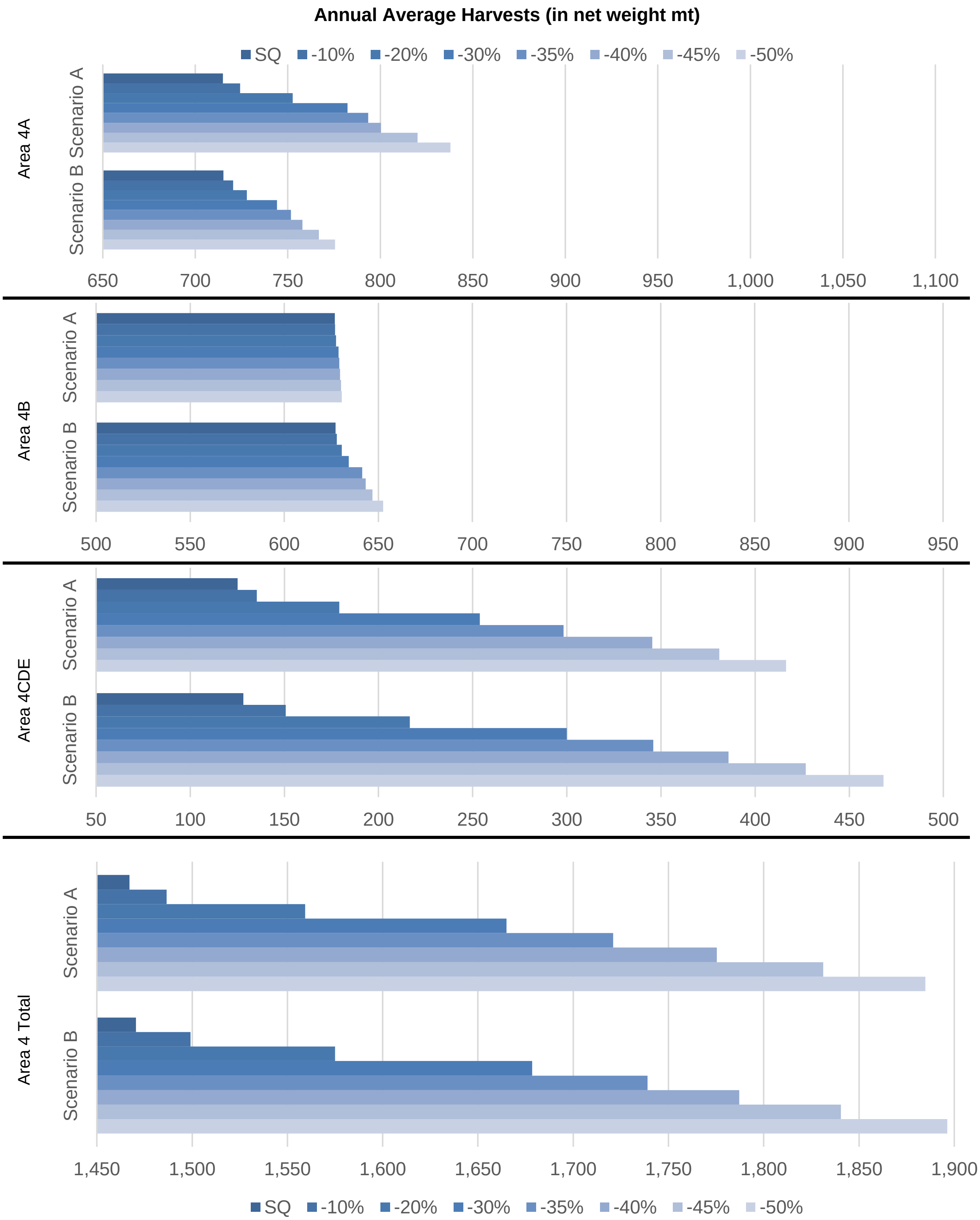
For ease of use, the commercial halibut fishery harvest portions of the overall summary table for Option 1 on page 286 above (Table 4-127) are reproduced below in Table 4-135. With the proposed PSC limit reductions for the A80-CPs, it is projected that the entire Area 4 halibut fishery could realize an increase in annual average harvest volumes by up to 29 percent if option 1g were chosen. Under that option, projected increases to harvest volumes in Area 4CDE would be expected to range between 232 and 265 percent of status quo levels. As noted in the discussion on page 287, the relationship between reductions in PSC from A80-CPs (as measured in round weight mt) and increases in O26 halibut harvest (measured in net weight mt) can be approximated by a 2 to 1 ratio. In other words, for every 100 mt (net weight) increase in harvests in the commercial halibut fishery, a decrease in PSC of by A80-CPs of approximately 200 mt (round weight) is required.

Table 4-134 Summary of Commercial Halibut Harvest Impacts under Option 1

	Commercial Halibut Fishery Impacts							
	Scenario A				Scenario B			
	4A	4B	4CDE	Area 4	4A	4B	4CDE	Area 4
Option	Average Annual Change from the Status Quo in Commercial Halibut Harvest (NW mt)							
Status Quo	714.9	626.9	125.2	1,467.1	715.2	627.2	128.2	1,470.6
1a: -10%	21.7	0.1	10.2	32.0	17.8	0.7	22.6	41.1
1b: -20%	50.1	0.6	54.0	104.7	25.2	3.3	88.5	116.9
1c: -30%	79.8	2.0	128.6	210.4	41.5	7.0	171.9	220.4
1d: -35%	90.9	2.4	173.1	266.4	49.0	14.1	217.7	280.9
1e: -40%	97.9	2.7	220.1	320.7	55.3	16.1	257.8	329.1
1f: -45%	117.6	3.3	255.8	376.7	64.1	19.6	298.7	382.5
1g: -50%	135.4	3.6	291.2	430.2	72.9	25.3	340.1	438.2

Figure 4-74, on the following page, summarizes harvest impacts in in Area 4 graphically—the figure shows annual average harvests under the status quo and the annual average harvests under the "change" case—noting the change in annual harvests shown in Table 4-134 is calculated by subtracting status quo harvests from the Change Case. It should be noted that in the figure, the horizontal scale for each Area is shown in increments of 50 net weight mt, but that the starting point for each is set at levels that are appropriate for each area. Because all areas use the same scale, it is easier to compare impact across areas.

Figure 4-74 Projected Annual Halibut Average Harvests (in net weight mt) under Option 1



Note: The figure does not include increases in harvests that could result from PSC Limit reductions in other groundfish fisheries.

Revenue Impacts to the Commercial Halibut Fishery

In this section we provide additional details regarding the wholesale revenue impacts to the commercial halibut fishery that are projected to occur with PSC limit reductions imposed on A80-CPs. For ease of use, the wholesale revenues from the commercial halibut fishery that were reported in the overall summary table for Option 1 on page 286 (Table 4-127) are reproduced below in Table 4-135. As indicated earlier, the numbers in the table represent the sum of wholesale revenues over the 10-year future period under the status quo (discounted to present values), and for each PSC limit reduction option, the changes in wholesale revenues over the 10-year future period, again discounted to present values. In general, the wholesale revenue impacts increase in approximately the same proportions as changes in halibut harvests.

Table 4-135 Summary of Wholesale Revenue Impacts of Option 1 to the Commercial Halibut Fishery

	10-year Sum of Status Quo Future Wholesale Revenues Discounted to Present Values and Projected Changes to Wholesale Revenues under the Options in 2013 $millions							
	Scenario A				Scenario B			
Option	4A	4B	4CDE	Area 4	4A	4B	4CDE	Area 4
Status Quo	$171.2	$149.8	$28.9	$349.8	$171.2	$149.8	$29.5	$350.5
1.a: -10%	$5.9	$0.0	$2.4	$8.3	$5.0	$0.2	$5.3	$10.5
1.b: -20%	$12.6	$0.1	$12.7	$25.4	$6.7	$0.8	$20.9	$28.3
1.c: -30%	$19.6	$0.4	$30.3	$50.3	$10.5	$1.6	$40.6	$52.7
1.d: -35%	$22.2	$0.5	$40.8	$63.5	$12.3	$3.3	$51.3	$66.8
1.e: -40%	$23.8	$0.6	$51.9	$76.2	$13.8	$3.7	$60.9	$78.4
1.f: -45%	$28.5	$0.7	$60.3	$89.5	$15.8	$4.6	$70.4	$90.7
1.g: -50%	$32.7	$0.8	$68.8	$102.3	$17.9	$5.9	$80.2	$103.9

Table 4-136 provides a slightly different perspective on the revenue impacts to the commercial halibut fishery. In this case, the first column shows the future value (discounted to present values) of the status quo for each of the 10 future years as an average over the 10,000 iterations run under the IMS Model. Columns to the right of the status quo show the changes relative to that status quo that can be expected under the specific options. The bottom line shows the average annual change over all of the years and over all of the iterations. A similar table is provided on the next page that shows discounted average annual wholesale revenues for each future year under Option 1 for Areas 4A, 4B and 4CDE.

Table 4-136 Discounted Average Annual Halibut Wholesale Revenues ($ million) for Each Future Year under Option 1 for Total Area 4

	Status Quo	1a):-10%	1b):-20%	1c):-30%	1d):-35%	1e): -40%	1f): -45%	1g): -50%
Year	Scenario A - B	Scenario A - B	Scenario A - B	Scenario A - B	Scenario A - B	Scenario A - B	Scenario A - B	Scenario A - B
Area 4 Total								
2014	$45.8 to $45.7	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0
2015	$38.9 to $39.0	$1.2 to $1.6	$5.0 to $5.6	$10.5 to $11.0	$13.4 to $14.2	$16.3 to $16.8	$19.3 to $19.5	$22.1 to $22.5
2016	$39.8 to $39.9	$0.5 to $0.7	$2.4 to $2.8	$5.4 to $5.7	$6.8 to $7.2	$8.3 to $8.6	$9.9 to $10.0	$11.4 to $11.5
2017	$37.6 to $37.7	$0.5 to $0.7	$2.3 to $2.6	$4.9 to $5.1	$6.3 to $6.7	$7.6 to $7.9	$9.0 to $9.2	$10.5 to $10.6
2018	$35.6 to $35.6	$0.5 to $0.6	$2.2 to $2.5	$4.7 to $4.9	$6.0 to $6.4	$7.3 to $7.5	$8.6 to $8.7	$9.9 to $10.0
2019	$33.7 to $33.7	$0.4 to $0.6	$2.1 to $2.3	$4.5 to $4.7	$5.8 to $6.1	$6.9 to $7.2	$8.3 to $8.3	$9.5 to $9.6
2020	$31.8 to $32.0	$0.4 to $0.6	$2.0 to $2.3	$4.3 to $4.5	$5.5 to $5.9	$6.7 to $6.9	$7.9 to $8.1	$9.1 to $9.3
2021	$30.3 to $30.4	$0.4 to $0.6	$2.0 to $2.2	$4.2 to $4.4	$5.5 to $5.7	$6.6 to $6.7	$7.8 to $7.8	$8.9 to $9.1
2022	$28.9 to $28.9	$0.4 to $0.6	$1.9 to $2.2	$4.1 to $4.3	$5.4 to $5.6	$6.4 to $6.6	$7.6 to $7.8	$8.7 to $8.9
2023	$27.3 to $27.4	$0.4 to $0.6	$1.8 to $2.1	$4.0 to $4.3	$5.1 to $5.4	$6.3 to $6.4	$7.4 to $7.5	$8.5 to $8.7
Average	$35.0 to $35.0	$0.5 to $0.7	$2.2 to $2.5	$4.7 to $4.9	$6.0 to $6.3	$7.3 to $7.5	$8.6 to $8.7	$9.9 to $10.0

Table 4-137 Discounted Average Annual Halibut Wholesale Revenues ($ million) under Halibut PSC Reductions Options for A80-CPs, Area 4A-E

	Status Quo	1a):-10%	1b):-20%	1c):-30%	1d):-35%	1e): -40%	1f): -45%	1g): -50%
Year	Scenario A - B	Scenario A - B	Scenario A - B	Scenario A - B	Scenario A - B	Scenario A - B	Scenario A - B	Scenario A - B
Area 4A								
2014	$25.4 to $25.4	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0
2015	$19.1 to $19.1	$0.6 to $0.4	$2.1 to $0.8	$3.7 to $1.6	$4.2 to $2.0	$4.6 to $2.3	$5.7 to $2.7	$6.6 to $3.2
2016	$18.9 to $19.0	$0.2 to $0.1	$1.0 to $0.3	$1.9 to $0.8	$2.1 to $0.9	$2.3 to $1.1	$2.8 to $1.4	$3.3 to $1.6
2017	$18.0 to $18.0	$0.2 to $0.1	$0.9 to $0.3	$1.7 to $0.7	$1.9 to $0.9	$2.1 to $1.0	$2.6 to $1.2	$3.1 to $1.4
2018	$17.0 to $16.9	$0.2 to $0.1	$0.9 to $0.3	$1.6 to $0.7	$1.8 to $0.8	$2.0 to $1.0	$2.4 to $1.2	$2.9 to $1.4
2019	$16.1 to $16.1	$0.2 to $0.1	$0.8 to $0.3	$1.5 to $0.6	$1.8 to $0.8	$1.9 to $0.9	$2.4 to $1.1	$2.8 to $1.3
2020	$15.3 to $15.3	$0.2 to $0.1	$0.8 to $0.3	$1.5 to $0.6	$1.7 to $0.8	$1.9 to $0.9	$2.3 to $1.1	$2.7 to $1.3
2021	$14.5 to $14.5	$0.2 to $0.1	$0.8 to $0.3	$1.4 to $0.6	$1.7 to $0.8	$1.8 to $0.9	$2.2 to $1.1	$2.6 to $1.3
2022	$13.8 to $13.8	$0.2 to $0.1	$0.8 to $0.3	$1.4 to $0.6	$1.6 to $0.8	$1.8 to $1.0	$2.2 to $1.1	$2.6 to $1.3
2023	$13.1 to $13.1	$0.2 to $0.1	$0.7 to $0.3	$1.3 to $0.6	$1.6 to $0.8	$1.8 to $1.0	$2.1 to $1.1	$2.5 to $1.3
Average	$17.1 to $17.1	$0.2 to $0.1	$0.9 to $0.3	$1.6 to $0.7	$1.8 to $0.9	$2.0 to $1.0	$2.5 to $1.2	$2.9 to $1.4
Area 4B								
2014	$20.5 to $20.4	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0
2015	$17.1 to $17.2	$0.0 to $0.0	$0.0 to $0.1	$0.0 to $0.3	$0.0 to $0.7	$0.0 to $0.8	$0.0 to $0.9	$0.1 to $1.2
2016	$16.8 to $16.8	$0.0 to $0.0	$0.0 to $0.1	$0.0 to $0.2	$0.0 to $0.3	$0.0 to $0.4	$0.0 to $0.5	$0.0 to $0.6
2017	$15.9 to $15.9	$0.0 to $0.0	$0.0 to $0.1	$0.0 to $0.1	$0.0 to $0.3	$0.0 to $0.4	$0.0 to $0.4	$0.0 to $0.6
2018	$15.0 to $15.0	$0.0 to $0.0	$0.0 to $0.1	$0.0 to $0.1	$0.0 to $0.3	$0.0 to $0.3	$0.0 to $0.4	$0.0 to $0.6
2019	$14.3 to $14.3	$0.0 to $0.0	$0.0 to $0.1	$0.0 to $0.1	$0.0 to $0.3	$0.0 to $0.3	$0.0 to $0.4	$0.0 to $0.5
2020	$13.5 to $13.6	$0.0 to $0.0	$0.0 to $0.1	$0.0 to $0.2	$0.1 to $0.3	$0.1 to $0.4	$0.1 to $0.4	$0.1 to $0.5
2021	$12.9 to $12.9	$0.0 to $0.0	$0.0 to $0.1	$0.1 to $0.2	$0.1 to $0.3	$0.1 to $0.4	$0.1 to $0.5	$0.1 to $0.6
2022	$12.2 to $12.2	$0.0 to $0.0	$0.0 to $0.1	$0.1 to $0.2	$0.1 to $0.3	$0.1 to $0.4	$0.2 to $0.5	$0.2 to $0.6
2023	$11.6 to $11.6	$0.0 to $0.0	$0.0 to $0.1	$0.1 to $0.2	$0.1 to $0.4	$0.2 to $0.4	$0.2 to $0.5	$0.2 to $0.6
Average	$15.0 to $15.0	$0.0 to $0.0	$0.0 to $0.1	$0.0 to $0.2	$0.1 to $0.3	$0.1 to $0.4	$0.1 to $0.5	$0.1 to $0.6
Area 4CDE								
2014	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0
2015	$2.7 to $2.8	$0.6 to $1.2	$2.9 to $4.7	$6.8 to $9.1	$9.2 to $11.5	$11.7 to $13.7	$13.6 to $15.8	$15.5 to $18.1
2016	$4.1 to $4.2	$0.2 to $0.6	$1.4 to $2.4	$3.5 to $4.8	$4.6 to $5.9	$6.0 to $7.1	$7.0 to $8.2	$8.0 to $9.3
2017	$3.7 to $3.8	$0.3 to $0.6	$1.4 to $2.3	$3.3 to $4.3	$4.3 to $5.5	$5.5 to $6.5	$6.4 to $7.5	$7.4 to $8.6
2018	$3.5 to $3.6	$0.2 to $0.5	$1.3 to $2.1	$3.1 to $4.1	$4.1 to $5.2	$5.3 to $6.2	$6.1 to $7.2	$7.0 to $8.1
2019	$3.3 to $3.3	$0.2 to $0.5	$1.3 to $2.0	$3.0 to $4.0	$4.0 to $5.0	$5.0 to $5.9	$5.9 to $6.8	$6.7 to $7.8
2020	$3.0 to $3.1	$0.2 to $0.5	$1.2 to $2.0	$2.8 to $3.8	$3.8 to $4.8	$4.8 to $5.7	$5.6 to $6.6	$6.4 to $7.5
2021	$3.0 to $3.0	$0.2 to $0.5	$1.2 to $1.9	$2.7 to $3.6	$3.7 to $4.6	$4.7 to $5.5	$5.5 to $6.3	$6.2 to $7.2
2022	$2.8 to $2.9	$0.2 to $0.5	$1.1 to $1.8	$2.6 to $3.5	$3.6 to $4.5	$4.5 to $5.3	$5.2 to $6.1	$6.0 to $7.0
2023	$2.6 to $2.7	$0.2 to $0.4	$1.1 to $1.8	$2.5 to $3.4	$3.4 to $4.3	$4.4 to $5.1	$5.1 to $5.9	$5.7 to $6.7
Average	$2.9 to $3.0	$0.2 to $0.5	$1.3 to $2.1	$3.0 to $4.1	$4.1 to $5.1	$5.2 to $6.1	$6.0 to $7.0	$6.9 to $8.0

Yield Increases to Commercial Halibut Fishery Resulting from U26 Savings

This section summarizes the future yield increases that are projected to result from savings of U26 fish when PSC by A80-CPs is reduced under Option 1. As described within Section 4.6.1.3, PSC reductions generate near-term yield increases due to savings of O26 fish and longer term yield increases due to savings of U26 fish. The near-term increases are realized only in the IPHC area in which the savings occurred, but the long-term yield increases due to U26 saving are assumed to be distributed coastwide in proportion to the distribution of biomass. If halibut PSC is reduced by 100 round weight mt and 60 percent of the savings are O26 fish, then the IMS Model assumes that a total of 30 net weight mt (30 net weight mt is the equivalent of 40 round weight mt) will be added to FCEYs in proportion to the overall distribution of biomass (see Table 4-100). The increased yield is expected to enter the fishery five full years after the saving of the U26 fish occurred. Thus, the IMS Model assumes that if PSC limits cuts are first implemented in 2014, then U26 fish will begin adding to FCEYs in 2019, and they will continue to add to yields for a period of seven years through 2024.

Table 4-138 summarizes the future yield impact in terms of harvest increases (in the left half of the table) and increases in future wholesale revenues (in the right half) that are expected to result from the suboptions (shown in the rows) for Option 1, which would reduce PSC limit for A80-CPs. Each half of the table shows impacts for three separate geographic areas and coastwide:

- Area 4 impacts (already included in previous results)
- Other AK impacts which include impacts in Area 2C, 3A and 3B
- External impacts are those that accrue outside of Alaska in British Columbia (Area 2B) or on the U.S. West Coast (Area 2A).

We also note that because yield increases do not start to appear until 2019, the annual average yield changes shown in the table are averages over five years rather than over the entire 10-year future period. Wholesale revenues (discounted to present values), on the other hand, are summed over the entire 10-year future period.

As seen in the table, Area 4 is projected to realize approximately 22 percent of the additional yield, Other Alaska is expected to realize approximately 65 percent of the added yield, and areas external to Alaska are expected to realize approximately 13 percent. We note here (as was discussed in Section 4.6.3) that the IMS Model assumes that increases are distributed to IPHC areas based on the biomass distribution estimated by the IPHC for the particular basis year in which the increased yield was realized.[52] Over all areas coastwide, the increased yield under Option 1g, which would reduce PSC limits for the A80-CPs by 50 percent, is projected to average from 103 to 105 net weight mt over the years 2019 to 2023. The sum of resulting wholesale revenues over the entire period (discounted to present values) is projected to range from $9.7 to $9.9 million.

Table 4-138 Summary of Future U26-based Yield Impacts in Area 4 and in Other Areas Outside of Area 4 under Option 1

Option	Area 4 Scen A - B	Other AK Scen A - B	External Scen A - B	Total U26 Coastwide Scen A - B	Area 4 Scen A - B	Other AK Scen A - B	External Scen A - B	Total U26 Coastwide Scen A - B
	Mean Annual Increase in Catch (net weight mt) over Last Half of the 10-year Future Period				Increased DPV of Wholesale Revenue (2013 millions) over 10-Year Future Period			
1a: -10%	1.0 - 1.5	3.0 - 4.4	0.6 - 0.9	4.7 - 6.9	$0.10 - $0.15	$0.28 - $0.41	$0.06 - $0.09	$0.44 - $0.65
1b: -20%	5.0 - 5.6	14.4 - 16.2	2.8 - 3.2	22.2 - 25.0	$0.50 - $0.56	$1.32 - $1.48	$0.28 - $0.31	$2.10 - $2.36
1c: -30%	10.8 - 11.4	31.3 - 32.8	6.2 - 6.5	48.3 - 50.6	$1.08 - $1.13	$2.87 - $3.00	$0.61 - $0.64	$4.56 - $4.77
1d: -35%	13.9 - 14.7	40.3 - 42.6	7.9 - 8.4	62.2 - 65.7	$1.39 - $1.47	$3.69 - $3.89	$0.78 - $0.83	$5.86 - $6.19
1e: -40%	17.0 - 17.4	49.1 - 50.4	9.7 - 9.9	75.7 - 77.8	$1.70 - $1.74	$4.49 - $4.61	$0.95 - $0.98	$7.13 - $7.33
1f: -45%	20.1 - 20.4	58.0 - 59.0	11.4 - 11.6	89.5 - 91.0	$2.01 - $2.04	$5.31 - $5.40	$1.13 - $1.14	$8.44 - $8.58
1g: -50%	23.0 - 23.5	66.7 - 67.9	13.1 - 13.4	102.8 - 104.7	$2.30 - $2.34	$6.09 - $6.21	$1.29 - $1.32	$9.69 - $9.88

Note: Yield increases and increases in wholesale revenues that accrue to Area 4 have already been included in all of the results described in earlier tables and figures.

4.8.2 Qualitative Assessment of the Impacts of Option 1 Suboption 2, Addressing Amendment 80 Limited Access Fisheries

At its February 2015 meeting, the Council added an option that would reduce PSC limits for A80-CPs operating in a limited access fishery by 60 percent. Under Amendment 80, individual vessels can choose to operate outside of an official cooperative in an A80 limited access fishery. In such cases, the vessels bring

[52] As noted in Section 4.6.3, the assumption to link increases in yield to the basis year in which yield was realized may be revisited.

with them the catch histories and halibut PSC apportionments that were assigned to them under the final rule. This option would have the effect of reducing the halibut PSC apportionment vessels bring to a limited access fishery by 60 percent from what could be brought to a limited access fishery under the status quo. While it is clear that a 60 percent reduction in the overall PSC limit for A80-CPs would reduce the overall limit to 930 mt, there isn't any way to know in advance which, if any, vessels will choose to enter the A80 limited access fishery and therefore how much of the Status Quo PSC will be included.

There are some precedents available that may shed light on how much PSC might be brought into a limited access fishery. During the first three years of A80, all of the vessels owned by Fishing Company of Alaska along with a few other smaller A80-CPs chose to participate in the limited access fishery. Since 2011, FCA has been the principal company in the Alaska Groundfish Cooperative. As required in A80, NMFS issued specific PSC amounts to the limited access fishery from 2008 to 2010; it also issued specific a PSC amount for the vessels in the cooperative—then known as the Best Use Cooperative, which now operates as the Alaska Seafood Cooperative. Since 2011, NMFS has issued separate halibut PSC limits to both cooperatives. These PSC limits were reported in Table 4-19 on page 148. That table is reproduced below and will serve as a guide to the qualitative assessment of this option.

Table 4-139 Halibut PSC Limits and Apportionments for A80-CPs, 2008 to 2013

	2008	2009	2010	2011	2012	2013
	Halibut PSC Mortality Limit (in Round Weight mt)					
All A80-CPs Combined	**2,525**	**2,475**	**2,425 / 2,765**	**2,375**	**2,325**	**2,325**
Amendment 80 Limited Access Fishery	688	682	671	-	-	-
Best Use Cooperative/Alaska Seafood Cooperative	1,837	1,793	1,754 / 2,094	1,643	1,609	1,609
Alaska Groundfish Cooperative	-	-	-	732	716	716

Note: In 2010, the A80 cooperative received a 340 mt re-apportionment of PSC from the BSAI TLA Fisheries.
Source: Developed by Northern Economics using data from NMFS (2014f)

- If it is assumed that the same vessels that participated in the A80 limited access fishery from 2008 through 2010, revert back to an A80 limited access fishery, the reduced PSC limits for the limited access fishery under this option would average 255 mt, noting that these estimates have been adjusted to overall PSC levels that are currently in place. This would represent a PSC limit reduction relative to the status quo averaging 383 mt.
- If it is assumed that all of the vessels that have been members of the Alaska Seafood Cooperative or its predecessor decide to disband in favor of an A80 limited access fishery, then the reduced PSC limits would average 659 mt—a PSC limit reduction relative to the status quo of 965 mt.
- If it is assumed that the vessels that have been members of the Alaska Groundfish Cooperative all decide to participate in an A80 limited access fishery, then their PSC limit would be 286.5 mt, which would represent a limit reduction relative to the status quo of 430 round weight mt.

Given these levels of PSC limits, it appears that the negative consequences of operating in an A80 limited access fishery would outweigh any foreseeable benefits. While it appears unlikely that vessels would voluntarily leave a cooperative to participate in the A80 limited access fishery under the status quo, Council approval of this option under Alternative 2 could provide incentives for vessels to continue to operate as part of a cooperative and avoid the additional PSC limit reduction for the Amendment 80 limited access fishery.

4.9 Option 2, Alternative 2: Analysis of Impacts of Options Affecting the BSAI Trawl Limited Access Fisheries

In this section we summarize the impacts of proposed reductions of halibut PSC limits for the BSAI TLA target fisheries as specified under Option 2. Four suboptions are specified as follows.

- Option 2.1: Reduce the BSAI TLA PSC limit by 10 percent to 787.5 mt.
- Option 2.2: Reduce the BSAI TLA PSC limit by 20 percent to 700 mt.
- Option 2.3: Reduce the BSAI TLA PSC limit by 30 percent to 612.5 mt.
- Option 2.4: Reduce the BSAI TLA PSC limit by 35 percent to 568.8 mt.
- Option 2.5: Reduce the BSAI TLA PSC limit by 40 percent to 525 mt
- Option 2.6: Reduce the BSAI TLA PSC limit by 45 percent to 481.3 mt
- Option 2.7: Reduce the BSAI TLA PSC limit by 50 percent 437.5 mt

A summary of methodological issues relevant to the vessels operating in BSAI TLA fisheries is provided below. The methodology discussion is followed by an overview of impacts to both the groundfish participants and the commercial halibut fishery, which in turn is followed by two separate sections that describe in more detail the impacts to the groundfish fisheries, and the impacts to the halibut fishery.

Methodological Issues Relevant to the Options to Reduce PSC Limits in BSAI TLA Fisheries

The PSC Limit for BSAI TLA fisheries is currently apportioned in the annual specification process to four targets groups: 1) yellowfin sole, rockfish, Pacific cod, and the Pollock|Atka Mackerel|Other target group. As discussed in Section 2.1 and later in the IMS Model assumption recap, the Pollock|Atka Mackerel|Other apportionment is unique, because it is not a fully binding constraint. If the PSC limit is reached, fishing for Atka mackerel and “Other species” is prohibited, but vessels may continue to fish for mid-water pollock.[53] Since 2008, less than $22 million has been generated in the BSAI TLA fisheries for Atka mackerel compared to over $7 billion in pollock.

It should be noted that in the status quo IMS Model runs, PSC limits are set equal to the apportionment for the target fishery identified in the Basis Year. In other words, if 2008 is drawn as the Basis Year, the PSC apportionments for yellowfin sole, Pacific cod, rockfish and Pollock|Atka Mackerel|Other from that Basis Year will be used in the IMS Model. As noted in IMS Model Assumption # 49, target fishery specific PSC limits are strictly enforced, there are no within-year transfers of PSC limits—from Pacific cod to yellowfin sole for example. While the IMS Model strictly enforces the target-specific apportionments and doesn’t permit internal transfers, the mid-water pollock fishery is allowed to continue even after the Pollock|Atka Mackerel|Other Species PSC limit has been taken.

We also note here that an exception to the assumption of strict enforcement has been made with respect to the BSAI Atka Mackerel fishery under Scenario A.

It must also be noted that there are weeks when BSAI TLA vessels are designated as participating in target fisheries for which there are no halibut PSC mortality apportionments. For example, the catch of a BSAI

[53] In a conversation with NMFS in May 2015, (Furuness 2015) it was determined that the assertion that *“if the PSC limit for Pollock|Atka Mackerel|Other is reached, fishing for Atka mackerel and “Other species” is prohibited, but vessels may continue to fish for mid-water pollock”* is not correct. According to NMFS the only action that would be taken by NMFS with attainment of the Pollock|Atka Mackerel|Other PSC apportionment is a closure of pollock fishery to bottom trawl gear. However, NMFS already prohibits use of any non-pelagic gear in the BSAI pollock fishery, and therefore no action at all is taken when Pollock|Atka Mackerel|Other apportionment is reached.

TLA vessel for a given week may be assigned to the Greenland turbot target fishery via NMFS' target fishery assignment algorithm, even though there is no specific PSC mortality apportionment against which the halibut PSC mortality should be counted. When this happens during the fishing year, NMFS in-season managers assign the halibut PSC mortality manually to the apportionment they think is most appropriate (Furuness, 2014). In the IMS Model, all halibut PSC mortality assigned to targets for which there are no halibut PSC mortality apportionments have been assigned to the yellowfin sole PSC mortality apportionment.

The strict enforcement of the PSC limits extends to the assessment of the fishery under the status quo, as well as under the proposed PSC limit reduction options. In the IMS Model under the status quo, strict enforcement means that if, in the actual fisheries as they took place during the Basis Years, NMFS had moved halibut from the Pacific cod apportionment to the yellowfin sole fishery, or if NMFS had allowed a target fishery to operate in excess of its specific PSC mortality apportionment, those transfers and exceptions are disallowed in the IMS Model. Thus, total halibut PSC mortality, total catch and total revenue under the status quo for a particular Basis Year may be less than it was during the fishing year.

Table 4-140 summarizes PSC limits for BSAI TLA target fisheries under each Basis Year as they were applied to future years under the IMS Model. The table also includes halibut PSC amounts that were actually taken and allowed under the IMS Model for the status quo, as well as the PSC amounts that were actually taken but disallowed under the IMS Model for the status quo. The amounts that were disallowed are records that, as sorted under catch progression ranking for each scenario, would have pushed the fishery over its PSC apportionment for the year. The disallowed amounts are excluded not only in the status quo, but also for each of the PSC limit reduction options. It should be noted that the all of the disallowed amounts in the Pollock|Atka Mackerel|Other target group, come from the Atka mackerel target fisheries.[54]

[54] As noted in Footnote # 53, NMFS takes no action at all when the PSC apportionment in the Pollock|Atka Mackerel|Other has been reached. Therefore reductions of PSC and groundfish from the Atka mackerel fishery in the status quo and under the PSC limit reduction options were made in error.

Table 4-140 Target-Specific Halibut PSC Limits in the BSAI TLA, as Modelled for Status Quo Basis Years 2008 to 2013

Target Fishery Grop for PSC Apportionment	2008 Scenario A	2008 Scenario B	2009 Scenario A	2009 Scenario B	2010 Scenario A	2010 Scenario B	2011 Scenario A	2011 Scenario B	2012 Scenario A	2012 Scenario B	2013 Scenario A	2013 Scenario B
Target Fishery Apportionments (mt) of the 875 mt Halibut PSC Limit for the BSAI TLA												
Yellowfin Sole	162		187		167		167		167		167	
Rockfish	3		5		5		5		5		5	
Pollock|Atka Mackerel|Other	125		175		250		250		250		250	
Pacific Cod	585		508		453		453		453		453	
All BSAI TLA Fisheries	**875**		**875**		**875**		**875**		**875**		**875**	
Halibut PSC (mt) Included in the IMS Model for the BSAI TLA under the Status Quo for the Basis Years												
Yellowfin Sole	159.7	149.8	145.9	145.9	28.8	28.8	100.5	100.5	160.0	160.0	163.1	166.5
Rockfish	2.0	2.0	2.0	2.0	0.4	0.4	3.5	3.5	0.5	0.5	3.4	3.4
Pollock|Atka Mackerel|Other	272.4	272.4	395.9	395.5	198.0	198.0	291.9	291.3	350.9	345.8	204.6	204.6
Pacific Cod	292.6	292.6	183.0	183.0	257.0	257.0	241.4	241.4	430.1	430.1	308.3	308.3
All BSAI TLA Fisheries	**726.7**	**716.8**	**726.9**	**726.5**	**484.2**	**484.2**	**637.3**	**636.7**	**941.5**	**936.3**	**679.5**	**682.9**
Halibut PSC (mt) for the Basis Years that were Disallowed under the IMS Model for Status Quo												
Yellowfin Sole	8.6	18.5	-	-	-	-	-	-	-	-	27.3	23.9
Rockfish	-	-	-	-	-	-	-	-	-	-	-	-
Pollock|Atka Mackerel|Other	3.3	3.3	-	0.4	-	-	-	0.6	18.5	23.7	-	-
Pacific Cod	-	-	-	-	-	-	-	-	-	-	-	-
All BSAI TLA Fisheries	**12.0**	**21.8**	**-**	**0.4**	**-**	**-**	**-**	**0.6**	**18.5**	**23.7**	**27.3**	**23.9**

Source: Developed by Northern Economics from AKFIN data (Fey 2014) and NMFS (2014f).

The IMS Model assumes that target fishery apportionments of the PSC limit for BSAI TLA fisheries that are currently utilized will continue to be used in the future. Apportionments are made for: a) Pacific cod; b) Yellowfin sole; c) Rockfish; and d) Pollock|AtkaM|Other. The IMS model also assumes that the pollock target fishery remains exempt from closure due to attainment of the PSC limit, but that the Atka mackerel fishery within the Pollock|AtkaM|Other is constrained by the PSC Limit.

Under both Scenarios (A and B) for the BSAI TLA fisheries, it is assumed that the PSC apportionment for the rockfish target fisheries, because of its very small size, is not cut and remains at the levels assigned to it during the Basis Year regardless of the size of the PSC limit reductions—since 2009 only 5 mt of the 876 PSC limit for the BSAI TLA fisheries have been apportioned to rockfish target fisheries. Maintaining the rockfish PSC apportionment at its status quo level during each basis year means that the other BSAI PSC apportionments must be reduced by a slightly higher percentage than the actual PSC limit cut percent under the option. An example of this calculation is shown below for the yellowfin sole fishery using the limits in place in 2013, as shown in Table 4-140, for a 20 percent PSC limit reduction (i.e. Option 2b).

For yellowfin sole, the PSC limit when 2013 is the basis year equals 167 mt. Under Scenario A for Option 2b), the YSOL PSC limit is calculated with the following steps:

1) Calculate the yellowfin sole PSC limit as a percentage of the status quo limit after it is reduced by the 5 mt rockfish PSC limit: 167 ÷ (876 – 5) = 19.174%
2) Calculate the total BSAI TLA limit under the option 2b): 876 × (1 – 0.2) = 700.8 mt.
3) Reduce the new BSAI TLA limit by the 5 mt rockfish limit: 700.8 – 5 = 695.8
4) Multiply the remaining total by the yellowfin sole percentage: 695.8 × 19.174 = 133.4

5) In the end the yellowfin sole PSC limit for Scenario A under Option 2b is 133.4 mt, a reduction of 20.11%

Similar calculations are undertaken for the new Pacific cod limit (362.3 mt) and for the new Pollock|AtkaM|Other limit (200.1 mt). In addition to the assumption that the Rockfish PSC limit is maintained at status-quo level for each basis year, the following assumptions are made for Scenario A:

- The yellowfin sole fishery is assumed to be rationalized. Fishery participants are assumed to use an independent contractor to help them determine the order in which months and NMFS areas should be placed off limits in order for the vessels in the target fishery to reduce their PSC to the new lower limit, while mitigating as much as possible the negative revenue impacts of the cuts in groundfish harvests.
- Because of the large number and the wide variety of vessel types participating in the Pacific cod fishery, it is assumed be a race for fish, and PSC reductions by cutting groundfish are achieved in a last-caught, first-cut methodology.
- Under Scenario A, vessels that target Atka mackerel within the PSC apportionment for Pollock|AtkaM|Other are assumed to continue to be constrained by time/area closures. In the A-Season, the IMS Model assumes they monitor the accumulating levels of PSC in the pollock target fishery and time their fishing efforts so as not to be constrained by A-season PSC. At the beginning of the B-season, if the pollock fishery has not yet reached its PSC limit (which closes the Atka mackerel fishery,[55] but not the pollock fishery), the IMS Model assumes that Atka mackerel vessels fish as soon as possible to avoid being closed out by PSC in the pollock fishery.
- Scenario A will have relatively low overall impacts because PSC apportionment for the pollock fishery will be reduced even though the pollock fishery will continue to be unconstrained and by assumption taking the same amount of PSC as was taken in each Basis Year.

The impacts to the BSAI TLA fleet under Scenario A for yellowfin sole fishery are demonstrated in Figure 4-75. The figure contains a catch progression line developed using a target-area-month ranking that is attainable if the fishery is assumed to be rationalized. For comparison, a “perfect knowledge” progression is also shown. The figure shows the 2012 base year—just one of the six base years for the target fishery that are used in the model runs. Similar figures for other years or for Scenario B are not provided for the BSAI TLA yellowfin sole fishery because of confidentiality concerns. In the figure, it is clear that the cuts are being made in target-area-month combinations that are producing relatively low levels of wholesale revenues per ton of PSC. For example, Option 2c with a 30 percent reduction cuts approximately 80 mt of PSC at a cost of $5 million in wholesale revenue. Moving to a 50 percent limit cut removes 30 additional mt of PSC and cuts and additional $5 million in wholesale revenues.

[55] As noted in footnote #53 this is an incorrect statement. In fact NMS takes no action when the PSC limit for Pollock|Atka Mackerel|Other fisheries is reached. This means that the IMS Model should not have closed the Atka mackerel fishery due to PSC under the status or under any of the option. The primary implication of this error is that negative impacts of the options to the BSAI TLA are slightly reduced, and that the status quo harvests in the Area 4B commercial halibut fishery should be slightly lower (2 net weight mt in an average year) than modelled.

Figure 4-75 A Demonstration of the Scenario A PSC Reductions for Yellowfin Sole in the 2012 Base Year

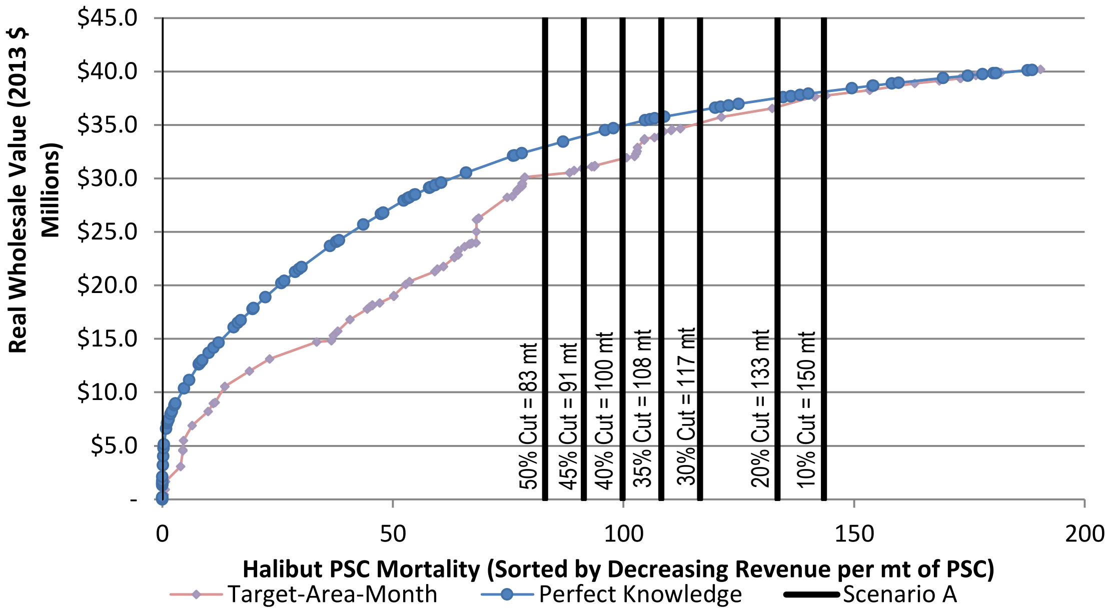


Figure 4-76 provides a demonstration of the differences under Scenario A and Scenario B for the BSAI TLA Pacific cod target fishery using 2012 as the basis year. The Pacific cod fishery is assumed to be a race for fish under both Scenario A and Scenario B, and therefore the catch progression lines are identical in the both the upper and lower figure. Note also that the horizontal axis is the same in both charts, as are the vertical axes. In fact, the only difference in the two figures is the placement along the horizontal of the PCS limits. Under Scenario A, it is assumed that all three of the major PSC apportionments (Pacific cod, yellowfin sole, and Pollock|AtkaM|Other) are reduced proportionally. Under Scenario B, however, the status quo Pollock|AtkaM|Other apportionment, like rockfish, is maintained at Basis Year levels. The reasoning behind this assumption is that because the pollock fishery is not constrained by its limit, a reduction in the limit has no real impact with respect to reducing PSC in the BSAI TLA fisheries. Therefore, in order to achieve the goal of the limit reduction options—i.e. to reduce halibut PSC—further reductions are imposed on the Pacific cod and yellowfin sole target fisheries.

In the figure, a 30 percent cut in the limit under Scenario A, reduces PSC from 428 mt down to 312 mt with a corresponding reduction in wholesale revenues from $74 million down to $50 million. Under Scenario B, the 30 percent reduction option results in a 168 mt PSC cut (down to 260 mt) and a $29 million cut in wholesale revenues down to $45 million. In both Scenarios, the PSC limit reduction generates relatively high levels of impact, particularly when compared to the optimal reduction that assumes perfect knowledge. If the Pacific cod fishery were rationalized, it appears that it would be better able to mitigate the costs of PSC reduction through behavioral changes.

Figure 4-76 Comparison of Impacts under Scenario A and B for BSAI TLA Pacific Cod, using 2012 as the Basis Year

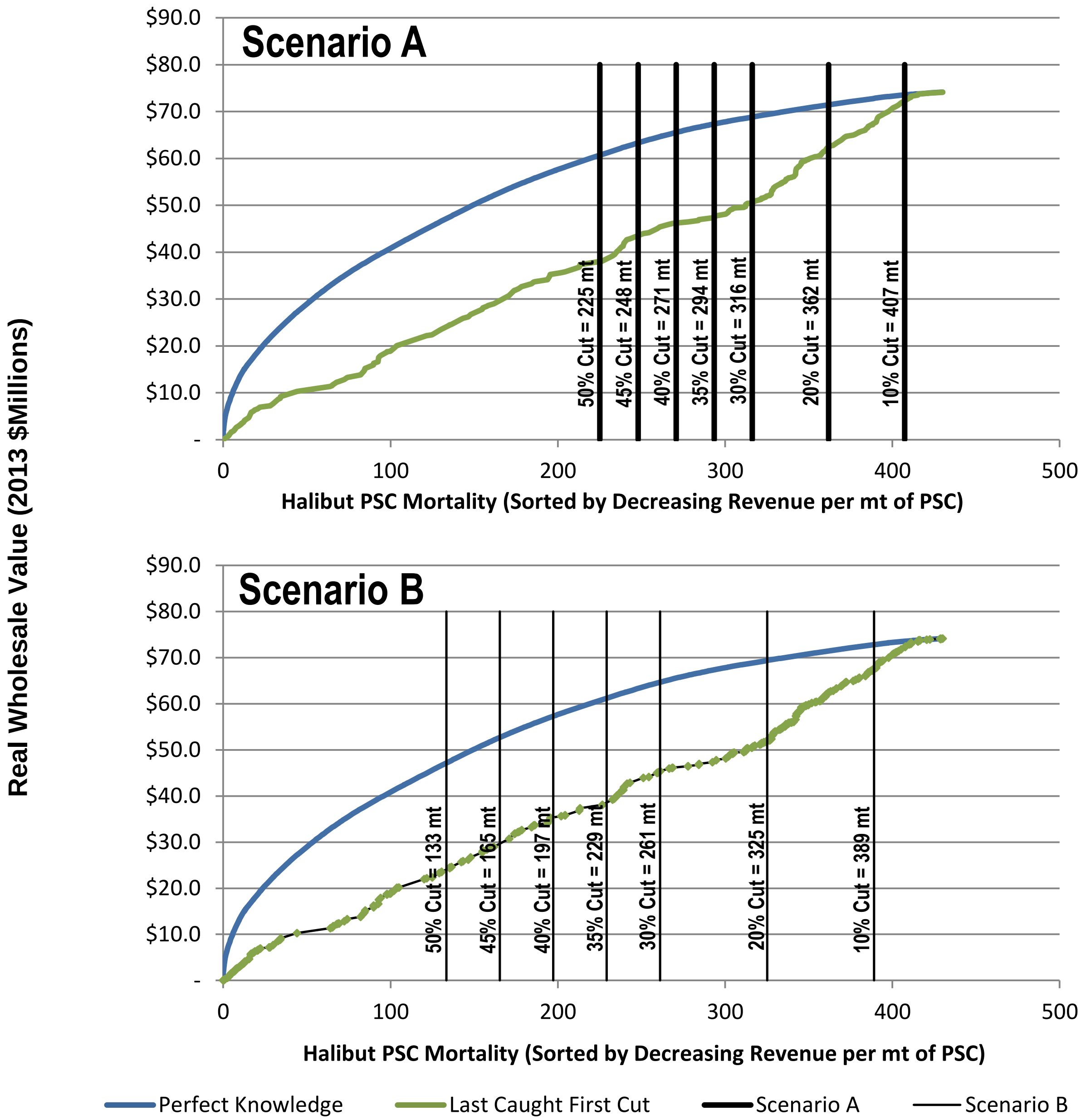


Table 4-141 shows the full suite of BSAI TLA target fishery PSC apportionments that are assumed in the IMS Model under Scenario A and Scenario B by Basis Year. It is apparent in the table that the rockfish PSC apportionment is unchanged relative to the status quo over all Options for each Basis Year. The fact that the PSC apportionment for Pollock|Atka Mackerel|Other (in the table abbreviated to Pollock|AtkaM.) is unchanged in Scenario B relative to its Basis Year value in the Status Quo is also apparent.

Table 4-141 BSAI Target Fishery PSC Apportionments by Scenario and Basis Year

		Option	2a): – 10%		2b): – 20%		2c): – 30%		2d): – 35%		2e): – 40%		2f): – 45%		2g): – 50%	
			Scenario		Scenario		Scenario		Scenario		Scenario		Scenario		Scenario	
Basis Year	Target Fishery	Status Quo	A	B	A	B	A	B	A	B	A	B	A	B	A	B
			All Target Fishery PSC Apportionments are Shown in Round Weight MT													
2008	Pacific Cod	585.0	526.3	516.5	467.6	448.0	408.9	379.4	379.5	345.2	350.2	310.9	320.8	276.6	291.5	242.4
2009	Pacific Cod	508.0	456.9	444.0	405.8	380.1	354.7	316.1	329.2	284.2	303.6	252.2	278.1	220.2	252.5	188.2
2010	Pacific Cod	453.0	407.4	389.1	361.9	325.1	316.3	261.2	293.5	229.2	270.8	197.3	248.0	165.3	225.2	133.3
2011	Pacific Cod	453.0	407.4	389.1	361.9	325.1	316.3	261.2	293.5	229.2	270.8	197.3	248.0	165.3	225.2	133.3
2012	Pacific Cod	453.0	407.4	389.1	361.9	325.1	316.3	261.2	293.5	229.2	270.8	197.3	248.0	165.3	225.2	133.3
2013	Pacific Cod	453.0	407.4	389.1	361.9	325.1	316.3	261.2	293.5	229.2	270.8	197.3	248.0	165.3	225.2	133.3
2008	Pollock|Atka M.	125.0	112.5	125.0	99.9	125.0	87.4	125.0	81.1	125.0	74.8	125.0	68.6	125.0	62.3	125.0
2009	Pollock|Atka M.	175.0	157.4	175.0	139.8	175.0	122.2	175.0	113.4	175.0	104.6	175.0	95.8	175.0	87.0	175.0
2010	Pollock|Atka M.	250.0	224.9	250.0	199.7	250.0	174.6	250.0	162.0	250.0	149.4	250.0	136.9	250.0	124.3	250.0
2011	Pollock|Atka M.	250.0	224.9	250.0	199.7	250.0	174.6	250.0	162.0	250.0	149.4	250.0	136.9	250.0	124.3	250.0
2012	Pollock|Atka M.	250.0	224.9	250.0	199.7	250.0	174.6	250.0	162.0	250.0	149.4	250.0	136.9	250.0	124.3	250.0
2013	Pollock|Atka M.	250.0	224.9	250.0	199.7	250.0	174.6	250.0	162.0	250.0	149.4	250.0	136.9	250.0	124.3	250.0
2008	Rockfish	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
2009	Rockfish	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
2010	Rockfish	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
2011	Rockfish	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
2012	Rockfish	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
2013	Rockfish	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
2008	Yellowfin Sole	162.0	145.7	143.0	129.5	124.0	113.2	105.1	105.1	95.6	97.0	86.1	88.8	76.6	80.7	67.1
2009	Yellowfin Sole	187.0	168.2	163.5	149.4	139.9	130.6	116.4	121.2	104.6	111.8	92.8	102.4	81.1	93.0	69.3
2010	Yellowfin Sole	167.0	150.2	143.4	133.4	119.9	116.6	96.3	108.2	84.5	99.8	72.7	91.4	60.9	83.0	49.2
2011	Yellowfin Sole	167.0	150.2	143.4	133.4	119.9	116.6	96.3	108.2	84.5	99.8	72.7	91.4	60.9	83.0	49.2
2012	Yellowfin Sole	167.0	150.2	143.4	133.4	119.9	116.6	96.3	108.2	84.5	99.8	72.7	91.4	60.9	83.0	49.2
2013	Yellowfin Sole	167.0	150.2	143.4	133.4	119.9	116.6	96.3	108.2	84.5	99.8	72.7	91.4	60.9	83.0	49.2
2008	All Targets	875.0	787.5	787.5	700.0	700.0	612.5	612.5	568.8	568.8	525.0	525.0	481.3	481.3	437.5	437.5
2009	All Targets	875.0	787.5	787.5	700.0	700.0	612.5	612.5	568.8	568.8	525.0	525.0	481.3	481.3	437.5	437.5
2010	All Targets	875.0	787.5	787.5	700.0	700.0	612.5	612.5	568.8	568.8	525.0	525.0	481.3	481.3	437.5	437.5
2011	All Targets	875.0	787.5	787.5	700.0	700.0	612.5	612.5	568.8	568.8	525.0	525.0	481.3	481.3	437.5	437.5
2012	All Targets	875.0	787.5	787.5	700.0	700.0	612.5	612.5	568.8	568.8	525.0	525.0	481.3	481.3	437.5	437.5
2013	All Targets	875.0	787.5	787.5	700.0	700.0	612.5	612.5	568.8	568.8	525.0	525.0	481.3	481.3	437.5	437.5

Note: The Pollock|Atka Mackerel|Other Species PSC Apportionment is abbreviated as Pollock|Atka M.

Table 4-142 below summarizes the projected impacts on PSC and wholesale revenues to Pacific cod fishery in each to the basis years for Scenario A and Scenario B. Table 4-143, on the following page, summarizes impacts for the BSAI TLA yellowfin sole fishery. As an example, a 50 percent limit reduction in the Pacific cod target fishery, under Scenario A in 2013, would decrease PSC and wholesale revenues by 83 mt and $18.8 million respectively. Under scenario B, the same 50 percent PSC reduction would result in a decrease of 176 mt in halibut PSC and $32.2 million in wholesale revenues.

Both Table 4-142 and Table 4-143 reveal that not all options have impacts in every base year. For example, in 2009, there are no impacts in either Scenario A or Scenario B in the Pacific cod target fishery under any option. The same is true for the yellowfin sole fishery in 2010.

Table 4-142 Projected PSC and Wholesale Revenue (2013 $millions) Cuts for the BSAI TLA Pacific Cod Fisheries by Suboption and Scenario for the Basis Years

		2008	2009	2010	2011	2012	2013
Alternative	**Scenario**	**MT Halibut PSC Cut in Each Basis Year**					
Status Quo	Scenario A	-	-	-	-	-	-
	Scenario B	-	-	-	-	-	-
2a: -10%	Scenario A	-	-	-	-	25	-
	Scenario B	-	-	-	-	42	-
2b: -20%	Scenario A	-	-	-	-	68	-
	Scenario B	-	-	-	-	105	-
2c: -30%	Scenario A	-	-	-	-	114	-
	Scenario B	-	-	-	-	169	51
2d: -35%	Scenario A	-	-	-	-	138	16
	Scenario B	-	-	28	12	204	80
2e: -40%	Scenario A	-	-	-	-	162	39
	Scenario B	-	-	60	45	235	112
2f: -45%	Scenario A	-	-	9	-	187	62
	Scenario B	16	-	94	80	268	143
2g: -50%	Scenario A	2	-	32	16	217	83
	Scenario B	51	-	124	109	300	176
		Real Wholesale Revenues ($2013 millions) Cut in Each Basis Year					
Status Quo	Scenario A	-	-	-	-	-	-
	Scenario B	-	-	-	-	-	-
2a: -10%	Scenario A	-	-	-	-	$2.3	-
	Scenario B	-	-	-	-	$6.8	-
2b: -20%	Scenario A	-	-	-	-	$11.7	-
	Scenario B	-	-	-	-	$22.2	-
2c: -30%	Scenario A	-	-	-	-	$23.6	-
	Scenario B	-	-	-	-	$28.7	$13.5
2d: -35%	Scenario A	-	-	-	-	$26.8	$3.6
	Scenario B	-	-	$15.6	$4.6	$36.1	$18.4
2e: -40%	Scenario A	-	-	-	-	$28.0	$10.4
	Scenario B	-	-	$23.7	$15.9	$38.9	$21.3
2f: -45%	Scenario A	-	-	$1.7	-	$31.3	$15.6
	Scenario B	$1.4	-	$27.8	$28.0	$45.2	$25.2
2g: -50%	Scenario A	$0.0	-	$16.8	$5.3	$36.8	$18.8
	Scenario B	$9.5	-	$33.4	$36.2	$50.6	$32.2

Table 4-143 Projected PSC and Wholesale Revenue (2013 $millions) Cuts for the BSAI TLA Yellowfin Sole Fisheries by Suboption and Scenario for the Basis Years

		2008	2009	2010	2011	2012	2013
Suboption	Scenario	MT Halibut PSC Cut in Each Basis Year					
Status Quo	Scenario A	9	-	-	-	-	27
	Scenario B	19	-	-	-	-	24
2a: -10%	Scenario A	27	-	-	-	12	46
	Scenario B	27	-	-	-	27	47
2b: -20%	Scenario A	48	-	-	-	28	58
	Scenario B	48	4	-	-	46	76
2c: -30%	Scenario A	67	27	-	-	42	78
	Scenario B	72	27	-	5	68	91
2d: -35%	Scenario A	67	27	-	-	52	82
	Scenario B	72	43	-	23	75	100
2e: -40%	Scenario A	72	51	-	-	57	93
	Scenario B	83	43	-	27	86	113
2f: -45%	Scenario A	86	51	-	13	63	95
	Scenario B	94	43	-	36	97	124
2g: -50%	Scenario A	90	51	-	13	63	108
	Scenario B	104	54	-	51	109	135
		Real Wholesale Revenues ($2013 millions) Cut in Each Basis Year					
Status Quo	Scenario A	$0.1	-	-	-	-	$1.3
	Scenario B	$0.2	-	-	-	-	$1.3
2a: -10%	Scenario A	$0.2	-	-	-	$0.3	$2.5
	Scenario B	$0.2	-	-	-	$1.2	$4.6
2b: -20%	Scenario A	$1.4	-	-	-	$1.3	$3.6
	Scenario B	$1.2	$0.2	-	-	$6.1	$15.2
2c: -30%	Scenario A	$3.7	$1.6	-	-	$3.2	$5.5
	Scenario B	$5.5	$2.4	-	$1.0	$11.3	$20.1
2d: -35%	Scenario A	$3.7	$1.6	-	-	$5.4	$6.3
	Scenario B	$5.5	$3.3	-	$2.0	$13.3	$22.1
2e: -40%	Scenario A	$4.7	$2.9	-	-	$6.1	$8.7
	Scenario B	$6.8	$3.3	-	$3.2	$16.3	$25.7
2f: -45%	Scenario A	$5.8	$2.9	-	$0.7	$7.2	$8.9
	Scenario B	$8.7	$3.4	-	$9.1	$17.2	$27.0
2g: -50%	Scenario A	$6.2	$2.9	-	$0.7	$7.2	$9.7
	Scenario B	$10.8	$5.0	-	$10.2	$22.5	$27.8

4.9.1 Overview of Groundfish and Halibut Impacts under Option 2

As previously noted, this summary section of impacts contains tables and figures that summarize the impacts of proposed options to reduce halibut PSC limits for BSAI target fisheries, and resulting increased harvests in the commercial halibut fishery in each of the Area 4 subareas and Area 4 as whole. The section begins by summarizing revenue and harvest impacts for both groundfish and commercial halibut fisheries across all suboptions, as shown in Table 4-144. Subsequent sections provide additional details for both fisheries, first for groundfish then for the commercial halibut fisheries. Additional details covered in the later section for groundfish include estimates of annual average revenue, annual average harvest impacts to each BSAI TLA target fishery, impacts to crew, and a summary of modelled behavior changes. Additional details provided for the halibut fishery include annual average revenue and harvest impacts to each subarea and Area 4 as a whole under each scenario and suboption. Finally, future U26-based yield impacts in Area 4, and areas outside of Area 4 are summarized for the options. We note that statistical details and histograms summarizing future revenue and harvest impacts pertaining to each individual halibut PSC limit reduction can be found in Appendix D, and that summaries of impacts to communities and regions in Alaska and for regions outside the state are found in Sections 4.13.1.3, 4.13.2.3 and 4.13.2.4.

Table 4-144 is organized into four basic quadrants as in the corresponding table for options affecting A80-CPs. The upper half focuses on projected impacts to wholesale revenues while the lower half focuses on PSC and harvests. The left side of the table summarizes the negative impacts on the affected groundfish sectors while the right summarizes the impacts for the commercial halibut fishery. With a 10 percent cut in limits, vessels in the BSAI TLA fisheries are projected to have cuts in wholesale revenues between $5 and $15 million discounted to present values. With the 50 percent cut, between $153 and $322 million less wholesale revenues over the 10-year future period discounted to present value are projected.

In the upper right quadrant we see that the commercial halibut fishery can be expected to gain between $1.3 and $1.7 million in discounted present value wholesale revenues under Option 1a. With a 50 percent cut in PSC limits, the overall discounted present value wholesale revenue gains jump up to around $11.9 million under Scenario A and $19.6 million under Scenario B. The majority of impacts to the commercial halibut fishery from PSC cuts to vessels in the BSAI TLA are expected to occur in Area 4A under Scenario A. In Scenario B, impacts are more evenly split between 4A and 4CDE. In most cases, the differences in Scenario A and B are beyond the control the Council and NMFS, but in the case of the BSAI TLA fisheries, decision makers do control how future PSC apportionments are divided.

Table 4-144 Summary of Impacts Over All Reduction Options Affecting BSAI TLA Vessels

	Groundfish Impacts				Commercial Halibut Fishery Impacts							
	Scenario A	Scenario B	Scenario A	Scenario B	Scenario A				Scenario B			
Option	All Areas		All Areas		4A	4B	4CDE	Area 4	4A	4B	4CDE	Area 4
	PSC Limit (r.w. mt)		10-year Sum of Changes to the DPV Wholesale Revenues (2013 $Millions) Relative to the Status Quo									
Status Quo	875		$10,221.7	$10,213.9	$171.18	$149.76	$28.87	$349.81	$171.20	$149.77	$29.52	$350.49
2a): -10%	788		($5.27)	($15.37)	$0.68	$0.02	$0.62	$1.31	$0.71	$0.05	$0.94	$1.70
2b): -20%	700		($22.35)	($58.61)	$1.37	$0.09	$1.29	$2.76	$1.61	$0.27	$2.12	$4.00
2c): -30%	613		($58.77)	($110.33)	$2.75	$0.39	$1.79	$4.93	$3.34	$0.45	$3.50	$7.29
2d): -35%	569		($72.67)	($161.55)	$3.19	$0.46	$2.17	$5.81	$4.76	$0.60	$4.43	$9.80
2e): -40%	525		($91.19)	($208.21)	$4.34	$0.51	$2.52	$7.36	$5.94	$0.77	$5.73	$12.43
2f): -45%	481		($109.66)	($261.24)	$5.25	$0.59	$3.22	$9.06	$7.07	$0.87	$8.03	$15.97
2g): -50%	438		($152.96)	($321.80)	$6.36	$0.74	$3.99	$11.09	$8.33	$1.04	$10.21	$19.58

	Groundfish Impacts				Commercial Halibut Fishery Impacts (net weight mt)							
	Scenario A	Scenario B	Scenario A	Scenario B	Scenario A				Scenario B			
Option	PSC taken (r.w. mt)		Groundfish (1,000s mt)		4A	4B	4CDE	Area 4	4A	4B	4CDE	Area 4
	Average Annual Change from the Status Quo											
Status Quo	699.3	697.2	1,009.8	1,009.8	714.9	626.9	125.2	1,467.1	715.2	627.2	128.2	1,470.6
2a): -10%	-12.4	-17.0	-0.7	-1.7	2.7	0.1	2.7	5.5	2.9	0.2	4.0	7.1
2b): -20%	-27.7	-41.3	-2.6	-7.5	5.6	0.4	5.5	11.6	6.7	1.2	9.1	17.0
2c): -30%	-49.9	-76.1	-6.2	-13.8	11.5	1.7	7.6	20.8	14.1	1.9	14.9	30.9
2d): -35%	-59.6	-101.5	-7.8	-18.6	13.3	2.0	9.2	24.6	20.1	2.6	18.9	41.5
2e): -40%	-75.8	-129.5	-10.1	-23.3	18.4	2.2	10.8	31.4	25.1	3.3	24.4	52.8
2f): -45%	-93.5	-164.9	-12.0	-28.6	22.2	2.6	13.7	38.4	29.9	3.8	34.2	67.9
2g): -50%	-114.2	-201.4	-15.9	-34.3	26.8	3.2	17.0	47.1	35.2	4.5	43.4	83.1

4.9.1.1 Impacts on Participants in the BSAI Trawl Limited Aaccess Fishery

In this section we examine in more detail the impacts of the PSC limit reduction options affecting the BSAI TLA fisheries. The section contains three parts that focus on: a) projected impacts to wholesale revenues; b) projected impacts on groundfish harvests; and c) behavioral changes in BSAI TLA fisheries while meeting the reduced PSC limits.

Revenue Impacts for Vessels in BSAI TLA Fisheries

This section provides additional details on the impacts to revenues and earning projected for BSAI TLA vessels resulting from options to reduce PSC Limits. The details that that are described include a summary of annual average future revenue impacts, and impacts to crew members. The latter are summarized over six different tables that break down impacts into specific vessels categories depending on whether the vessel is a CV or CP, and whether vessel has diversified into fisheries other than pollock. These vessel categories were introduced in Section 4.4.3.1.

Table 4-128 summarizes the annual average impacts to wholesale revenues (discounted to present values) for the BSAI TLA fisheries projected for each future year resulting from potential halibut PSC limit reductions. The first column of the table shows the range between Scenarios A and B of expected average future values under the status quo, while the columns to the right show the range of projected future values under PSC limit reduction options. Also included at the bottom of the table are the present values of annual average impacts of wholesale revenues over all years in the 10-year future period.

Table 4-145 Annual Average Future Revenue Impacts of PSC Reduction Options for BSAI TLA Fisheries

	DPV of Wholesale Revenue Under the Status Quo	2a: -20%	2b: -20%	2c: -30%	2d: -35%	2e: -40%	2f: -45%	2g: -50%
		Forgone Annual Average Discounted Present Value of Wholesale Revenue Under the Alternatives						
Year	Scen. A - B	Scen. A - B	Scen. A - B	Scen. A - B	Scen. A - B	Scen. A - B	Scen. A - B	Scen. A - B
2014	$1,273.7 - $1,272.7	$0.7 - $1.9	$2.8 - $7.3	$7.3 - $13.6	$9.0 - $20.1	$11.3 - $25.8	$13.6 - $32.4	$19.0 - $40.0
2015	$1,210.0 - $1,209.1	$0.6 - $1.8	$2.6 - $6.9	$7.0 - $13.0	$8.5 - $19.1	$10.8 - $24.5	$12.9 - $30.8	$18.0 - $38.0
2016	$1,149.5 - $1,148.6	$0.6 - $1.7	$2.5 - $6.6	$6.6 - $12.3	$8.1 - $18.1	$10.2 - $23.3	$12.2 - $29.2	$17.1 - $36.1
2017	$1,092.0 - $1,091.2	$0.6 - $1.6	$2.4 - $6.3	$6.3 - $11.7	$7.7 - $17.2	$9.7 - $22.1	$11.6 - $27.8	$16.3 - $34.3
2018	$1,037.4 - $1,036.6	$0.5 - $1.5	$2.3 - $5.9	$6.0 - $11.1	$7.3 - $16.3	$9.2 - $21.0	$11.1 - $26.4	$15.5 - $32.6
2019	$985.6 - $984.8	$0.5 - $1.5	$2.1 - $5.7	$5.7 - $10.6	$6.9 - $15.5	$8.8 - $20.0	$10.5 - $25.1	$14.7 - $30.9
2020	$936.3 - $935.6	$0.5 - $1.4	$2.0 - $5.4	$5.4 - $10.0	$6.6 - $14.8	$8.3 - $19.0	$10.0 - $23.8	$13.9 - $29.4
2021	$889.5 - $888.8	$0.5 - $1.3	$1.9 - $5.1	$5.1 - $9.5	$6.3 - $14.0	$7.9 - $18.0	$9.5 - $22.6	$13.2 - $27.9
2022	$845.0 - $844.3	$0.4 - $1.3	$1.8 - $4.8	$4.9 - $9.1	$5.9 - $13.3	$7.5 - $17.1	$9.0 - $21.5	$12.6 - $26.5
2023	$802.7 - $802.1	$0.4 - $1.2	$1.8 - $4.6	$4.6 - $8.6	$5.7 - $12.6	$7.1 - $16.3	$8.6 - $20.4	$12.0 - $25.2
Average	$1,022.2 - $1,021.4	$0.5 - $1.5	$2.2 - $5.9	$5.9 - $10.9	$7.2 - $16.1	$9.1 - $20.7	$10.9 - $26.0	$15.2 - $32.1

Table 4-146 through Table 4-151 summarize the impacts of the options to crew members and crew payments on all vessels categories in the BSAI TLA (see Table 4-146), and over each of the five specific vessel categories defined in the existing conditions section of the analysis—i.e. in Section 4.4.3.1.

- Table 4-147 summarizes impacts to crew on Non-Diversified CPs—these are AFA-CPs that focus almost exclusively on the AFA pollock fishery and have **not** been engaged in either the yellowfin sole or Pacific cod fisheries.
- Table 4-148 summarizes impacts to crew on Non-Diversified CVs— these are AFA-CVs that focus almost exclusively on the AFA pollock fishery and have **not** been engaged in the Pacific cod fishery.

- Table 4-149 summarizes impacts to crew on Diversified CPs—these are AFA-CPs that have been engaged in either the yellowfin sole or Pacific cod fisheries, in addition to or instead of the AFA pollock fishery.
- Table 4-150 summarizes impacts to crew on Diversified CVs—these are AFA-CVs that have been engaged in either the yellowfin sole or Pacific cod fisheries in addition to or instead of the AFA pollock fishery.
- Table 4-151 summarizes impacts to crew on Non-AFA Trawl-CVs—these vessels do not participate in the pollock fishery and instead focus on yellowfin sole and Pacific cod.

It should be noted that the tables for these vessels shown in in Section 4.4.3.1 included estimates of crew payments generated in CDQ groundfish fisheries, while the tables that follow include only crew payments from non-CDQ efforts. It should also be noted that dollar values shown in the tables are discounted out over the 10-year future period to reflect present values of future payments—the discounting results in dollar values that are approximately 20 percent less than values that are not discounted to reflect the present value of the payments.

In all of the tables the first row of data shows the annual average discounted present value of payments to crew under the status quo over the future period, and then moving right, shows the projected reductions in the annual average present value of crew payments under the options. The tables then summarize two alternative ways to deal with the reductions in crew: companies can keep the same number of crew employees as under the status quo, and reduce crew member compensation proportionally; or they can cut the number of person employed and maintain the same level of payments per person. Most likely the end result will be a combination of both.

Impacts over all BSAI TLA crew are summarized in Table 4-146. Over all vessels under Scenario A, crew member payment are expected to decline by up to $2.7 million per year (discounted to present values) with a 50 percent reduction in PSC limits. Under Scenario B, crew member payments could decline by up to $6.0 million per year under Option 2g. If vessels decide to cut crew and maintain average payments per person, then the number of employees cut ranges up to 57 under Scenario A and up to 130 under Scenario B.

Table 4-146 Average Annual Impacts of PSC Limits to Crew Members on All Vessels within the BSAI TLA Fleet

	Status Quo	2a: –10%	2b: –20%	2c: –30%	2d: –35%	2e: –40%	2f: –45%	2g: –50%
Scenario A	**SQ**	**Impacts relative to the Status Quo Under Scenario A**						
DPV of Average Payments to Crew (2013 $millions)	$191.93	($0.12)	($0.45)	($1.14)	($1.39)	($1.76)	($2.08)	($2.73)
Which can be achieved by either reducing payments per person or reducing the number of persons employed:								
Payments Per Person (DPV) in (2013 $)	$47,818	($29)	($112)	($285)	($346)	($440)	($518)	($681)
Employee Cuts to Maintain SQ Income/person	4,013.6	-2.4	-9.4	-23.9	-29.0	-36.9	-43.5	-57.2
Scenario B	**SQ**	**Impacts relative to the Status Quo Under Scenario B**						
DPV of Average Payments to Crew (2013 $millions)	$191.75	($0.30)	($1.26)	($2.31)	($3.16)	($3.92)	($4.84)	($6.02)
Which can be achieved by either reducing payments per person or reducing the number of persons employed:								
Payments Per Person (DPV) in (2013 $)	$47,774	($75)	($315)	($575)	($786)	($978)	($1,205)	($1,499)
Employee Cuts to Maintain SQ Income/person	4,013.6	-6.3	-26.4	-48.3	-66.1	-82.1	-101.2	-125.9

Note: Payments to Crew Members described in the existing conditions included incomes from CDQ fisheries. (See Table 4-33).

As can be seen in Table 4-147 and Table 4-148, crew on non-diversified AFA vessels are not projected to feel any significant impacts from any of the options. This is a result of the fact that the pollock fishery is assumed to be exempt from direct effect of the PSC limit reductions. It is certainly possible that these vessels will see some impacts as they "voluntarily" work to reduce their pollock PSC.

Table 4-147 Average Annual Impacts of PSC Limits to Crew Members on Non-Diversified CPs

	Status Quo	2a: –10%	2b: –20%	2c: –30%	2d: –35%	2e: –40%	2f: –45%	2g: –50%
Scenario A	**SQ**	**Impacts relative to the Status Quo Under Scenario A**						
DPV of Average Payments to Crew (2013 $millions)	$37.98	-	-	-	-	-	($0.03)	($0.03)
Which can be achieved by either reducing payments per person or reducing the number of persons employed:								
Payments Per Person (DPV) in (2013 $)	$39,196	-	-	-	-	-	($31)	($31)
Employee Cuts to Maintain SQ Income/person	968.8	-	-	-	-	-	-0.8	-0.8
Scenario B	**SQ**	**Impacts relative to the Status Quo Under Scenario B**						
DPV of Average Payments to Crew (2013 $millions)	$37.98	-	-	($0.00)	($0.00)	($0.00)	($0.01)	($0.01)
Which can be achieved by either reducing payments per person or reducing the number of persons employed:								
Payments Per Person (DPV) in (2013 $)	$39,196	-	-	($2)	($2)	($2)	($12)	($12)
Employee Cuts to Maintain SQ Income/person	968.8	-	-	-0.0	-0.0	-0.0	-0.3	-0.3

Note: Payments to Crew Members described in the existing conditions included incomes from CDQ fisheries. (See Table 4-29).

Table 4-148 Average Annual Impacts of PSC Limits to Crew Members on Non-Diversified CVs

	Status Quo	2a: –10%	2b: –20%	2c: –30%	2d: –35%	2e: –40%	2f: –45%	2g: –50%
Scenario A	**SQ**	**Impacts relative to the Status Quo Under Scenario A**						
DPV of Average Payments to Crew (2013 $millions)	$44.99	($0.00)	($0.00)	($0.00)	($0.00)	($0.00)	($0.00)	($0.01)
Which can be achieved by either reducing payments per person or reducing the number of persons employed:								
Payments Per Person (DPV) in (2013 $)	$100,414	($0)	($0)	($7)	($9)	($9)	($10)	($13)
Employee Cuts to Maintain SQ Income/person	448.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.1
Scenario B	**SQ**	**Impacts relative to the Status Quo Under Scenario B**						
DPV of Average Payments to Crew (2013 $millions)	$44.99	($0.00)	($0.00)	($0.00)	($0.00)	($0.00)	($0.00)	($0.01)
Which can be achieved by either reducing payments per person or reducing the number of persons employed:								
Payments Per Person (DPV) in (2013 $)	$100,414	($0)	($1)	($3)	($3)	($4)	($5)	($20)
Employee Cuts to Maintain SQ Income/person	448.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.1

Note: Payments to Crew Members described in the existing conditions included incomes from CDQ fisheries. (See Table 4-31).

The direct impacts of PSC reduction options to BSAI TLA vessels will be borne almost entirely by the Diversified AFA-CPs, the Diversified AFA-CVs and the Non-AFA Trawl CVs. If we compare projected employee cuts across the three categories under Scenario A for Option 2g with its 50 percent reduction in PSC limits, we see that Diversified CPs are projected to cut 18.4 annual positions; that Diversified CVs are projected to cut 15.2 annual positions; and the non-AFA Trawl CV are projected to cut 22 annual positions. If these impacts are measured as a percent of status quo employees however, then the impacts to the Diversified CPs are minimal at 0.7 percent of annual positions, while Diversified CVs would face cuts of 3.9 percent of their status quo annual employee count. The non-AFA trawl CVs, however, would potentially need to cut 31.4 percent their estimated 70 annual positions from the status quo. The impacts under Scenario B are significantly greater for all three vessel categories.

Table 4-149 Average Annual Impacts of PSC Limits to Crew Members on Diversified CPs

	Status Quo	2a: –10%	2b: –20%	2c: –30%	2d: –35%	2e: –40%	2f: –45%	2g: –50%
Scenario A	**SQ**	**Impacts relative to the Status Quo Under Scenario A**						
DPV of Average Payments to Crew (2013 $millions)	$77.40	($0.05)	($0.13)	($0.34)	($0.40)	($0.57)	($0.61)	($0.67)
Which can be achieved by either reducing payments per person or reducing the number of persons employed:								
Payments Per Person (DPV) in (2013 $)	$36,279	($25)	($62)	($158)	($189)	($267)	($288)	($312)
Employee Cuts to Maintain SQ Income/person	2,133.5	-1.5	-3.6	-9.3	-11.1	-15.7	-16.9	-18.4
Scenario B	**SQ**	**Impacts relative to the Status Quo Under Scenario B**						
DPV of Average Payments to Crew (2013 $millions)	$77.35	($0.12)	($0.57)	($1.06)	($1.26)	($1.49)	($1.72)	($2.07)
Which can be achieved by either reducing payments per person or reducing the number of persons employed:								
Payments Per Person (DPV) in (2013 $)	$36,256	($56)	($265)	($496)	($592)	($697)	($807)	($971)
Employee Cuts to Maintain SQ Income/person	2,133.5	-3.3	-15.6	-29.2	-34.8	-41.0	-47.5	-57.1

Note: Payments to Crew Members described in the existing conditions included incomes from CDQ fisheries. (See Table 4-28).

Table 4-150 Average Annual Impacts of PSC Limits to Crew Members on Diversified CVs

	Status Quo	2a: –10%	2b: –20%	2c: –30%	2d: –35%	2e: –40%	2f: –45%	2g: –50%
Scenario A	**SQ**	**Impacts relative to the Status Quo Under Scenario A**						
DPV of Average Payments to Crew (2013 $millions)	$28.64	($0.02)	($0.17)	($0.35)	($0.41)	($0.52)	($0.71)	($1.11)
Which can be achieved by either reducing payments per person or reducing the number of persons employed:								
Payments Per Person (DPV) in (2013 $)	$72,841	($54)	($445)	($895)	($1,051)	($1,315)	($1,804)	($2,821)
Employee Cuts to Maintain SQ Income/person	393.1	-0.3	-2.4	-4.8	-5.7	-7.1	-9.7	-15.2
Scenario B	**SQ**	**Impacts relative to the Status Quo Under Scenario B**						
DPV of Average Payments to Crew (2013 $millions)	$28.64	($0.08)	($0.33)	($0.59)	($1.07)	($1.40)	($1.83)	($2.50)
Which can be achieved by either reducing payments per person or reducing the number of persons employed:								
Payments Per Person (DPV) in (2013 $)	$72,841	($215)	($850)	($1,511)	($2,709)	($3,558)	($4,657)	($6,363)
Employee Cuts to Maintain SQ Income/person	393.1	-1.2	-4.6	-8.2	-14.6	-19.2	-25.1	-34.3

Note: Payments to crew members described in the existing conditions included incomes from CDQ fisheries. (See Table 4-30).

Table 4-151 Average Annual Impacts of PSC Limits to Crew Members on Non-AFA CVs

	Status Quo	2a: –10%	2b: –20%	2c: –30%	2d: –35%	2e: –40%	2f: –45%	2g: –50%
Scenario A	**SQ**	**Impacts relative to the Status Quo Under Scenario A**						
DPV of Average Payments to Crew (2013 $millions)	$2.93	($0.04)	($0.14)	($0.45)	($0.57)	($0.67)	($0.72)	($0.92)
Which can be achieved by either reducing payments per person or reducing the number of persons employed:								
Payments Per Person (DPV) in (2013 $)	$41,717	($602)	($2,001)	($6,443)	($8,081)	($9,592)	($10,266)	($13,139)
Employee Cuts to Maintain SQ Income/person	70.2	-1.0	-3.4	-10.8	-13.6	-16.1	-17.3	-22.1
Scenario B	**SQ**	**Impacts relative to the Status Quo Under Scenario B**						
DPV of Average Payments to Crew (2013 $millions)	$2.80	($0.09)	($0.36)	($0.65)	($0.83)	($1.04)	($1.27)	($1.42)
Which can be achieved by either reducing payments per person or reducing the number of persons employed:								
Payments Per Person (DPV) in (2013 $)	$39,869	($1,350)	($5,175)	($9,318)	($11,758)	($14,746)	($18,102)	($20,248)
Employee Cuts to Maintain SQ Income/person	70.2	-2.4	-9.1	-16.4	-20.7	-26.0	-31.9	-35.7

Note: Payments to Crew Members described in the existing conditions included incomes from CDQ fisheries. (See Table 4-32).

Harvest Impacts for BSAI TLA Fisheries

This section provides additional details on the harvest and PSC impacts to A80-CPs from options to reduce PSC Limits. The following figures and tables are used to summarize these additional details.

- Figure 4-77 Impacts to Total Groundfish Harvests Including Pollock by BSAI TLA Vessels under the PSC Limit Reduction Options
- Figure 4-78 Impacts to Total Groundfish Harvests Excluding Pollock by BSAI TLA Vessels under the PSC Limit Reduction Options
- Table 4-152 Annual Average Impacts of PSC Reduction Options to Future Harvests in BSAI TLA Target Fisheries
- Figure 4-79 Percentage Change from Status Quo in BSAI TLA Target Harvests under Option 2

Figure 4-77 and Figure 4-78 provide an overall picture of the projected annual average impacts on groundfish harvests that are expected with the PSC limit reduction percentages under Option 2. The former shows impacts if the pollock fishery is included, while the latter shows the impacts if pollock is excluded, noting again that the pollock fisheries are not expected to be directly affected by the PSC limit reduction options. In each of the figures, there are two pies representing harvest impacts under Scenario A and Scenario B. The large portions of the pies represent the percentage of the total harvest that remains uncut under all of the options. A quick look at the pies with pollock included (Figure 4-77) reveals the relative magnitude of the pollock fishery relative to the other target fisheries in which BSAI vessels participate. In these pies the impacts appear insignificant.

Figure 4-77 Impacts to Total Groundfish Harvests Including Pollock by BSAI TLA Vessels under the PSC Limit Reduction Options

As indicated above, Figure 4-78 excludes pollock allowing the impacts on the non-pollock targets to be examined. It is clear that under Scenario B the impacts are significantly greater than under Scenario A. This is obviously a function of the fact that under Scenario B, PSC limit cuts that were assigned to the pollock fishery have been re-directed to the pacific cod and yellowfin sole fisheries. Under Scenario A, 79 percent of the groundfish harvest is unaffected under any of the options, but under Scenario B, the "unaffected" harvests fall to 54 percent. It should be noted here that the individual slices of the pie charts represent the incremental amounts of groundfish that are expected to be cut under the different limit reduction percentages. The labels for each suboption indicate the cumulative amount cut, and include amounts from all of preceding cuts (i.e. moving back in a counter-clockwise manner).

Figure 4-78 Impacts to Total Groundfish Harvests Excluding Pollock by BSAI TLA Vessels under the PSC Limit Reduction Options

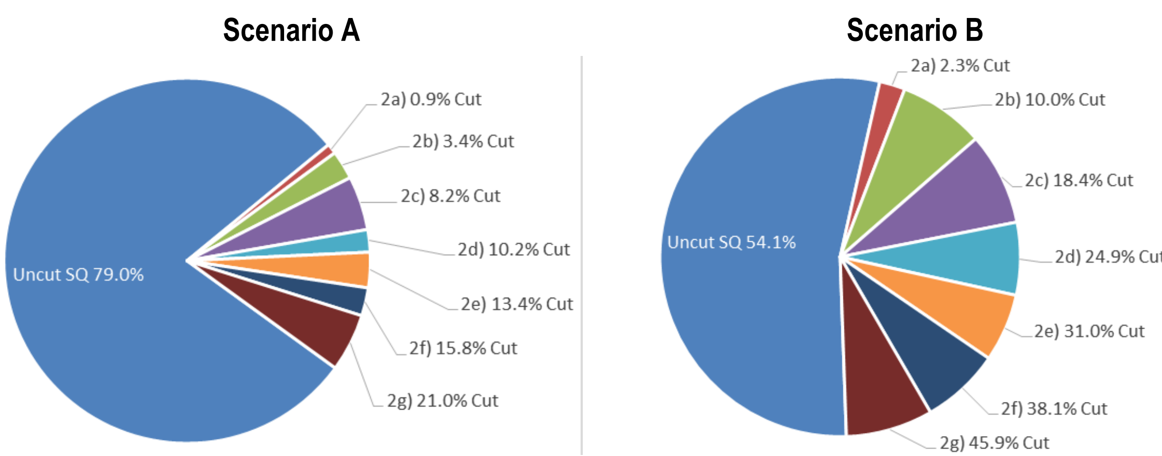


Table 4-152 summarizes annual average impacts from the PSC limit reduction options on future harvest levels for five specific A80 target fisheries, and for all targets combined. The same impacts as a percent of the status quo are represented graphically in Figure 4-79, but only for the Pacific cod and yellowfin sole fisheries. In both the table and the figure, the differential impacts between Scenarios A and B are shown. The following list, which is sorted by the volume of harvests, shows the range of percentage impacts under Option 2g which would reduce PSC limits by 50 percent.

- Pacific cod: Cuts under Option 2g range from 24 to 48 percent of the status quo under Scenarios A and B
- Yellowfin sole: Under Option 2g cuts range from 17 percent of the status quo under Scenario A to 47 percent under Scenario B.
- Atka mackerel: Under Option 2g cuts are 49 percent of the status quo under Scenario A. Under Scenario B, no cuts are projected from the status quo in the Atka mackerel fishery.[56]
- Pollock: There are no direct impacts to the pollock fishery.
- Rockfish: No impacts as there are no changes modelled.
- All BSAI TLA Groundfish: Under Option 2g overall harvest cuts range from 1.6 percent to 3.4 percent of the status quo under Scenario A and B respectively. If pollock is excluded, cuts relative to the status quo under Option 2g range from 21 percent with Scenario A to 46 percent with Scenario B.

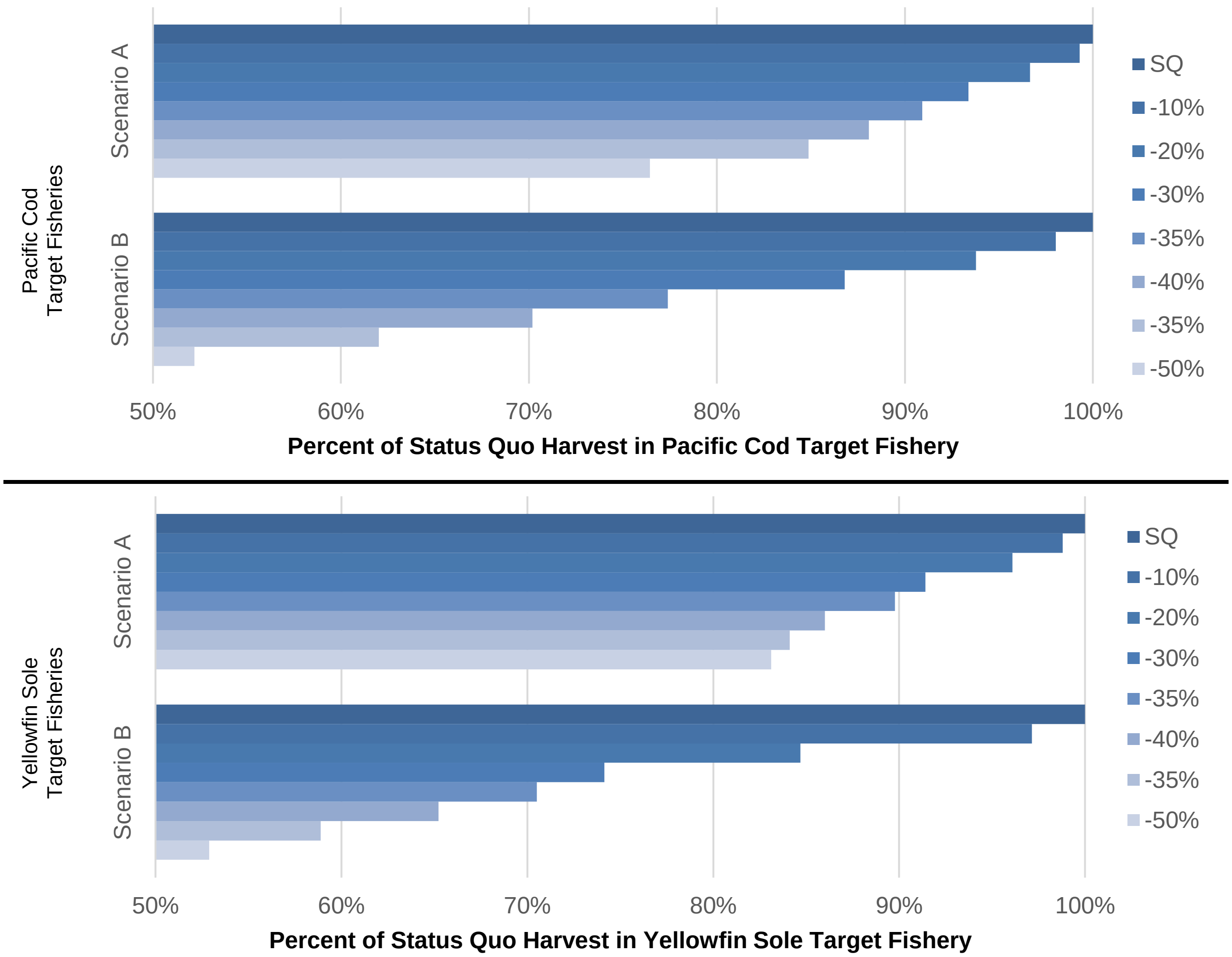
Table 4-152 Annual Average Impacts of PSC Reduction Options to Future Harvests in BSAI TLA Target Fisheries

	Status Quo	2a: – 10 %	2b: – 20 %	2c: – 30%	2d: – 35%	2e: – 40%	2f: – 45%	2g: – 50%
Annual Average Harvests (MT) in the Pacific Cod Target Fishery								
Scenario A	39,278	39,002	37,963	36,676	35,714	34,593	33,334	30,024
Scenario B	39,278	38,501	36,833	34,091	30,394	27,567	24,359	20,507
Annual Average Harvests (MT) in Target Fisheries Using the Yellowfin Sole PSC Apportionment								
Scenario A	33,181	32,779	31,886	30,334	29,787	28,534	27,910	27,578
Scenario B	33,123	32,173	28,049	24,559	23,357	21,602	19,503	17,516
Annual Average Harvests (MT) in Atka Mackerel Target Fisheries Using the Pollock|Atka Mackerel PSC Apportionment								
Scenario A	2,050	2,050	2,050	1,272	1,272	1,272	1,272	1,035
Scenario B	1,290	1,290	1,290	1,290	1,290	1,290	1,290	1,290
Annual Average Harvests (MT) in Pollock Target Fisheries Using the Pollock|Atka Mackerel PSC Apportionment								
Scenario A	934,061	934,061	934,061	934,061	934,061	934,061	934,061	934,061
Scenario B	934,061	934,061	934,061	934,061	934,061	934,061	934,061	934,061
Annual Average Harvests (MT) in Rockfish Target Fisheries								
Scenario A	1,188	1,188	1,188	1,188	1,188	1,188	1,188	1,188
Scenario B	1,188	1,188	1,188	1,188	1,188	1,188	1,188	1,188
Annual Average Harvests (MT) in All BSAI TLA Target Fisheries								
Scenario A	1,009,758	1,009,081	1,007,149	1,003,531	1,002,021	999,649	997,765	993,886
Scenario B	1,008,940	1,007,214	1,001,422	995,190	990,290	985,709	980,402	974,563

Note: All incidental occurrences of BSAI TLA tows being assigned to a flatfish target other than yellowfin sole are assigned by NMFS to the PSC apportionment for yellowfin sole.

[56] As discussed in earlier footnotes, the results for the Atka mackerel fishery are incorrect. NMFS does not close the BSAI TLA fishery for Atka mackerel (as was modelled) when the PSC apportionment for Pollock|AtkaM|Other target has been reached.

Figure 4-79 Percentage Change from Status Quo in BSAI TLA Target Harvests under Option 2



Behavioral Changes of BSAI TLA Vessels in Response to the Options

Behavioral changes with respect to halibut PSC are discussed for the existing conditions in Section 4.4.1.5 for all vessels, and more specifically in Section 4.4.3 for BSAI TLA vessels. As shown in those sections, changes in halibut PSC result from changes in any of three separate factors: halibut encounter rates, the discard mortality rate (which can be reviewed in Table 4-106 on page 242), and the total volume of groundfish harvested. In this section, we summarize the behavioral changes that are both explicitly and implicitly modeled in the analysis.

Table 4-153 summarizes the impacts relative to all BSAI TLA fisheries including the pollock fishery. As indicated earlier, the pollock fishery is exempt from the constraints of the PSC limits, and therefore changes in the pollock fishery have not been explicitly modelled. Because of the very large volumes in the pollock fishery, the impacts as a percent of total groundfish appear to be quite small. Table 4-154 that follows summarizes changes to the BSAI TLA fisheries that are directly affected by the PSC limit options. All of the discussion of this issue will focus on Table 4-154, which excludes the pollock fishery.

Table 4-153 Groundfish Harvest Changes and Resulting Changes in Halibut Encounters, Halibut Encounter Rates (HER), and PSC for BSAI TLA Vessels (including Pollock)

	Scenario A							
	SQ	**2a: -10%**	**2b: -20%**	**2c: -30%**	**2d: -35%**	**2e: -40%**	**2f: -45%**	**2g: -50%**
Variable	**Status Quo and Changes (Δ) in Annual Average Outcomes under the Suboptions**							
Groundfish (mt)	1,009,758	-677	-2,610	-6,228	-7,737	-10,110	-11,993	-15,872
Encounters (mt)	906	-16	-36	-65	-78	-100	-123	-151
HER (kg/mt)	0.90	-0.02	-0.03	-0.06	-0.07	-0.09	-0.11	-0.14
PSC (r.w. mt)	699	-12	-28	-50	-59	-76	-93	-114
	Percentage Change from SQ Under the Suboptions							
Groundfish (Δ %)	-	-0.1%	-0.3%	-0.6%	-0.8%	-1.0%	-1.2%	-1.6%
Encounters (Δ %)	-	-1.8%	-4.0%	-7.2%	-8.6%	-11.0%	-13.6%	-16.7%
HER (Δ %)	-	-1.7%	-3.7%	-6.6%	-7.9%	-10.1%	-12.5%	-15.4%
PSC (Δ %)	-	-1.8%	-4.0%	-7.2%	-8.5%	-10.9%	-13.3%	-16.3%
	Scenario B							
	2SQ	**2a: -10%**	**2b: -20%**	**2c: -30%**	**2d: -35%**	**2e: -40%**	**2f: -45%**	**2g: -50%**
Variable	**Status Quo and Changes (Δ) in Annual Average Outcomes under the Suboptions**							
Groundfish (mt)	1,008,940	-1,726	-7,518	-13,749	-18,650	-23,231	-28,538	-34,377
Encounters (mt)	903	-22	-54	-100	-135	-173	-221	-271
HER (kg/mt)	0.89	-0.02	-0.05	-0.09	-0.12	-0.15	-0.20	-0.25
PSC (r.w. mt)	697	-17	-41	-76	-102	-129	-165	-201
	Percentage Change from SQ Under the Suboptions							
Groundfish (Δ %)	-	-0.2%	-0.7%	-1.4%	-1.8%	-2.3%	-2.8%	-3.4%
Encounters (Δ %)	-	-2.4%	-6.0%	-11.1%	-14.9%	-19.1%	-24.4%	-30.0%
HER (Δ %)	-	-2.3%	-5.3%	-9.8%	-13.3%	-17.2%	-22.2%	-27.5%
PSC (Δ %)	-	-2.4%	-5.9%	-10.9%	-14.6%	-18.6%	-23.6%	-28.9%

Table 4-154 summarizes all potentially affected BSAI target fisheries and excludes pollock since halibut PSC limits are non-binding; and rockfish since halibut PSC limits are not reduced under Scenario A or Scenario B. Halibut encounter rates under Scenario A decrease gradually over all suboptions. This is an indication that behavior changes are mitigating some of the negative consequences of reductions in PSC. Because cuts in the Pacific cod fishery are assumed to result from a last-caught, first-cut progression of harvests, the reductions in halibut encounter rates are most likely the result of the actions in the yellowfin sole target fishery. It is assumed under Scenario A that the yellowfin sole fishery is rationalized, and therefore that vessels are able to mitigate some of the negative impacts of the reductions by ranking their trips from best the target-area-month combination to the worst target-area-month combination. In Scenario B, both fisheries are assumed to operate under race-for-fish conditions. As shown in the bottom half of the table, halibut encounter rates actually increase relative to the status quo under suboptions 2b, 2c, 2d, and 2e. Under Scenario B, the reductions in PSC are almost entirely due to the reductions in groundfish harvests. The differences between Scenario A and Scenario B are almost certainly the result of the behavioral changes that are assumed to occur in the yellowfin sole fishery under Scenario A.

Table 4-154 Groundfish Harvest Changes and Resulting Changes in Halibut Encounters, Halibut Encounter Rates (HER), and PSC for BSAI TLA Vessels (excluding Pollock)

	Scenario A							
	2SQ	**2a: -10%**	**2b: -20%**	**2c: -30%**	**2d: -35%**	**2e: -40%**	**2f: -45%**	**2g: -50%**
Variable	**Annual Average Outcome under the Status Quo and the Changes (Δ) in Annual Average Outcomes from the Status Quo under the Suboptions**							
Groundfish (mt)	75,697	-677	-2,610	-6,228	-7,737	-10,110	-11,993	-15,872
Encounters (mt)	563	-16	-36	-65	-78	-100	-123	-151
HER (kg/mt)	7.43	-0.15	-0.23	-0.27	-0.30	-0.37	-0.53	-0.55
PSC (r.w. mt)	416	-12	-28	-50	-59	-76	-93	-114
	Percentage Change from SQ Under the Suboptions							
Groundfish (Δ %)	-	-0.9%	-3.4%	-8.2%	-10.2%	-13.4%	-15.8%	-21.0%
Encounters (Δ %)	-	-2.8%	-6.4%	-11.6%	-13.8%	-17.7%	-21.8%	-26.8%
HER (Δ %)	-	-2.0%	-3.1%	-3.7%	-4.0%	-5.0%	-7.1%	-7.4%
PSC (Δ %)	-	-3.0%	-6.6%	-12.1%	-14.3%	-18.2%	-22.4%	-27.4%

	Scenario B							
	2SQ	**2a: -10%**	**2b: -20%**	**2c: -30%**	**2d: -35%**	**2e: -40%**	**2f: -45%**	**2g: -50%**
Variable	**Annual Average Outcome under the Status Quo and the Changes (Δ) in Annual Average Outcomes from the Status Quo under the Suboptions**							
Groundfish (mt)	74,878	-1,726	-7,518	-13,749	-18,650	-23,231	-28,538	-34,377
Encounters (mt)	560	-22	-54	-100	-135	-173	-221	-271
HER (kg/mt)	7.48	-0.12	+0.03	+0.05	+0.08	+0.02	-0.16	-0.34
PSC (r.w. mt)	414	-17	-41	-76	-102	-129	-165	-201
	Percentage Change from SQ Under the Suboptions							
Groundfish (Δ %)	-	-2.3%	-10.0%	-18.4%	-24.9%	-31.0%	-38.1%	-45.9%
Encounters (Δ %)	-	-3.9%	-9.6%	-17.8%	-24.1%	-30.8%	-39.4%	-48.3%
HER (Δ %)	-	-1.6%	+0.4%	+0.6%	+1.1%	+0.3%	-2.1%	-4.5%
PSC (Δ %)	-	-4.1%	-10.0%	-18.3%	-24.6%	-31.2%	-39.8%	-48.7%

4.9.1.2 Impacts of Option 2 on the Commercial Halibut Fishery

This section provides a summary of impacts on the commercial halibut fishery of proposed options to reduce PSC limit for A80-CPs, and is divided into three parts:

- Harvest Impacts to the Commercial Halibut Fishery
- Revenue Impacts to the Commercial Halibut Fishery
- Yield Increases to Commercial Halibut Fishery Resulting from U26 Savings

Harvest Impacts to the Commercial Halibut Fishery

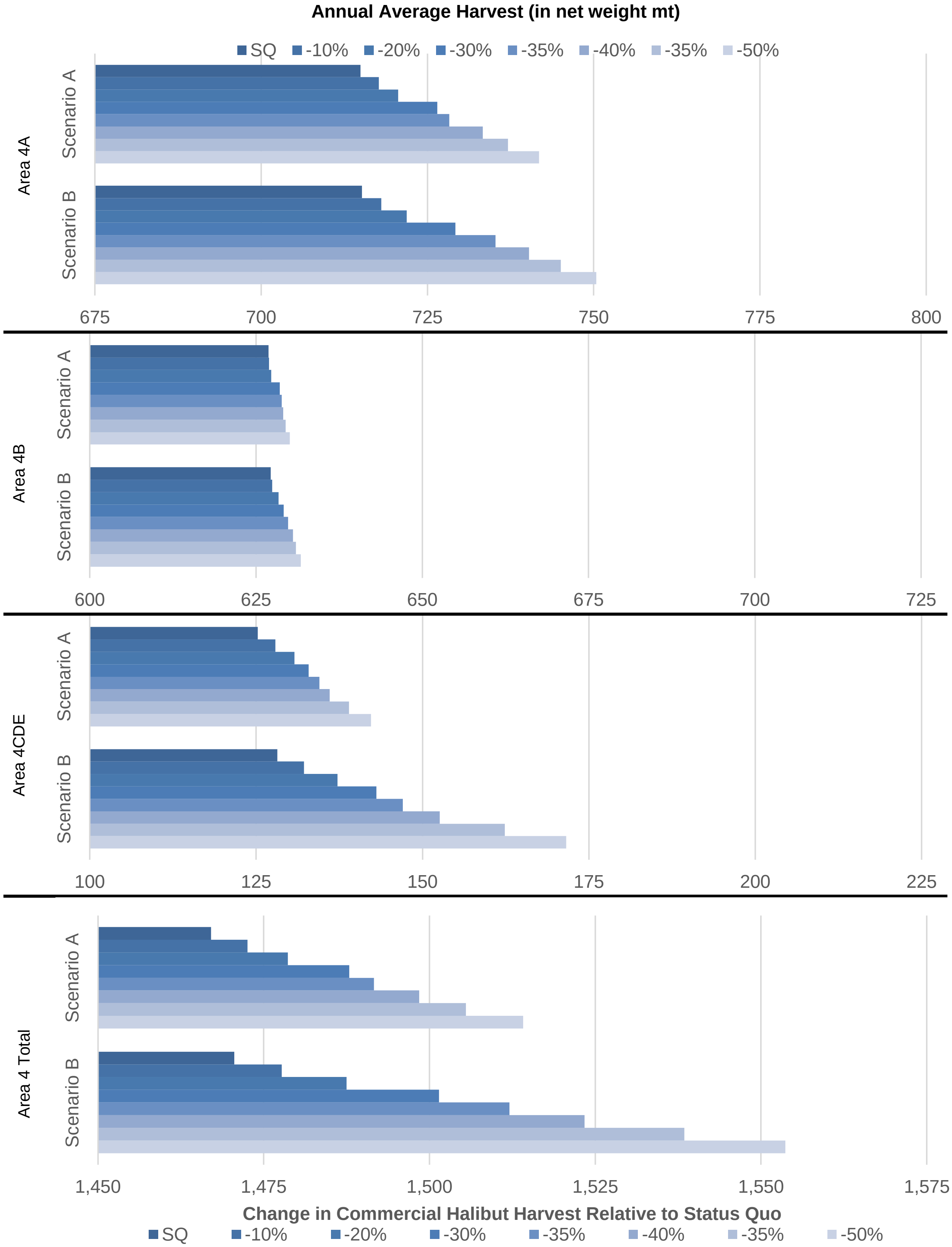
For ease of use, the commercial halibut fishery harvest portions of the overall summary table for Option 2 are reproduced below in Table 4-155. With the proposed PSC limit reductions for vessels operating in the BSAI TLA fisheries, it is projected that for all of Area 4, annual average harvest volumes for the halibut fishery will increase by to as much as 3 percent under Scenario A, if option 2g were chosen. The increased harvests would jump to 6 percent over all of Area 4 under Scenario B for the same option. The relative magnitude of change between Scenario A and Scenario B for the commercial halibut fishery is unique to options affecting the BSAI TLA fisheries, and results from the fact that under Scenario B, the overall reduction in PSC is actually increased because the non-binding PSC apportionment to the Pollock|AtkaM|Other fishery is maintained at status quo levels. Under Scenario A, increases are largest in Area 4A, while under Scenario B, increases to Area 4CDE exceed those in 4A.

Table 4-155 Summary of Commercial Halibut Harvest Impacts under Option 2

	Commercial Halibut Fishery Impacts							
	Scenario A				Scenario B			
	4A	4B	4CDE	Area 4	4A	4B	4CDE	Area 4
Option	Average Annual Change from the Status Quo in Commercial Halibut Harvest (net weight mt)							
Status Quo	714.9	626.9	125.2	1,467.1	715.2	627.2	128.2	1,470.6
2a: -10%	2.7	0.1	2.7	5.5	2.9	0.2	4.0	7.1
2b: -20%	5.6	0.4	5.5	11.6	6.7	1.2	9.1	17.0
2c: -30%	11.5	1.7	7.6	20.8	14.1	1.9	14.9	30.9
2d: -35%	13.3	2.0	9.2	24.6	20.1	2.6	18.9	41.5
2e: -40%	18.4	2.2	10.8	31.4	25.1	3.3	24.4	52.8
2f: -45%	22.2	2.6	13.7	38.4	29.9	3.8	34.2	67.9
2g: -50%	26.8	3.2	17.0	47.1	35.2	4.5	43.4	83.1

Figure 4-80, on the following page, summarizes harvest impacts in Area 4 graphically—the figure shows annual average harvests under the status quo and the annual average harvests under the "change" case—noting that the change in annual harvests shown in Table 4-155 above, is calculated by subtracting harvests under the status quo from the harvests in the "change" case. It should be noted that in the figure, the horizontal scale for each area is shown in increments of 25 net weight mt, but that the starting point for each is set at levels that are appropriate for each area. Because all areas use the same scale, it is easier to compare impact across areas.

Figure 4-80 Projected Annual Average Halibut Harvests (in net weight mt) under Option 2



Note: The figure does not include increases in harvests that could result from PSC Limit reductions in other groundfish fisheries.

Revenue Impacts to the Commercial Halibut Fishery

In this section we provide additional details regarding the wholesale revenue impacts to the commercial halibut fishery that are projected to occur with PSC limit reductions imposed on A80-CPs. For ease of use, the wholesale revenues from the commercial halibut fishery that were reported in the overall summary table for Option 2 on page 286 above (Table 4-144) are reproduced below in Table 4-156. As indicated earlier, the numbers in the table represent the sum of wholesale revenues over the 10-year future period under the status quo (discounted to present values), and for each PSC limit reduction option, the changes in wholesale revenues over the 10-year future period, again discounted to present values. In general, the wholesale revenue impacts increase in approximately the same proportions as changes in halibut harvests.

Table 4-156 Summary of Wholesale Revenue Impacts of Option 2 to the Commercial Halibut Fishery

	10-year Sum of Status Quo Future Wholesale Revenues Discounted to Present Values and Projected Changes to Wholesale Revenues under the Options in 2013 $millions							
	Scenario A				Scenario B			
Option	4A	4B	4CDE	Area 4	4A	4B	4CDE	Area 4
Status Quo	$171.18	$149.76	$28.87	$349.81	$171.20	$149.77	$29.52	$350.49
1.a: -10%	$0.68	$0.02	$0.62	$1.31	$0.71	$0.05	$0.94	$1.70
1.b: -20%	$1.37	$0.09	$1.29	$2.76	$1.61	$0.27	$2.12	$4.00
1.c: -30%	$2.75	$0.39	$1.79	$4.93	$3.34	$0.45	$3.50	$7.29
1.d: -35%	$3.19	$0.46	$2.17	$5.81	$4.76	$0.60	$4.43	$9.80
1.e: -40%	$4.34	$0.51	$2.52	$7.36	$5.94	$0.77	$5.73	$12.43
1.f: -45%	$5.25	$0.59	$3.22	$9.06	$7.07	$0.87	$8.03	$15.97
1.g: -50%	$6.36	$0.74	$3.99	$11.09	$8.33	$1.04	$10.21	$19.58

Table 4-157 provides a slightly different perspective on the revenue impacts to the commercial halibut fishery. In this case, the first column shows the future value (discounted to present values) of the status quo for each of the 10 future years as an average over the 10,000 iterations run under the IMS Model. Columns to the right of the status quo show the changes relative to that status quo that can be expected under the specific options. The bottom line shows the average annual change over all of the years and over all of the iterations. A similar table is provided on the next page that shows discounted average annual wholesale revenues for each future year under Option 2 for Areas 4A, 4B and 4CDE.

Table 4-157 Discounted Average Annual Wholesale Revenues ($ million) under Option 2 for all of Area 4

	Status Quo	2a):-10%	2b):-20%	2c):-30%	2d):-35%	2e): -40%	2f): -45%	2g): -50%
Year	Scenario A - B	Scenario A - B	Scenario A - B	Scenario A - B	Scenario A - B	Scenario A - B	Scenario A - B	Scenario A - B
Area 4 Total								
2014	$45.8 to $45.7	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0
2015	$38.9 to $39.0	$0.4 to $0.5	$0.7 to $1.0	$1.2 to $1.7	$1.4 to $2.3	$1.8 to $2.9	$2.1 to $3.7	$2.6 to $4.4
2016	$39.8 to $39.9	$0.1 to $0.2	$0.3 to $0.4	$0.5 to $0.8	$0.6 to $1.1	$0.8 to $1.4	$1.1 to $1.8	$1.3 to $2.2
2017	$37.6 to $37.7	$0.1 to $0.2	$0.3 to $0.4	$0.5 to $0.7	$0.6 to $1.0	$0.7 to $1.3	$0.9 to $1.6	$1.2 to $2.1
2018	$35.6 to $35.6	$0.1 to $0.2	$0.3 to $0.4	$0.5 to $0.7	$0.6 to $1.0	$0.8 to $1.2	$0.9 to $1.6	$1.1 to $1.9
2019	$33.7 to $33.7	$0.1 to $0.1	$0.3 to $0.4	$0.5 to $0.7	$0.5 to $0.9	$0.7 to $1.2	$0.8 to $1.5	$1.0 to $1.8
2020	$31.8 to $32.0	$0.1 to $0.1	$0.2 to $0.3	$0.4 to $0.6	$0.5 to $0.9	$0.7 to $1.1	$0.8 to $1.5	$1.0 to $1.8
2021	$30.3 to $30.4	$0.1 to $0.1	$0.2 to $0.4	$0.4 to $0.7	$0.5 to $0.9	$0.7 to $1.1	$0.8 to $1.5	$1.0 to $1.8
2022	$28.9 to $28.9	$0.1 to $0.1	$0.2 to $0.4	$0.4 to $0.7	$0.5 to $0.9	$0.7 to $1.1	$0.8 to $1.4	$1.0 to $1.8
2023	$27.3 to $27.4	$0.1 to $0.1	$0.2 to $0.4	$0.4 to $0.6	$0.5 to $0.9	$0.7 to $1.1	$0.8 to $1.4	$1.0 to $1.7
Average	$35.0 to $35.0	$0.1 to $0.2	$0.3 to $0.4	$0.5 to $0.7	$0.6 to $1.0	$0.7 to $1.2	$0.9 to $1.6	$1.1 to $2.0

Table 4-158 Discounted Average Annual Wholesale Revenues ($ million) under Option 2 for Areas 4A, 4B and 4CDE

Year	Status Quo Scenario A - B	2a):-10% Scenario A - B	2b):-20% Scenario A - B	2c):-30% Scenario A - B	2d):-35% Scenario A - B	2e): -40% Scenario A - B	2f): -45% Scenario A - B	2g): -50% Scenario A - B
Area 4A								
2014	$25.4 to $25.4	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0
2015	$19.1 to $19.1	$0.3 to $0.3	$0.4 to $0.5	$0.7 to $0.9	$0.8 to $1.2	$1.1 to $1.5	$1.3 to $1.7	$1.5 to $2.0
2016	$18.9 to $19.0	$0.1 to $0.1	$0.1 to $0.2	$0.3 to $0.4	$0.4 to $0.5	$0.5 to $0.7	$0.6 to $0.8	$0.7 to $1.0
2017	$18.0 to $18.0	$0.1 to $0.1	$0.1 to $0.1	$0.3 to $0.3	$0.3 to $0.5	$0.4 to $0.6	$0.5 to $0.7	$0.7 to $0.9
2018	$17.0 to $16.9	$0.0 to $0.1	$0.1 to $0.1	$0.3 to $0.3	$0.3 to $0.5	$0.4 to $0.6	$0.5 to $0.7	$0.6 to $0.8
2019	$16.1 to $16.1	$0.0 to $0.1	$0.1 to $0.1	$0.2 to $0.3	$0.3 to $0.4	$0.4 to $0.6	$0.5 to $0.6	$0.6 to $0.8
2020	$15.3 to $15.3	$0.0 to $0.0	$0.1 to $0.1	$0.2 to $0.3	$0.3 to $0.4	$0.4 to $0.5	$0.5 to $0.6	$0.6 to $0.8
2021	$14.5 to $14.5	$0.0 to $0.0	$0.1 to $0.1	$0.2 to $0.3	$0.3 to $0.4	$0.4 to $0.5	$0.5 to $0.6	$0.5 to $0.7
2022	$13.8 to $13.8	$0.0 to $0.1	$0.1 to $0.1	$0.2 to $0.3	$0.3 to $0.4	$0.4 to $0.5	$0.4 to $0.6	$0.5 to $0.7
2023	$13.1 to $13.1	$0.0 to $0.0	$0.1 to $0.1	$0.2 to $0.3	$0.3 to $0.4	$0.4 to $0.5	$0.4 to $0.6	$0.5 to $0.7
Average	$17.1 to $17.1	$0.1 to $0.1	$0.1 to $0.2	$0.3 to $0.3	$0.3 to $0.5	$0.4 to $0.6	$0.5 to $0.7	$0.6 to $0.8
Area 4B								
2014	$20.5 to $20.4	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0
2015	$17.1 to $17.2	$0.0 to $0.0	$0.0 to $0.1	$0.1 to $0.1	$0.1 to $0.1	$0.1 to $0.2	$0.1 to $0.2	$0.1 to $0.2
2016	$16.8 to $16.8	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.1	$0.1 to $0.1	$0.1 to $0.1	$0.1 to $0.1
2017	$15.9 to $15.9	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.1	$0.0 to $0.1	$0.1 to $0.1	$0.1 to $0.1
2018	$15.0 to $15.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.1	$0.0 to $0.1	$0.1 to $0.1	$0.1 to $0.1
2019	$14.3 to $14.3	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.1	$0.0 to $0.1	$0.1 to $0.1	$0.1 to $0.1
2020	$13.5 to $13.6	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.1	$0.0 to $0.1	$0.1 to $0.1	$0.1 to $0.1
2021	$12.9 to $12.9	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.1	$0.1 to $0.1	$0.1 to $0.1	$0.1 to $0.1
2022	$12.2 to $12.2	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.1	$0.0 to $0.1	$0.1 to $0.1	$0.1 to $0.1	$0.1 to $0.1
2023	$11.6 to $11.6	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.1	$0.1 to $0.1	$0.1 to $0.1	$0.1 to $0.1	$0.1 to $0.1
Average	$15.0 to $15.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.1	$0.1 to $0.1	$0.1 to $0.1	$0.1 to $0.1
Area 4CDE								
2014	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0
2015	$2.7 to $2.8	$0.1 to $0.2	$0.3 to $0.5	$0.4 to $0.8	$0.5 to $1.0	$0.6 to $1.3	$0.7 to $1.8	$0.9 to $2.3
2016	$4.1 to $4.2	$0.1 to $0.1	$0.1 to $0.2	$0.2 to $0.4	$0.2 to $0.5	$0.3 to $0.6	$0.4 to $0.9	$0.4 to $1.1
2017	$3.7 to $3.8	$0.1 to $0.1	$0.1 to $0.2	$0.2 to $0.4	$0.2 to $0.5	$0.3 to $0.6	$0.3 to $0.8	$0.4 to $1.1
2018	$3.5 to $3.6	$0.1 to $0.1	$0.1 to $0.2	$0.2 to $0.4	$0.2 to $0.4	$0.3 to $0.6	$0.3 to $0.8	$0.4 to $1.0
2019	$3.3 to $3.3	$0.1 to $0.1	$0.1 to $0.2	$0.2 to $0.3	$0.2 to $0.4	$0.2 to $0.6	$0.3 to $0.8	$0.4 to $1.0
2020	$3.0 to $3.1	$0.1 to $0.1	$0.1 to $0.2	$0.2 to $0.3	$0.2 to $0.4	$0.2 to $0.5	$0.3 to $0.8	$0.4 to $1.0
2021	$3.0 to $3.0	$0.1 to $0.1	$0.1 to $0.2	$0.2 to $0.3	$0.2 to $0.4	$0.2 to $0.5	$0.3 to $0.7	$0.4 to $0.9
2022	$2.8 to $2.9	$0.1 to $0.1	$0.1 to $0.2	$0.2 to $0.3	$0.2 to $0.4	$0.2 to $0.5	$0.3 to $0.7	$0.4 to $0.9
2023	$2.6 to $2.7	$0.1 to $0.1	$0.1 to $0.2	$0.2 to $0.3	$0.2 to $0.4	$0.2 to $0.5	$0.3 to $0.7	$0.4 to $0.9
Average	$2.9 to $3.0	$0.1 to $0.1	$0.1 to $0.2	$0.2 to $0.4	$0.2 to $0.4	$0.3 to $0.6	$0.3 to $0.8	$0.4 to $1.0

Yield Increases to Commercial Halibut Fishery Resulting from U26 Savings under Option 2

This section summarizes the future yield increases that are projected to result from savings of U26 fish when PSC by vessels in the BSAI TLA is reduced under Option 2. More complete discussions regarding the reasoning behind these yield increases as well as the process involved in developing estimates can be found within Section 4.6.1.3 beginning on page 238. Additional background information in provided in the text summarizing U26-based yield increases estimated under Option 1 beginning on 298.

Table 4-159 summarizes the future yield impact in terms of harvest increases (on the left side of the table) and increases in future wholesale revenues (on the right) that are expected to result from Option 2. Increased harvests and wholesale revenues are summarized for Area 4, Other Alaska (IPHC Areas 3A, 3B, and 2C), and for regions "External" to Alaska (IPHC Areas 2B and 2A). Also note that because yield increases do not start to appear until 2019, the annual average yield changes shown in the table are averaged over 5 years rather than over the entire 10-year future period; wholesale revenues (discounted to present values), are summed over the entire 10-year future period. Over all areas coastwide, the increased yield under Option 2G is projected to average from 17 to 29 net weight mt over the years 2019 to 2023. The sum of resulting wholesale revenues over the entire period (discounted to present values) is projected to range from $1.6 to $2.8 million.

Table 4-159 Summary of Future U26-based Yield Impacts in Area 4 and in Other Areas Outside of Area 4 under Option 2

Option	Area 4 Scen A - B	Other AK Scen A - B	Scenarios A - B Scenarios A - B	Total U26 Scen A - B	Area 4 Scen A - B	Other AK Scen A - B	External Scen A - B	Total U26 Scen A - B
	Mean Annual Increase in Catch (in net weight mt) over Last Half of the 10-year Future Period				Increased DPV of Wholesale Revenue (2013 millions) over 10-Year Future Period			
2a): -10%	0.4 - 0.6	1.2 - 1.7	0.2 - 0.3	1.9 - 2.6	$0.04 - $0.06	$0.11 - $0.15	$0.02 - $0.03	$0.18 - $0.24
2b): -20%	0.9 - 1.4	2.7 - 4.0	0.5 - 0.8	4.2 - 6.1	$0.09 - $0.14	$0.25 - $0.36	$0.05 - $0.08	$0.39 - $0.58
2c): -30%	1.6 - 2.6	4.7 - 7.4	0.9 - 1.5	7.3 - 11.4	$0.16 - $0.26	$0.43 - $0.68	$0.09 - $0.14	$0.69 - $1.08
2d): -35%	2.0 - 3.4	5.8 - 9.8	1.1 - 1.9	8.9 - 15.2	$0.20 - $0.34	$0.53 - $0.90	$0.11 - $0.19	$0.84 - $1.43
2e): -40%	2.5 - 4.3	7.3 - 12.4	1.4 - 2.4	11.2 - 19.1	$0.25 - $0.43	$0.67 - $1.13	$0.14 - $0.24	$1.06 - $1.80
2f): -45%	3.1 - 5.5	9.0 - 15.8	1.8 - 3.1	13.8 - 24.4	$0.31 - $0.54	$0.82 - $1.44	$0.17 - $0.31	$1.30 - $2.30
2g): -50%	3.8 - 6.6	10.9 - 19.0	2.1 - 3.7	16.8 - 29.3	$0.37 - $0.65	$1.00 - $1.74	$0.21 - $0.37	$1.58 - $2.76

4.10 Option 3, Alternative 2: Analysis of Options Affecting Longline Catcher Processors

In this section we summarize the impacts of proposed reductions of halibut PSC limits for the Pacific cod fishery of the longline CPs (LGL-CPs) as specified under Option 3. We note that a second option that would affect all hook and line vessels that target fisheries other than Pacific cod and IFQ sablefish will be discussed in conjunction with the option to reduce PSC limit for the Longline CV Pacific cod fishery in Section 4.11. Seven suboptions are specified to reduce the current 760 mt PSC limit for LGL-CPs targeting Pacific cod as follows:

- Suboption a: Reduce status quo longline CP Halibut PSC Limits by 10 percent to 684 mt
- Suboption b: Reduce status quo longline CP Halibut PSC Limits by 20 percent to 608 mt
- Suboption c: Reduce status quo longline CP Halibut PSC Limits by 30 percent to 532 mt
- Suboption d: Reduce status quo longline CP Halibut PSC Limits by 35 percent to 494 mt
- Suboption e: Reduce status quo longline CP Halibut PSC Limits by 40 percent to 456 mt
- Suboption f: Reduce status quo longline CP Halibut PSC Limits by 45 percent to 418 mt
- Suboption g: Reduce status quo longline CP Halibut PSC Limits by 50 percent to 360 mt

A summary of methodological issues relevant to these options is provided below. The methodology discussion is followed by an overview of impacts to both the groundfish participants and the commercial halibut fishery. The overview is followed by two separate sections that describe in more detail the impact to the groundfish fisheries and to the commercial halibut fishery.

Methodological Issues Relevant to the Options to Reduce PSC Limits for LGL-CPs

The assessment of impacts to the longline CP Pacific cod fishery specifically acknowledges the fact that the fleet has formed its own cooperative that operates without specific regulation from NMFS. While the specific operating rules of the cooperative are not publically known, it is presumed to operate in a manner similar to the A80 cooperatives. Thus, it is presumed that within the cooperative, PSC mortality is apportioned to the companies that own participating vessels. In addition, it is presumed that halibut PSC mortality may be transferred from one owner to another.

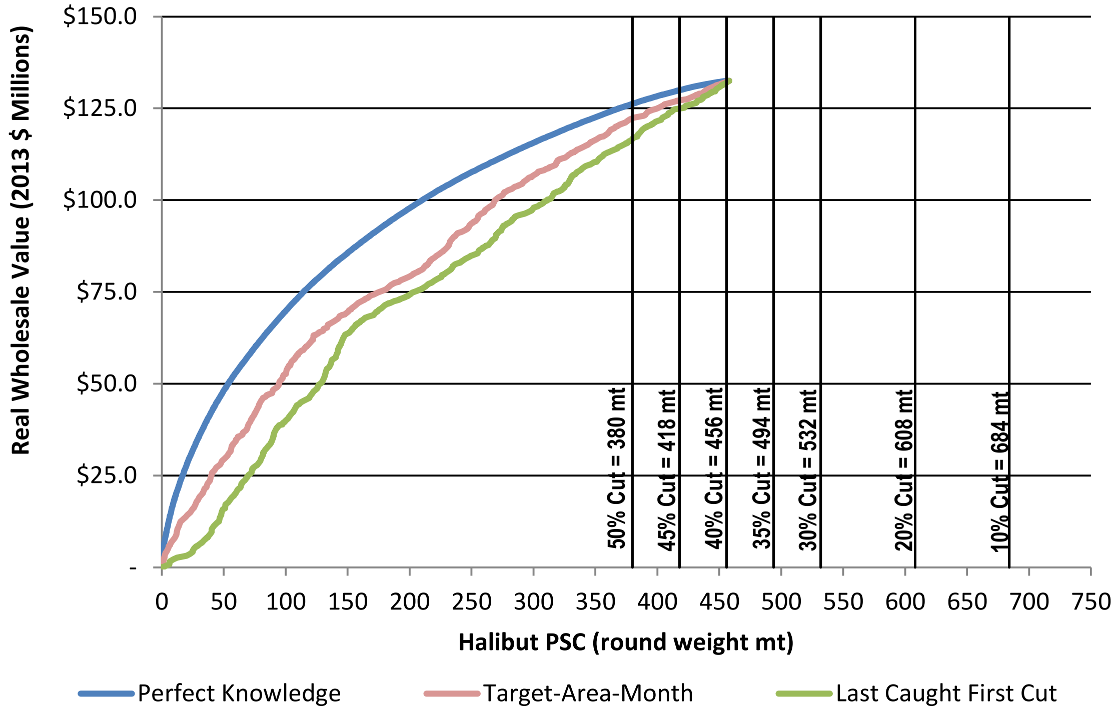
As with other options assessed for the BSAI TLA and A80-CP fisheries, the assessment of impacts of the proposed reductions in PSC limits for the longline CP Pacific cod fishery is accomplished through the use of the IMS Model that is described in considerable detail in Section 4.6.2.

For each suboption (Option 3a–3g), the IMS Model is run with 10,000 iterations under two different scenarios that represent a low impact case (Scenario A) and a high impact case (Scenario B). The two scenarios are basically the same as those used in the assessment of impacts to A80-CPs. The two scenarios are described below:

- Scenario A: Under Scenario A it is assumed that operators of LGL-CPs operating in the Pacific cod fishery, using sector-wide fishery data for the years 2008 to 2013, determine a ranking for each month and NMFS management area based on the wholesale revenue per ton of halibut mortality. They then collectively determine which months and areas must be avoided in order for the cooperative to remain below the PSC limit that has been imposed. Figure 4-81 displays this ranked target-area progression used when 2013 is the basis year. Also shown in the figure are lines representing a last-caught, first-cut catch progression and a fully optimized line that assumes perfect knowledge. For analytical purposes, it is assumed that operators know in advance how much halibut savings will be created by dropping these target months from their repertoire. It is also worth noting that the last-caught, first-cut catch progression in Figure 4-81 is the same progression line shown in Figure 4-40 in Section 4.4.4.5. The figure also includes a vertical line running up the horizontal axis that corresponds to PSC limits imposed under Option 3. Finally it is important to note that Figure 4-81 graphically represents 2013—only one of the six basis years between 2008 and 2013—other basis year will generate different levels of mitigation.
- Scenario B: Under Scenario B it is assumed that each LGL-CP company is assigned its own halibut cap by the cooperative. Companies that have excess PSC mortality are assumed to transfer PSC mortality to companies that don't have enough PSC mortality. It is also assumed, however, that each company with excess PSC mortality holds back five percent of their halibut in case they need it later in the year. Finally, Scenario B assumes that if transfers of halibut are not available, then companies with a PSC mortality shortfall will prioritize their fishery efforts by month. This month-based ranking system assumes that each company reviews its historical fishing data and ranks each month in terms of the wholesale revenues per halibut PSC. Once they know how much PSC they must cut, they choose the set of months in which all of their vessels will operate dropping the worst months in order reduce their PSC usage. This is the same methodology used in scenario B for the A80 fleet. A graphical representation of company-specific halibut PSC limits and impacts is explained in the text preceding Figure 4-70 on page 284.

Scenario A ends up having a lower impact than Scenario B in part because of the assumption that transfers of allocations Pacific cod and of PSC among cooperative members is assumed to be "friction-free". If a vessel needs additional PSC, is it assumed that another vessel or company will provide it.

Figure 4-81 Proposed Scenario A PSC Limit Reduction for LGL-CPs, 2013



In Figure 4-81 above, the section of the line located to the right of any option is the amount of PSC cut and the amount of wholesale revenue that is considered forgone under each halibut PSC reduction option. Table 4-160 details the impacts to the LGL-CP Pacific cod target fishery under each scenario for each of the Basis Years. In the table we see that the 50 percent limit reduction in the Pacific cod target fishery, under Scenario A in 2013, would decrease wholesale revenues and halibut PSC by $10.4 million and 79 mt, respectively. Under Scenario B, the same 50 percent PSC reduction would result in a decrease of $15.7 million in wholesale revenues and 93 mt of halibut PSC. Again, these values represent the section of line that falls to the right 50 percent reduction option.

Table 4-160 also reveals that not all options have impacts in every year. For example, options to reduce halibut PSC by 10 percent or 20 percent have no impacts in any of the basis years under Scenario A or Scenario B. These are the result of total halibut PSC not surpassing any of the proposed halibut PSC reductions in any of the base years. Total wholesale revenues and halibut PSC for each individual year were discussed in section 4.4.2.5.

Table 4-160 LGL-CP Halibut PSC and Wholesale Revenue (2013$millions) Amounts Cut from Each Basis Year by Alternative and Scenario

Alternative	Scenario	2008	2009	2010	2011	2012	2013
		MT Halibut PSC Cut in Each Basis Year					
Status Quo	Scenario A	-	-	-	-	-	-
	Scenario B	-	-	-	-	-	-
3a: -10%	Scenario A	-	-	-	-	-	-
	Scenario B	-	-	-	-	-	-
3b: -20%	Scenario A	-	-	-	-	-	-
	Scenario B	-	-	-	-	-	-
3c: -30%	Scenario A	34	30	-	-	19	-
	Scenario B	66	38	-	-	46	-
3d: -35%	Scenario A	75	63	-	-	56	-
	Scenario B	91	76	23	-	86	-
3e: -40%	Scenario A	110	101	34	23	94	3
	Scenario B	125	122	54	49	107	19
3f: -45%	Scenario A	147	141	72	60	138	40
	Scenario B	162	160	99	77	152	57
3g: -50%	Scenario A	186	184	110	97	170	79
	Scenario B	205	202	123	113	185	93
		Real Wholesale Revenues ($2013 millions) Cut in Each Basis Year					
Status Quo	Scenario A	-	-	-	-	-	-
	Scenario B	-	-	-	-	-	-
3a: -10%	Scenario A	-	-	-	-	-	-
	Scenario B	-	-	-	-	-	-
3b: -20%	Scenario A	-	-	-	-	-	-
	Scenario B	-	-	-	-	-	-
3c: -30%	Scenario A	$2.9	$2.1	-	-	$2.7	-
	Scenario B	$4.8	$5.2	-	-	$6.6	-
3d: -35%	Scenario A	$6.0	$5.3	-	-	$7.2	-
	Scenario B	$9.1	$10.6	$2.2	-	$11.3	-
3e: -40%	Scenario A	$9.7	$11.7	$2.8	$0.8	$12.2	$0.4
	Scenario B	$15.6	$18.5	$6.7	$5.1	$16.6	$4.2
3f: -45%	Scenario A	$15.2	$18.4	$12.9	$5.0	$18.3	$4.8
	Scenario B	$22.0	$25.2	$13.3	$9.1	$22.7	$10.3
3g: -50%	Scenario A	$21.8	$23.9	$22.0	$10.5	$24.8	$10.4
	Scenario B	$29.2	$31.9	$18.4	$15.5	$31.5	$15.7

4.10.1 Overview of Groundfish and Halibut Impacts under Option 3

As previously noted, this summary section of impacts contains tables and figures that summarize the impacts of proposed options to reduce halibut PSC limits for the LGL-CP Pacific cod target fishery, and resulting increased harvests in the commercial halibut fishery in each of the Area 4 subareas and Area 4 as whole. The section begins by summarizing revenue and harvest impacts for both groundfish and commercial halibut fisheries across all suboptions, as shown in Table 4-161. The subsequent sections provide additional details for the groundfish fishery and for the commercial halibut fishery

Additional details covered in the later section for groundfish include estimates of annual average revenue, annual average harvest impacts to the Pacific cod fishery, impacts to crew, and a summary of modelled behavior changes that are seen as the LGL-CPs reduce groundfish harvest to meet the new PSC constraints. Additional details provided for the halibut fishery include annual average harvest and wholesale revenue impacts to each subarea and Area 4 as a whole under each scenario and suboption (both in tables and graphically). Finally, future U26-based yield impacts in Area 4, and in other areas outside of Area 4 are summarized for all of the options. We note that statistical details and histograms summarizing future revenue and harvest impacts pertaining to each individual halibut PSC limit reduction can be found in the Appendix D, and that summaries of impacts to communities and regions in Alaska and for regions outside the state are found in Sections 4.13.1.3, 4.13.2.3 and 4.13.2.4.

Table 4-161 is organized into four basic quadrants. The upper half focuses on projected impacts to wholesale revenues while the lower half focuses on PSC and harvests. The left side of the table summarizes the negative impacts on the affected groundfish sectors while the right summarizes the positive impacts for the commercial halibut fishery. As discussed in the methodology section above, Scenario A is intended to serve as a lower impact case and Scenario B is intended to serve as a higher impact case—for the groundfish fishery, the difference between Scenario A and Scenario B can be quite large, while the differences between the two scenarios for the commercial halibut fishery are relatively small. (This contrasts with A and B Scenarios for impacts to the BSAI TLA fisheries, for which differences across scenario were significant for both groundfish and halibut.) It should also be noted that the scenarios do not represent a decision point—the Council and NMFS have no immediate control over whether Scenario A or Scenario B is closer to reality. In the table it is noted that Options 3a and 3b, which would reduce the LGL-CP Pacific cod PSC limit by 10 and 20 percent, are projected to have no direct material impact on LGL-CPs. Reducing the cap by 20 percent would preclude future increases in PSC.

Table 4-161 Summary of Impacts Over All Reduction Options Affecting LGL-CPs

	Groundfish Impacts				Commercial Halibut Fishery Impacts							
	Scenario A	Scenario B	Scenario A	Scenario B	Scenario A				Scenario B			
Option	All Areas		All Areas		4A	4B	4CDE	Area 4	4A	4B	4CDE	Area 4
	PSC Limit (r.w. mt)		10-year Sum of Changes to the DPV Wholesale Revenues (2013 $Millions) Relative to the Status Quo									
Status Quo	760		$1,276.43	$1,276.43	$171.18	$149.76	$28.87	$349.81	$171.20	$149.77	$29.52	$350.49
3a): -10%	684		These options are non-constraining and have no material impact on the affected participants									
3b): -20%	608											
3c): -30%	532		($10.40)	($22.27)	$0.55	$1.26	$0.07	$1.88	$0.77	$0.51	$1.89	$3.17
3d): -35%	494		($24.94)	($44.48)	$0.86	$2.04	$1.26	$4.16	$1.24	$0.89	$3.58	$5.71
3e): -40%	456		($50.31)	($89.49)	$2.41	$2.93	$2.25	$7.59	$2.54	$1.11	$6.19	$9.84
3f): -45%	418		($100.10)	($137.59)	$4.24	$3.15	$4.90	$12.30	$3.82	$1.28	$9.34	$14.44
3g): -50%	380		($152.18)	($191.06)	$7.08	$3.63	$6.20	$16.91	$4.71	$1.62	$12.47	$18.80
	Groundfish Impacts				Commercial Halibut Fishery Impacts (net weight mt)							
	Scenario A	Scenario B	Scenario A	Scenario B	Scenario A				Scenario B			
Option	PSC taken (r.w. mt)		Groundfish (1,000s mt)		4A	4B	4CDE	Area 4	4A	4B	4CDE	Area 4
	Average Annual Change from the Status Quo											
Status Quo	520.5	520.5	0.1	0.1	714.9	626.9	125.2	1,467.1	715.2	627.2	128.2	1,470.6
3a): -10%	These options are non-constraining and have no material impact on the affected participants											
3b): -20%												
3c): -30%	-13.8	-25.0	-0.9	-1.9	2.2	5.3	0.3	7.9	3.1	2.2	8.0	13.3
3d): -35%	-32.3	-45.7	-2.1	-3.9	3.4	8.6	5.4	17.4	5.1	3.8	15.2	24.1
3e): -40%	-60.6	-79.3	-4.4	-8.0	10.1	12.4	9.6	32.1	10.6	4.7	26.3	41.5
3f): -45%	-99.7	-117.6	-8.9	-12.4	17.8	13.4	20.9	52.1	16.1	5.5	39.6	61.2
3g): -50%	-137.6	-153.3	-13.7	-17.3	29.9	15.4	26.4	71.6	19.8	6.9	52.8	79.6

In Table 4-161 above, each successive suboption represents a bigger cut in the existing PSC limits and a correspondingly greater level in the present value of foregone wholesale revenues over the 10-year future period. With a 30 percent cut in limits, LGL-CPs are projected to realize from between $10 and $32 million in foregone discounted future revenue. With the 50 percent cut in the current PSC limits, LGL-CPs are projected to generate between $152 and $191 million less wholesale revenues over the 10-year future period, discounted to present value.

In the upper right quadrant of Table 4-161, we see that the commercial halibut fishery can be expected to gain between $5.5 and $6.9 million in discounted present value wholesale revenues under Option 3c. With a 50 percent cut in PSC limits, the overall discounted present value wholesale revenue gains for the commercial halibut fishery increase up to an average of $22 million. While the two different Scenarios result in large differences over Area 4 as a whole, gains to 4A and 4B are greater under Scenario A, while gains to Area 4CDE are greater under Scenario B. As indicated above, decision makers and regulatory agencies currently don't have the degree of control within the fishery to force PSC reductions to occur in one IPHC area or another; similarly, decisions maker don't control how the industry responds to PSC limit reduction options and can't force users to adopt Scenario B over Scenario A. Under Option 3g (a 50 percent cut in PSC limit) Area 4CDE is expected to see increased annual average harvests of 26.4 net weight mt, while under Scenario B, the annual increase is projected to average 52.8 net weight mt.

As in all of the options to reduce PSC limits, one of the key points is the fact that halibut PSC reductions in the affected groundfish sector are significantly larger than the gains to the halibut fishery in Area 4. There are several reasons for this:

1) PSC are reported in round weight mt and data for the halibut fishery are reported in net weight mt—to convert to net weight mt, multiply the round weight mt by 0.75.
2) Most of the gains in Area 4 halibut due to PSC reductions result from savings of O26 halibut. The "rule of thumb" is that 60 percent of the PSC are O26 fish and the remaining 40 percent are U26. To convert PSC in round weight mt to O26 net weight mt, multiply by 0.75 then multiply by 0.6. The result is a number much closer to the Area 4 harvest increases.
3) It is assumed that on average U26 fish taken as PSC do not recruit into the fishery for another five years. While the IMS Model does account for increased yield due to U26 savings, the increased yields are distributed over entire range of Pacific halibut, and only about 20 percent (approximately) of the future gains are expected to be realized within Area 4.

4.10.1.1 Impacts on Longline Catcher Processors

In this section we examine in more detail the impacts of the PSC limit reduction options affecting LGL-CPs. The section contains three parts that focus on: a) projected impacts to wholesale revenues for LGL-CPs; b) projected impacts on groundfish harvests for LGL-CPs; and c) behavioral changes of LGL-CPs while meeting the reduced PSC limits.

Revenue Impacts for LGL-CPs

This section provides additional details on the impacts to revenues and earning projected for LGL-CPs resulting from options to reduce PSC Limits. The following figures and tables are used to summarize these additional details.

- Figure 4-82 Annual Average Wholesale Revenue and Halibut PSC under the PSC Limit Reduction Options for LGL-CPs
- Table 4-162 Annual Average Future Revenue Impacts of the Option 3 on LGL-CPs
- Table 4-163 Average Annual Impacts of Option 3 to Crew Members on LGL-CPs

Figure 4-82 provides a graphical summary of the annual average PSC reductions by LGL-CPs needed to meet the lower PSC limits under all options, along with the projections of the discounted annual average wholesale revenues they are expected to forego. The figure shows the annual average catch progression lines that are assumed under Scenarios A and B, along with alternative catch progression lines that could have been used if it were assumed that LGL-CPs had perfect knowledge about their upcoming harvests, or conversely that the LGL fishery did not make any behavioral changes and instead reduced its PSC using a last-caught, first-cut methodology. In the figure it is clear that outcomes under Scenario A and Scenario B fall between the two more extreme PSC reduction assumptions. While the Scenario B catch progression does, in fact, yield a better outcome than the last-caught, first-cut catch progression line that represents the actual annual average monthly harvests from 2008–2013, the difference is not that large , which may be an indicator that the LGL-CPs are already operating in a manner that keeps PSC mortality at relatively low levels.

The bolded ✚ markers on the Scenario A and B catch progression lines indicate the spots at which PSC cuts occur under each option. The color-coded segments of the line indicate the incremental amounts by which both annual average present value wholesale revenues and PSC are projected to change with each incremental change in the PSC limits. For example, the dark blue line segment from the origin to the first ✚ marker is the portion of the average year that is expected to remain "open" under all options. The entire portion of the line to the right of the first ✚ marker represents the projected cuts in annual average discounted present value of wholesale revenue and PSC with a 50-percent reduction in the limit. The lighter blue colored segments between the first ✚ on the left and the second ✚ from the left represent the incremental cuts expected when moving between a 45 percent reduction in the PSC limit to a 50 percent reduction. Each subsequent shaded segment represents incremental cuts for the corresponding option.

Figure 4-82 Annual Average Wholesale Revenue and Halibut PSC under the PSC Limit Reduction Options for LGL-CPs

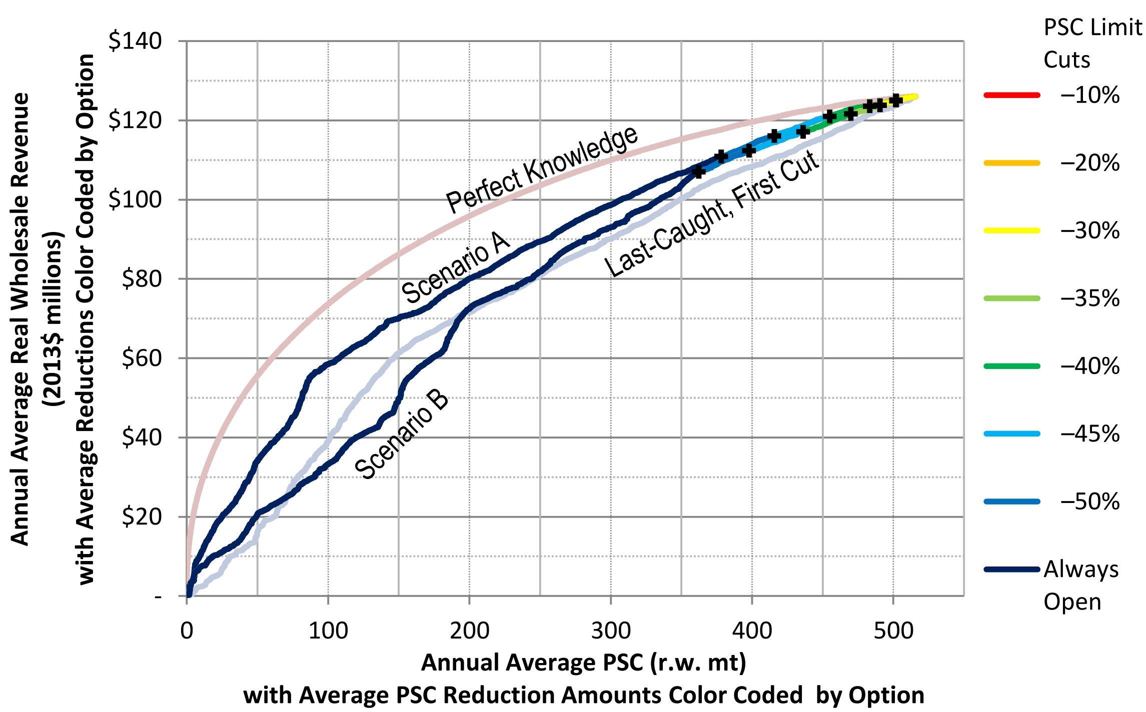


Table 4-162 summarizes the annual average impacts to wholesale revenues (discounted to present values) for LGL-CPs projected for each future year resulting from potential PSC limit reduction options. The first column of the table shows expected average future values under the status quo, while the columns to the right show the range of projected future values under each of the PSC limit reduction options. As indicated earlier, Options 3a and 3b are not expected to have a direct material impact on LGL-CPs, noting that choosing 3b would limit any future increases in PSC by LGL-CPs. At the bottom of the table are the annual average impacts of wholesale revenues over all years during the 10-year future period (discounted to present values). This set of annual average revenue impacts mirrors the revenue impacts shown in the figure above.

Table 4-162 Annual Average Future Revenue Impacts of the Option 3 on LGL-CPs

Year	DPV of Wholesale Revenue Under the Status Quo	3a: -10%	3b: -20%	3c: -30%	3d: -35%	3e: -40%	3f: -45%	3g: -50%
		Forgone Annual Average Discounted Present Value of Wholesale Revenue Under the Alternatives						
	Scen. A - B	Scen. A - B	Scen. A - B	Scen. A - B	Scen. A - B	Scen. A - B	Scen. A - B	Scen. A - B
2014	$157.1	These options are non-constraining and have no material impact on the affected participants.		$1.3 - $2.8	$3.1 - $5.5	$6.3 - $11.1	$12.4 - $17.1	$18.9 - $23.7
2015	$149.2			$1.2 - $2.6	$2.9 - $5.2	$5.9 - $10.6	$11.8 - $16.2	$17.9 - $22.5
2016	$141.7			$1.2 - $2.5	$2.8 - $5.0	$5.6 - $10.0	$11.2 - $15.4	$17.0 - $21.4
2017	$134.7			$1.1 - $2.4	$2.6 - $4.7	$5.4 - $9.5	$10.7 - $14.7	$16.2 - $20.3
2018	$127.9			$1.1 - $2.3	$2.5 - $4.5	$5.1 - $9.1	$10.1 - $13.9	$15.4 - $19.3
2019	$121.5			$1.0 - $2.1	$2.4 - $4.3	$4.8 - $8.6	$9.6 - $13.2	$14.6 - $18.3
2020	$115.5			$1.0 - $2.0	$2.3 - $4.1	$4.6 - $8.2	$9.1 - $12.6	$13.9 - $17.4
2021	$109.7			$0.9 - $1.9	$2.2 - $3.9	$4.4 - $7.8	$8.7 - $11.9	$13.2 - $16.6
2022	$104.2			$0.9 - $1.8	$2.0 - $3.7	$4.2 - $7.4	$8.2 - $11.3	$12.5 - $15.7
2023	$99.0			$0.8 - $1.8	$1.9 - $3.5	$3.9 - $7.0	$7.8 - $10.8	$11.9 - $14.9
Average	$126.0			$1.0 - $2.2	$2.5 - $4.4	$5.0 - $8.9	$10.0 - $13.7	$15.2 - $19.0

Table 4-163 summarizes the impacts of the PSC limit reduction options to crew members and payments to crew members under Scenarios A and B with impact under Scenario A shown in the upper half of the table and Scenario B in the lower half. Similar tables were generated for the existing conditions in Section 4.4.4.1 on page 179, although it should be noted that the earlier tables included estimates of crew payments generated in CDQ groundfish fisheries, while the table below includes only crew payments from non-CDQ effort. It should also be noted that dollar values shown in the table are discounted out over the 10-year future period to reflect present values of future payments—the discounting results in dollar values that are approximately 20 percent less than values that are not discounted to reflect the present value of the payments.

The first row of data in the table shows the annual average discounted present value of payments to crew under the status quo ($44 million) over the future period, and then shows the projected reductions in the annual average present value of crew payments under the options. The table then demonstrates the impacts of two alternative ways to distribute the reductions among crew members: companies can keep the same number of crew employees as under the status quo (estimated at 1,278), and reduce everyone's compensation proportionally (as shown in the 2nd row of numbers for each scenario); or they can cut the number of person employed and maintain the same level of payments per person (estimated at $34,510 under the status quo), as shown in the third row of numbers. Most likely the end result will be a combination of both.

Under Option 3g and Scenario A, if it assumed the companies keep the same number of employees per year, then the cutting back on PSC is projected to reduce each crew person's pay by an average of $4,149 per year (discounted to present values). Under Scenario B assuming all employees per year remain, the present value of the average annual pay reduction per employee is projected to be $5,209. If companies instead choose to cut the number employees, the reductions range from an annual cut of 154 employees (fleet-wide) under Scenario A to a reduction of 193 persons under Scenario B.

Table 4-163 Average Annual Impacts of Option 3 to Crew Members on LGL-CPs

	Status Quo	3a: –10%	3b: –20%	3c: –30%	3d: –35%	3e: –40%	3f: –45%	3g: –50%
Scenario A	**SQ**	**Impacts relative to the Status Quo Under Scenario A**						
DPV of Average Payments to Crew (2013 $millions)	$44.12	-	-	($0.36)	($0.87)	($1.76)	($3.49)	($5.30)
Which can be achieved by either reducing payments per person or reducing the number of persons employed:								
Payments Per Person (DPV) in (2013 $)	$34,510	-	-	($285)	($678)	($1,375)	($2,731)	($4,149)
Employee Cuts to Maintain SQ Income/person	1,278.3	-	-	-10.5	-25.1	-50.9	-101.2	-153.7
Scenario B	**SQ**	**Impacts relative to the Status Quo Under Scenario B**						
DPV of Average Payments to Crew (2013 $millions)	$44.12	-	-	($0.78)	($1.55)	($3.13)	($4.80)	($6.66)
Which can be achieved by either reducing payments per person or reducing the number of persons employed:								
Payments Per Person (DPV) in (2013 $)	$34,510	-	-	($610)	($1,214)	($2,446)	($3,755)	($5,209)
Employee Cuts to Maintain SQ Income/person	1,278.3	-	-	-22.6	-45.0	-90.6	-139.1	-193.0

Note: Payments to crew members described in the existing conditions section included incomes from CDQ fisheries.

Harvest Impacts for LGL-CPs

This section provides additional details on the harvest and PSC impacts to LGL-CPs from options to reduce PSC Limits. The following figures and tables are used to summarize these additional details.

- Figure 4-83 Overall Impacts to Total Groundfish Harvests in LGL-CP Fisheries under
- Table 4-164 Annual Average Impacts of Option 3 to Future Harvests in LGL-CP Target Fisheries
- Figure 4-84 Percentage Change from Status Quo in LGL-CP Pacific Cod Harvests under Option 3

Figure 4-83 provides an overall picture of the projected annual average impacts on groundfish harvests that are expected with the PSC limit reduction percentages under Option 3. The two pies represent harvest impacts under Scenario A and Scenario B. The large portions of the pies represent the percentage of the total harvest that remains uncut under all of the options. Under Scenario A (which assumes that LGL-CPs use an area-month ranking to determine which fisheries to avoid) a minimum of 88 percent of overall groundfish harvests are expected to remain uncut regardless of the option chosen. Under Scenario B, (which relies more on individual company choices and assumes greater friction in transfers of quota), a minimum average of 84.7 percent of overall harvests is expected to remain under Option 3g with the largest of the proposed PSC limit cuts. It should be noted that the individual slices of the pie charts represent the incremental amounts of groundfish that are expected to be cut under the different limit reduction percentages. The labels for each suboption indicate the cumulative amount cut, and include amounts from all of preceding cuts (i.e., moving back in a counter-clockwise manner).

Figure 4-83 Overall Impacts to Total Groundfish Harvests in LGL-CP Fisheries under Option 3

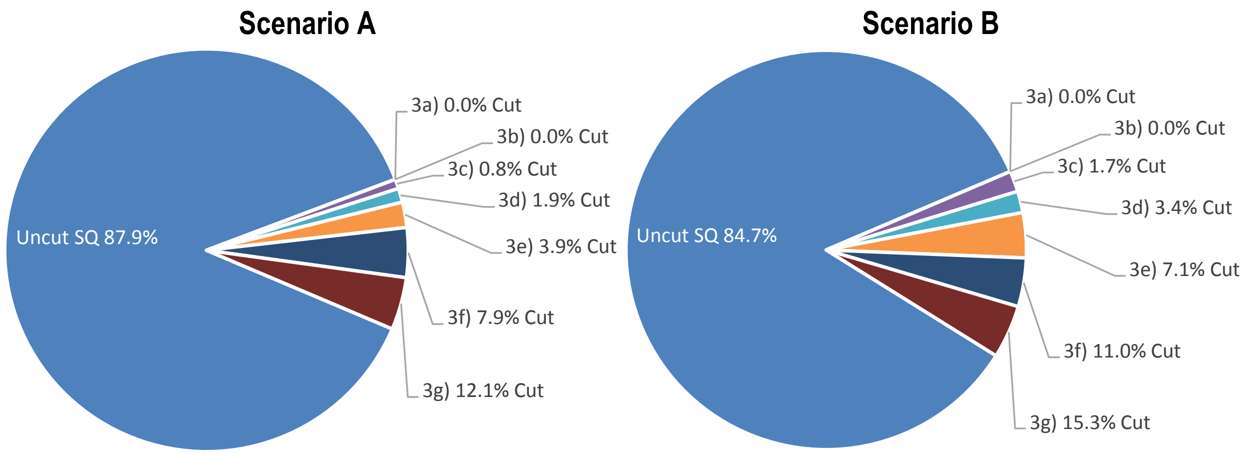
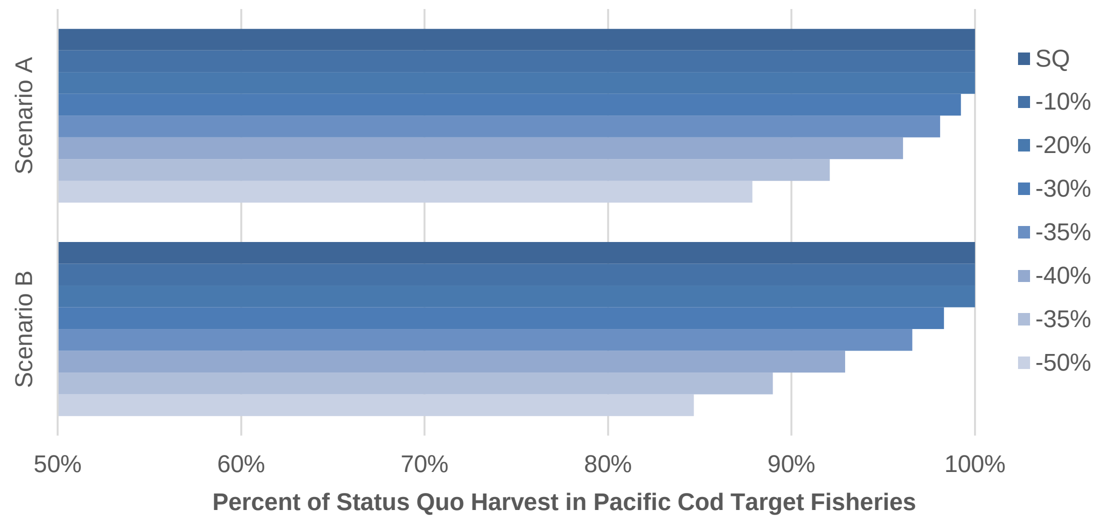


Table 4-164 summarizes annual average impacts from the PSC limit reduction options on future harvest levels for the two target fisheries of LGL-CPs to which PSC is assigned, and for all targets combined. The same impacts as a percent of the status quo are represented graphically in Figure 4-84, but only for the Pacific cod fishery. In both the table and the figure below, the differential impacts between Scenarios A and B are shown. While Option 3 does not affect LGL-CP activities in target fisheries other than Pacific cod or IFQ sablefish (e.g. Greenland turbot), harvests in those targets are included in the interest of showing a more complete picture of LGL-CP activities. We also note that Option 4, which is summarized in Section 4.11, includes suboptions that would reduce PSC limits for those other target fisheries. It should also be noted that no changes in harvests are projected under Options 3a and 3b. Under Option 3c, the first of the PSC limit reduction options that materially affects LGL-CPs, annual average Pacific cod harvests are expected to range between 112,119, and 111,081 mt. Under Option 3g (which imposes a 50 percent cut in the PSC limit down to 380 mt), annual average harvests in the Pacific cod target fishery over the 10-year future period are expected to range between 99,284 mt and 95,672 mt.

Table 4-164 Annual Average Impacts of Option 3 to Future Harvests in LGL-CP Target Fisheries

	Status Quo	3a: – 10 %	3b: – 20 %	3c: – 30%	3d: – 35%	3e: – 40%	3f: – 45%	3g: – 50%
Annual Average Harvests (MT) in the Pacific Cod Target Fishery								
Scenario A	112,981	112,981	112,981	112,119	110,850	108,553	104,044	99,284
Scenario B	112,981	112,981	112,981	111,081	109,118	104,990	100,540	95,672
Annual Average Harvests (MT) in All Other Target Fisheries Excluding Sablefish								
Scenario A	2,087	2,087	2,087	2,087	2,087	2,087	2,087	2,087
Scenario B	2,087	2,087	2,087	2,087	2,087	2,087	2,087	2,087
Annual Average Harvests (MT) in All LGL-CP Target Fisheries (Excluding Sablefish)								
Scenario A	115,068	115,068	115,068	114,206	112,938	110,641	106,131	101,372
Scenario B	115,068	115,068	115,068	113,168	111,205	107,078	102,627	97,759

Figure 4-84 Percentage Change from Status Quo in LGL-CP Pacific Cod Harvests under Option 3



Behavioral Changes of LGL-CPs in Response to the Options

Table 4-165 summarizes the behavioral changes that are both explicitly and implicitly modeled in the analysis for LGL-CPs. For example, a common assumption may be that reducing total groundfish harvest will reduce the amount of halibut encounters proportionately. Table 4-165 summarizes the total change in groundfish harvest and halibut PSC as estimated in the analysis using the IMS model along with changes in halibut encounters and halibut encounter rates. By examining these three measures separately, it is possible to determine the impact of behavioral change undertaken by the LGL-CPs. As shown, changes in halibut encounters are in fact larger than changes in total groundfish harvest, thereby decreasing halibut encounter rates relative to the status quo. This is an outcome of the methodology used under both scenarios for LGL-CPs and it makes intuitive sense given the fleet's assumed ability to prioritizing fishing operations so they can eliminate the worst area-month combinations, thus eliminating fishing operations with higher halibut encounter rates.

As noted previously, LGL-CPs are not affected under Options 3a and 3b, but with Option 3c, under scenario A, a 30 percent reduction in halibut PSC limits is projected to result reduce the annual average groundfish harvest by 0.7 percent. This reduction leads to a halibut PSC reduction of 2.7 percent, which is primarily caused by a decrease of 1.8 percent in the annual average halibut encounter rate. This indicates that by having the ability to optimize fishing, a small decrease in total groundfish harvested can lead to larger reductions in halibut PSC. Under Scenario B with the same PSC limit reduction option (a 30 percent cut), a 1.7 percent reduction in groundfish harvest combined with a 4.6 percent decrease in halibut encounters creates a 4.8 percent decrease in PSC.

We note here that technically speaking, the total amount of halibut PSC taken in any fishery is the multiplicative product of three factors, all of which can be changed through behavioral changes: 1) total groundfish; 2) the halibut encounter rate (HER)—which equals the total halibut encounter (in kg) ÷ total groundfish in mt); and 3) the discard mortality rate DMR). From a mathematical perspective:

PSC (kg) = Groundfish (mt) × HER (in kg/mt) × DMR;

Behavioral changes can independently affect any of these measures. As an example, assume that a vessel reduced its groundfish harvest by 10 percent, and because there were no behavior changes, it realized no change at all it its halibut encounter rate. This implies that halibut encounters would have also decreased by 10 percent, and since DMRs are fixed in regulation, the resulting change in PSC would in fact be equal a 10 percent change. In all of the results shown in Table 4-165, the percentage change in PSC is greater than the percentage change in groundfish; therefore, behavioral changes, reducing the amount of halibut encounters by a percentage greater than reductions in groundfish, must have taken place.

Table 4-165 Groundfish Harvest Changes and Resulting Changes in Halibut Encounters, Halibut Encounter Rates (HER), and PSC for LGL-CPs

	Scenario A							
	SQ	**3a: -10%**	**3b: -20%**	**3c: -30%**	**3d: -35%**	**3e: -40%**	**3f: -45%**	**3g: -50%**
Variable	**Status Quo and Changes (Δ) in Annual Average Outcomes under the Suboptions**							
Groundfish (mt)	115,068	-	-	-861	-2,130	-4,427	-8,937	-13,696
Encounters (mt)	5,114	-	-	-128	-302	-576	-962	-1,334
HER (kg/mt)	44.44	-	-	-0.79	-1.84	-3.42	-5.32	-7.15
PSC (r.w. mt)	521	-	-	-14	-32	-61	-100	-138
	Percentage Change from SQ Under the Suboptions							
Groundfish (Δ %)	-	-	-	-0.7%	-1.9%	-3.8%	-7.8%	-11.9%
Encounters (Δ %)	-	-	-	-2.5%	-5.9%	-11.3%	-18.8%	-26.1%
HER (Δ %)	-	-	-	-1.8%	-4.1%	-7.7%	-12.0%	-16.1%
PSC (Δ %)	-	-	-	-2.7%	-6.2%	-11.7%	-19.2%	-26.4%
	Scenario B							
	3SQ	**3a: -10%**	**3b: -20%**	**3c: -30%**	**3d: -350%**	**3e: -40%**	**3f: -45%**	**3g: -50%**
Variable	**Status Quo and Changes (Δ) in Annual Average Outcomes under the Suboptions**							
Groundfish (mt)	115,068	-	-	-1,900	-3,863	-7,990	-12,441	-17,309
Encounters (mt)	5,114	-	-	-235	-432	-760	-1,139	-1,488
HER (kg/mt)	44.44	-	-	-1.33	-2.34	-3.79	-5.71	-7.35
PSC (r.w. mt)	521	-	-	-25	-46	-79	-118	-153
	Percentage Change from SQ Under the Suboptions							
Groundfish (Δ %)	-	-	-	-1.7%	-3.4%	-6.9%	-10.8%	-15.0%
Encounters (Δ %)	-	-	-	-4.6%	-8.5%	-14.9%	-22.3%	-29.1%
HER (Δ %)	-	-	-	-3.0%	-5.3%	-8.5%	-12.9%	-16.5%
PSC (Δ %)	-	-	-	-4.8%	-8.8%	-15.3%	-22.6%	-29.4%

4.10.1.2 Impacts of Option 3 on the Commercial Halibut Fishery

This section provides a summary of impacts on the commercial halibut fishery of proposed options to reduce PSC limits for LGL-CPs in the Pacific cod target fishery, and is divided into three parts:

- Harvest Impacts to the Commercial Halibut Fishery
- Revenue Impacts to the Commercial Halibut Fishery
- Yield Increases to the Commercial Halibut Fishery Resulting from U26 Savings

Harvest Impacts to the Commercial Halibut Fishery of Option 3

For ease of use, the commercial halibut fishery harvest portions of the overall summary table for Option 3 above are reproduced below in Table 4-166. With the proposed PSC limit reductions for the LGL-CPs, it is projected that the entire Area 4 halibut fishery could realize an increase in annual average harvest volumes by up to 29 percent if option 3g were chosen. Under that option, projected increases to harvest volumes in Area 4CDE would be expected to range between 232 and 265 percent of status quo levels. As noted in the discussion previously, the relationship between reductions in PSC from LGL-CPs (as measured in round weight mt) and increases in O26 halibut harvest (measured in net weight mt) can be very roughly approximated by a 2 to 1 ratio. In other words, for every 100 mt (net weight) increase in harvests in the commercial halibut fishery, a decrease in PSC of by LGL-CPs of approximately 200 mt (round weight) is required.

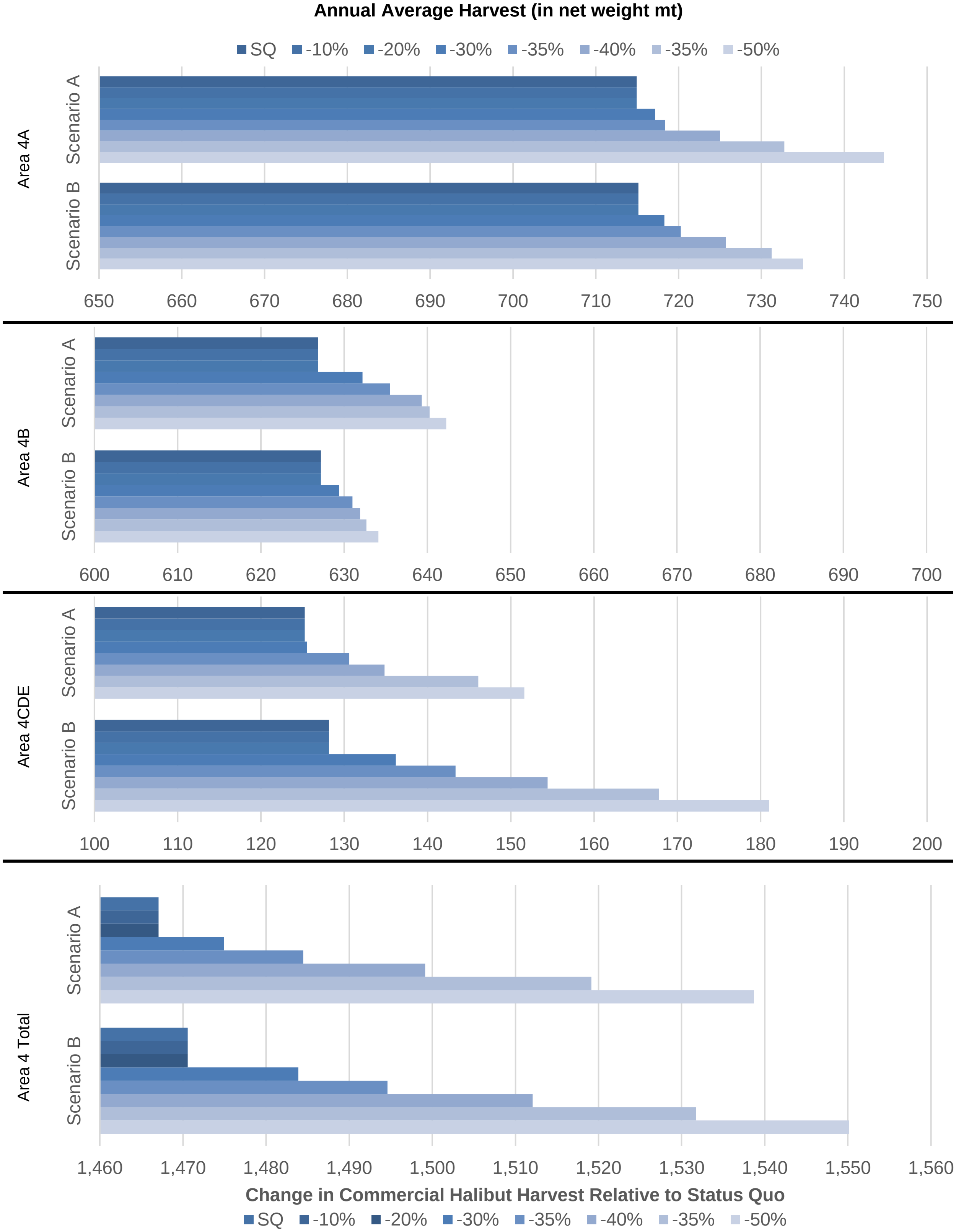
Another key point to take away from Table 4-166 is that the distribution of harvest changes across IPHC areas varies noticeably depending on the Scenario. Under Scenario A, a greater percentage of the PSC reductions occur in Area 4A and 4B than under Scenario B, which tends to elicit a greater impact in Area 4CDE. Under Option 3g and Scenario A, 42 percent of the annual average increase in harvests accrue to Area 4A and 21 percent to Area 4B. Under Scenario B for the same option, only 35 percent of the increase occurs in Area 4A while 66 percent accrues to Area 4CDE.

Table 4-166 Summary of Commercial Halibut Harvest Impacts under Option 3

	Commercial Halibut Fishery Impacts							
	Scenario A				Scenario B			
	4A	4B	4CDE	Area 4	4A	4B	4CDE	Area 4
Option	Average Annual Change from the Status Quo in Commercial Halibut Harvest (NW MT)							
Status Quo	714.9	626.9	125.2	1,467.1	715.2	627.2	128.2	1,470.6
3a: -10%	These options are non-constraining and have no material impact on the affected participants							
3b: -20%								
3c: -30%	2.2	5.3	0.3	7.9	3.1	2.2	8.0	13.3
3d: -35%	3.4	8.6	5.4	17.4	5.1	3.8	15.2	24.1
3e: -40%	10.1	12.4	9.6	32.1	10.6	4.7	26.3	41.5
3f: -45%	17.8	13.4	20.9	52.1	16.1	5.5	39.6	61.2
3g: -50%	29.9	15.4	26.4	71.6	19.8	6.9	52.8	79.6

Figure 4-85, on the following page, summarizes harvest impacts in Area 4 graphically—the figure shows annual average harvests under the status quo and the annual average harvests under the “change” case—noting that the change in harvests in Table 4-166 above is calculated by subtracting status quo harvests from the change case. It should be noted that in the figure, the horizontal scale for each area is shown in increments of 10 net weight mt, but that the starting point for each is set at levels that are appropriate for each area. Because all areas use the same scale, it is easier to compare impacts across areas.

Figure 4-85 Projected Annual Average Halibut Harvests (in net weight mt) under Option 3



Note: The figure does not include increases in harvests that could result from PSC Limit reductions in other groundfish fisheries.

Revenue Impacts to the Commercial Halibut Fishery

In this section we provide additional details regarding the wholesale revenue impacts to the commercial halibut fishery that are projected to occur with PSC limit reductions imposed on LGL-CPs. For ease of use, the wholesale revenues from the commercial halibut fishery that were reported in the overall summary table for Option 3, are reproduced below in Table 4-167. As indicated earlier, the numbers in the table represent the sum of wholesale revenues over the 10-year future period under the status quo (discounted to present values), and for each PSC limit reduction option, the changes in wholesale revenues over the 10-year future period, again discounted to present values. In general, the wholesale revenue impacts increase in approximately the same proportions as changes in halibut harvests.

Table 4-167 Summary of Impacts on Wholesale Revenues to the Commercial Halibut Fishery under Option 3

	Commercial Halibut Fishery Impacts							
	Scenario A				Scenario B			
	4A	4B	4CDE	Area 4	4A	4B	4CDE	Area 4
Option	10-year Sum of Changes to the DPV Wholesale Revenues (2013 $Millions) Relative to the Status Quo							
Status Quo	$171.18	$149.76	$28.87	$349.81	$171.20	$149.77	$29.52	$350.49
3a: -10%	These options are non-constraining and have no material impact on the affected participants							
3b: -20%								
3c: -30%	$0.55	$1.26	$0.07	$1.88	$0.77	$0.51	$1.89	$3.17
3d: -35%	$0.86	$2.04	$1.26	$4.16	$1.24	$0.89	$3.58	$5.71
3e: -40%	$2.41	$2.93	$2.25	$7.59	$2.54	$1.11	$6.19	$9.84
3f: -45%	$4.24	$3.15	$4.90	$12.30	$3.82	$1.28	$9.34	$14.44
3g: -50%	$7.08	$3.63	$6.20	$16.91	$4.71	$1.62	$12.47	$18.80

Table 4-168 provides a slightly different perspective on the revenue impacts to the commercial halibut fishery. In this case, the first column shows the future value (discounted to present values) of the status quo for each of the 10 future years as an average over the 10,000 iterations run under the IMS Model. Columns to the right of the status quo show the changes relative to that status quo that can be expected under the specific options. The bottom line shows the average annual change over all of the years and over all of the iterations. A similar table is provided on the next page that shows discounted average annual wholesale revenues for each future year under Option 3 for Areas 4A, 4B and 4CDE.

Table 4-168 Discounted Average Annual Halibut Wholesale Revenues ($ million) under Option 3

	Status Quo	3a):-10%	3b):-20%	3c):-30%	3d):-35%	3e): -40%	3f): -45%	3g): -50%
Year	Scenario A - B	Scenario A - B	Scenario A - B	Scenario A - B	Scenario A - B	Scenario A - B	Scenario A - B	Scenario A - B
Area 4 Total								
2014	$45.8 to $45.7	These options are non-constraining and have no material impact on the affected participants		$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0
2015	$38.9 to $39.0			$0.6 to $0.8	$1.0 to $1.4	$1.8 to $2.3	$2.9 to $3.4	$3.9 to $4.4
2016	$39.8 to $39.9			$0.2 to $0.3	$0.5 to $0.6	$0.8 to $1.1	$1.4 to $1.6	$1.9 to $2.1
2017	$37.6 to $37.7			$0.2 to $0.3	$0.4 to $0.6	$0.8 to $1.0	$1.3 to $1.5	$1.8 to $2.0
2018	$35.6 to $35.6			$0.2 to $0.3	$0.4 to $0.6	$0.7 to $1.0	$1.2 to $1.5	$1.7 to $1.9
2019	$33.7 to $33.7			$0.2 to $0.3	$0.4 to $0.5	$0.7 to $0.9	$1.2 to $1.4	$1.6 to $1.8
2020	$31.8 to $32.0			$0.2 to $0.3	$0.4 to $0.5	$0.7 to $0.9	$1.1 to $1.3	$1.5 to $1.7
2021	$30.3 to $30.4			$0.2 to $0.3	$0.4 to $0.5	$0.7 to $0.9	$1.1 to $1.3	$1.5 to $1.7
2022	$28.9 to $28.9			$0.1 to $0.3	$0.4 to $0.5	$0.7 to $0.9	$1.1 to $1.3	$1.5 to $1.6
2023	$27.3 to $27.4			$0.1 to $0.3	$0.3 to $0.5	$0.6 to $0.8	$1.0 to $1.2	$1.4 to $1.6
Average	$35.0 to $35.0			$0.2 to $0.3	$0.4 to $0.6	$0.8 to $1.0	$1.2 to $1.4	$1.7 to $1.9

Table 4-169 Discounted Average Annual Halibut Wholesale Revenues ($ million) under Option 3

Year	Status Quo Scenario A - B	3a):-10% Scenario A - B	3b):-20% Scenario A - B	3c):-30% Scenario A - B	3d):-35% Scenario A - B	3e): -40% Scenario A - B	3f): -45% Scenario A - B	3g): -50% Scenario A - B
Area 4A								
2014	$25.4 to $25.4			$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0
2015	$19.1 to $19.1			$0.3 to $0.3	$0.3 to $0.4	$0.7 to $0.7	$1.1 to $1.0	$1.7 to $1.2
2016	$18.9 to $19.0			$0.1 to $0.1	$0.1 to $0.1	$0.3 to $0.3	$0.5 to $0.4	$0.8 to $0.5
2017	$18.0 to $18.0			$0.0 to $0.1	$0.1 to $0.1	$0.2 to $0.2	$0.4 to $0.4	$0.7 to $0.5
2018	$17.0 to $16.9	These options are non-constraining and have no material impact on the affected participants		$0.0 to $0.1	$0.1 to $0.1	$0.2 to $0.2	$0.4 to $0.4	$0.7 to $0.5
2019	$16.1 to $16.1			$0.0 to $0.1	$0.1 to $0.1	$0.2 to $0.2	$0.4 to $0.3	$0.7 to $0.4
2020	$15.3 to $15.3			$0.0 to $0.1	$0.1 to $0.1	$0.2 to $0.2	$0.4 to $0.3	$0.6 to $0.4
2021	$14.5 to $14.5			$0.0 to $0.1	$0.1 to $0.1	$0.2 to $0.2	$0.4 to $0.3	$0.6 to $0.4
2022	$13.8 to $13.8			$0.0 to $0.1	$0.1 to $0.1	$0.2 to $0.2	$0.4 to $0.3	$0.6 to $0.4
2023	$13.1 to $13.1			$0.0 to $0.1	$0.1 to $0.1	$0.2 to $0.2	$0.3 to $0.3	$0.6 to $0.4
Average	$17.1 to $17.1			$0.1 to $0.1	$0.1 to $0.1	$0.2 to $0.3	$0.4 to $0.4	$0.7 to $0.5
Area 4B								
2014	$20.5 to $20.4			$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0
2015	$17.1 to $17.2			$0.3 to $0.1	$0.5 to $0.2	$0.7 to $0.2	$0.7 to $0.3	$0.8 to $0.4
2016	$16.8 to $16.8			$0.2 to $0.1	$0.2 to $0.1	$0.4 to $0.1	$0.4 to $0.1	$0.4 to $0.2
2017	$15.9 to $15.9			$0.1 to $0.1	$0.2 to $0.1	$0.3 to $0.1	$0.3 to $0.1	$0.4 to $0.2
2018	$15.0 to $15.0	These options are non-constraining and have no material impact on the affected participants		$0.1 to $0.1	$0.2 to $0.1	$0.3 to $0.1	$0.3 to $0.1	$0.4 to $0.2
2019	$14.3 to $14.3			$0.1 to $0.0	$0.2 to $0.1	$0.3 to $0.1	$0.3 to $0.1	$0.4 to $0.2
2020	$13.5 to $13.6			$0.1 to $0.0	$0.2 to $0.1	$0.3 to $0.1	$0.3 to $0.1	$0.3 to $0.1
2021	$12.9 to $12.9			$0.1 to $0.0	$0.2 to $0.1	$0.3 to $0.1	$0.3 to $0.1	$0.3 to $0.1
2022	$12.2 to $12.2			$0.1 to $0.0	$0.2 to $0.1	$0.3 to $0.1	$0.3 to $0.1	$0.3 to $0.2
2023	$11.6 to $11.6			$0.1 to $0.0	$0.2 to $0.1	$0.2 to $0.1	$0.3 to $0.1	$0.3 to $0.2
Average	$15.0 to $15.0			$0.1 to $0.1	$0.2 to $0.1	$0.3 to $0.1	$0.3 to $0.1	$0.4 to $0.2
Area 4CDE								
2014	$0.0 to $0.0			$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0
2015	$2.7 to $2.8			$0.0 to $0.4	$0.3 to $0.8	$0.5 to $1.4	$1.1 to $2.1	$1.4 to $2.8
2016	$4.1 to $4.2			$0.0 to $0.2	$0.1 to $0.4	$0.2 to $0.7	$0.5 to $1.0	$0.7 to $1.4
2017	$3.7 to $3.8			$0.0 to $0.2	$0.1 to $0.4	$0.2 to $0.7	$0.5 to $1.0	$0.7 to $1.3
2018	$3.5 to $3.6	These options are non-constraining and have no material impact on the affected participants		$0.0 to $0.2	$0.1 to $0.4	$0.2 to $0.6	$0.5 to $1.0	$0.6 to $1.3
2019	$3.3 to $3.3			$0.0 to $0.2	$0.1 to $0.3	$0.2 to $0.6	$0.5 to $0.9	$0.6 to $1.2
2020	$3.0 to $3.1			$0.0 to $0.2	$0.1 to $0.3	$0.2 to $0.6	$0.5 to $0.9	$0.6 to $1.1
2021	$3.0 to $3.0			$0.0 to $0.2	$0.1 to $0.3	$0.2 to $0.6	$0.4 to $0.8	$0.6 to $1.1
2022	$2.8 to $2.9			$0.0 to $0.2	$0.1 to $0.3	$0.2 to $0.5	$0.4 to $0.8	$0.6 to $1.1
2023	$2.6 to $2.7			$0.0 to $0.2	$0.1 to $0.3	$0.2 to $0.5	$0.4 to $0.8	$0.5 to $1.0
Average	$2.9 to $3.0			$0.0 to $0.2	$0.1 to $0.4	$0.2 to $0.6	$0.5 to $0.9	$0.6 to $1.2

Yield Increases to Commercial Halibut Fishery Resulting from U26 Savings

This section summarizes the future yield increases that are projected to result from savings of U26 fish when PSC taken by vessels in the LGL-CP Pacific cod target fishery is reduced under Option 3. More complete discussions regarding the reasoning behind these yield increases as well as the process involved in developing estimates can be found in Section 4.6.1.2 beginning on page 233. Additional background information is provided in the text summarizing U26-based yield increases estimated under Option 1, beginning on page 298.

Table 4-170 summarizes the future yield impact in terms of harvest increases (on the left side of the table) and increases in future wholesale revenues (on the right) that are expected to result from Option 3. Increased harvests and wholesale revenues are summarized for Area 4, Other Alaska (IPHC Areas 3A, 3B, and 2C), and for regions "External" to Alaska (IPHC Areas 2B and 2A). Also note that because yield increases do not start to appear until 2019, the annual average yield changes shown in the table are averaged over 5 years rather than over the entire 10-year future period; wholesale revenues (discounted to present values), are summed over the entire 10-year future period. Over all areas coastwide, the increased yield under Option 3G is projected to average from 13.6 to 15.2 net weight mt over the years 2019 to 2023 with the largest portion accruing to the commercial halibut fishery in the Gulf of Alaska (Other AK). The sum of resulting wholesale revenues over the entire period (discounted to present values) is projected to range from $1.3 to $1.4 million.

Table 4-170 Summary of Future "U26 Impacts" in Area 4 and in Other Areas Outside of Area 4 under Option 3

Option	Area 4 Scen A - B	Other AK Scen A - B	Scenarios A - B Scenarios A - B	Total U26 Scen A - B	Area 4 Scen A - B	Other AK Scen A - B	External Scen A - B	Total U26 Scen A - B
	Mean Annual Increase in Catch (nw mt) over Last Half of the 10-year Future Period				Increased DPV of Wholesale Revenue (2013 millions) over 10-Year Future Period			
3a): -10%	These options are non-constraining and have no material impact on the affected participants							
3b): -20%								
3c): -30%	0.3 - 0.6	0.9 - 1.6	0.2 - 0.3	1.3 - 2.5	$0.03 - $0.06	$0.08 - $0.15	$0.02 - $0.03	$0.12 - $0.23
3d): -35%	0.7 - 1.0	2.0 - 2.9	0.4 - 0.6	3.1 - 4.5	$0.07 - $0.10	$0.19 - $0.27	$0.04 - $0.06	$0.30 - $0.42
3e): -40%	1.3 - 1.7	3.8 - 5.0	0.8 - 1.0	5.9 - 7.8	$0.13 - $0.17	$0.35 - $0.46	$0.07 - $0.10	$0.55 - $0.73
3f): -45%	2.2 - 2.6	6.4 - 7.5	1.3 - 1.5	9.9 - 11.6	$0.22 - $0.26	$0.58 - $0.69	$0.12 - $0.15	$0.93 - $1.10
3g): -50%	3.1 - 3.4	8.8 - 9.9	1.7 - 1.9	13.6 - 15.2	$0.31 - $0.34	$0.81 - $0.90	$0.17 - $0.19	$1.28 - $1.43

4.11 Option 4 and 5, Alternative 2: Analysis of Options Affecting Longline Vessels

Option 4: PSC limit for hook-and-line vessels targeting species other than Pacific cod and sablefish

The Council's Option 4 would reduce the 58 mt PSC limit of hook-and-line vessels targeting species other than Pacific cod and sablefish. Technically, this PSC limit constrains both hook and line CVs and CPs, but since 2008 there have been no NMFS catch records that document participation by hook and line CVs in target fisheries for groundfish species other than Pacific cod or sablefish (which is currently exempt from the limit). Therefore, in practice, this option focuses on longline CPs that participate in the Greenland turbot fishery, which is the primary target fishery for groundfish species other than Pacific cod or sablefish for those vessels. There are no records of longline catcher vessels participating in this fishery between 2008 and 2013.

As shown in Table 4-171, the PSC limit under the status quo for hook and line fisheries other than for Pacific cod or sablefish has been established at 58 mt. The longline CPs are the only group that participate in these fisheries and are focusing almost exclusively on Greenland turbot when this apportionment is used. From 2008 to 2013, an average of 4.9 mt of halibut PSC mortality have been taken, with a maximum of 10.3 mt taken in 2010. On average, 53.1 mt of potential halibut mortality has been left unused. Under the Option 4g, to reduce the PSC limit by 50 percent to 29 mt, there would have been 27.4 mt of halibut PSC mortality left on the table in 2010. The longline CP fleet could have expanded their efforts almost three-fold in these fisheries and still not hit the reduced cap. From this we conclude that there would be no material impact to the longline CP fleet if this PSC limit were reduced as proposed under option 4g.

Table 4-171 Halibut PSC Limits for hook-and-line other targets under the Status Quo and under a 50 percent PSC limit reduction, with Halibut PSC mortality and Unused PSC mortality from 2008 to 2013 (round weight mt)

	2008	2009	2010	2011	2012	2013	Average
Historical Halibut PSC Limits in the Fishery and Actual Halibut PSC mortality							
Status Quo PSC Limit	58.0	58.0	58.0	58.0	58.0	58.0	58.0
Actual Halibut PSC	1.3	6.4	10.3	4.5	5.7	1.4	4.9
Unused PSC	56.7	51.6	47.7	53.5	52.3	56.6	53.1
Halibut PSC Limit and Halibut PSC mortality under Option 4g (Reduce PSC Limit by 50%)							
Option 4g PSC Limit	29	29	29	29	29	29	29
Actual Halibut PSC	1.3	6.4	10.3	4.5	5.7	1.4	4.9
Unused PSC	27.7	22.6	18.7	24.5	23.3	27.6	24.1

Source: Developed by Northern Economics based on AKFIN data (Fey 2014).

Option 5: PSC limit for longline catcher vessels targeting Pacific cod

Option 5 would reduce the 15 mt longline catcher vessel PSC limit for vessels targeting Pacific cod. As shown in Table 4-172, longline catcher vessels have taken a maximum of 5.4 mt in any year between 2008 and 2013. Their PSC usage for the time period is an average of 2.7 mt of halibut PSC mortality, leaving 12.3 mt of potential halibut mortality unused. Under the Option 5g, a PSC limit reduction of 50 percent to 8 mt, there would have been 2.6 mt of halibut PSC mortality left on the table in the year of highest usage, 2008. From this we conclude that there would be no material impact to the longline CP fleet if this PSC limit were reduced as proposed under in this action. In this case, however, reducing the PSC limit for longline catcher vessels by the maximum reduction could prohibit growth in this sector, as there is not much room to expand the fishery within the reduced PSC apportionment. Table 4-173 describes harvest, revenue, and value in the fishery from 2008 to 2013. While there is not a clear trend towards increasing activity in the fishery, the Council recently took action on an amendment to allow a small boat Pacific cod fishery under the CDQ program in the BSAI. The support of the CDQ groups may generate a similar interest in expanding activity in the longline CV fishery as well, which could be precluded under a restrictive PSC limit.

Table 4-172 Halibut PSC Limits for longline Pacific cod catcher vessels under the Status Quo and under a 50 percent PSC limit reduction, with Halibut PSC mortality and Unused PSC mortality from 2008 to 2013 (round weight mt)

	2008	2009	2010	2011	2012	2013	Average
Historical Halibut PSC Limits in the Pacific Cod Fishery and Actual Halibut PSC mortality							
Status Quo PSC Limit	15	15	15	15	15	15	15
Actual Halibut PSC	5.4	2.9	1.7	1.3	1.8	3.3	2.7
Unused PSC	9.6	12.1	13.3	13.7	13.2	11.7	12.3
Halibut PSC Limit and Halibut PSC mortality under Option 5g (Reduce PSC Limit by 50%)							
Option 5g PSC Limit	8	8	8	8	8	8	8
Actual Halibut PSC	5.4	2.9	1.7	1.3	1.8	3.3	2.7
Unused PSC	2.6	5.1	6.3	6.7	6.2	4.7	5.3

Source: Developed by Northern Economics based on AKFIN data (Fey 2014).

Table 4-173 Groundfish Harvest, Revenue, and Value in Longline CV Pacific Cod Fishery, 2008 to 2013

	2008	2009	2010	2011	2012	2013	Total
Groundfish Harvested in Pacific cod Target Fishery (mt)	1.29	0.69	0.36	0.48	0.75	1.03	4.60
Wholesale Revenue (in millions of 2013 $)	$2.63	$0.98	$0.57	$0.86	$1.29	$1.31	$7.62
Ex-Vessel Value ($Millions 2013)	$1.95	$0.47	$0.23	$0.37	$0.61	$0.67	$0.72
Wholesale Value Generated by Processors ($Millions 2013)	$2.63	$0.98	$0.57	$0.86	$1.29	$1.31	$1.27
Processor Value Added ($Millions 2013)	$0.67	$0.50	$0.34	$0.48	$0.68	$0.64	$0.55

Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

4.12 Option 6, Alternative 2: Analysis of Options Affecting the Groundfish CDQ Fisheries

In this section we summarize the impacts of proposed reductions of halibut PSC limits (technically, reductions to their halibut prohibited species quota (PSQ) reserve) for the CDQ groundfish fisheries as proposed under Option 6. Seven suboptions are specified as follows.

- Option 6.a: Reduce Halibut PSC Limits for CDQ groundfish by 10%, from 393 mt to 353.7 mt
- Option 6.b: Reduce Halibut PSC Limits for CDQ groundfish by 20%, from 393 mt to 314.4 mt
- Option 6.c: Reduce Halibut PSC Limits for CDQ groundfish by 30%, from 393 mt to 275.1 mt
- Option 6.d: Reduce Halibut PSC Limits for CDQ groundfish by 35%, from 393 mt to 255.1 mt
- Option 6.e: Reduce Halibut PSC Limits for CDQ groundfish by 40%, from 393 mt to 235.8 mt
- Option 6.f: Reduce Halibut PSC Limits for CDQ groundfish by 45%, from 393 mt to 216.2 mt
- Option 6.g: Reduce Halibut PSC Limits for CDQ groundfish by 50%, from 393 mt to 196.5 mt

A summary of methodological issues relevant these options is provide below. The methodology discussion is followed by an overview of impacts to both the groundfish participants and the commercial halibut fishery. The overview is followed by two separate sections that describe in more detail the impact to the groundfish fisheries and to the commercial halibut fishery.

Methodological Issues Relevant to the Options to Reduce PSC Limits for CDQ Fisheries

The CDQ groundfish fisheries from 2008 to 2013 were described in detail in Section 4.4.6 beginning on page 197. Table 4-174, reproduced from Section 4.4.6.4m describes PSC mortality in the CDQ groundfish fisheries by target fishery. Halibut PSC mortality occurs primarily in the non-pollock fisheries, which accounted for 86 percent of halibut PSC mortality in the CDQ fishery, on average from 2008 to 2013. In those same years, halibut PSC mortality in CDQ fisheries closely tracked total harvest of non-pollock, increasing during years of increased harvest in non-pollock fisheries. CDQ PSC usage fell 29 percent in 2009 and 2010, during which time there was a decrease in total yellowfin sole harvest. PSC in the CDQ fisheries peaked in 2013 at 265 mt, roughly 67 percent of the CDQ fisheries' total halibut PSC limit of 393 mt. Recent increases in halibut PSC mortality are primarily due to increased CDQ participation in the yellowfin sole fishery.

Table 4-174 Halibut PSC Mortality in CDQ Target Fisheries, 2008 to 2013

	2008	2009	2010	2011	2012	2013	Average
Target Group	**Halibut PSC Mortality (in Round Weight mt)**						
Pollock|Atka Mackerel|Other Species	28.8	29.3	12.4	49.6	31.9	27.0	29.8
Pacific Cod	82.7	66.3	73.1	53.8	50.9	66.8	65.6
Yellowfin Sole	56.3	14.7	18.7	67.6	96.6	112.3	61.0
All other targets	46.2	40.7	54.4	51.9	72.3	58.7	54.0
All Targets	**214.0**	**151.0**	**158.6**	**223.0**	**251.7**	**264.8**	**210.5**

Source: Table developed by Northern Economics using AKFIN data (Fey 2014).

As with other options assessed for the LGL-CPs, BSAI TLA and A80-CP fisheries, the assessment of impacts of the proposed reductions in PSC limits for CDQ groundfish fisheries is accomplished through the use of the IMS Model that is described in considerable detail in Section 4.6.2. But, as indicated in the discussion above, PSC use in the CDQ groundfish fisheries have been growing in the most recent three years, and was highest in 2013 at 264.8 mt—67 percent of the current 393 mt PSC limit. As indicated in the introduction, Options 6a, 6b, and 6c, PSC limit reductions of 10, 20, or 30 percent, would not have had a direct impact of CDQ groundfish fisheries. Because the first three options do not appear to directly affect the CDQ groundfish fisheries, no additional for these assessment of these options is undertaken.

The IMS Model is used to assess the impacts of suboptions 6d–6g, with cuts from 35 to 50 percent of the current PSC limit. The IMS Model relies heavily on the assumption that the basis years (2008 through 2013) can be used to represent PSC use during the 10-year future period. No assumptions have been made within the IMS Model framework to account for growth within a particular fishery, such as appears to be occurring with the CDQ groundfish fisheries. These issues should be kept in mind when reviewing the assessment of impacts of options to reduce PSC limits in the CDQ groundfish fisheries.

For each suboption assessed, the IMS Model is run with 10,000 iterations under two different scenarios that represent a low impact case (Scenario A) and a high impact case (Scenario B). The CDQ groundfish fisheries are considered to be rationalized, and therefore the CDQ groups are assumed to be able to organize their fishing effort in a form of collective decision making which lead directly to scenario assumed for the CDQ fisheries. These Scenarios are very similar to the Scenarios used to model the PSC limit reduction options for LGL-CP Pacific cod target fishery and are described below:

- Under Scenario A, it is assumed that the organizations make a joint decision to rank target fisheries to determine the fisheries in which all CDQs will participate, and those that will be avoided in order for all CDQ groups to stay under the limit. The ranking is done in terms of the overall wholesale revenue per PSC for each fishery.
- Under Scenario B, it is assumed that CDQ organizations make a joint decision to determine which fisheries must be off limits in order for CDQs as a whole to remain below the PSC limit, while cutting the groundfish harvests with high levels of halibut encounters and relatively low amounts of wholesale revenue generated.

The IMS Model develops catch progression lines for the CDQ fisheries to prioritize wholesale revenues and halibut PSC and under the two Scenarios. Figure 4-86 provides an example of catch progression lines from the 2013 CDQ fishery. For purposes of comparison, the figure also includes a catch progression line that could be realized if the CDQ organizations had perfect knowledge of the revenue they would generate and the PSC they would take. Also shown is the actual 2013 catch by month progression line. The latter represents the sorting of catch that would be used in a last-caught first-cut PSC reduction methodology. The resemblance of the Scenario A and Scenario B lines to the “perfect knowledge” progression line is striking, and may be related to the fact that vessels operating CDQ groundfish fisheries are allowed to declare after the fact, whether a tow will count against a CDQ allocation, or whether it will be a part of the non-CDQ operations. In the example shown for 2013, there is little difference in the revenue generated in any of the curves over the last 80 percent of PSC mortality.

Figure 4-86 Examples of Scenario A and B Catch Progression Lines in the CDQ Fishery

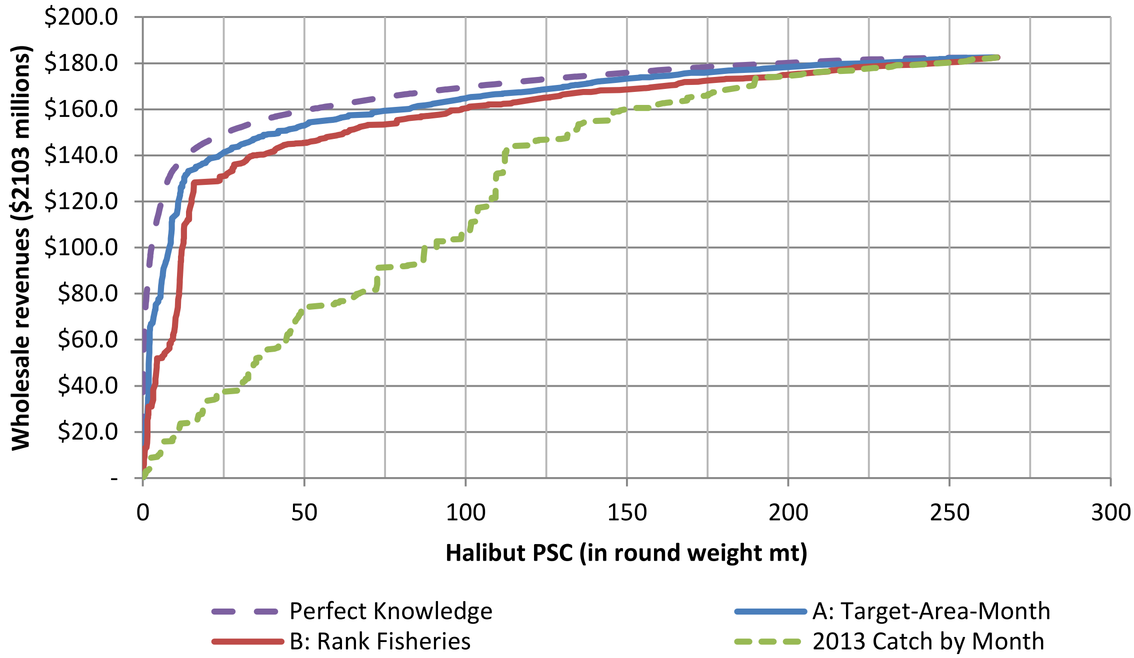


Table 4-175 documents information provided above, that some of the PSC limit reduction options for CDQs have no material impacts (e.g., 6a through 6c), and that two of the basis years (2009 and 2010) are not affected by any of the options, and that a third year (2008) is affected only under 6g.

Table 4-175 CDQ Halibut PSC and Wholesale Revenue (2013$millions) Amounts Cut from Each Basis Year by Alternative and Scenario

		2008	2009	2010	2011	2012	2013
Alternative	**Scenario**	**mt Halibut PSC Cut in Each Basis Year**					
Status Quo	Scenario A	-	-	-	-	-	-
	Scenario B	-	-	-	-	-	-
6a: -10%	Scenario A	-	-	-	-	-	-
	Scenario B	-	-	-	-	-	-
6b: -20%	Scenario A	-	-	-	-	-	-
	Scenario B	-	-	-	-	-	-
6c: -30%	Scenario A	-	-	-	-	-	-
	Scenario B	-	-	-	-	-	-
6d: -35%	Scenario A	-	-	-	-	-	14
	Scenario B	-	-	-	-	-	10
6e: -40%	Scenario A	-	-	-	-	17	29
	Scenario B	-	-	-	-	19	31
6f: -45%	Scenario A	-	-	-	15	39	54
	Scenario B	-	-	-	8	43	52
6g: -50%	Scenario A	21	-	-	27	63	72
	Scenario B	19	-	-	27	58	68
		Real Wholesale Revenues ($2013 millions) Cut in Each Basis Year					
Status Quo	Scenario A	-	-	-	-	-	-
	Scenario B	-	-	-	-	-	-
6a: -10%	Scenario A	-	-	-	-	-	-
	Scenario B	-	-	-	-	-	-
6b: -20%	Scenario A	-	-	-	-	-	-
	Scenario B	-	-	-	-	-	-
6c: -30%	Scenario A	-	-	-	-	-	-
	Scenario B	-	-	-	-	-	-
6d: -35%	Scenario A	-	-	-	-	-	$0.33
	Scenario B	-	-	-	-	-	$1.64
6e: -40%	Scenario A	-	-	-	-	$0.13	$1.86
	Scenario B	-	-	-	-	$3.64	$3.36
6f: -45%	Scenario A	-	-	-	$0.29	$1.23	$3.16
	Scenario B	-	-	-	$3.20	$6.45	$6.16
6g: -50%	Scenario A	$0.68	-	-	$0.74	$5.09	$4.90
	Scenario B	$5.80	-	-	$4.79	$8.36	$8.41

4.12.1 Overview of Groundfish and Halibut Impacts under Option 6

As previously noted, this summary section of impacts contains tables and figures that summarize the impacts of proposed options to reduce halibut PSC limits for CDQ participants, and resulting increased harvests in the commercial halibut fishery in each of the Area 4 subareas and Area 4 as whole. The section begins by summarizing revenue and harvest impacts for both groundfish and commercial halibut fisheries across all suboptions, as shown in Table 4-180. The subsequent sections provide additional details for the groundfish fishery and for the commercial halibut fishery

As in the impact section for options affecting other groundfish fisheries, the additional details covered here include estimates of annual average revenue, annual average harvest impacts to the CDQ fisheries, and a summary of modelled behavior changes that are seen as the CDQ fisheries reduce groundfish harvest to meet the new PSC constraints. In addition to the “standard” set of tables and figures, a table assessing the impacts of PSC limit reduction Option 1-5 on CDQ-owned vessels assets is included.

Additional details provided on the impact of Option 6 for the commercial halibut fishery include annual average harvest and wholesale revenue impacts to each subarea, and Area 4 as a whole, under each scenario and suboption (both in tables and graphically), and an assessment of future U26-based yield impacts in Area 4, and in other areas outside of Area 4. We note that statistical details and histograms summarizing future revenue and harvest impacts pertaining to each individual halibut PSC limit reduction can be found in Appendix D, and that summaries of impacts to communities and regions in Alaska, and for regions outside the state, are found in Sections 4.13.1.3, 4.13.2.3, and 4.13.2.4.

Table 4-180 indicates that there are no material impacts to either the CDQ groundfish fishery or the commercial halibut fishery under the first three options. The first impact would occur under a 35 percent reduction in PSC limits under which CDQs are projected to realize very minimal negative impacts, resulting from the fact that only one of the basis years (2013) is affected. With the 50 percent reduction in the current PSC limits, CDQ organizations are projected to generate between $15 and $37 million less wholesale revenues over the 10-year future period, discounted to present value. As mentioned in the introduction to this Option, it is likely that the IMS Model underestimates the real magnitude of impacts, because of the growth trend in the CDQ groundfish fisheries in recent years, particularly in fisheries other than pollock and Pacific cod.

In the upper right quadrant of Table 4-180, the commercial halibut fishery is also projected to realize relatively small levels of gain. With a 50 percent reduction in PSC limits, the 10-year sum of discounted present value of wholesale revenue for the commercial halibut fishery is projected to increase by roughly $3 million. Again, it should noted that the IMS Model results are likely to understate the impacts if the CDQ groundfish groups wish to continue the growth they experienced between 2011 and 2013. In general the majority of impacts for the commercial halibut fishery will be realized in Area 4CDE. Under Scenario A, over 60 percent of the harvest gain would accrue to 4CDE, increasing to 73 percent under Scenario B.

Table 4-176 Summary of Impacts Over All Reduction Options Affecting CDQ Participants

	Groundfish Impacts				Commercial Halibut Fishery Impacts							
	Scenario A	Scenario B	Scenario A	Scenario B	Scenario A				Scenario B			
Option	All Areas		All Areas		4A	4B	4CDE	Area 4	4A	4B	4CDE	Area 4
	PSC Limit (r.w. mt)		10-year Sum of Changes to the DPV Wholesale Revenues (2013 $Millions) Relative to the Status Quo									
Status Quo	393		$1,606.25	$1,606.25	$171.18	$149.76	$28.87	$349.81	$171.20	$149.77	$29.52	$350.49
6a): -10%	354											
6b): -20%	314		These options are non-constraining and have no material impact on the affected participants									
6c): -30%	275											
6d): -35%	255		($0.45)	($2.20)	$0.25	$0.00	$0.18	$0.44	$0.33	$0.00	$0.02	$0.35
6e): -40%	236		($2.67)	($9.27)	$0.64	$0.01	$0.35	$0.99	$0.37	$0.01	$0.67	$1.05
6f): -45%	216		($6.25)	($21.19)	$0.84	$0.01	$1.26	$2.11	$0.63	$0.01	$1.35	$1.99
6g): -50%	197		($15.23)	($36.68)	$1.28	$0.08	$2.09	$3.44	$0.72	$0.16	$2.35	$3.23
	Groundfish Impacts				Commercial Halibut Fishery Impacts (net weight mt)							
	Scenario A	Scenario B	Scenario A	Scenario B	Scenario A				Scenario B			
Option	PSC taken (r.w. mt)		Groundfish (1,000s mt)		4A	4B	4CDE	Area 4	4A	4B	4CDE	Area 4
	Average Annual Change from the Status Quo											
Status Quo	210.5	210.5	0.2	0.2	714.9	626.9	125.2	1,467.1	715.2	627.2	128.2	1,470.6
6a): -10%												
6b): -20%	These options are non-constraining and have no material impact on the affected participants											
6c): -30%												
6d): -35%	-2.3	-1.6	-0.1	-0.3	0.9	0.0	0.8	1.7	1.2	0.0	0.1	1.3
6e): -40%	-7.6	-8.3	-0.4	-1.1	2.5	0.0	1.5	4.0	1.4	0.0	2.9	4.3
6f): -45%	-18.1	-17.1	-0.9	-2.4	3.4	0.1	5.3	8.8	2.5	0.1	5.8	8.3
6g): -50%	-30.4	-28.6	-2.1	-3.8	5.2	0.3	8.9	14.5	2.9	0.7	10.0	13.6

4.12.1.1 Impacts on CDQ Participants in Groundfish Fisheries

In this section we examine in more detail the impacts of the PSC limit reduction options affecting CDQ groundfish fisheries. The section contains three parts that focus on: a) projected impacts to wholesale revenues; b) projected impacts on groundfish harvests; and c) behavioral changes while meeting the reduced PSC limits.

Revenue Impacts in CDQ Groundfish Fisheries

This section provides additional details on the impacts to revenues and earnings resulting from options to reduce PSC limits in the CDQ groundfish fisheries.

Figure 4-87 provides a graphical summary of the annual average PSC reductions that CDQ groundfish fisheries need to undertake in order to achieve the lower PSC limits under all options, along with the projections of the discounted annual average wholesale revenues they are expected to forego (noting that the figure reflects the annual revenue impacts summarized in Table 4-177). The figure shows the annual average catch progression lines that are assumed under Scenarios A and B, along with alternative catch progression lines that could have been used, if the IMS model assumed that CDQ groundfish fisheries had perfect knowledge about their upcoming harvests, or conversely if the CDQ fisheries did not make any behavioral changes and instead reduced their PSC mortality using a last-caught, first-cut methodology. In the figure, outcomes under Scenario A and Scenario B fall just below, but relatively close to the "perfect knowledge" scenario, and appear to be much better outcomes than under a last-caught first-cut methodology. As with similar figures for the A80-CPs and LGL-CPs, the bolded **+** markers on the Scenario A and B catch progression lines indicate the spots at which PSC reductions occur under each option.

Figure 4-87 Annual Average Wholesale Revenue and Halibut PSC under Option 6, CDQ fisheries

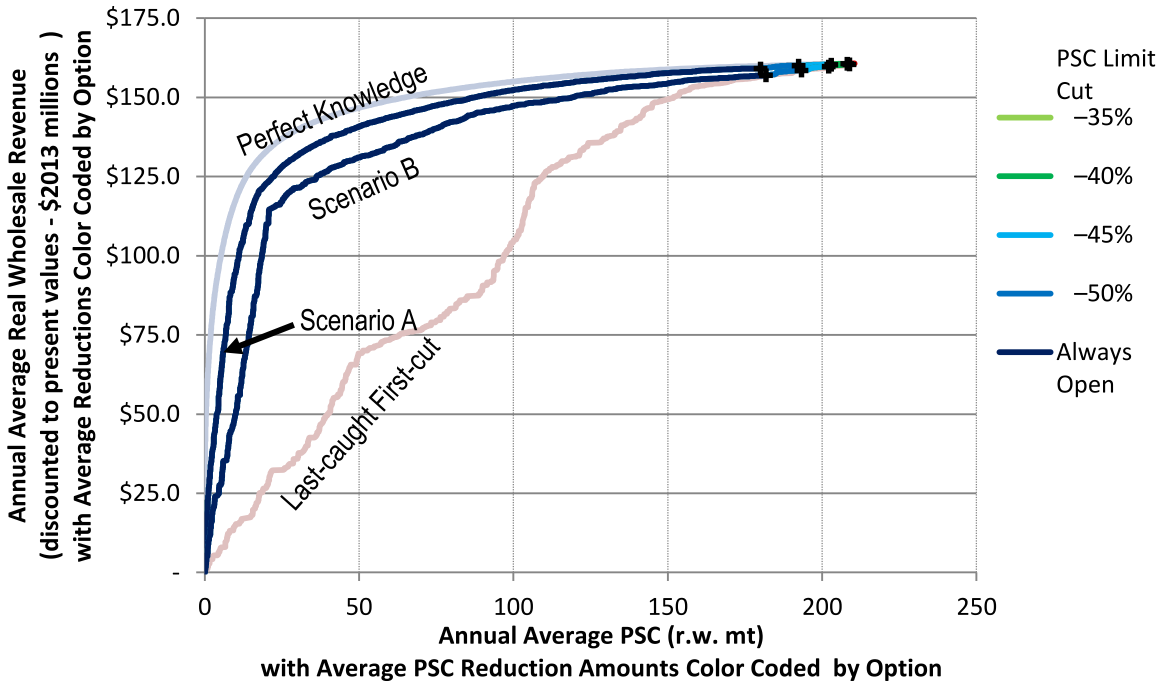


Table 4-177 Annual Average Future Revenue Impacts of PSC Reduction Options for CDQ Groundfish Fisheries

Year	DPV of Wholesale Revenue Under the Status Quo	6a: -10%	6b: -20%	6c: -30%	6d: -35%	6e: -40%	6f: -45%	6g: -50%
		Forgone Annual Average Discounted Present Value of Wholesale Revenue Under the Alternatives						
	Scen. A - B	Scen. A - B	Scen. A - B	Scen. A - B	Scen. A - B	Scen. A - B	Scen. A - B	Scen. A - B
2014	$200.1 - $200.1	These options are non-constraining and have no material impact on the affected participants.			$0.1 - $0.3	$0.3 - $1.2	$0.8 - $2.6	$1.9 - $4.6
2015	$190.1 - $190.1				$0.1 - $0.3	$0.3 - $1.1	$0.7 - $2.5	$1.8 - $4.3
2016	$180.6 - $180.6				$0.1 - $0.2	$0.3 - $1.1	$0.7 - $2.4	$1.7 - $4.1
2017	$171.6 - $171.6				$0.0 - $0.2	$0.3 - $1.0	$0.7 - $2.3	$1.6 - $3.9
2018	$163.0 - $163.0				$0.0 - $0.2	$0.3 - $1.0	$0.6 - $2.1	$1.5 - $3.7
2019	$154.9 - $154.9				$0.0 - $0.2	$0.3 - $0.9	$0.6 - $2.0	$1.5 - $3.5
2020	$147.1 - $147.1				$0.0 - $0.2	$0.2 - $0.9	$0.6 - $1.9	$1.4 - $3.4
2021	$139.8 - $139.8				$0.0 - $0.2	$0.2 - $0.8	$0.5 - $1.8	$1.3 - $3.2
2022	$132.8 - $132.8				$0.0 - $0.2	$0.2 - $0.8	$0.5 - $1.7	$1.3 - $3.0
2023	$126.1 - $126.1				$0.0 - $0.2	$0.2 - $0.7	$0.5 - $1.7	$1.2 - $2.9
Average	$160.6 - $160.6				$0.0 - $0.2	$0.3 - $0.9	$0.6 - $2.1	$1.5 - $3.7

Table 4-178 summarizes impacts to the discounted present value of the annual average impact on payments to crew members on vessels participating in CDQ groundfish fisheries under Option 6. Annual average crew payments under the status quo show that approximately 75 percent of CDQ groundfish crew payments are made to crew on BSAI TLA vessels, primarily in the CDQ pollock fishery but also in yellowfin sole fisheries. Crew members on longline CPs earn slightly less than 20 percent of total payments, and the Amendment 80 CP crew account for about 5 percent. Under Option 6g, which would cut the CDQ PSC limit by 50 percent, it is projected that with Scenario A, an average of $420,000 over each year in the 10-year future period (discounted to present values) would be cut. About 40 percent of the crew payment reductions under Scenario A are expected to accrue to A80-CP vessels. Under Scenario B, annual average reductions in crew pay are expected to approach 1.2 million per year (discounted to present values), but in this, approximately 70 percent of the reductions are expected to be borne by crew on longline CPs.

Table 4-178 Discounted Present Values of the Annual Average Impacts on Payments to Crew Members on Vessels Participating in CDQ Fisheries

	Status Quo (2013 $million)	6a: -10 %	6b: -20 %	6c: -30%	6d: -35%	6e: -40%	6f: -45%	6g: -50%
Scenario A	**Status Quo**	**Impacts relative to the Status Quo Under Scenario A (2013 $million)**						
For Crew of All Affected Sectors	$44.69	-	-	-	($0.01)	($0.07)	($0.17)	($0.42)
For BSAI TLA Crew Members	$31.91		-		($0.00)	($0.01)	($0.08)	($0.24)
A80-CP Crew Members	$4.47	-	-	-	($0.01)	($0.06)	($0.08)	($0.16)
LGL-CP Crew Members	$8.30	-	-	-	-	($0.01)	($0.01)	($0.01)
LGL-CV Crew Members	$0.000	-	-	-	-	-	-	-
Scenario B	**Status Quo**	**Impacts relative to the Status Quo Under Scenario B (2013 $million)**						
For Crew of All Affected Sectors	$44.69	-	-	-	($0.08)	($0.30)	($0.66)	($1.16)
For BSAI TLA Crew Members	$31.91		-		-	($0.02)	($0.11)	($0.20)
A80-CP Crew Members	$4.47	-	-	-	-	($0.06)	($0.09)	($0.15)
LGL-CP Crew Members	$8.30	-	-	-	($0.08)	($0.23)	($0.46)	($0.81)
LGL-CV Crew Members	$0.000	-	-	-	-	-	-	-

Table 4-179 summarizes the impacts to CDQ organizations on revenues generated by vessels in which they have an ownership interest. These ownership interests were summarized in Table 4-73 and Table 4-74, beginning on page 199. The impacts summarized in the table below cover PSC limit reduction options for all groundfish fisheries (i.e., Option 1 through Option 6), and are included because of their relevance to CDQ groups. A more complete discussion of this table is found on the next page.

Table 4-179 Summary of the DPV of Foregone Wholesale Revenue (2013 $millions) for CDQ-Owned Vessel Assets under the PSC Reduction Alternatives

	10-year DPV of Wholesale Revenue of CDQ Vessel Assets Under Status Quo	10% Limit Reductions	20% Limit Reductions	30% Limit Reductions	35% Limit Reductions	40% Limit Reductions	45% Limit Reductions	50% Limit Reductions
		10-Year Forgone Discounted Present Value of Revenue Under the Alternatives Incurred by Vessel Assets Owned by CDQ Organizations						
Sector	**Scen. A - B**	**Scen. A - B**	**Scen. A - B**	**Scen. A - B**	**Scen. A - B**	**Scen. A - B**	**Scen. A - B**	**Scen. A - B**
A80-CPs	$37.6	$0.0 - $0.8	$0.5 - $2.9	$1.7 - $5.0	$2.6 - $6.6	$3.7 - $8.5	$4.8 - $10.7	$6.6 - $12.5
BSAI TLA	$853.3	$0.2 - $0.5	$0.7 - $3.6	$2.3 - $6.1	$2.9 - $8.4	$3.8 - $9.6	$4.5 - $11.9	$5.4 - $16.1
LGL-CPs	$246.5	No Material Impacts		$3.3 - $3.4	$5.4 - $6.8	$8.9 - $12.7	$16.2 - $18.6	$27.0 - $28.9
CDQs	$392.6	No Material Impacts			$0.0 - $1.2	$0.2 - $3.0	$0.9 - $7.8	$2.6 - $12.4
All	**$1,529.9**	**$0.3 - $1.3**	**$1.2 - $6.5**	**$7.3 - $14.4**	**$10.9 - $22.9**	**$16.7 - $33.8**	**$26.3 - $48.9**	**$41.6 - $69.9**
	Percentage of each Sector's Foregone Revenues Incurred by Vessel Assets Owned by CDQ Organizations							
A80-CPs	1.93%	1.93 - 1.91%	1.93 - 1.86%	1.92 - 1.86%	1.91 - 1.85%	1.90 - 1.82%	1.90 - 1.77%	1.85 - 1.75%
BSAI TLA	11.17%	11.17 - 11.18%	11.19 - 11.19%	11.20 - 11.21%	11.21 - 11.24%	11.22 - 11.28%	11.23 - 11.31%	11.27 - 11.32%
LGL-CPs	25.83%	No Material Impacts		25.69 - 25.92%	25.76 - 26.02%	25.91 - 26.34%	26.18 - 26.75%	26.09 - 26.80%
CDQs	32.69%	No Material Impacts			32.70 - 32.64%	32.70 - 32.64%	32.73 - 32.63%	32.75 - 32.47%
All	**13.03%**	**13.03 - 13.06%**	**13.06 - 13.13%**	**13.11 - 13.24%**	**13.15 - 13.32%**	**13.20 - 13.40%**	**13.23 - 13.46%**	**13.26 - 13.50%**

Note: The type of revenue included varies by vessel. If the vessel is a catcher vessel, ex-vessel revenue is added to the total. If the vessel is a catcher processor then wholesale revenue is added. If the vessel is a mothership only valued-added revenues are included.

Source Developed by NEI based on CDQ annual reports and AKFIN data (Fey, 2014).

Table 4-179, above, consists of two halves. The upper half summarizes the foregone amount of vessel-based revenues projected from CDQ ownership interests in groundfish vessels that are affected by PSC limit reduction options. The lower half of the table shows the percentage of each sector's foregone revenues that are incurred by vessel assets owned by CDQ organizations. As an example, look at the option to reduce PSC limits by 50 percent. In the row for LGL-CPs, Option 3g is expected to generate $27 to $29 million in foregone revenues on CDQ-owned vessels—noting that this amount factors in the CDQ ownership percentage of LGL-CP vessels. Looking at the bottom half of the table, the foregone revenues attributed to CDQ ownership constitutes approximately 26 percent of the total foregone revenues that are expected over all LGL-CPs.

Harvest Impacts in the CDQ Groundfish Fisheries

This section provides additional details on the harvest and PSC impacts to CDQ fisheries from options to reduce PSC limits. Figure 4-88 provides an overall picture of the projected annual average impacts on groundfish harvests that are expected with the PSC limit reduction percentages under Option 6. The two pies represent harvest impacts under Scenario A and Scenario B. The large portions of the pies represent the percentage of the total harvest that remains uncut under all of the options. Under Scenario A it is projected that over 98 percent of overall groundfish harvests would remain uncut, regardless of the option chosen. Under Scenario B, the portion of harvest volume that remains uncut under any of the options is slightly less, at 97.6 percent. It should be noted that the individual slices of the pie charts represent the incremental amounts of groundfish that are expected to be cut under the different PSC limit reduction percentages. The labels for each suboption indicate the cumulative amount cut, and include amounts from all of the preceding cuts (i.e., moving back in a counter-clockwise manner).

Figure 4-88 Impacts to Total Groundfish Harvests in CDQ Groundfish Fisheries under the PSC Limit Reduction Options

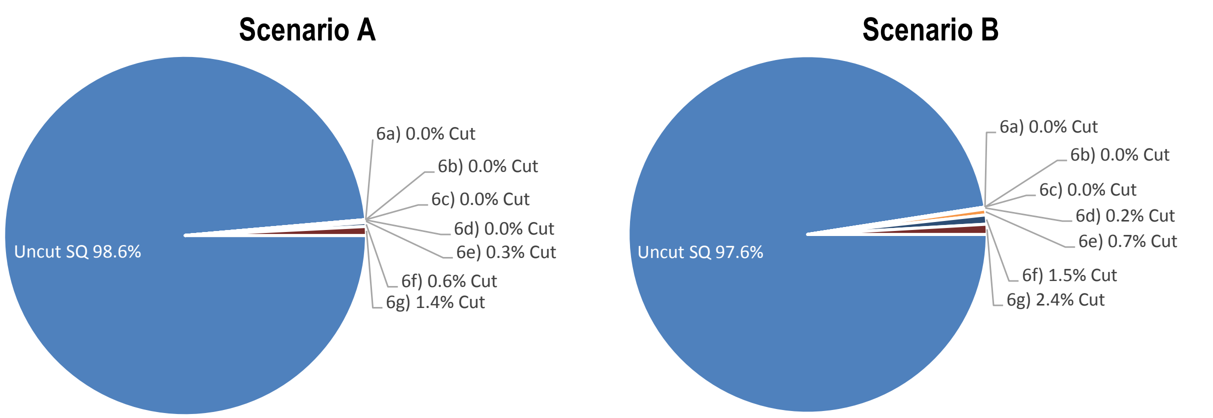


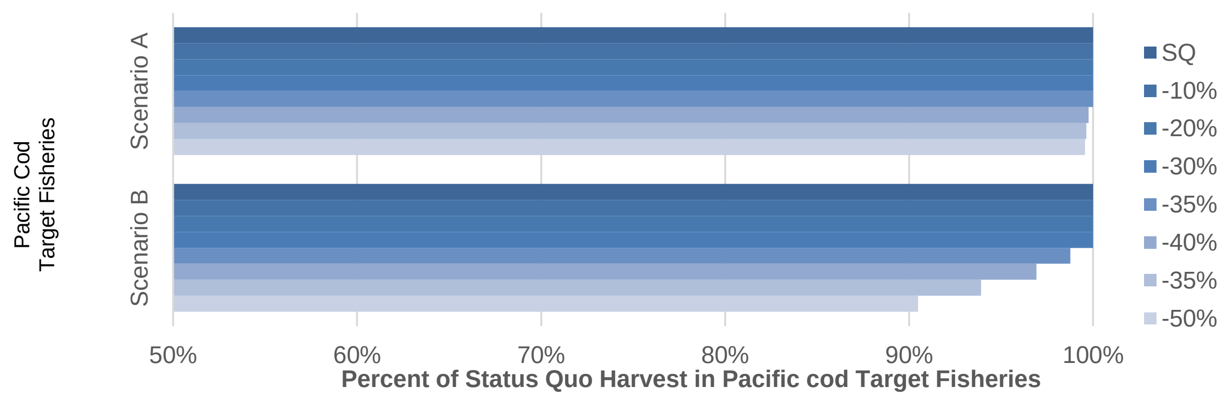
Table 4-180 summarizes annual average reductions in harvests under Option 6, by target fishery. The impacts are summarized by target in the bulleted list below for Pacific cod and yellowfin sole target fisheries, and shown graphically in Figure 4-89:

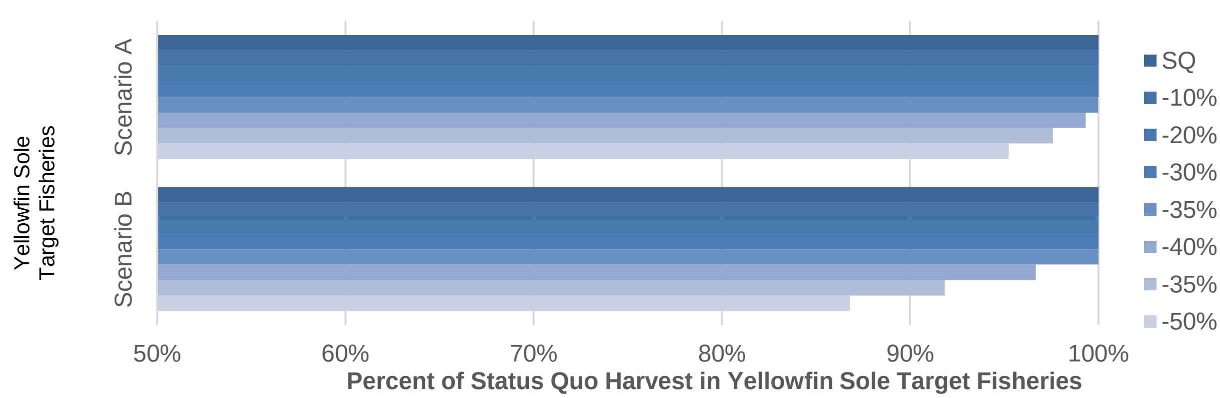
- Pollock Target Fisheries: pollock accounts for 69 percent of status quo harvest and very little pollock is expected to be foregone under any of the options.
- Pacific Cod Target Fisheries: Pacific cod accounts for 14 percent of status quo harvest volumes and it is projected that 2,000 mt would be cut under Option 6g with Scenario B, while under Scenario A, only 90 mt would be cut.
- Yellowfin sole Targets: Groundfish in yellowfin sole comprises 8 percent of the CDQ harvest volumes under the status quo and under Option 6g and Scenario B would see a 13 percent reduction in harvests.

Table 4-180 Annual Average Impacts of Option 6 to Future Harvests in CDQ Groundfish Target Fisheries

	SQ	6a: -10%	6b: -20%	6c: -30%	6d: -35%	6e: -40%	6f: -45%	6g: -50%
Annual Average Harvests (mt) in the Pollock Target Fishery								
Scenario A	106,095	106,095	106,095	106,095	106,095	106,086	106,079	106,059
Scenario B	106,095	106,095	106,095	106,095	106,095	106,095	106,095	106,095
Annual Average Harvests (mt) in the Pacific Cod Target Fishery								
Scenario A	21,324	21,324	21,324	21,324	21,323	21,272	21,246	21,233
Scenario B	21,324	21,324	21,324	21,324	21,061	20,668	20,028	19,296
Annual Average Harvests (mt) in the Yellowfin Sole Target Fishery								
Scenario A	12,529	12,529	12,529	12,529	12,528	12,445	12,227	11,931
Scenario B	12,529	12,529	12,529	12,529	12,529	12,112	11,505	10,876
Annual Average Harvests (mt) in the Rockfish Target Fisheries								
Scenario A	2,334	2,334	2,334	2,334	2,334	2,333	2,315	2,306
Scenario B	2,334	2,334	2,334	2,334	2,334	2,334	2,307	2,301
Annual Average Harvests (mt) in All Other Target Fisheries								
Scenario A	11,887	11,887	11,887	11,887	11,829	11,644	11,379	10,482
Scenario B	11,887	11,887	11,887	11,887	11,887	11,883	11,875	11,827
Annual Average Harvests (mt) in All CDQ Target Fisheries								
Scenario A	154,168	154,168	154,168	154,168	154,108	153,780	153,247	152,011
Scenario B	154,168	154,168	154,168	154,168	153,905	153,092	151,809	150,396

Figure 4-89 Percentage Change from Status Quo in CDQ Target Harvests under Option 6





Behavioral Changes of CDQs in Response to PSC Limit Reduction Options

Table 4-181 provides data on changes in groundfish, halibut encounters, halibut encounter rates and PSC in CDQ groundfish fisheries. Because the changes are minimal, inferences are not realistic.

Table 4-181 Groundfish Harvest Changes and Resulting Changes in Halibut Encounters, Halibut Encounter Rates (HER), and PSC for CDQs

	Scenario A							
	SQ	6a: -10%	6b: -20%	6c: -30%	6d: -35%	6e: -40%	6f: -45%	6g: -50%
Variable	Status Quo and Changes (Δ) in Annual Average Outcomes under the Suboptions							
Groundfish (mt)	154,168	-	-	-	-60	-388	-921	-2,158
Encounters (mt)	783	-	-	-	-3	-13	-26	-42
HER (kg/mt)	5.08	-	-	-	-0.02	-0.07	-0.14	-0.20
PSC (r.w. mt)	211	-	-	-	-2	-8	-18	-30
	Percentage Change from Status Quo Under the Suboptions							
Groundfish (Δ %)	-	-	-	-	-0.0%	-0.3%	-0.6%	-1.4%
Encounters (Δ %)	-	-	-	-	-0.4%	-1.6%	-3.3%	-5.4%
HER (Δ %)	-	-	-	-	-0.3%	-1.4%	-2.7%	-4.0%
PSC (Δ %)	-	-	-	-	-1.1%	-3.6%	-8.6%	-14.5%
	Scenario B							
	6SQ	6a: -10%	6b: -20%	6c: -30%	6d: -35%	6e: -40%	6f: -45%	6g: -50%
Variable	Status Quo and Changes (Δ) in Annual Average Outcomes under the Suboptions							
Groundfish (mt)	154,168	-	-	-	-263	-1,076	-2,359	-3,773
Encounters (mt)	783	-	-	-	-16	-41	-76	-119
HER (kg/mt)	5.08	-	-	-	-0.10	-0.23	-0.42	-0.67
PSC (r.w. mt)	211	-	-	-	-2	-8	-17	-29
	Percentage Change from Status Quo Under the Suboptions							
Groundfish (Δ %)	-	-	-	-	-0.2%	-0.7%	-1.5%	-2.4%
Encounters (Δ %)	-	-	-	-	-2.1%	-5.2%	-9.7%	-15.3%
HER (Δ %)	-	-	-	-	-1.9%	-4.5%	-8.3%	-13.1%
PSC (Δ %)	-	-	-	-	-0.8%	-4.0%	-8.1%	-13.6%

4.12.1.2 Impacts of Option 6 on the Commercial Halibut Fishery

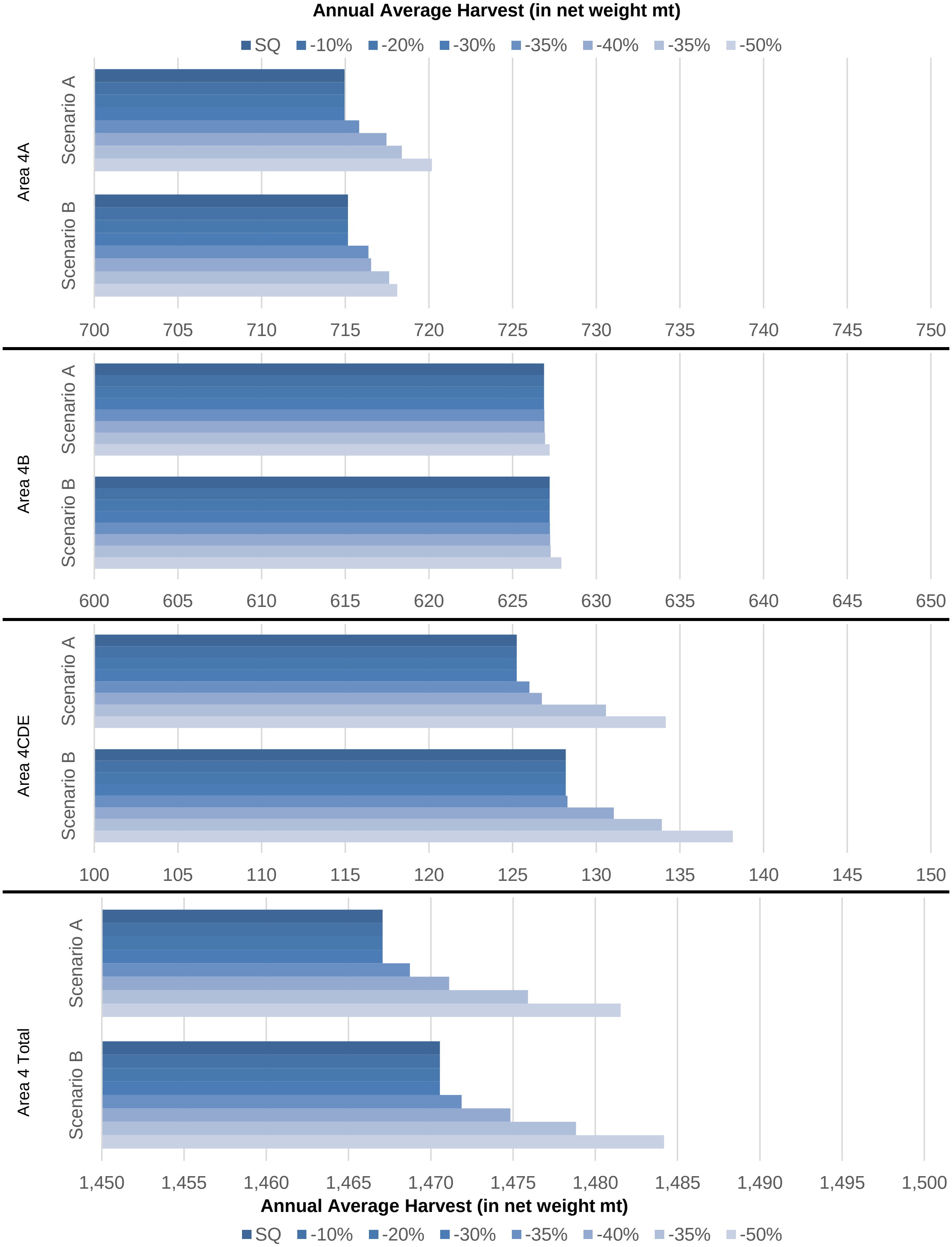
Harvest Impacts to the Commercial Halibut Fishery of Option 6

Table 4-182 summarizes changes in annual average halibut harvest by IPHC Area Option 6. Figure 4-90 summarizes the same information graphically. The Area 4 halibut fishery could realize an increase in annual average harvest volumes of 14 mt under Option 6g, as modelled. We reiterate here that the estimated impacts of Option 6 may be underestimated, because the CDQ fishery has not fully matured.

Table 4-182 Summary of Commercial Halibut Harvest Impacts under Option 6

	Commercial Halibut Fishery Impacts							
	Scenario A				Scenario B			
	4A	4B	4CDE	Area 4	4A	4B	4CDE	Area 4
Option	Average Annual Change from the Status Quo in Commercial Halibut Harvest (NW MT)							
Status Quo	714.9	626.9	125.2	1,467.1	715.2	627.2	128.2	1,470.6
6d: -35%	0.9	0.0	0.8	1.7	1.2	0.0	0.1	1.3
6e: -40%	2.5	0.0	1.5	4.0	1.4	0.0	2.9	4.3
6f: -45%	3.4	0.1	5.3	8.8	2.5	0.1	5.8	8.3
6g: -50%	5.2	0.3	8.9	14.5	2.9	0.7	10.0	13.6

Figure 4-90 Projected Annual Average Harvests (in n.w. mt) under Option 6



Note: The figure does not include increases in harvests that could result from PSC Limit reductions in other groundfish fisheries.

Revenue Impacts to the Commercial Halibut Fishery

In this section we provide additional details regarding the wholesale revenue impacts to the commercial halibut fishery that are projected to occur with PSC limit reductions imposed on CDQs. For ease of use, the wholesale revenues from the commercial halibut fishery that were reported in the overall summary table for Option 6 are reproduced below in Table 4-183. As indicated earlier, the numbers in the table represent the sum of wholesale revenues over the 10-year future period under the status quo (discounted to present values), and for each PSC limit reduction option, the changes in wholesale revenues over the 10-year future period, again discounted to present values. In general, impacts to the halibut fishery resulting from Option 6 are relatively small, summing to just over $3 million over the 10-year future period, in present values.

Table 4-183 Summary of Impacts on Wholesale Revenues the Commercial Halibut Fishery under Option 6

	Commercial Halibut Fishery Impacts							
	Scenario A				Scenario B			
	4A	4B	4CDE	Area 4	4A	4B	4CDE	Area 4
Option	10-year Sum of Changes to the DPV Wholesale Revenues (2013 $Millions) Relative to the Status Quo							
Status Quo	$171.18	$149.76	$28.87	$349.81	$171.20	$149.77	$29.52	$350.49
6a: -10%	These options are non-constraining and have no material impact on the affected participants							
6b: -20%								
6c: -30%								
6d: -35%	$0.25	$0.00	$0.18	$0.44	$0.33	$0.00	$0.02	$0.35
6e: -40%	$0.64	$0.01	$0.35	$0.99	$0.37	$0.01	$0.67	$1.05
6f: -45%	$0.84	$0.01	$1.26	$2.11	$0.63	$0.01	$1.35	$1.99
6g: -50%	$1.28	$0.08	$2.09	$3.44	$0.72	$0.16	$2.35	$3.23

Table 4-184 provides a slightly different perspective on the revenue impacts to the commercial halibut fishery. In this case, the first column shows the future value (discounted to present values) of the status quo for each of the 10 future years, as an average over the 10,000 iterations run under the IMS Model. Columns to the right of the status quo show the changes relative to the model status quo which can be expected under the specific options. The bottom line shows the average annual change over all of the years and over all of the iterations. A similar table is provided on the next page which shows discounted average annual wholesale revenues for each future year under Option 6 for Areas 4A, 4B and 4CDE. It should be noted that in Table 4-185, the changes resulting from the Option are minimal.

Table 4-184 Discounted Average Annual Halibut Wholesale Revenues ($ million) under Option 6 for Area 4

Year	Status Quo Scenario A - B	6a):-10% Scenario A - B	6b):-20% Scenario A - B	6c):-30% Scenario A - B	6d):-35% Scenario A - B	6e): -40% Scenario A - B	6f): -45% Scenario A - B	6g): -50% Scenario A - B
Area 4 Total								
2014	$45.8 to $45.7	These options are non-constraining and have no material impact on the affected participants			$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0
2015	$38.9 to $39.0				$0.2 to $0.2	$0.4 to $0.4	$0.6 to $0.6	$0.9 to $0.9
2016	$39.8 to $39.9				$0.0 to $0.0	$0.1 to $0.1	$0.2 to $0.2	$0.4 to $0.3
2017	$37.6 to $37.7				$0.0 to $0.0	$0.1 to $0.1	$0.2 to $0.2	$0.3 to $0.3
2018	$35.6 to $35.6				$0.0 to $0.0	$0.1 to $0.1	$0.2 to $0.2	$0.3 to $0.3
2019	$33.7 to $33.7				$0.0 to $0.0	$0.1 to $0.1	$0.2 to $0.2	$0.3 to $0.3
2020	$31.8 to $32.0				$0.0 to $0.0	$0.1 to $0.1	$0.2 to $0.2	$0.3 to $0.3
2021	$30.3 to $30.4				$0.0 to $0.0	$0.1 to $0.1	$0.2 to $0.2	$0.3 to $0.3
2022	$28.9 to $28.9				$0.0 to $0.0	$0.1 to $0.1	$0.2 to $0.2	$0.3 to $0.3
2023	$27.3 to $27.4				$0.0 to $0.0	$0.1 to $0.1	$0.2 to $0.2	$0.3 to $0.3
Average	$35.0 to $35.0				$0.0 to $0.0	$0.1 to $0.1	$0.2 to $0.2	$0.3 to $0.3

Table 4-185 Discounted Average Annual Halibut Wholesale Revenues ($ million) under Option 6 by IPHC Area 4A, 4B, and 4CDE

Year	Status Quo Scenario A - B	6a):-10% Scenario A - B	6b):-20% Scenario A - B	6c):-30% Scenario A - B	6d):-35% Scenario A - B	6e): -40% Scenario A - B	6f): -45% Scenario A - B	6g): -50% Scenario A - B
Area 4A								
2014	$25.4 to $25.4				$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0
2015	$19.1 to $19.1				$0.2 to $0.2	$0.3 to $0.2	$0.3 to $0.3	$0.4 to $0.3
2016	$18.9 to $19.0				$0.0 to $0.0	$0.1 to $0.0	$0.1 to $0.1	$0.1 to $0.1
2017	$18.0 to $18.0				$0.0 to $0.0	$0.0 to $0.0	$0.1 to $0.0	$0.1 to $0.1
2018	$17.0 to $16.9				$0.0 to $0.0	$0.0 to $0.0	$0.1 to $0.0	$0.1 to $0.1
2019	$16.1 to $16.1	These options are non-constraining and have no material impact on the affected participants			$0.0 to $0.0	$0.0 to $0.0	$0.1 to $0.0	$0.1 to $0.1
2020	$15.3 to $15.3				$0.0 to $0.0	$0.0 to $0.0	$0.1 to $0.0	$0.1 to $0.0
2021	$14.5 to $14.5				$0.0 to $0.0	$0.0 to $0.0	$0.1 to $0.0	$0.1 to $0.1
2022	$13.8 to $13.8				$0.0 to $0.0	$0.0 to $0.0	$0.1 to $0.0	$0.1 to $0.0
2023	$13.1 to $13.1				$0.0 to $0.0	$0.0 to $0.0	$0.1 to $0.0	$0.1 to $0.1
Average	$17.1 to $17.1				$0.0 to $0.0	$0.1 to $0.0	$0.1 to $0.1	$0.1 to $0.1
Area 4B								
2014	$20.5 to $20.4				$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0
2015	$17.1 to $17.2				$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0
2016	$16.8 to $16.8				$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0
2017	$15.9 to $15.9				$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0
2018	$15.0 to $15.0				$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0
2019	$14.3 to $14.3	These options are non-constraining and have no material impact on the affected participants			$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0
2020	$13.5 to $13.6				$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0
2021	$12.9 to $12.9				$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0
2022	$12.2 to $12.2				$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0
2023	$11.6 to $11.6				$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0
Average	$15.0 to $15.0				$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0
Area 4CDE								
2014	$0.0 to $0.0				$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0	$0.0 to $0.0
2015	$2.7 to $2.8				$0.0 to $0.0	$0.1 to $0.1	$0.3 to $0.3	$0.5 to $0.5
2016	$4.1 to $4.2				$0.0 to $0.0	$0.0 to $0.1	$0.1 to $0.1	$0.2 to $0.3
2017	$3.7 to $3.8				$0.0 to $0.0	$0.0 to $0.1	$0.1 to $0.1	$0.2 to $0.3
2018	$3.5 to $3.6				$0.0 to $0.0	$0.0 to $0.1	$0.1 to $0.1	$0.2 to $0.2
2019	$3.3 to $3.3	These options are non-constraining and have no material impact on the affected participants			$0.0 to $0.0	$0.0 to $0.1	$0.1 to $0.1	$0.2 to $0.2
2020	$3.0 to $3.1				$0.0 to $0.0	$0.0 to $0.1	$0.1 to $0.1	$0.2 to $0.2
2021	$3.0 to $3.0				$0.0 to $0.0	$0.0 to $0.1	$0.1 to $0.1	$0.2 to $0.2
2022	$2.8 to $2.9				$0.0 to $0.0	$0.0 to $0.1	$0.1 to $0.1	$0.2 to $0.2
2023	$2.6 to $2.7				$0.0 to $0.0	$0.0 to $0.1	$0.1 to $0.1	$0.2 to $0.2
Average	$2.9 to $3.0				$0.0 to $0.0	$0.0 to $0.1	$0.1 to $0.1	$0.2 to $0.2

Yield Increases to Commercial Halibut Fishery Resulting from U26 Savings

Table 4-186 summarizes the future yield impact in terms of harvest increases (on the left side of the table) and increases in future wholesale revenues (on the right) which are expected to result from Option 6. Increased harvests and wholesale revenues are summarized for Area 4, Other Alaska (IPHC Areas 3A, 3B, and 2C), and for regions "External" to Alaska (IPHC Areas 2A and 2B). The yield increases projected to result from Option 6 are fairly minimal, in part because the CDQ groundfish fishery has not taken a lot of PSC in the past. If the CDQ fishery continues to mature, then the Options to reduce PSC limits would likely have a greater impact.

Table 4-186 Summary of Future "U26 Impacts" in Area 4 and in Other Areas Outside of Area 4 Option 6

Option	Area 4 Scen A - B	Other AK Scen A - B	External Scenarios A - B	Total U26 Scen A - B	Area 4 Scen A - B	Other AK Scen A - B	External Scen A - B	Total U26 Scen A - B
	Mean Annual Increase in Catch (nw mt) over Last Half of the 10-year Future Period				Increased DPV of Wholesale Revenue (2013 millions) over 10-Year Future Period			
6a): -10%								
6b): -20%	These options are non-constraining and have no material impact on the affected participants							
6c): -30%								
6d): -35%	0.1 - 0.0	0.2 - 0.1	0.0 - 0.0	0.3 - 0.2	$0.01 - $0.00	$0.02 - $0.01	$0.00 - $0.00	$0.03 - $0.02
6e): -40%	0.2 - 0.2	0.6 - 0.7	0.1 - 0.1	1.0 - 1.1	$0.02 - $0.02	$0.06 - $0.06	$0.01 - $0.01	$0.09 - $0.10
6f): -45%	0.5 - 0.5	1.5 - 1.4	0.3 - 0.3	2.3 - 2.2	$0.05 - $0.05	$0.14 - $0.13	$0.03 - $0.03	$0.22 - $0.20
6g): -50%	0.8 - 0.8	2.5 - 2.3	0.5 - 0.5	3.8 - 3.6	$0.08 - $0.08	$0.22 - $0.21	$0.05 - $0.05	$0.36 - $0.34

4.13 Summary of Alternative 2 Impacts Across All Options and Sectors

This section provides an overall summary of the impacts of Alternative 2, which would reduce halibut PSC limits of the non-exempt groundfish fisheries in the BSAI. The PSC reduction impacts are discussed by individual groundfish sectors in the sections above, but the Council may select multiple options simultaneously, and consequently this section provides a discussion of the impacts of applying PSC reduction options across all sectors. This is particularly important for considering impacts to the halibut fishery (Section 4.13.1), as the net effect on directed halibut participants will be the cumulative result of the PSC reduction options for multiple sectors. Although the primary impacts for the groundfish fishery are best described at the sector level, there are also some cumulative considerations which are touched on in Section 4.13.2.

The multiplicity of ways in which the PSC reductions for each sector could be combined is such that it is not possible to discuss each individual combination. Rather, the sections that follow describe the impacts of applying the same percentage reduction option to each of the affected sectors. This provides some basis for a cumulative discussion. In the Council's deliberating, it will also be possible to arrive at the results of a specific Council recommendation that includes different percentage reductions for the sectors by summing the model output for the individual sectors.

Recall that the potential reductions under Alternative 2 are organized by the six different trawl and hook-and-line participant groups or sectors, listed as options. Seven PSC limit reduction percentages are considered for each of the sectors, ranging from a 10 to a 50 percent reduction. Table 4-187 (reproduced from Chapter 2) provides a summary of the Alternative 2 options, PSC limit reduction percentages, and the PSC limits that would result.

Table 4-187 Proposed PSC Limits under Alternative 2 (in mt)

	Status quo	a) -10%	b) -20%	c) -30%	d) -35%	e) -40%	f) -45%	g) -50%	h) -60%
Option 1: Amendment 80*	2,325	2,093	1,860	1,628	1,511	1,395	1,279	1,163	930
Option 2: BS trawl limited access	875	788	700	613	569	525	481	438	
Option 3: Hook and line Pcod – CP	760	684	608	532	494	456	418	380	
Option 4: Hook and line CV and CP – targets other than Pcod or sablefish	58	52	46	41	38	35	32	29	
Option 5: Hook and line Pcod – CV	15	14	12	11	10	9	8	8	
Option 6: CDQ PSQ	393	354	314	275	255	236	216	197	

* Note, the eighth possibility in the range, h) -60%, only applies to Amendment 80 Suboption 2, which allows for a different PSC limit reduction for the Amendment 80 limited access fishery.

Under Option 1 for Amendment 80, the Council has included two Suboptions. The analysis focuses primarily on Suboption 1, which is to set a PSC limit for Amendment 80 cooperatives, as all Amendment 80 vessels have participated in cooperatives since 2011. There is also a separate Suboption 2, by which the Council could choose to set a separate PSC limit for any vessels choosing to participate in the Amendment 80 limited access sector; the Council has also extended the range of potential reductions for the Amendment 80 limited access fishery to include an upper limit of a 60 percent reduction from the status quo PSC limit. Suboption 2 for Amendment 80 is analyzed in Section 4.8.2, but not discussed further in this summary.

Technically, Option 4 (PSC limit for hook-and-line other targets) would constrain both longline CVs and longline CPs, but since 2008 there have been no NMFS catch records that document participation by longline CVs in target fisheries for groundfish species other than for Pacific cod or sablefish. Therefore, in practice, this option focuses on longline CPs that participate in the Greenland turbot fishery, which is the primary target fishery for groundfish species other than Pacific cod or sablefish for those vessels.

Table 3-12 provides a summary of the historical halibut PSC usage by the BSAI groundfish fisheries, by sector, from 2008 to 2014. The table also shows what the PSC usage represents in terms of the proportion of the sector's 2013 PSC limit. The 2013 limit is used as a benchmark because there has been some variation in the PSC limits over that timeframe. In almost all cases, the sectors are consistently below their PSC limits throughout the timeframe, although there is considerable interannual variability in PSC usage.

Table 4-188 Halibut PSC mortality in BSAI groundfish target fisheries, by sector, 2008 to 2014, in metric tons, and mortality as a percentage of the 2013 halibut PSC limit for each sector

Sector	2013 PSC limit		2008	2009	2010	2011	2012	2013	2014	Average PSC used 2008-2013
Amendment 80	2,325	mt	1,969	2,074	2,254	1,810	1,945	2,168	2,106	2,037
		%	78%	84%	93%	76%	84%	93%	91%	88%
BSAI TLA	875	mt	739	727	484	637	960	707	717	700
		%	84%	83%	55%	73%	110%	81%	82%	80%
Hook and line cod CPs	760	mt	564	554	489	477	550	458	412*	521
		%	74%	73%	64%	63%	72%	60%	50%	69%
Other non-trawl	58	mt	1	6	10	5	6	1	*	5
		%	2%	10%	17%	9%	10%	2%	*	9%
Hook and line cod CVs	15	mt	5	3	2	1	2	3	7	3
		%	33%	20%	13%	7%	13%	20%	47%	20%
CDQ	393	mt	214	151	159	223	252	265	244	210
		%	62%	44%	40%	57%	64%	67%	62%	53%
Total	**4,426**	mt	**3,493**	**3,516**	**3,398**	**3,153**	**3,714**	**3,603**	**3,406**	**3,301**
		%	**76%**	**78%**	**75%**	**70%**	**84%**	**81%**	**79%**	**75%**

* All 2014 halibut PSC mortality accruing to the other non-trawl PSC limit was intercepted by longline CPs, and is included with the longline Pacific cod CP amount. Source: AKFIN.

The assessment of the impacts of these options is described in terms of changes from the status quo over a 10-year period in the future—specifically, from 2014 to 2023. The impact of each option is estimated through the IMS Model described in Section 4.6. The IMS model simulates the groundfish and halibut fishery over the 10-year future period. In each of the 10,000 iterations of model, each future year is represented by one of the years between 2008 and 2013. The primary outputs of the IMS Model are the following measures:

- The annual average change, relative to the status quo, in halibut PSC mortality (PSC in round weight mt) by IPHC area over the 10-year period by affected groundfish fisheries;
- The annual average change, relative to the status quo, in halibut harvests (in net weight mt) of the commercial halibut fishery by IPHC area over the 10-year period;
- The average change relative to the status quo in the discounted present value (DPV) of wholesale revenues over the 10-year period for the affected groundfish fisheries;
- The average change relative to the status quo in the discounted present value (DPV) of wholesale revenues over the 10-year period for the commercial halibut fisheries.
- The total increased yield generated from the savings of U26 halibut over the 10-year future period, and reported for IPHC Areas 4A, 4B, 4CDE, Gulf of Alaska (IPHC Areas 2C, 3A, and 3B combined) and the Pacific Coast and Canada (IPHC Areas 2A and 2B combined).
- Total discounted present value (DPV) of wholesale revenues over the 10-year period generated from the savings of U26 halibut and reported for the same areas listed in the previous element.

Table 4-189 and Table 4-190 provide an overview of impacts of the options and these six major impact categories. These summary tables are reproduced from Section 2.3. With the exception of the current and proposed PSC limits, all of the numbers in the table are estimated using the IMS Model including the estimates of the Status Quo for both the groundfish fishery and the commercial halibut fishery.

Table 4-189 Comparison of the alternatives and options in terms of harvest and revenue impacts in BSAI fisheries

Note, when numbers are shown as a range, they represent estimates from two Scenarios—Scenario A is a relatively "low impact" scenario and Scenario B is a relatively "high impact" scenario.

	Impacts to the Affected Groundfish Fisheries				Impacts to the Area 4 Commercial Halibut Fishery					
	PSC Limit	Annual Average PSC Taken under the Status Quo and Estimated Mean Future Reductions under the Options	Discounted Present Value (DPV) of Wholesale Revenues under the Status Quo and Foregone DPV under the Options from 2014 to 2023 (2013$ Millions)		Annual Average Status Quo Commercial Halibut Harvest Amounts and Reallocated Average Yield to the Fishery Under the Options. Includes yield from savings of both O26 and U26 PSC. (Net Weight Pounds 1,000s)				Discounted Present Value of Wholesale Revenue under the Status Quo and Gains under the Options. Includes both O26 & U26 ($2013 Millions)	
	(mt)	(mt)	10-Year Sum	Average Annual	4A	4B	4CDE	Area 4	10-Year Sum	Average Annual
Option 1: Reduce Halibut PSC Limits for Amendment 80 Catcher Processors (A80-CPs)										
Status Quo	2,325	2,037 - 2,031	$2,610 - $2,609	$261.0 - $260.9	1,576 - 1,577	1,382 - 1,383	276 - 283	3,234 - 3,242	$349.8 - $350.5	$35.0 - $35.0
1a): -10%	2,093	40 - 59	$5 - $32	$0.5 - $3.2	20 - 12	0 - 2	22 - 50	43 - 63	$4.6 - $6.8	$0.5 - $0.7
1b): -20%	1,860	192 - 217	$36 - $123	$3.6 - $12.2	83 - 28	1 - 7	119 - 195	203 - 230	$21.7 - $24.6	$2.2 - $2.5
1c): -30%	1,628	414 - 435	$105 - $263	$10.5 - $26.2	148 - 64	4 - 15	283 - 379	436 - 458	$46.6 - $49.0	$4.7 - $4.9
1d): -35%	1,511	532 - 562	$164 - $366	$16.3 - $36.5	173 - 81	5 - 31	382 - 480	560 - 592	$59.8 - $63.2	$6.0 - $6.3
1e): -40%	1,395	647 - 664	$229 - $469	$22.8 - $46.7	188 - 94	6 - 35	485 - 568	680 - 698	$72.5 - $74.7	$7.3 - $7.5
1f): -45%	1,279	764 - 777	$293 - $575	$29.2 - $57.2	232 - 114	7 - 43	564 - 659	803 - 816	$85.8 - $87.0	$8.6 - $8.7
1g): -50%	1,163	878 - 894	$375 - $699	$37.3 - $69.6	271 - 133	8 - 56	642 - 750	921 - 939	$98.6 - $100.2	$9.9 - $10.0
Option 2: Reduce Halibut PSC Limits in BSAI Trawl Limited Access Fisheries (BSAI TLA)										
Status Quo	875	699 - 697	$10,222 - $10,214	$1,022.2 - $1,021.4	1,576 - 1,577	1,382 - 1,383	276 - 283	3,234 - 3,242	$349.8 - $350.5	$35.0 - $35.0
2a): -10%	788	12 - 17	$5 - $15	$0.5 - $1.5	6 - 6	0 - 0	6 - 9	12 - 16	$1.3 - $1.7	$0.1 - $0.2
2b): -20%	700	28 - 41	$22 - $59	$2.2 - $5.9	12 - 15	1 - 3	12 - 20	25 - 37	$2.8 - $4.0	$0.3 - $0.4
2c): -30%	613	50 - 76	$59 - $110	$5.9 - $10.9	25 - 31	4 - 4	17 - 33	46 - 68	$4.9 - $7.3	$0.5 - $0.7
2d): -35%	569	60 - 101	$73 - $162	$7.2 - $16.1	29 - 44	4 - 6	20 - 42	54 - 92	$5.8 - $9.8	$0.6 - $1.0
2e): -40%	525	76 - 129	$91 - $208	$9.1 - $20.7	41 - 55	5 - 7	24 - 54	69 - 117	$7.4 - $12.4	$0.7 - $1.2
2f): -45%	481	93 - 165	$110 - $261	$10.9 - $26.0	49 - 66	6 - 8	30 - 75	85 - 150	$9.1 - $16.0	$0.9 - $1.6
2g): -50%	438	114 - 201	$153 - $322	$15.2 - $32.1	59 - 78	7 - 10	38 - 96	104 - 183	$11.1 - $19.6	$1.1 - $2.0
Option 3: Reduce Halibut PSC Limits for Hook and Line Catcher Processors (LGL-CPs) in Pacific Cod Target Fisheries										
Status Quo	760	521 - 521	$1,276 - $1,276	$126.0 - $126.0	1,576 - 1,577	1,382 - 1,383	276 - 283	3,234 - 3,242	$349.8 - $350.5	$35.0 - $35.0
3a): -10%	684	These options are non-constraining and have no material impact on the affected participants.								
3b): -20%	608									
3c): -30%	532	14 - 25	$10 - $22	$1.0 - $2.2	5 - 7	12 - 5	1 - 18	17 - 29	$1.9 - $3.2	$0.2 - $0.3
3d): -35%	494	32 - 46	$25 - $44	$2.5 - $4.4	8 - 11	19 - 8	12 - 33	38 - 53	$4.2 - $5.7	$0.4 - $0.6
3e): -40%	456	61 - 79	$50 - $89	$5.0 - $8.9	22 - 23	27 - 10	21 - 58	71 - 92	$7.6 - $9.8	$0.8 - $1.0
3f): -45%	418	100 - 118	$100 - $138	$10.0 - $13.7	39 - 35	30 - 12	46 - 87	115 - 135	$12.3 - $14.4	$1.2 - $1.4
3g): -50%	380	138 - 153	$152 - $191	$15.2 - $19.0	66 - 44	34 - 15	58 - 116	158 - 175	$16.9 - $18.8	$1.7 - $1.9
Option 4: Reduce Halibut PSC Limits for Hook and Line Catcher Processors and Catcher Vessels in Target Fisheries Other than Pacific Cod or Sablefish										
Status Quo	58	5	$11.95							
All Options	These options are non-constraining and have no material impact on the affected participants.									
Option 5: Reduce Halibut PSC Limits for Hook and Line Catcher Vessels (LGL-CVs) in Pacific Cod Target Fisheries										
Status Quo	15	3	$1.20							
All Options	These options are non-constraining and have no material impact on the affected participants.									
Option 6: Reduce Halibut PSC Limits for Vessels Participating in CDQ Groundfish Fisheries										
Status Quo	393	211 - 211	$1,606.3 - $1,606.3	$160.6 - $160.6	1,576 - 1,577	1,382 - 1,382	276 - 283	3,234 - 3,242	$349.8 - $350.5	$35.0 - $35.0
6a): -10%	354	These options are non-constraining and have no material impact on the affected participants.								
6b): -20%	314									
6c): -30%	275									
6d): -35%	255	2 - 2	$0.4 - $2.2	$0.0 - $0.2	2 - 3	0.0 - 0.0	2 - 0	4 - 3	$0.4 - $0.3	$0.0 - $0.0
6e): -40%	236	8 - 8	$2.7 - $9.3	$0.3 - $0.9	6 - 3	0.1 - 0.1	3 - 6	9 - 9	$1.0 - $1.1	$0.1 - $0.1
6f): -45%	216	18 - 17	$6.3 - $21.2	$0.6 - $2.1	8 - 5	0.1 - 0.1	12 - 13	19 - 18	$2.1 - $2.0	$0.2 - $0.2
6g): -50%	197	30 - 29	$15.2 - $36.7	$1.5 - $3.7	12 - 6	0.7 - 1.5	20 - 22	32 - 30	$3.4 - $3.2	$0.3 - $0.3

Table 4-190 Comparison of Halibut Fishery Yield Impacts from U26 PSC Savings in the BSAI, in Areas External to the BSAI (Gulf of Alaska, British Columbia, Pacific Coast)

	From Option 1 A80-CPs		From Option 2 BSAI TLA		From Option 3 LGL-CPs		Option 6 CDQ Fisheries	
PSC Limit Cut Percent	Annual Average Harvest from U26 Savings from 2019 to 2023 (1,000's n.w. lb)	10-Year Sum of Future Discounted Present Value of Wholesale Revenue (2013 $millions)	Annual Average Harvest from U26 Savings from 2019 to 2023 (1,000's n.w. lb)	10-Year Sum of Future Discounted Present Value of Wholesale Revenue (2013 $millions)	Annual Average Harvest from U26 Savings from 2019 to 2023 (1,000's n.w. lb)	10-Year Sum of Future Discounted Present Value of Wholesale Revenue (2013 $millions)	Annual Average Harvest from U26 Savings from 2019 to 2023 (1,000's n.w. lb)	10-Year Sum of Future Discounted Present Value of Wholesale Revenue (2013 $millions)
-10%	8 to 12	$0.34 to $0.50	4 to 5	$0.13 to $0.18	These suboptions are not expected to produce material impacts		These suboptions are not expected to produce material impacts	
-20%	38 to 43	$1.60 to $1.79	7 to 11	$0.30 to $0.44				
-30%	83 to 86	$3.48 to $3.64	12 to 19	$0.52 to $0.82	2 to 5	$0.10 to $0.18		
-35%	106 to 112	$4.47 to $4.72	16 to 26	$0.64 to $1.09	5 to 7	$0.23 to $0.33	0 to 0	$0.02 to $0.01
-40%	129 to 133	$5.44 to $5.59	19 to 32	$0.81 to $1.37	10 to 13	$0.42 to $0.56	1 to 2	$0.07 to $0.07
-45%	153 to 156	$6.44 to $6.54	24 to 42	$0.99 to $1.75	17 to 20	$0.70 to $0.84	4 to 4	$0.17 to $0.16
-50%	176 to 179	$7.38 to $7.53	29 to 50	$1.21 to $2.11	23 to 26	$0.98 to $1.09	6 to 6	$0.27 to $0.26

Note: The first yield increases from U26 PSC Savings that accrue as a result of PSC limit reductions are not realized until 2019. For this reason average annual harvests are estimated over the last five years only. Also note that when numbers are shown as a range, they represent estimates from two Scenarios—Scenario A is a relatively "low impact" scenario and Scenario B is a relatively "high impact" scenario.

In the remainder of this section, we show the combined impact of simultaneously selecting options for all sectors to the commercial halibut fishery and to the affected sectors in the groundfish fishery.

4.13.1 Commercial halibut fishery impacts

This section looks specifically at the commercial halibut fishery, and cumulative impacts from applying PSC reductions in multiple groundfish sectors. This is particularly appropriate because the ultimate effect of this action on the halibut fishery is likely to be a combined outcome of multiple sector PSC reductions.

As there are too many unique combinations of sector PSC reductions to allow each to be easily examined individually, this analysis uses a proxy of applying the equivalent PSC reductions across all sectors to look at the effect of their combined impact on halibut harvest and revenue. This evaluation has two parts. The first focuses on effects in the Area 4/BSAI halibut fishery (Section 4.13.1.1), where the majority of the impact on the halibut fishery will be felt. The second section (Section 4.13.1.2) reports on benefits to the coastwide halibut fishery from the savings of U26 fish. As described in Section 3.1.3.5 and 4.6.1.3, halibut PSC mortality in the BSAI comprises 36 percent of total mortality by weight. Removals of U26 halibut are not immediately transferred to the directed halibut fisheries, but the reduction in future yield to the directed fisheries from U26 PSC mortality cumulatively totals about a pound of directed yield per pound of halibut PSC mortality in groundfish fisheries. It is known that juvenile halibut migrate, but the rate at which movement occurs among areas is not known, and the savings in U26 PSC mortality is implicitly assumed to have an equal effect on the productivity of all regulatory areas. In the model, the potential future yield is distributed coastwide among all regulatory areas in accordance with apportionment among the areas from the IPHC setline survey.

The purpose and need statement for this action (Section 1.2) reflects that while one purpose of this action is to minimize bycatch to the extent practicable, as directed by National Standard 9, another is to provide additional harvest opportunities in the directed halibut fishery, especially in Area 4CDE for western Alaska and Pribilof Island coast communities. National Standard 8 requires the Council to provide for the sustained participation of and minimize adverse economic impacts on fishing communities, and these communities in particular are affected by reduced catch limits for the directed halibut fishery. Looking only at the metric of revenue generated from halibut PSC versus halibut in the directed fishery is insufficient to understand the impacts of this action on the affected stakeholders. Section 4.13.1.3

provides a summary of the community analysis included in Appendix C, which looks at community engagement in and dependency on the halibut fishery (and also the groundfish fishery, summarized in Section 4.13.2.3, below), to provide additional context to the value of the fisheries in these communities. Section 4.13.1.4 provides a different look at the impact of PSC mortality reduction in the groundfish fisheries on the directed halibut fishery, through examples that illustrate the process by which PSC savings would have flowed through to community residents had they been in effect in 2015.

The Council does not have authority to set harvest limits for the commercial halibut fisheries, and halibut PSC mortality in the groundfish fisheries is only one of the factors that affects harvest limits for the commercial halibut fisheries. The model used to estimate impacts in this analysis mimics the IPHC's application of the blue line application of the IPHC's current harvest policy, but the IPHC is not bound by the blue line in setting harvest limits, and is also in the process of re-evaluating its current harvest policy so that it may in fact change in future. The IPHC is also pursuing studies to improve estimation of biomass and juvenile migration, and to further develop the coastwide and spatial stock assessment, all of which will affect halibut harvest limits. Because of these unknown factors, it is not appropriate to link a PSC reduction decision to the achievement of a specific harvest limit outcome in the directed halibut fisheries. PSC mortality in the groundfish fisheries is, however, a significant portion of total mortality in BSAI IPHC areas, and reducing the overall level of halibut PSC mortality is likely to increase the harvest limits available for the directed fisheries in Area 4 regardless of other changes.

4.13.1.1 Harvest and revenue impacts for reductions across all sectors

The commercial halibut fishery harvest under the implementation of combined reductions across all sectors is summarized in Table 4-191. For example, the rows showing outcomes under a -10% change include a 10 percent reduction in halibut PSC limits for the A80-CPs, the BSAI TLA fisheries, the LGL-CPs and the groundfish CDQ fisheries. If the 30 percent PSC reduction were chosen across all sectors, it is projected that the entire Area 4 halibut fishery could realize an increase in annual average harvest volumes by up to 18 percent. Under a 50 percent PSC reduction for all sectors, the Area 4 halibut fishery could realize an increase in annual average harvest volumes of up to 42 percent. Under PSC limit reductions of 50 percent, projected increases to harvest volumes in Area 4CDE would be expected to range between 275 and 349 percent of status quo levels, which, as modelled, were very low – lower, in fact, than current or historic levels of harvest. This is because the model uses our interpretation of the IPHC's current blue line application of the harvest policy, without adjustments to the directed fishery harvest limit (as occurred in 2015 for Area 4B and Area 4CDE (Section 4.6)), so this represents an increase from the blue line catch limits for Area 4CDE, not the actual 4CDE harvest limit as adopted. As noted earlier, halibut PSC reductions in the BSAI are significantly larger than gains to the halibut fishery in Area 4, and the relationship between reductions in PSC from groundfish fisheries and increases in O26 halibut harvest can be approximated by a 2 to 1 ratio. In other words, for every 100 mt (net weight) increase in harvests in the commercial halibut fishery, a decrease in PSC by groundfish fleets of approximately 200 mt (round weight) is required. This results from a combination of the conversion from round weight to net weight, and the proportion of savings that accrue immediately from O26 halibut, and those that accrue over time from U26 halibut.

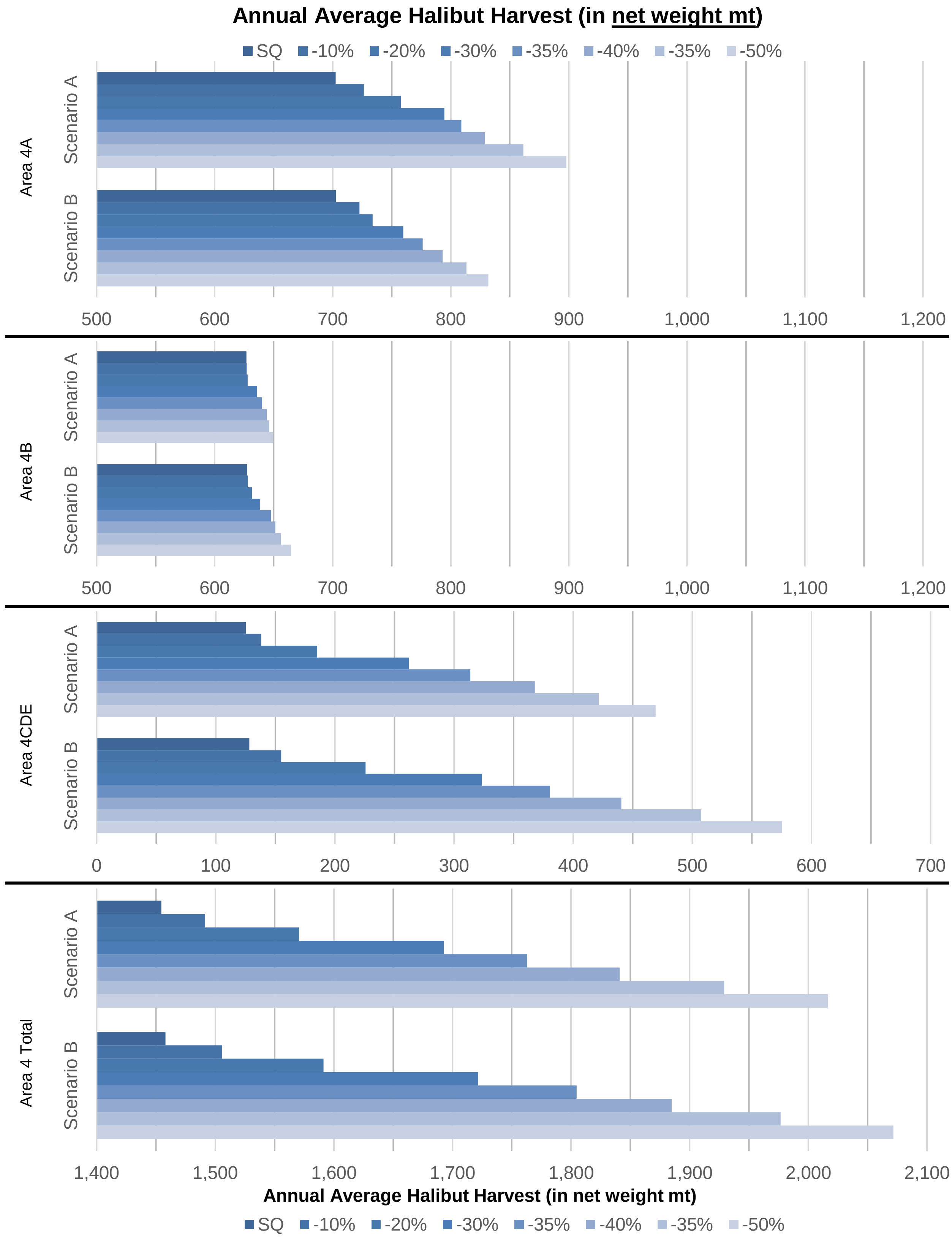
Table 4-191 Summary of harvest impacts for commercial halibut fishery from reductions across all sectors combined, in pounds net weight

Option	Commercial Halibut Fishery Impacts							
	Scenario A				Scenario B			
	4A	4B	4CDE	Area 4	4A	4B	4CDE	Area 4
	Average Annual Change from the Status Quo in Commercial Halibut (net weight 1,000s pounds)							
Status Quo	1,549	1,382	276	3,207	1,549	1,383	283	3,215
All Sectors: -10%	52	0.4	28	81	44	2	59	105
All Sectors: -20%	122	2	132	256	69	10	215	293
All Sectors: -30%	203	20	302	525	126	24	431	581
All Sectors: -35%	235	29	416	679	162	45	557	764
All Sectors: -40%	279	38	534	852	199	53	688	941
All Sectors: -45%	351	43	653	1,046	244	63	835	1,143
All Sectors: -50%	431	50	758	1,239	284	82	986	1,353

Figure 4-91 summarizes projected annual average halibut harvests by IPHC areas if PSC limit reduction options are imposed on all sectors at the same percentage of change from the Status Quo. Note, this figure is in net weight mt, not pounds. There are two sets of bars for each IPHC Area—over all Area 4 subarea Scenario A will generally show slightly lower annual average harvests than under Scenario B, however Area 4A is expected to see lower increases under Scenario B and higher increases under Scenario A. These differences are due primarily to the different sets of behavioral changes in groundfish fisheries in response to the new lower PSC limits. We also note that unlike most of the results that are reported in the analysis, the results show the projected outcomes under the "Change Case" rather than the difference from the status quo. Finally it is important to realize that the starting point for the bars is not always set at zero because the total harvest level varies among subareas, however, the scale of the figure over all of the areas is the same—all of the vertical lines represent an increment of 50 net weight mt of halibut or roughly 110,000 net weight pounds.

If we compare the figures across IPHC areas we see that Area 4CDE is projected to realize the largest increases of the three subareas, while increases in Area 4B are projected to be less than 50 net weight mt even if PSC limits are reduced by 50 percent across the board. In Area 4A increases are projected to range as high 195 net weight mt with a 50 percent across the board cut, but under Scenario B the same cut is projected to add 129 net weight mt. In Area 4CDE, annual average halibut harvests are projected to range between 185 and 225 mt with a 20 percent across the board cut in PSC limit. If a 35 percent cut in PSC limits is imposed across the board, projected annual average halibut harvests range between 314 and 381 net weight mt. The projected range of annual average halibut harvests is 469 to 575 net weight mt in 4CDE with a 50 percent across the board cut in PSC limits.

Figure 4-91 Projected Annual Average Halibut Harvests (in net weight mt) under All Options Combined



Note: This chart includes outcomes for halibut under the same PSC limit reduction option implemented across all sectors simultaneously.

Table 4-192 and Table 4-193 provide wholesale revenues from the commercial halibut fishery under the implementation of combined reductions across all sectors. The numbers in Table 4-192 represent the ten-year sum of wholesale revenues over the modeled future period under the status quo (discounted to present values), and the 10-year sum of changes in wholesale value for each PSC limit reduction option, again discounted to present values. In general, the wholesale revenue impacts increase in approximately the same proportions as changes in halibut harvests. Table 4-193 breaks out average annual revenue increases that would accrue over the modeled years. The decline in revenue over the ten-year model period is the result of discounting to present values. The bottom line of Table 4-193 shows the average annual change over all of the years and over all of the iterations.

Table 4-192 Summary of revenue impacts for commercial halibut fishery from reductions across all sectors combined

Option	Commercial Halibut Fishery Impacts							
	Scenario A				Scenario B			
	4A	4B	4CDE	Area 4	4A	4B	4CDE	Area 4
	Discounted Present Value of the Change from the Status Quo in Wholesale Revenues ($2013 Millions)							
Status Quo	$167.48	$149.76	$28.87	$346.12	$167.50	$149.77	$29.52	$346.79
All Sectors: -10%	$6.40	$0.04	$3.02	$9.46	$5.50	$0.21	$6.28	$11.99
All Sectors: -20%	$13.82	$0.21	$14.09	$28.12	$8.12	$1.02	$23.00	$32.14
All Sectors: -30%	$22.48	$2.10	$32.26	$56.84	$14.20	$2.57	$46.04	$62.81
All Sectors: -35%	$25.88	$3.01	$44.41	$73.30	$18.04	$4.77	$59.46	$82.27
All Sectors: -40%	$30.59	$4.03	$57.14	$91.75	$22.03	$5.61	$73.62	$101.26
All Sectors: -45%	$38.22	$4.46	$69.80	$112.48	$26.73	$6.73	$89.33	$122.79
All Sectors: -50%	$46.78	$5.18	$81.04	$133.00	$31.12	$8.71	$105.57	$145.40

Table 4-193 Discounted Average Annual Halibut Wholesale Revenues ($ million) under Halibut PSC Reductions Options Combined for All Sectors

Year	Status Quo Scenario A - B	All - a):-10% Scenario A - B	All - b):-20% Scenario A - B	All - c):-30% Scenario A - B	All - d):-35% Scenario A - B	All - e): -40% Scenario A - B	All - f): -45% Scenario A - B	All - g): -50% Scenario A - B
Area 4 Total								
2014	$42.1 to $42.0	$3.7 to $3.7	$3.7 to $3.7	$3.7 to $3.7	$3.7 to $3.7	$3.7 to $3.7	$3.7 to $3.7	$3.7 to $3.7
2015	$38.9 to $39.0	$1.5 to $2.0	$5.6 to $6.5	$12.0 to $13.3	$15.6 to $17.6	$19.7 to $21.8	$24.4 to $26.6	$28.9 to $31.7
2016	$39.8 to $39.9	$0.6 to $0.9	$2.7 to $3.1	$6.1 to $6.8	$8.0 to $9.0	$10.1 to $11.3	$12.5 to $13.7	$15.0 to $16.3
2017	$37.6 to $37.7	$0.6 to $0.9	$2.6 to $3.0	$5.6 to $6.3	$7.4 to $8.3	$9.3 to $10.4	$11.6 to $12.6	$13.7 to $15.1
2018	$35.6 to $35.6	$0.6 to $0.8	$2.5 to $2.8	$5.3 to $5.9	$7.0 to $7.9	$8.8 to $9.6	$10.9 to $11.9	$13.0 to $14.3
2019	$33.7 to $33.7	$0.5 to $0.8	$2.3 to $2.8	$5.1 to $5.7	$6.7 to $7.5	$8.6 to $9.4	$10.5 to $11.5	$12.4 to $13.6
2020	$31.8 to $32.0	$0.5 to $0.8	$2.3 to $2.7	$4.9 to $5.4	$6.5 to $7.4	$8.1 to $9.1	$10.0 to $11.0	$12.0 to $13.1
2021	$30.3 to $30.4	$0.5 to $0.8	$2.2 to $2.6	$4.8 to $5.4	$6.3 to $7.1	$8.1 to $8.8	$9.8 to $10.8	$11.6 to $12.9
2022	$28.9 to $28.9	$0.5 to $0.7	$2.2 to $2.6	$4.7 to $5.3	$6.2 to $7.0	$7.7 to $8.7	$9.6 to $10.6	$11.6 to $12.5
2023	$27.3 to $27.4	$0.5 to $0.7	$2.1 to $2.4	$4.6 to $5.1	$6.0 to $6.8	$7.6 to $8.5	$9.4 to $10.3	$11.1 to $12.3
Average	$34.6 to $34.7	$0.8 to $1.2	$2.5 to $3.2	$5.0 to $6.3	$6.3 to $8.2	$7.6 to $10.1	$9.0 to $12.3	$10.2 to $14.5

4.13.1.2 U26 fish and Coastwide Halibut Impacts

This section summarizes the future yield increases that are projected to result from savings of U26 fish when PSC is reduced in the combined groundfish sectors. As described within Sections 3.1.3.5 and 4.6.1.3, PSC reductions generate near-term yield increases due to savings of O26 fish, and longer term yield increases due to savings of U26 fish. The near-term increases are realized only in the IPHC area in which the savings occurred, but the long-term yield increases due to U26 savings are assumed to be distributed coastwide, in proportion to the distribution of biomass. If halibut PSC is reduced by 100 round weight mt and 60 percent of the savings are O26 fish, then the IMS Model assumes that a total of 30 net weight mt (30 net weight mt is the equivalent of 40 round weight mt) will be added to FCEYs in proportion to the overall distribution of biomass from the IPHC setline survey (see Table 4-100). The increased yield is expected to enter the fishery five full years after the saving of the U26 fish occurred. Thus, the IMS Model assumes that if PSC limit cuts are first implemented in 2014, then U26 fish will begin adding to FCEYs in 2019, and they will continue to add to yields for a period of seven years through 2024. For this analysis, the model assumes that the entire equivalent value of U26 fish will add yield to the fishery within those seven years, which is in actuality too compressed a timeframe, therefore there is likely some overestimation the additional yield within the ten year period (Section 4.6).

Table 4-194 summarizes the future yield impact in terms of harvest increases (in the left half of the table) and increases in future wholesale revenues (in the right half) that are expected to result from the suboptions (shown in the rows) applying similar PSC reduction levels across all sectors. Each half of the table shows impacts for three separate geographic areas and coastwide:

- Area 4 impacts (also included already in previous results)
- Other AK impacts, which include impacts in the Gulf of Alaska, Areas 2C, 3A and 3B
- External impacts that accrue outside of Alaska, in British Columbia (Area 2B) or on the U.S. West Coast (Area 2A).

We also note that because yield increases do not start to appear until 2019, the annual average yield changes shown in the table are averages over five years rather than over the entire 10-year future period. Wholesale revenues (discounted to present values), on the other hand, are summed over the entire 10-year future period.

As seen in the table, Area 4 is projected to realize approximately 22 percent of the additional yield, Other Alaska is expected to realize approximately 65 percent of the added yield and areas external to Alaska are expected to realize approximately 13 percent from U26 savings. We note here (as was discussed in Section 4.6.3) that the IMS Model assumes that increases are distributed to IPHC areas based on the biomass distribution estimated by the IPHC for the particular basis year in which the increased yield was realized.[57] Over all halibut fisheries outside of the BSAI, the increased yield under a 50 percent reduction in PSC limits across all sectors is projected to average from 234,000 to 261,000 pounds net weight annually over the years 2019 to 2023. The sum of resulting wholesale revenues over the entire period (discounted to present values) is projected to range from $12.9 to $14.4 million.

[57] The assumption to link increases in yield to the basis year in which the yield was realized may be revisited.

Table 4-194 Summary of Future "U26 Impacts" in Area 4 and in Other Areas Outside of Area 4 Under All Reduction Options, in net weight mt

Option	Area 4 Scen A - B	Other AK (GOA: Areas 2C, 3A, 3B) Scen A - B	Pacific Coast, Canada (Areas 2A, 2B) Scenarios A - B	Total U26 Scen A - B	Area 4 Scen A - B	Other AK (GOA: Areas 2C, 3A, 3B) Scen A - B	Pacific Coast, Canada (Areas 2A, 2B) Scen A - B	Total U26 Scen A - B
	Mean Annual Increase in Catch (net weight pounds, 1,000s) over Last Half of the 10-year Future Period				Increased DPV of Wholesale Revenue (2013 millions) over 10-Year Future Period			
Status Quo	138 - 139	400 - 402	79 - 79	618 - 620	$1.73 - $1.74	$4.59 - $4.62	$0.97 - $0.98	$7.30 - $7.34
All Sectors: -10%	3 - 5	9 - 13	2 - 3	15 - 21	$0.15 - $0.21	$0.39 - $0.56	$0.08 - $0.12	$0.62 - $0.89
All Sectors: -20%	13 - 15	38 - 44	7 - 9	58 - 68	$0.59 - $0.69	$1.57 - $1.83	$0.33 - $0.39	$2.50 - $2.92
All Sectors: -30%	28 - 32	82 - 92	16 - 18	126 - 142	$1.28 - $1.44	$3.38 - $3.82	$0.72 - $0.81	$5.37 - $6.08
All Sectors: -35%	37 - 42	106 - 122	21 - 24	164 - 188	$1.66 - $1.91	$4.42 - $5.07	$0.94 - $1.07	$7.02 - $8.06
All Sectors: -40%	46 - 52	134 - 151	26 - 30	207 - 233	$2.10 - $2.37	$5.55 - $6.27	$1.18 - $1.33	$8.83 - $9.97
All Sectors: -45%	57 - 64	165 - 184	32 - 36	255 - 284	$2.58 - $2.89	$6.86 - $7.64	$1.45 - $1.62	$10.90 - $12.15
All Sectors: -50%	68 - 76	196 - 218	39 - 43	302 - 337	$3.07 - $3.42	$8.13 - $9.07	$1.73 - $1.92	$12.93 - $14.41

4.13.1.3 Alaska Communities and the Area 4 Halibut Fishery

In general, the potential beneficial impacts to the various halibut fisheries would be spread more widely among Alaska communities than would be the potential adverse impacts to the groundfish fisheries. While there are many more Alaska communities directly engaged in the BSAI halibut fisheries than in the BSAI groundfish fisheries in general, the communities that are assumed to have the greatest potential for realizing substantial beneficial impacts under Alternative 2 are 15 communities identified as halibut-dependent. These are Adak, Atka, Akutan, Chefornak, Hooper Bay, Kipnuk, Merkoyuk, Newtok, Nightmute, Savoonga, St. George, St. Paul, Toksook Bay, Tununak, and Unalaska[58]. Relative levels of BSAI halibut fishery engagement for these communities along with selected demographic characteristics are shown graphically in Table 4-195.

It is important to note that commercial halibut fisheries in Alaska have not been in equilibrium, with substantial reductions in the net weight pounds of halibut IFQ and CDQ harvests seen in recent years. As noted elsewhere, between 2003 and 2013, there was a 60 percent decrease in the reported net weight pounds of halibut harvested in Alaska according to AKFIN data, with roughly 19 percent of the net weight pounds of halibut harvested by IFQs and CDQs in Alaska being harvested in Area 4 in 2013, a proportion that has stayed relatively stable over the past decade. Between 2012 and 2013 there was a 24 percent decrease in the reported net weight of IFQ and CDQ halibut harvests in Area 4, with accompanying decreases in ex-vessel revenues and crew payments (influenced both by volume of harvest and price per pound received by the vessel). While price may fluctuate due to many factors, it is assumed that trends of decline in volume of some amount (or lack of increase to former levels) would continue under the no-action alternative, resulting in negative impacts to BSAI halibut-dependent communities. Conversely, it is assumed that beneficial impacts would accrue to BSAI halibut-dependent communities in relation to rebounding accessibility to commercially viable halibut stocks.

[58] Note, to the extent that the reduction in PSC mortality of U26 fish in the BSAI results in halibut that migrate and recruit into halibut fisheries in the GOA, British Columbia, and the Pacific Coast, there will be benefits realized to halibut-dependent communities in these areas also. As summarized in Table 4-189 and Table 4-190, the effects of reducing PSC mortality of U26 fish in the BSAI are much lower on fisheries outside of Area 4 than on Area 4 halibut fisheries. Coastwide effects of reduced mortality of U26 fish will also be realized over a long range of years, not beginning until 4 to 7 years after the instance of PSC reduction in the BSAI. This will further dilute the benefits to individual halibut-dependent communities outside of Area 4. Consequently, no attempt has been made in this document to analyze community-level impacts of the reduction in U26 halibut PSC mortality on halibut fisheries outside of Area 4.

Table 4-195 Graphic Representation of Potentially Affected BSAI Halibut-Dependent Communities' Annual Average Engagement in BSAI Halibut Fisheries

Community	CDQ Group	Community Size	Proportion of Total Population			Shore-Based Processing Location	Number of Halibut CVs	Halibut Ex-Vessel Gross Revenues as Percentage of Total Ex-Vessel Gross Revenues	
			Alaska Native	Minority	Low-Income			Halibut CVs Only	All Community CVs
Adak		•	•	●	○	•	•	●	●
Akutan	APICDA	○	•	●	○	○	•		
Atka	APICDA	•	●	●	•	•	•		
St. George	APICDA	•	●	●	•	•	•		
Unalaska		○	•	○	•	●	●	●	○
St. Paul	CBSFA	•	●	●	•	○	●	●	●
Chefornak	CVRF	•	●	●	○	•	●	●	•
Hooper Bay	CVRF	○	●	●	●	•	○	●	•
Quinhagak*	CVRF	•	●	●	●	•	○		
Kipnuk	CVRF	•	●	●	●	•	●	●	•
Mekoryuk	CVRF	•	●	●	○	•	●	●	●
Newtok	CVRF	•	●	●	●		○	●	○
Nightmute	CVRF	•	●	●	○		○	●	●
Toksook Bay	CVRF	•	●	●	•	•	●	●	○
Tununak	CVRF	•	●	●	●	•	●	●	●
Nome*	NSEDC	○	○	○	•	○	○	○	•
Savoonga	NSEDC	•	●	●	●	•	○	●	●

*Note: Quinhagak and Nome were not identified as BSAI halibut-dependent communities. Quinhagak has been included to allow for more complete data disclosure than would be possible otherwise; Nome has been included as a regional center (and was close to a dependency threshold).

KEY for Table 4-195

Type/Level of Engagement		•	○	●
Community Size	2010 population =	less than 1,000	1,000 – 9,999	greater than 10,000
Alaska Native and Minority Proportion	2010 population =	less than 50 percent	50.0 – 74.9 percent	75.0 or more percent
Low-Income Population Proportion	2010 population =	less than 15 percent	15.0 – 24.9 percent	25.0 or more percent
BSAI Halibut Shore-Based Processing Participation	2008-13 annual avg. =	0.5 – 0.9 plants	1.0 – 1.9 plants	2.0 or more plants
BSAI Halibut Catcher Vessel Participation	2008-13 annual avg. =	1.0 – 4.9 vessels	5.0 – 9.9 vessels	10.0 or more vessels
BSAI Halibut Ex-Vessel Gross Revenue Proportion	2008-13 annual avg. =	less than 25 percent	25.0 – 49.9 percent	50.0 or more percent

Dependence of the total resident-owned catcher vessel fleet (all resident-owned commercial fishing vessels, not just resident-owned vessels that participated in the halibut fishery) for these communities varied widely, as the fleets of some communities are more exclusively focused on the halibut fishery than are others. St. Paul, the community with the highest 2003 to 2013 annual average catcher vessel halibut ex-vessel gross revenues by far (at over $2 million, more than twice that of the next closest community), was also the community with the second-highest percentage of community fleet dependency on BSAI halibut ex-vessel gross revenues (96.9 percent). The only community with a higher local fleet dependency on BSAI halibut ex-vessel gross revenues was Savoonga (at 100 percent), which had an annual average of ex-vessel gross revenues for all resident-owned commercial fishing vessels combined of approximately $95,000 (or about 4.3 percent of the analogous value seen for St. Paul). Among the communities for which revenue totals can be disclosed on an individual community basis, three other communities (Mekoryuk, Nightmute, and Tununak) have resident-owned catcher vessels fleets that were more than 50 percent dependent on BSAI halibut ex-vessel gross revenues on an annual average basis for the years 2003 to 2013, while four others were 20 percent or more dependent. In terms of ex-vessel gross revenues to BSAI halibut vessels specifically, among the halibut-dependent communities for which revenues can be disclosed on an individual community basis, nine have dependencies of 90 percent or greater and one is more than 80 percent dependent, with the remaining community halibut fleet being over 60 percent dependent on BSAI halibut ex-vessel gross revenues alone.

The BSAI halibut-dependent communities that would potentially experience high and adverse impacts under the no-action alternative, and that would potentially benefit the most from the various Alternative 2 options, include communities with high proportions of minority populations and high proportions of low-income populations. In terms of minority populations, of the 15 BSAI halibut-dependent communities, in 2010 minority residents (including Alaska Native residents) accounted for more than 90 percent of the population in 12 communities, between 80 and 90 percent of the population in two communities, and more than 65 percent of the population in the remaining community. In terms of Alaska Native populations specifically, 13 of the 15 halibut-dependent communities are members of CDQ groups and, of these, Alaska Native residents make up over 90 percent of the total population in 10 of the communities and over 80 percent of the total population in another two communities; in the other BSAI halibut-dependent CDQ community, and in the two BSAI halibut-dependent non-CDQ communities, Alaska Native residents make up between five and six percent of the total population of these communities.

In terms of low-income populations, of the 15 identified BSAI halibut-dependent communities, as of 2010, one had 50 percent or more of its residents living below the poverty threshold; two had between 40 and less than 50 percent of their residents living below the poverty threshold; one had between 30 and less than 40 percent of their residents living below the poverty threshold; two had between 20 and less than 30 percent of their residents living below the poverty threshold; and six had between 10 and less than 20 percent of their residents living below the poverty threshold. Only three had less than 10 percent of their residents living below the poverty threshold. Given these minority population and low-income population demographics, if these communities were to experience disproportionate high and adverse impacts under the no-action alternative, environmental justice would be a concern[59]. Conversely, if these communities were to experience beneficial impacts under Alternative 2, environmental justice would not be an issue of concern.

4.13.1.4 Example of PSC reduction flow through

The purpose of the proposed action is to minimize halibut PSC mortality in the BSAI commercial groundfish fisheries to the extent practicable, consistent with National Standard 9 of the MSA. The Council has determined that reductions to halibut PSC mortality also would be consistent with National Standard 8 of the MSA to promote fishery participation and minimize adverse economic impacts to Bering Sea fishing communities by providing additional harvest opportunities in the directed halibut fisheries. Because halibut PSC limit reductions could potentially constrain harvest of groundfish TACs, the proposed action would be an allocation of fishing privileges and must be consistent with National

[59] Per CEQ guidance on environmental justice, under NEPA, the identification of a disproportionately high and adverse human health or environmental effect (including interrelated social, cultural, and economic effects) on a low-income population, minority population, or Indian tribe does not preclude a proposed agency action from going forward, nor does it necessarily compel a conclusion that a proposed action is environmentally unsatisfactory. Rather, the identification of such an effect should heighten agency attention to alternatives, mitigation strategies, monitoring needs, and preferences expressed by the affected community or population (http://www.epa.gov/environmentaljustice/resources/policy/ej_guidance_nepa_ceq1297.pdf).

Standard 4. National Standard 4 requires that allocations of harvest privileges do not discriminate between residents of different states, are fair and equitable, and prevent acquisition of excessive shares of harvesting privileges. In addition to the National Standards in the MSA, this action must be consistent with the requirements of the Halibut Act. While the reduction of PSC limits as proposed in this analysis does not directly regulate participants in the directed halibut fisheries, there would be an indirect effect on halibut fisheries as a result of this action. Therefore, the Council should consider the directions in the Halibut Act about the regulations that may result from this action. Much of the direction listed in the Halibut Act relevant to Council action is duplicative with National Standard 4 of the MSA. Section 6.1 provides additional detail on the 10 National Standards in the MSA and the requirements of the Halibut Act as they apply to this action.

As described in Section 1.2, halibut savings that occur from reducing halibut PSC mortality below current levels would provide additional harvest opportunities to the directed halibut fisheries in both the near term and long term. Near term benefits to Bering Sea halibut fisheries would result from the PSC mortality reductions of halibut that are over 26 inches in length (O26). These halibut would be available to the commercial halibut fishery in the area and year that the PSC mortality is foregone, or when the fish reach the legal size limit for the commercial halibut fishery. Longer term benefits in the directed halibut fisheries would accrue throughout the distribution of the halibut stock, from a reduction of halibut PSC mortality from fish that are less than 26 inches (U26). These benefits are described in detail in Section 3.1.3.5.

The near term additional harvest opportunities in the directed Bering Sea halibut fisheries from PSC savings of O26 halibut can be estimated by using the IPHC's current process for apportioning halibut PSC among regulatory areas and deducting O26 PSC from the regulatory area TCEYs to arrive at the blue line FCEY, or the area commercial catch limit calculated using the IPHC's current harvest policy (see Section 3.1.2.2). Reversing the IPHC's annual process of deducting PSC from area TCEYs provides a method for estimating increases in directed fishery catch limits resulting from PSC savings in the groundfish fisheries. The following analysis provides estimates of the increases in directed fishery catch limits if a given amount of PSC savings had occurred in 2015.

The analysis also demonstrates the process by which increased commercial catch limits for the directed halibut fisheries from reductions in PSC use would flow through to affected fishery participants in the Area 4 IFQ and CDQ fisheries. To further demonstrate the distributional impacts, the analysis examines the portions of Area 4 halibut quota share held by persons who are residents in Area 4, in Alaska, and outside of Alaska. This provides an estimate of the benefits of PSC savings from increased directed fishery catch limits for each participant category in the Area 4 directed halibut fisheries: non-Alaska residents, Alaska residents, Area 4 residents, and CDQ. This provides estimates of the additional harvest opportunities that will accrue to the directed halibut fisheries in the near term and provides information on the distribution of those impacts among participants.

The Area 4 directed commercial fisheries include IFQ and CDQ harvests, as described in Section 3.1.4.1. Non-CDQ participants in the IFQ Program hold halibut quota share that is categorized by the area of the harvest and the type of vessel used to land the harvest. Quota shares equate to individual harvesting privileges that are given effect on an annual basis through the issuance of IFQ permits. An annual IFQ permit authorizes the permit holder to harvest a specified amount of IFQ halibut in a regulatory area. Table 4-196 presents non-CDQ quota share holdings in Areas 4A, 4B, 4C, and 4D at the end of 2014.[60] Quota share holdings are presented for three residency categories: non-Alaska, Alaska, and Area 4. For purposes of this analysis, residency is based on mailing address information reported to NMFS by quota share holders. Quota share holders reporting an address outside of Alaska were assigned to the non-

[60] 100 percent of the commercial catch limit in Area 4E is allocated to the CDQ Program.

Alaska resident category. Quota share holders reporting an address in Alaska were assigned to the Alaska resident category. Residency for Area 4 is determined by assigning all quota share holders with addresses in an Alaska community along the Bering Sea coast. CDQ groups and CDQ group subsidiaries also hold non-CDQ quota share, and these holdings were assigned Area 4 residency to recognize the benefits to Area 4 residents from these holdings. It is possible that some catcher/processor quota share held by CDQ groups is used to support freezer longline operations and may not be directly available for harvest by Area 4 residents. Therefore, this analysis likely includes a liberal estimate of Area 4 residency.

The method to determine residency in this analysis by using reported address information is consistent with the method used for the community impacts section of this analysis (Appendix C, summarized in Section 4.13.1.3). The community analysis evaluates impacts on owners of vessels that participate in the Bering Sea directed halibut fisheries. This analysis evaluates impacts on holders of halibut quota share, a substantial portion of which are also expected to own vessels. This PSC savings analysis is intended to complement the community impacts analyses by estimating the amount by which Area 4 directed fishery catch limits would increase from halibut PSC savings as well as presenting how those benefits are distributed among IFQ and CDQ participants.

It is important to note that while this analysis focuses on gains to Area 4 residents from this action, all quota share holders in Area 4 would benefit from increased commercial catch limits that result from PSC savings.

Table 4-196 shows that Area 4 quota share is fairly equally divided among Alaska and non-Alaska residents in all areas except Area 4D, where non-Alaska residents hold 66 percent of QS. Area 4 residents hold, on average, 17 percent of the quota share in Area 4. The portion of quota share held by Area 4 residents is higher in Area 4C, where Area 4 residents hold 37 percent of the area quota share. The analysis of quota share holdings also shows that the total number of unique quota share holders varies by area, with the largest total number of quota share holders in Area 4A and the smallest number of quota share holders in Area 4D. Therefore, any increases in directed fishery catch limits will be distributed in proportion to the total quota share holdings shown for each category. While the information on quota share holdings indicates that Area 4 residents do not hold the majority of quota share in Area 4, it is important to consider the analysis of relative dependence on the Area 4 halibut fisheries with respect to other fisheries in Section 4.5.2 and in the community impacts analysis (Appendix C). The analysis in Section 4.5.2 shows that non-Area 4 residents harvest a larger portion of Area 4 halibut harvests and thus earn more revenue in those fisheries. The analysis also shows that these quota share holders earn a larger portion of revenue from harvests of halibut in the Gulf of Alaska. Area 4 residents have little to no participation in Gulf of Alaska halibut fisheries, suggesting that Area 4 residents may be more dependent on Area 4 halibut fisheries than non-Area 4 residents for fisheries-related revenue.

The quota share residency analysis shows that although the proportions of the Area 4 quota share pool held by Alaska residents (47 percent) and non-Alaska residents (53 percent) are almost equally divided, a larger number of Alaska residents hold quota share than non-Alaska residents. There are 173 unique Area 4A quota share holders (62 percent of total) that are Alaska residents and 106 Area 4A quota share holders (38 percent of total) that are non-Alaska residents. In addition, the analysis shows that there are 71 Area 4 resident quota share holders, or 25 percent of the total number of Area 4 quota share holders.

Analysis of the quota share holdings for the top 10 holders indicates the concentration of holdings by persons with the largest individual holdings for each area. The top 10 quota share holders in Area 4 hold 12 percent of the total amount of quota share. The data also show that the top 10 quota share holders have a larger portion of the quota share pool for Area 4C and 4D (49 percent), likely because there are fewer total quota share holders in these areas.

Table 4-196 Quota share (QS) holdings by Residency and CDQ Participation

	Total QS units	QS held by Non-AK residents		QS held by AK residents		QS held by Area 4 residents		QS holdings by top 10 QS holders		Number of Unique QS holders			
		Units	% of total	Units	% of total	Units	% of total	Units	% of total	Overall	Non-AK	AK	Area 4
Area 4A	14,586,011	6,983,493	48%	7,602,518	52%	2,115,220	15%	3,075,784	21%	201	75	126	45
Area 4B	9,284,774	4,910,618	53%	4,374,156	47%	1,577,308	17%	3,613,339	39%	87	42	45	14
Area 4C	4,016,352	2,082,183	52%	1,934,169	48%	1,480,906	37%	1,980,283	49%	53	22	31	21
Area 4D	4,958,250	3,281,686	66%	1,676,564	34%	560,788	11%	2,447,791	49%	46	30	16	5
Total Area 4A-4D	32,845,387	17,257,980	53%	15,587,407	47%	5,734,222	17%	4,028,739	12%	279	106	173	71

Note: Percent of AK / Non-AK QS based on reported residency data from RAM QS/IFQ holder data base on December 31, 2014.

Note: Persons with residency in Area 4 (Bering Sea coast) in the RAM database are assigned an Area 4 residency. All QS held by CDQ groups and CDQ group subsidiaries are also assigned an Area 4 residency.

Note: Some of the A shares held by CDQ groups may be used to support freezer longline operations and may not be available for Area 4 residents. Therefore, this is likely a liberal estimate of residency.

As described in Section 3.1.4.1, the IPHC establishes catch limits for the Area 4 regulatory areas, and these catch limits are allocated between the IFQ and CDQ fisheries. Table 4-197 shows the allocation of 2015 CDQ and IFQ catch limits among CDQ and IFQ fishery participants. Allocations to the CDQ fishery vary by area and range from 20 to 100 percent of the area allocation. After deducting the CDQ allocation, the remaining catch limit is allocated to the IFQ fishery for each area. The quota share residency analysis was extended to combine the CDQ allocations with the IFQ allocations to determine total holdings for each resident category. The IFQ and CDQ allocations were combined and attributed as allocations to Alaska residents and Area 4 residents, which increases the overall portion of the Area 4 halibut fishery allocated to Alaska residents to 58.61 percent and the portion allocated to Area 4 residents to 36.49 percent, compared to the quota share holdings of 47 percent for Alaska residents and 17 percent for Area 4 residents, as shown in Table 4-196.

Table 4-197 2015 IPHC Allocations

Area	IPHC Harvest Limits	CDQ		IFQ				Total (CDQ & IFQ)				
		% to CDQ	CDQ Allocation	Remaining IFQ Allocation	IFQ Allocation to Non-AK	IFQ Allocation to AK	IFQ to Area 4 Resident	Total AK Allocation (CDQ & IFQ)	Total Area 4 Resident Allocation (CDQ & IFQ)	% of total allocation to Non-AK	% of total allocation to AK	% of total allocation to Area 4 resident
4A	1,390,000	0%	0	1,390,000	665,504	724,496	201,574	724,496	201,574	47.88%	52.12%	14.50%
4B	1,140,000	20%	228,000	912,000	482,347	429,653	236,135	657,653	464,135	42.31%	57.69%	40.71%
4CDE	1,285,000											
4C	596,600	50%	298,300	298,300	154,647	143,653	109,989	441,953	408,289	25.92%	74.08%	68.44%
4D	596,600	30%	178,980	417,620	276,408	141,212	47,234	320,192	226,214	46.33%	53.67%	37.92%
4E	91,800	100%	91,800	0	0	0	0	91,800	91,800	0.00%	100.00%	100.00%
Total	3,815,000		797,080	3,017,920	1,578,906	1,439,014	594,931	2,236,094	1,392,011	41.39%	58.61%	36.49%

To determine how halibut PSC savings would be distributed among participants in Area 4 IFQ and CDQ fisheries, the analysis apportions PSC among IPHC regulatory areas using data from the IPHC's 2015 halibut stock assessment. The IPHC estimated halibut PSC of 5.82 million pounds in Area 4 and apportioned it among the areas as shown in Table 4-198. The IPHC estimates that approximately 78.52 percent of Area 4 PSC is taken in Area 4CDE. To further apportion PSC among the Area 4CDE subareas, the analysis uses the 2015 IPHC catch limit allocations as specified by the Council's catch sharing plan (see Section 3.1.2.3). This results in a halibut PSC apportionment of 46.3 percent to Area 4C and Area 4D and 7.14 percent to Area 4E. As described in Sections 3.1.2.2 and 3.1.3.5, PSC savings of O26 halibut would increase the directed fishery catch limits on a one to one basis. Consistent with the IPHC process for developing harvest advice for the 2015 fishery, this analysis uses NMFS observer data to estimate the relative proportion of halibut PSC mortality that is O26 (see Section 3.1.2.4). The proportion of O26 to U26 PSC is consistent at around 60 percent of the total for all subareas except Area 4B, where O26 halibut are estimated to be 87 percent of bycatch. The estimates of bycatch in Area 4B are limited, however, to about 7 percent of all Area 4 bycatch.

Table 4-198 Data on Bycatch Proportions by IPHC Regulatory Area

	% of Total Area 4 Bycatch	% of Total 4CDE Allocation	Bycatch (Millions lb).	O26 Bycatch (Millions lb).	% O26 Bycatch	U26 Bycatch (Millions lb).	% U26 Bycatch
Total Area 4			5.82	3.74	64.26%	2.08	35.74%
4A*	14.78%		0.86	0.49	56.98%	0.37	43.02%
4B*	6.70%		0.39	0.34	87.18%	0.05	12.82%
4CDE*	78.52%		4.57	2.91	63.68%	1.66	36.32%
4C^		46.43%	2.12	1.35		0.49	
4D^		46.43%	2.12	1.35	63.68%	0.49	36.32%
4E^		7.14%	0.33	0.21		0.08	

* Derived from Appendix IV, p.240, 2015 IPHC Blue Book.
^ Area 4CDE breakout assumes bycatch is apportioned among each area in proportion to the 2015 IPHC allocations as specified by the Council's catch sharing plan. O26/U26 ratios are assumed to be constant in each area.

The analysis to determine the distribution of PSC savings among Area 4 IFQ and CDQ fishery participants is based on the following assumptions.

- Bycatch is accounted for by NMFS in metric ton round weights but must be converted to net weight in pounds and to O26 for consideration in the savings analysis.
- One metric ton (mt) = 2204.62 pounds (NMFS standard practice)
- Net Pounds of Bycatch Savings = 75% of round weight
- The proportion of bycatch savings attributable to Area 4A, Area 4B, and Area 4CDE (including the closed area) is based on the proportions of bycatch observed and assigned to each IPHC area in Appendix IV, p. 240 of the 2015 IPHC Blue Book.
- Bycatch is apportioned among Areas 4C, 4D, and 4E in proportion to the 2015 catch limit allocations specified by the Council's catch sharing plan and established by the IPHC.
- The percentage of O26 and U26 bycatch in Area 4A, Area 4B, and Area 4CDE as O26 is based on the proportions of O26/U26 by area as described in Appendix IV of the 2015 IPHC Blue Book
- As per IPHC procedures, O26 results in a one-to-one increase in the harvestable surplus. This analysis does not attempt to account for the percentage of O26 bycatch saved that is less than the 32" legal limit and not available for commercial harvest.

Two examples of PSC reductions, or savings, are presented below: a reduction of 350 mt (Table 4-199) and a reduction of 700 mt (Table 4-200).

A 350 mt reduction in PSC mortality would result in an increase of approximately 371,887 pounds to the Area 4 IFQ and CDQ fishery catch limits (Table 4-199). About 72 percent of the total Area 4 catch limit increase would accrue to Areas 4C and 4D because the largest proportion of bycatch is taken in those areas. About 64 percent, or 236,980 pounds would accrue to the Area 4 IFQ fisheries, and 36 percent, or 134,908 pounds of the increase would accrue to the Area 4 CDQ fisheries. Area 4 resident IFQ allocations would increase by 52,846 pounds. When the gains to CDQ and IFQ fisheries are combined, the total gain to Area 4 residents from increased commercial fishery catch limits is approximately 187,753 pounds, or 50 percent of the total amount of O26 halibut made available from PSC savings.

For a reduction of 350 mt of halibut PSC mortality, total area gains range from 20,672 pounds in Area 4E to 134,342 pounds in Area 4C and Area 4D. The total gain for Area 4CDE is 289,356 pounds. Adding the area gains to the 2015 blue line total FCEYs specified by the IPHC harvest policy (see Table 3-3) would result in a total FCEY of 1,440,000 pounds in Area 4A, 764,000 pounds in Area 4B, and 809,000 pounds in Area 4CDE.

Table 4-199 also presents information on the average pound increase per IFQ fishery participant. For a 350 mt reduction in halibut PSC mortality, the average poundage gain per Area 4 IFQ fishery participant ranges from 3,515 to 4,948 pounds by residency category. The largest average subarea gains per IFQ holder are in Areas 4C and 4D, where the largest gains are realized and there are smaller numbers of quota share holders among whom the gains would be distributed. The "average gain" figures are a straightforward calculation of the poundage gain divided by the number of quota share holders for Area 4 and for each subarea. The impact for individual IFQ fishery participants will depend on their individual quota share holdings.

The analysis also presents information on the average pound increase per CDQ fishery participant for a 350 mt reduction in halibut PSC mortality. The average gain is calculated for each CDQ group, and varies from 108 pounds to 2,687 pounds per participant, likely owing to large variations in the number of halibut CDQ harvesters among groups and areas. While much of this variation is likely due to the different allocations among CDQ groups, Table 4-199 shows that the number of CDQ harvesters varies significantly by group, ranging from 3 to 244 in 2014. This reflects the different fleet structures and varying levels of reliance on the CDQ fisheries by individual participants throughout Area 4.

A 700 mt reduction in PSC mortality would result in an increase of approximately 743,775 pounds to the Area 4 IFQ and CDQ fishery catch limits (Table 4-200). About 64 percent, or 473,960 pounds would accrue to the Area 4 IFQ fisheries, and 36 percent, or 269,813 pounds of the increase would accrue to the Area 4 CDQ fisheries. Area 4 resident IFQ allocations would increase by 105,690 pounds. When the gains to CDQ and IFQ fisheries are combined, the total gain to Area 4 residents from increased commercial fishery catch limits is approximately 375,503 pounds, or 50 percent of the total amount of O26 halibut made available from PSC savings.

For a reduction of 700 mt of halibut PSC mortality, individual area gains range from 41,343 pounds in Area 4E to 268,684 pounds in Area 4C and Area 4D. The total gain for Area 4CDE is 578,711 pounds. Adding the area gains to the 2015 blue line total FCEYs specified by the IPHC harvest policy (see Table 3-3) would result in a total FCEY of 1,490,000 pounds in Area 4A, 798,000 pounds in Area 4B, and 1,090,000 pounds in Area 4CDE.

For a 700 mt reduction in halibut PSC mortality, the average poundage gain per Area 4 IFQ fishery participant ranges from 7,031 to 9,896 pounds by residency category. The largest average subarea gains per IFQ holder are in Areas 4C and 4D, where the largest gains are realized and there are smaller numbers of quota share holders among whom the gains would be distributed. The average gain per CDQ participant among all areas varies from 216 pounds to 5,374 pounds because, as described above, there is significant variation in the number of halibut CDQ harvesters among CDQ groups and areas.

Table 4-199 Example of Impact of 350 mt Bycatch Savings in Area 4A through Area 4E

	Bycatch savings		
Example:	in mt	in round weight lb	in net weight lb
	350	**771,617**	**578,713**

IPHC Area	Net wt. savings in area		O26 net wt. savings in area		O26 to CDQ		O26 to IFQ		Pounds of IFQ to:			Gain to Top 10 QS/IFQ holders in the area	Average gain to:		
	%	lb	%	lb	%	lb	%	lb	Non-AK residents	AK Residents	Area 4 Residents		a Non-AK QS Holder	an AK QS holder	an Area 4 resident QS holder
4A	15%	85,514	57%	48,723	0%	0	100%	48,723	23,328	25,396	7,066	10,274	311	202	157
4B	7%	38,780	57%	22,093	20%	4,419	80%	17,674	9,348	8,327	3,003	6,878	223	185	214
4C	36%	210,978	64%	134,342	50%	67,171	50%	67,171	34,823	32,348	24,767	33,119	1,583	1,043	1,179
4D	36%	210,978	64%	134,342	30%	40,303	70%	94,040	62,241	31,798	16,418	46,426	2,075	1,987	3,284
4E	6%	32,464	64%	20,672	100%	20,672									
Total		578,714		371,887		134,908		236,980	134,697	102,284	52,846	100,345	4,310	3,515	4,948

CDQ

IPHC Area:	**4A**	**4B**		**4C**		**4D**		**4E**		**Total Area 4**	
CDQ group	Allocation	Allocation		Allocation		Allocation		Allocation		Number of unique CDQ harvesters (2014)	Average gain per CDQ participant
	%	%	lb	%	lb	%	lb	%	lb		
APICDA	0	100%	6,742	15%	10,076	0%	0	0%	0	23	731
BBEDC	0	0%	0	0%	0	26%	10,479	30%	6,201	70	238
CBSFA	0	0%	0	85%	57,096	0%	0	0%	0	53	1,077
CVRF	0	0%	0	0%	0	24%	9,673	70%	14,470	224	108
NSEDC	0	0%	0	0%	0	30%	12,091	0%	0	44	275
YDFDA	0	0%	0	0%	0	20%	8,061	0%	0	3	2,687

Total gain to all IFQ participants in Area 4 (only takes into account O26 fish)**:**

IPHC Area	**4A**	**4B**	**4C**	**4D**	**4E**	**Total 4CDE**	**Total for Area 4**
Net weight lb	**48,723**	**33,808**	**134,342**	**134,342**	**20,672**	**289,356**	**371,887**

Total gain to residents of Area 4 (CDQ & IFQ):

IPHC Area	**4A**	**4B**	**4C**	**4D**	**4E**	**Total 4CDE**	**Total for Area 4**
Net weight lb	**7,066**	**11,356**	**91,939**	**56,720**	**20,672**	**169,331**	**187,753**

Table 4-200 Example of Impact of 700 mt Bycatch Savings in Area 4A through Area 4E

Example:	Bycatch savings in mt	Bycatch savings in round weight lb	Bycatch savings in net weight lb
	700	1,543,234	1,157,426

IPHC Area	Net wt. savings in area %	Net wt. savings in area lb	O26 net wt. savings in area %	O26 net wt. savings in area lb	O26 to CDQ %	O26 to CDQ lb	O26 to IFQ %	O26 to IFQ lb	Pounds of IFQ to: Non-AK residents	Pounds of IFQ to: AK Residents	Pounds of IFQ to: Area 4 Residents	Gain to Top 10 QS/IFQ holders in the area	Average gain to: a Non-AK QS Holder	Average gain to: an AK QS holder	Average gain to: an Area 4 resident QS holder
4A	15%	171,029	57%	97,446	0%	0	100%	97,446	46,655	50,791	14,131	20,549	622	403	314
4B	7%	77,559	87%	67,616	20%	13,523	80%	54,093	28,609	25,484	9,189	21,051	681	566	656
4C	36%	421,955	64%	268,685	50%	134,342	50%	134,342	69,647	64,696	49,535	66,238	3,166	2,087	2,359
4D	36%	421,955	64%	268,685	30%	80,605	70%	188,079	124,483	63,596	32,835	92,851	4,149	3,975	6,567
4E	6%	64,927	64%	41,343	100%	41,343									
Total		1,157,425		743,775		269,813		473,960	269,394	204,567	105,690	200,689	8,618	7,031	9,896

CDQ

IPHC Area:	4A	4B		4C		4D		4E		Total Area 4	
CDQ group	Allocation	Allocation		Allocation		Allocation		Allocation		Number of unique CDQ harvesters (2014)	Average gain per CDQ participant
	%	%	lb	%	lb	%	lb	%	lb		
APICDA	0	100%	6,742	15%	10,076	0%	0	0%	0	23	1,464
BBEDC	0	0%	0	0%	0	26%	10,479	30%	6,201	70	477
CBSFA	0	0%	0	85%	57,096	0%	0	0%	0	53	2,155
CVRF	0	0%	0	0%	0	24%	9,673	70%	14,470	224	216
NSEDC	0	0%	0	0%	0	30%	12,091	0%	0	44	550
YDFDA	0	0%	0	0%	0	20%	8,061	0%	0	3	5,374

Total gain to all IFQ participants in Area 4 (only takes into account O26 fish)**:**

IPHC Area	4A	4B	4C	4D	4E	Total 4CDE	Total for Area 4
Net weight lb	97,446	67,616	268,684	268,684	41,343	578,711	743,773

Total gain to residents of Area 4 (CDQ & IFQ):

IPHC Area	4A	4B	4C	4D	4E	Total 4CDE	Total for Area 4
Net weight lb	14,131	22,713	183,877	113,441	41,343	338,661	375,503

4.13.2 Groundfish fishery impacts

For the groundfish fisheries, the primary impacts of the PSC reduction options in Alternative 2 are best described at the sector level, as in Sections 4.8 through 4.12. As the Council may select multiple options simultaneously, however, a brief discussion of the overall revenue and harvest effect of cumulative sector reductions on the groundfish fishery as a whole is included in Section 4.13.2.1.

The purpose and need for this action, in Section 1.2, highlights that the proposed action needs to be considered in the context of the National Standards. An inherent tradeoff in this type action is between National Standard 1 and National Standard 9, where the Council and NMFS use management tools such as halibut PSC mortality limits to minimize bycatch (halibut PSC) in the groundfish fisheries to the extent practicable, while achieving, on a continuing basis, the optimum yield from the groundfish fisheries. The discussion of the potential for groundfish harvest reductions resulting from all sectors combined in Section 4.13.2.1 may be informative to the Council's consideration of National Standard 1, because optimum yield is defined in the BSAI Groundfish FMP for the groundfish complex as a whole. Similarly, Section 4.13.2.2 provides additional information to assess the practicability standard of National Standard 9, with respect to behavior changes that may be possible under the alternatives to mitigate groundfish harvest losses associated with the PSC reductions for some sectors.

The purpose and need section also highlights the tension, for this action, between National Standard 8, which requires provision for the sustained participation of and minimized adverse economic impacts on fishing communities, and National Standard 4, which states that management measures shall not discriminate between residents of different states, and requires allocations of fishing privileges to be fair and equitable to all fishery participants. Sections 4.13.2.3 and 4.13.2.4 provide a summary of the community analysis included in Appendix C, for Alaska and Pacific northwest communities, with respect to community engagement in and dependency on the groundfish fishery. A similar summary for the halibut fishery is included above in Section 4.13.2.3.

4.13.2.1 Revenue and harvest impacts for reductions across all sectors

Revenue

Table 4-201 and Table 4-202 provide wholesale revenues from the groundfish fishery under the implementation of combined reductions across all sectors. As described in the halibut section above, there are too many unique combinations of sector PSC reductions to allow each to be easily examined individually, so a proxy is used by applying the equivalent PSC reductions across all sectors to look at the effect of their combined impact on halibut harvest and revenue.

The numbers in Table 4-201 represent the ten-year sum of wholesale revenues over the modeled future period under the status quo (discounted to present values), and the 10-year sum of changes in wholesale value for each PSC limit reduction option, again discounted to present values. Table 4-202 breaks out average annual revenue increases that would accrue over the modeled years. The decline in revenue over the ten years of the model is the result of discounting to present values. The bottom line of Table 4-202 shows the average annual change over all of the years and over all of the iterations. Under a 30 percent PSC reduction across all sectors, the sum of reduced wholesale revenue for the ten-year period ranges from $174 to $393 million. This would represent a loss of $21.7 to $49 million in the first modeled future year (2014), and decreasing annually due to discounting to a range of $13.7 to $30.9 million in future year 2023.

Table 4-201 Summary of Groundfish Revenue and Harvest Impacts, Over Reduction Options Affecting All Affected Sectors Combined

Option	Proposed PSC Limit	Groundfish Revenue Scenario A	Groundfish Revenue Scenario B	Halibut PSC Scenario A	Halibut PSC Scenario B	Groundfish Harvest Scenario A	Groundfish Harvest Scenario B
	round weight mt	10-year Sum of Discounted Present Value Wholesale Revenues ($2013 Millions)		PSC taken (round weight mt)		Groundfish (1,000s mt)	
		Status Quo, and Change from Status Quo		Status Quo, and Average Annual Change from the Status Quo			
Status Quo	4,353	$15,723.01	$15,780.89	3,504.6	3,497.1	1,607.7	1,607.6
All Sectors: -10%	3,918	($9.94)	($47.06)	-52.7	-75.8	-1.4	-6.1
All Sectors: -20%	3,482	($58.41)	($180.09)	-220.2	-257.6	-8.3	-24.2
All Sectors: -30%	3,047	($173.90)	($393.01)	-478.1	-535.5	-22.6	-50.9
All Sectors: -35%	2,829	($260.46)	($572.32)	-626.0	-711.8	-33.4	-71.5
All Sectors: -40%	2,612	($370.97)	($772.36)	-790.7	-881.2	-47.4	-94.1
All Sectors: -45%	2,394	($506.44)	($991.39)	-975.4	-1,076.1	-63.6	-118.9
All Sectors: -50%	2,177	($692.56)	($1,245.27)	-1,159.8	-1,277.5	-85.1	-147.8

Table 4-202 Annual Average Future Revenue Impacts of PSC Reduction Options for All Sectors Combined

Year	DPV of Wholesale Revenue Under the Status Quo	All a: -10%	All b: -20%	All c: -30%	All d: -35%	All e: -40%	All f: -45%	All g: -50%
		Forgone Discounted Present Value of Wholesale Revenue Under the Alternatives						
	Scen. A - B	Scen. A - B	Scen. A - B	Scen. A - B	Scen. A - B	Scen. A - B	Scen. A - B	Scen. A - B
2014	$1,959.4 - $1,958.3	$1.2 - $5.9	$7.3 - $22.5	$21.7 - $49.0	$32.4 - $71.3	$46.3 - $96.2	$63.1 - $123.5	$86.3 - $155.0
2015	$1,861.4 - $1,860.4	$1.2 - $5.6	$6.9 - $21.4	$20.6 - $46.6	$30.8 - $67.7	$44.0 - $91.4	$60.0 - $117.3	$82.0 - $147.3
2016	$1,768.3 - $1,767.3	$1.1 - $5.3	$6.6 - $20.3	$19.6 - $44.3	$29.3 - $64.4	$41.8 - $86.8	$57.0 - $111.4	$77.9 - $139.9
2017	$1,679.9 - $1,679.0	$1.1 - $5.0	$6.2 - $19.3	$18.6 - $42.0	$27.8 - $61.1	$39.7 - $82.5	$54.1 - $105.8	$74.0 - $132.9
2018	$1,595.9 - $1,595.0	$1.0 - $4.8	$5.9 - $18.3	$17.7 - $39.9	$26.4 - $58.1	$37.7 - $78.4	$51.4 - $100.6	$70.3 - $126.3
2019	$1,516.1 - $1,515.3	$1.0 - $4.5	$5.6 - $17.4	$16.8 - $37.9	$25.1 - $55.2	$35.8 - $74.5	$48.8 - $95.5	$66.8 - $120.0
2020	$1,440.3 - $1,439.5	$0.9 - $4.3	$5.4 - $16.6	$15.9 - $36.0	$23.8 - $52.4	$34.0 - $70.7	$46.4 - $90.7	$63.4 - $114.0
2021	$1,368.3 - $1,367.5	$0.9 - $4.1	$5.1 - $15.7	$15.1 - $34.2	$22.6 - $49.8	$32.3 - $67.2	$44.1 - $86.2	$60.3 - $108.3
2022	$1,299.9 - $1,299.2	$0.8 - $3.9	$4.8 - $14.9	$14.4 - $32.5	$21.5 - $47.3	$30.7 - $63.8	$41.9 - $81.9	$57.2 - $102.8
2023	$1,234.9 - $1,234.2	$0.8 - $3.7	$4.6 - $14.2	$13.7 - $30.9	$20.4 - $44.9	$29.2 - $60.6	$39.8 - $77.8	$54.4 - $97.7
Average	$1,572.4 - $1,571.6	$1.0 - $4.7	$5.8 - $18.1	$17.4 - $39.4	$26.0 - $57.2	$37.2 - $77.2	$50.6 - $99.1	$69.2 - $124.4

Note: Status Quo revenues include revenues from Hook and Line fisheries for targets other than Pacific cod and Sablefish and for LGL CVs. The PSC reduction option for these fisheries had no material impact on the participants.

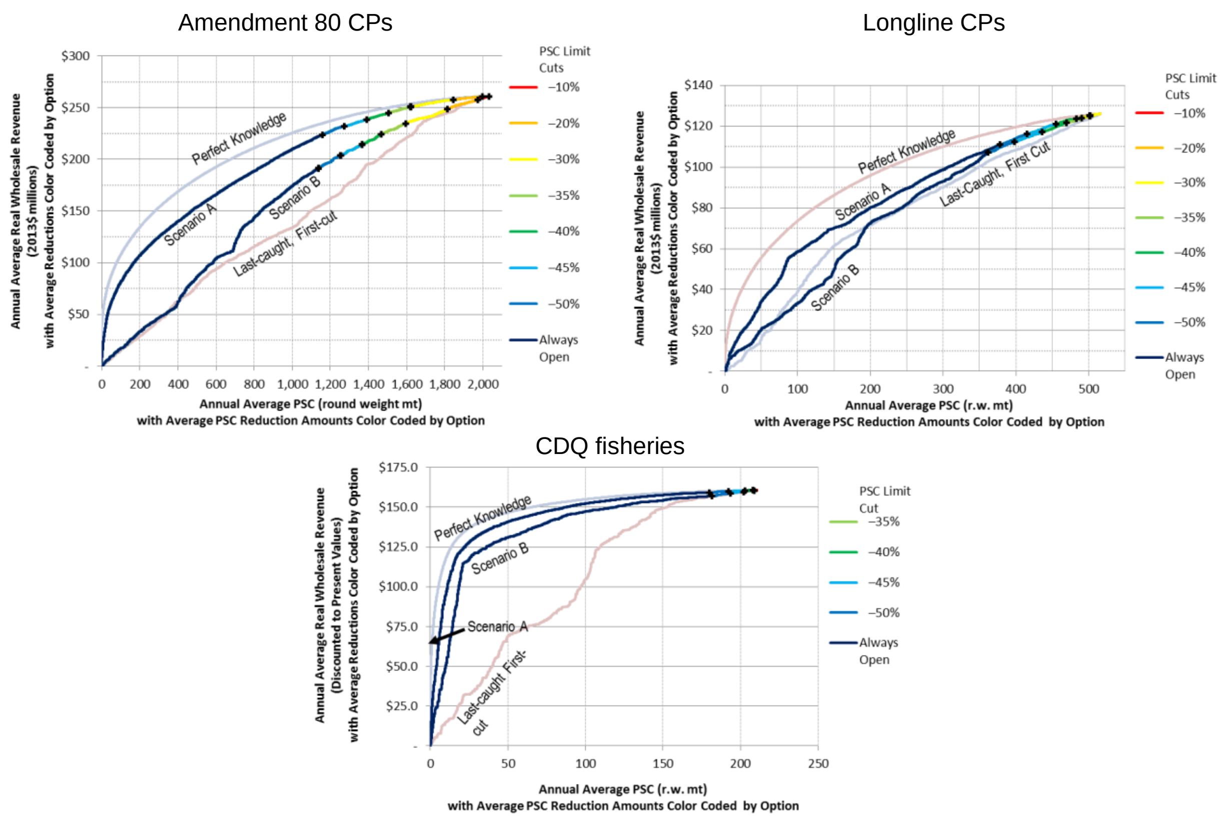
The catch progression charts, included where possible in the impacts sections for the individual sectors, highlight that there is often not a strict linear relationship between the reduction of PSC mortality and the reduction of revenue to the sector. For example, Figure 4-92, for the Amendment 80 CPs, shows the Scenario A trajectory as a curve, which becomes flatter in the upper right-hand quadrant of the graph. The bolded **✚** marks the spot on the catch progression line corresponding with the PSC reduction percentages in the Council's alternative, and the segments are incrementally color-coded to indicate the additional amount of annual average wholesale revenue (discounted to present values) that is projected as foregone with each percentage reduction. In Scenario A for Amendment 80, the additional foregone revenue associated with moving from a ten to a twenty percent reduction in the PSC limit is relatively little compared with the reduction in moving for example from a forty-five to a fifty percent reduction, for which the trajectory of the line is much steeper. It is important to note that in terms of absolute foregone revenue, the larger percentage reductions also incorporate the segments from all the previous reductions as well.

For the Amendment 80 CP example, the figure also shows the catch progression line for Scenario B as well as alternative catch progression lines for comparison. The 'perfect knowledge' line would result if the IMS

Model had assumed the sector had perfect knowledge in advance about their upcoming harvests, and chose not to fish as many individual trips with the lowest revenue to PSC ratio as necessary in order to meet the PSC constraint. Conversely, the last-caught first-cut reduction methodology assumes that fishermen would not change behavior in any way in response to a reduced PSC limit, and vessels fish as they did historically until the fishery is closed. There is a much more linear relationship between PSC and revenue under the last-caught-first-cut methodology. For longline CPs, the fact that Scenario A and B are closer to the last-caught-first-cut catch progression line may be an indicator that the longline CPs are already operating in a manner that keeps PSC mortality at relatively low levels. For CDQ fisheries, the resemblance of the Scenario A and B lines to the "perfect knowledge" progression line is striking, and may be related to the fact that vessels operating CDQ groundfish fisheries are allowed to declare after the fact, whether a tow will count against a CDQ allocation, or whether it will be a part of the non-CDQ operations.

One downside of using the catch progression lines to display impacts over multiple years is that the considerable interannual variability that occurs with respect to annual PSC mortality is lost. The actual model used to generate the impact analysis used the yearly equivalent of the catch progression lines shown in the figure. Table 4-188, at the beginning of Section 4.13, illustrates this variability using the PSC mortality values for each sector for 2008 to 2013.

Figure 4-92 Annual Average Discounted Present Value of Wholesale Revenue and Halibut PSC under the PSC Limit Reduction Options



Harvest

The impacts of equal PSC reduction options across all sectors on total groundfish catch are illustrated in Figure 4-93 and Figure 4-94. Figure 4-93 provides a pie chart showing the impacts of the PSC limit reduction options for all groundfish fisheries, including the pollock fishery. The reduction in groundfish catch resulting from each analyzed option is shown as a portion of the pie chart. The effect of increasingly larger PSC reductions, as applied across all sectors equally, is illustrated in the change in colors. The PSC reduction options result in a reduction in total groundfish harvest between 5.3 and 9.2 percent of status quo.

Figure 4-94 presents the same data, but excludes the pollock fishery, as the volume of the pollock tends to overshadow the impacts on groundfish fisheries, and the pollock fishery is exempt from closure due to attainment of the PSC limit for pollock, and therefore the options have no direct effect on the pollock fishery itself. In Figure 4-94, the reduction in groundfish harvest for all species except pollock ranges between 16.7 and 22 percent.

Figure 4-93 Potential Reduction in Total Groundfish Harvest (Including Pollock) Under the Combined PSC Limit Reduction Options for All Groundfish Fisheries

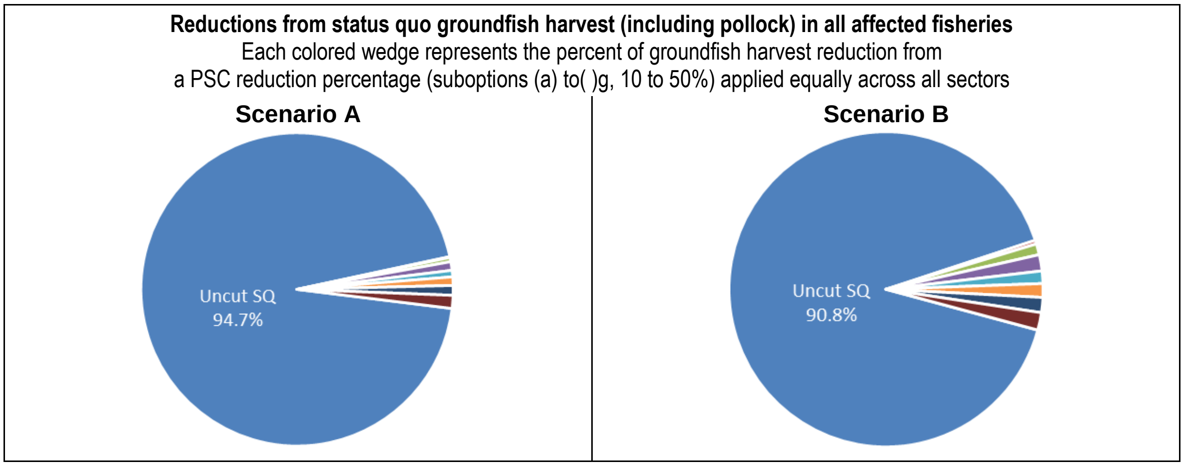


Figure 4-94 Potential Reduction in Total Groundfish Harvest (Excluding Pollock) Under the Combined PSC Limit Reduction Options for All Groundfish Fisheries

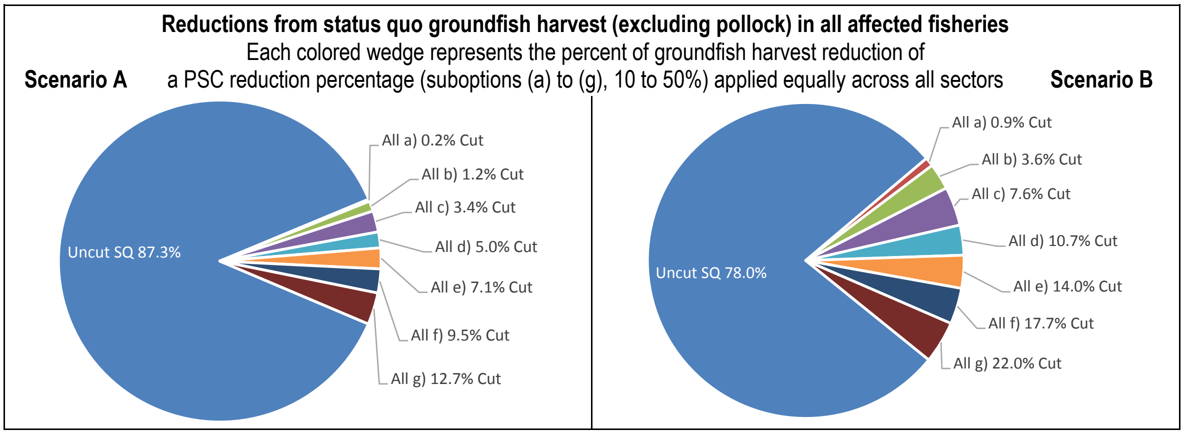


Table 4-203 and Table 4-204 identify groundfish catch reductions compared to the status quo under the PSC limit reduction options, by species. Table 4-203 provides catch reductions in mt, and Table 4-204 lists reductions in terms of percent reduction from status quo. As has been discussed above, the directed pollock fishery is not affected in this analysis. Under the 50 percent reduction across all sectors, the most impacted fishery is for arrowtooth and Kamchatka flounder (24 to 41 percent), followed by cuts to all flatfish fisheries (up to 34 percent), and sablefish (19 to 29 percent) and Pacific cod (14 to 22 percent).

Table 4-203 Groundfish Catch Reductions Relative to Status Quo, by Species, for the Options Combined (All Sectors)

Species	Status Quo Annual Average (mt)	a) -10% Scen A - B	b) -20% Scen A - B	c) -30% Scen A - B	d) -35% Scen A - B	e) -40% Scen A - B	f) -45% Scen A - B	g) -50% Scen A - B
		Range Across Scenarios of Annual Average Catch Reductions from the Status Quo, by Species (mt)						
Alaska Plaice	18,514	68 - 314	332 - 1,351	904 - 2,622	1,392 - 3,311	1,956 - 4,143	2,519 - 5,027	3,224 - 5,936
Arrwth & Kamchatka	29,914	42 - 479	881 - 1,763	2,545 - 4,113	3,591 - 6,617	4,421 - 8,150	5,880 - 9,483	7,294 - 12,245
Atka mackerel	53,044	3 - 51	37 - 168	747 - 586	779 - 1,319	802 - 1,580	833 - 2,508	1,110 - 3,083
Flathead Sole	17,580	38 - 171	361 - 1,150	847 - 2,356	1,246 - 3,393	2,139 - 4,231	2,563 - 4,927	3,321 - 6,023
Greenland Turbot	3,496	2 - 27	51 - 94	180 - 250	247 - 401	299 - 652	391 - 732	483 - 958
Northern Rockfish	2,958	0.5 - 19	2 - 36	51 - 84	54 - 130	58 - 184	65 - 240	86 - 300
Other Flatfish	2,576	6 - 31	87 - 106	169 - 242	227 - 324	308 - 430	395 - 543	478 - 705
Other Rockfish	637	0.3 - 5	4 - 11	16 - 30	20 - 46	26 - 61	36 - 78	46 - 102
Pacific Cod	180,953	346 - 1,167	1,705 - 3,892	4,434 - 9,463	7,097 - 15,547	10,936 - 22,855	16,537 - 31,040	24,524 - 40,342
Pac. Ocean Perch	21,647	7 - 392	44 - 812	333 - 1,641	378 - 2,188	431 - 3,217	546 - 3,650	827 - 4,509
Pollock	1,049,397	137 - 391	731 - 1,705	1,688 - 3,490	2,458 - 4,872	3,656 - 6,261	4,675 - 7,876	6,211 - 9,924
Rock Sole	58,276	357 - 379	1,740 - 1,680	3,256 - 3,563	4,079 - 4,965	6,041 - 6,611	7,340 - 8,908	9,474 - 11,323
Rougheye Rockfish	208	0.1 - 3	2 - 8	6 - 18	8 - 26	10 - 37	15 - 42	20 - 54
Sablefish	242	0.3 - 2	5 - 7	18 - 20	24 - 30	30 - 41	39 - 48	46 - 69
Sculpins	5,461	20 - 46	91 - 192	208 - 415	301 - 591	417 - 793	574 - 1,045	785 - 1,302
Sharks	96	0.00 - 0.04	0.1 - 0.1	0.9 - 0.96	1.4 - 1.8	1.9 - 3.23	3.0 - 5.0	4.5 - 7.04
Shortraker Rockfish	250	0.2 - 5	2 - 10	7 - 24	9 - 34	10 - 47	16 - 55	23 - 67
Skates	24,755	19 - 61	83 - 262	289 - 711	512 - 1,103	832 - 1,863	1,426 - 2,792	2,171 - 3,747
Squids	221	0.1 - 0.6	2.1 - 1.3	8.3 - 7.5	11.6 - 12.0	13.3 - 17.3	18.2 - 22.5	24.0 - 33.2
Octopuses	52	0.04 - 0.15	0.2 - 0.5	0.6 - 1.40	1.0 - 2.8	1.5 - 5.10	2.5 - 7.9	4.5 - 10.45
Unspecified	284	1.2 - 3	6 - 10	11 - 20	15 - 39	20 - 55	27 - 73	46 - 95
Yellowfin Sole	139,396	384 - 2,561	2,159 - 10,857	6,820 - 21,082	10,783 - 26,339	14,775 - 32,674	19,382 - 39,725	24,605 - 46,872
All Gfish Species	**1,609,958**	**1,431 - 6,108**	**8,325 - 24,118**	**22,540 - 50,738**	**33,232 - 71,292**	**47,185 - 93,912**	**63,284 - 118,828**	**84,809 - 147,709**
All but Pollock	**560,561**	**1,294 - 5,717**	**7,594 - 22,413**	**20,852 - 47,248**	**30,774 - 66,420**	**43,529 - 87,651**	**58,609 - 110,952**	**78,598 - 137,785**

Table 4-204 Groundfish Catch Reductions as a Percent of Status Quo, by Species, for the Options Combined (All Sectors)

Species	Status Quo Annual Average (mt)	a) -10% Scen A - B	b) -20% Scen A - B	c) -30% Scen A - B	d) -35% Scen A - B	e) -40% Scen A - B	f) -45% Scen A - B	g) -50% Scen A - B
		Range Across Scenarios of Annual Average Catch Reductions from the Status Quo by Species (mt)						
Alaska Plaice	18,514	0.37 - 1.70%	1.8 - 14.2%	5 - 14%	8 - 18%	11 - 22%	14 - 27%	17 - 32%
Arrwth & Kamchatka	29,914	0.14 - 1.60%	2.9 - 13.7%	9 - 14%	12 - 22%	15 - 27%	20 - 32%	24 - 41%
Atka mackerel	53,044	0.00 - 0.10%	0.1 - 1.1%	1.4 - 1.1%	1.5 - 2.5%	2 - 3%	2 - 5%	2 - 6%
Flathead Sole	17,580	0.22 - 0.97%	2.1 - 13.4%	5 - 13%	7 - 19%	12 - 24%	15 - 28%	19 - 34%
Greenland Turbot	3,496	0.05 - 0.76%	1.4 - 7.1%	5 - 7%	7 - 11%	9 - 19%	11 - 21%	14 - 27%
Northern Rockfish	2,958	0.02 - 0.67%	0.1 - 2.9%	2 - 3%	2 - 4%	2 - 6%	2 - 8%	3 - 10%
Other Flatfish	2,576	0.25 - 1.21%	3.4 - 9.4%	7 - 9%	9 - 13%	12 - 17%	15 - 21%	19 - 27%
Other Rockfish	637	0.05 - 0.76%	0.7 - 4.7%	3 - 5%	3 - 7%	4 - 10%	6 - 12%	7 - 16%
Pacific Cod	180,953	0.19 - 0.64%	0.9 - 5.2%	2 - 5%	4 - 9%	6 - 13%	9 - 17%	14 - 22%
Pac. Ocean Perch	21,647	0.03 - 1.82%	0.2 - 7.6%	2 - 8%	2 - 10%	2 - 15%	3 - 17%	4 - 21%
Pollock	1,049,397	0.01 - 0.04%	0.1 - 0.3%	0.2 - 0.3%	0.2 - 0.5%	0.3 - 0.6%	0.4 - 0.8%	0.6 - 0.9%
Rock Sole	58,276	0.61 - 0.65%	3.0 - 6.1%	6 - 6%	7 - 9%	10 - 11%	13 - 15%	16 - 19%
Rougheye Rockfish	208	0.06 - 1.59%	1.1 - 8.8%	3 - 9%	4 - 13%	5 - 18%	7 - 20%	10 - 26%
Sablefish	242	0.13 - 0.98%	2.2 - 8.1%	7 - 8%	10 - 12%	12 - 17%	16 - 20%	19 - 29%
Sculpins	5,461	0.37 - 0.85%	1.7 - 7.6%	4 - 8%	6 - 11%	8 - 15%	11 - 19%	14 - 24%
Sharks	96	0.00 - 0.05%	0.1 - 1.0%	0.9 - 1.0%	2 - 2%	2 - 3%	3 - 5%	5 - 7%
Shortraker Rockfish	250	0.07 - 1.82%	0.9 - 9.6%	3 - 10%	3 - 13%	4 - 19%	6 - 22%	9 - 27%
Skates	24,755	0.08 - 0.25%	0.3 - 2.9%	1.2 - 3%	2 - 4%	3 - 8%	6 - 11%	9 - 15%
Squids	221	0.04 - 0.25%	0.9 - 3.4%	4 - 3%	5 - 5%	6 - 8%	8 - 10%	11 - 15%
Octopuses	52	0.07 - 0.28%	0.4 - 2.7%	1.2 - 3%	2 - 5%	3 - 10%	5 - 15%	9 - 20%
Unspecified	284	0.41 - 1.14%	1.9 - 7.1%	4 - 7%	5 - 14%	7 - 19%	10 - 26%	16 - 34%
Yellowfin Sole	139,396	0.28 - 1.84%	1.5 - 15.1%	5 - 15%	8 - 19%	11 - 23%	14 - 29%	18 - 34%
All Gfish Species	**1,609,958**	**0.09 - 0.38%**	**0.5 - 3.2%**	**1.4 - 3.2%**	**2 - 4%**	**3 - 6%**	**4 - 7%**	**5 - 9%**
All but Pollock	**560,561**	**0.23 - 1.02%**	**1.4 - 8.4%**	**4 - 8%**	**5 - 12%**	**8 - 16%**	**10 - 20%**	**14 - 25%**

4.13.2.2 Response to PSC limit reductions

There are three ways to reduce PSC mortality in the groundfish fisheries. The first is simply to reduce groundfish fishing effort. Second, the fleet can reduce encounters with halibut. This requires some knowledge of where halibut are, to avoid fishing in those areas to begin with, or at least requires a change in behavior for fishermen to move away from areas of high halibut interception once landings demonstrate that there are halibut on the grounds. The fleet also can modify the gear used in the water, to encourage halibut to escape before they can be landed. Third, reductions can be achieved by reducing the mortality of halibut that encounter the fishing gear. This can involve changes both to gear and handling procedures, to improve the survivability of halibut once they are released back into the water.

Mathematically, these three factors can be translated to halibut PSC (kg) = groundfish (mt) × halibut encounter rate (kg/mt) × DMR. As described in Section 4.4.1.5, a reduction of an equivalent percentage in any one of the three components has the same relative impact on halibut PSC. While reductions in halibut encounters and/or total groundfish are in the control of the fishermen, through changes in fishing patterns and techniques, the discard mortality rates are determined through the harvest specifications process. Even though handling practices that measurably reduce the discard mortality rate in a groundfish fishery will have the same effect as a reduction in actual PSC of the same percentage, these changes will not be accounted for in the estimation of PSC mortality unless there is an amendment or exemption to the regulations.

Behavior Changes to Mitigate PSC Reductions in the Model

In the impacts analysis for this action, the modelled response to reduced PSC limits is to reduce total groundfish harvest. The methodology includes, however, an assumption that, where possible, fishermen will optimize their harvest in response to constraining limits. The development of two Scenarios (A and B) for each sector was intended to provide reasonable high and low bounds of a behavioral response to the constraining limits. Where a sector has the appropriate tools, the scenarios optimize the sector's groundfish harvest reductions in response to the constraining PSC limits, for example by prioritizing fishing operations in the best target/area/months for revenue per mt of halibut PSC, and reducing effort in the least efficient months. While the intention of the analytical methodology was to reduce groundfish harvest in an optimized way, the corollary is that when the optimized scenario is modeled, it in fact changes both total groundfish and the halibut encounter rate to achieve PSC reduction. In most cases, changes in halibut encounters are larger on a percentage basis than changes in total groundfish harvest (Table 4-205), and this, the analysts assert, is and indication that behavior changes have occurred. For example, under the 50 percent reduction option with Scenario A for Amendment 80 CPs, a PSC mortality reduction of 43 percent is achieved with reductions in the halibut encounter rate of 32 percent and of the groundfish harvest by only 16 percent. The fact that the percentage reduction in halibut encounter was twice that of the reduction in groundfish harvest indicates the level of behavioral change undertaken by the fleet. This indicates that by having the ability to optimize fishing, relatively small decreases in groundfish harvested can lead to larger reductions in PSC. This ability is assumed for all sectors constrained by PSC limits except for the BSAI TLA sector (which still operates in a race for fish for some targets). Nonetheless some behavior change is possible as, for example, at a 50 percent reduction under Scenario A, to reduce BSAI TLA halibut PSC by 27 percent requires a reduction in groundfish harvest of 21 percent.

Table 4-205 Groundfish Harvest Changes (Δ) and Resulting Changes in Halibut Encounters, Halibut Encounter Rates, and PSC mortality for Amendment 80 CPs, BSAI trawl limited access, and Longline CPs

		Percentage Change from Status Quo Under the Suboptions							
	Variable	1a: -10%		1b: -20%	1c: -30%	1d: -35%	1e: -40%	1f: -45%	1g: -50%
A80-CPs					**Scenario A**				
	Groundfish Harvest (Δ %)	-0.2%	-1.3%	-1.7%	-4.7%	-7.1%	-9.9%	-12.7%	-16.2%
	Halibut Encounters (Δ %)	-1.9%	-2.9%	-9.4%	-20.4%	-26.2%	-31.9%	-37.6%	-43.2%
	Halibut Encounter Rate (Δ %)	-1.7%	-1.6%	-7.8%	-16.4%	-20.6%	-24.4%	-28.5%	-32.2%
	Halibut PSC mortality (Δ %)	-2.0%	-2.9%	-9.4%	-20.3%	-26.2%	-31.8%	-37.5%	-43.1%
					Scenario B				
	Groundfish Harvest (Δ %)	-1.3%		-5.1%	-10.7%	-14.8%	-18.8%	-23.0%	-28.1%
	Halibut Encounters (Δ %)	-2.9%		-10.6%	-21.4%	-27.7%	-32.7%	-38.2%	-44.0%
	Halibut Encounter Rate (Δ %)	-1.6%		-5.8%	-11.9%	-15.1%	-17.1%	-19.8%	-22.2%
	Halibut PSC mortality (Δ %)	-2.9%		-10.7%	-21.4%	-27.7%	-32.7%	-38.2%	-44.0%
BSAI TLA					**Scenario A**				
(excluding	Groundfish Harvest (Δ %)	-0.9%		-3.4%	-8.2%	-10.2%	-13.4%	-15.8%	-21.0%
pollock)	Halibut Encounters (Δ %)	-2.8%		-6.4%	-11.6%	-13.8%	-17.7%	-21.8%	-26.8%
	Halibut Encounter Rate (Δ %)	-2.0%		-3.1%	-3.7%	-4.0%	-5.0%	-7.1%	-7.4%
	Halibut PSC mortality (Δ %)	-3.0%		-6.6%	-12.1%	-14.3%	-18.2%	-22.4%	-27.4%
					Scenario B				
	Groundfish Harvest (Δ %)	-2.3%		-10.0%	-18.4%	-24.9%	-31.0%	-38.1%	-45.9%
	Halibut Encounters (Δ %)	-3.9%		-9.6%	-17.8%	-24.1%	-30.8%	-39.4%	-48.3%
	Halibut Encounter Rate (Δ %)	-1.6%		+0.4%	+0.6%	+1.1%	+0.3%	-2.1%	-4.5%
	Halibut PSC mortality (Δ %)	-4.1%		-10.0%	-18.3%	-24.6%	-31.2%	-39.8%	-48.7%
LGL-CPs					**Scenario A**				
	Groundfish Harvest (Δ %)	-		-	-0.7%	-1.9%	-3.8%	-7.8%	-11.9%
	Halibut Encounters (Δ %)	-		-	-2.5%	-5.9%	-11.3%	-18.8%	-26.1%
	Halibut Encounter Rate (Δ %)	-		-	-1.8%	-4.1%	-7.7%	-12.0%	-16.1%
	Halibut PSC mortality (Δ %)	-		-	-2.7%	-6.2%	-11.7%	-19.2%	-26.4%
					Scenario B				
	Groundfish Harvest (Δ %)	-		-	-1.7%	-3.4%	-6.9%	-10.8%	-15.0%
	Halibut Encounters (Δ %)	-		-	-4.6%	-8.5%	-14.9%	-22.3%	-29.1%
	Halibut Encounter Rate (Δ %)	-		-	-3.0%	-5.3%	-8.5%	-12.9%	-16.5%
	Halibut PSC mortality (Δ %)	-		-	-4.8%	-8.8%	-15.3%	-22.6%	-29.4%

Mitigation of PSC Reduction Impacts Observer Data Analysis

Another way to look at how participants may modify their behavior onboard vessels to accommodate reduced PSC limits is presented in detail in Appendix B, and summarized here. The appendix looks at three sectors (Amendment 80 CPs, the BSAI trawl limited access fishery, and longline CPs), and analyzes specific patterns of halibut PSC rates by vessel, by target fishery, and by area, using observer data. Where possible, the analysis looks at data on a haul-by-haul basis, although for the BSAI trawl limited access fishery this level of data is incomplete.

The analysis focuses only on halibut PSC rates in fisheries operating in the Bering Sea (approximately equivalent to IPHC Areas 4A, and 4CDE), and not the Aleutian Islands (Area 4B), given the substantially greater groundfish harvest, halibut PSC, and PSC rates in the Bering Sea. The comparisons also focus on halibut PSC rates as measured in total halibut PSC usage, and not PSC mortality, given the complexities of assigning a specific halibut mortality to the range of fisheries over the years considered in this analysis.

The patterns of halibut PSC rates in the observer data suggest that participants in these fisheries, primarily in the Amendment 80 sector, could modify their fishing operations in several ways to reduce halibut PSC use. Note, although the analysis looked at data on a haul-by-haul basis, the patterns are generalized to the sector-level.

- When relatively high halibut PSC rates are observed in immediately preceding hauls, participants could apply more stringent standards for relocating, or otherwise changing fisheries operations.
- The Amendment 80 CP sector could limit harvests of arrowtooth flounder and flathead sole, which have higher halibut PSC rates relative to other target fisheries.
- In all three sectors (Amendment 80 CPs, BSAI trawl limited access fishery, and longline CPs) there is a pattern of relatively higher halibut PSC rates at the end of the year. This suggests an opportunity for operational improvement.
- Participants could avoid specific areas where a higher proportion of the hauls exceed specific halibut PSC rate threshold levels. Appendix B maps the geographic distribution such areas, some of which correspond to particular target fisheries.

Quantifying the amount of halibut PSC savings that would accrue from adopting, or more fully implementing, the suggestions included above, is challenging due to the complex nature of the fisheries, and has not been attempted in this analysis. Nevertheless, some of these operational suggestions could be implemented and are likely to offset some, but not all, of the adverse impacts of halibut PSC reductions in these sectors. Even without precise quantifiable data, it is reasonable to conclude that these operational responses would be most likely to mitigate the effects of halibut PSC reductions at lower levels of halibut PSC reductions and potentially limit impacts on overall groundfish harvests.

Discard Mortality Rates

Discard mortality rates are the third component of the PSC reduction equation identified above. As described in Section 3.1.3.2, DMRs are established for each BSAI groundfish fishery category (including CDQ target fisheries), and applied to the total halibut catch to calculate halibut PSC mortality. In 2000, the Council adopted a plan in which the DMRs used to monitor halibut PSC mortality are an average of data from the most recent 10-year period, and these 10-year mean DMRs for each fishery are used by NMFS for a 3-year period.

In practice, this means that under the current process, DMRs that are used for managing BSAI PSC limits in the groundfish fisheries are based on a ten-year average of observed DMRs in that target fishery, with a one to four year lag between the base year period from which the data was calculated to the year in which it is used. While any change that the industry may make in handling processes to improve the condition of halibut on release and reduce observed DMRs may help halibut survive, the impact will not be felt in terms of management of PSC over a very long time period. The IPHC, however, calculates the actual DMRs from observed data after the end of the fishing year, and uses this information in the stock assessment and resulting harvest limit calculations, so there would be an impact on the assessment of the halibut biomass on a shorter timeframe.

In Section 3.1.3.6, a report is included on progress with the 2015 deck sorting EFP, which is evaluating a process to sort halibut on deck in order to improve release condition and survivability. Under the EFP, vessels are not subject to the assumed DMR adopted by the Council in the harvest specifications process for deck-sorted hauls, and will be credited with the actual halibut release condition for fish that are sorted on deck, although all halibut that are not sorted on deck and flow through to the factory will have a higher mortality rate assigned as the catch monitoring requirements of the EFP require them to be held longer than they would under normal fishing conditions. The complexity of the EFP requirements onboard vessels, and the changes to the catch accounting system necessary to accommodate the EFP, are such that the 2015 EFP is unlikely to be the model for implementing deck sorting in perpetuity. Rather, if successful, the experiment will help to inform a process for developing an assumed DMR for deck-sorted tows that can be adopted on a periodic basis as with current DMRs. Any such process would have to be implemented with a regulatory analysis.

The Council could adopt a different process for calculating DMRs on an annual or triennial basis (the DMR process itself is not set in regulation), however it is unlikely that it will be possible to base the management of PSC limits inseason on realtime data. The ten-year average also smooths out interannual variability in the data. The longline CP sector has the greatest incentive to encourage the Council to change the process for adopting DMRs to use a more recent time period than the ten-year mean, applied every three years. For the longline sector, actual DMRs have consistently been below the assumed DMR since 2002 (Figure 3-13, on page 70). Amendment 80 CPs may receive some benefit from deck sorting under a new EFP for 2016, if such an application were approved, but are unlikely to be able to use an EFP process indefinitely. The results of the 2015 EFP will help to determine whether and how deck sorting can be implemented in regulation.

A final uncertainty with respect to DMRs in the future is that the IPHC is beginning a study to re-evaluate the survivability associated with different release conditions and injury levels of halibut in groundfish fisheries, which would change the calculation of all target fishery actual DMRs. A comprehensive evaluation of DMRs for all sizes of fish is not expected to be ready before December 2015, when the Council is scheduled to adopt its next three-year set of assumed DMRs for the Alaska fisheries, for 2016 through 2018. Once they are available, the recalculations of survivability and actual DMRs will be used in the halibut stock assessment to inform the IPHC process for assessing halibut harvest limits. Depending on when the results become available, the Council may or may not choose to revise the adopted DMRs that are used for the management of halibut PSC limits before the next scheduled review in December 2018.

4.13.2.3 Alaska Communities and the BSAI Groundfish Fishery

Relatively few Alaska communities directly and on a consistent basis participate in the BSAI groundfish fisheries, as determined by location of community resident-owned vessels participation in the fishery and/or location of shore-based processor participation in the fishery in 2008 to 2013. This section summarizes BSAI groundfish fishery participation patterns for Alaska communities substantially dependent on or substantially engaged in the harvest or processing of fishery resources to meet social and economic needs of these communities and the likely community-level impacts of Alternative 2 on these communities.[61] Relative levels of BSAI groundfish fishery engagement for Alaska communities (only) are also shown graphically in Table 4-206.

[61] Alaska resident ownership of active BSAI groundfish hook-and-line catcher vessels is not considered in this summary; given that all of the BSAI halibut PSC limit revision alternative options and suboptions are non-constraining for this sector, no community based impacts related to this sector are anticipated.

Table 4-206 Graphic Representation of Potentially Affected Alaska Communities' Annual Average Engagement in BSAI Groundfish and Halibut Fisheries

Note, however, that the Seattle metropolitan statistical area has the greatest engagement, by far, for all communities in all categories (except BSAI groundfish hook-and-line catcher vessels and being the location of BSAI groundfish or halibut shore-based processing). Newport (Oregon) has the second-highest engagement in the BSAI groundfish trawl catcher vessel sector.

Community	Relative Community Size	BSAI Groundfish Engagement					BSAI Halibut Engagement	
		Locally Owned Catcher Vessels		Locally Owned Catcher Processors		Shore-Based Processing Location	Locally Owned Catcher Vessels	Shore-Based Processing Location
		Trawl	Hook & Line	Trawl	Hook & Line			
Adak	•		•			○	•	•
Akutan	○					○	•	○
Anchorage	●		•	•	○	•		
King Cove	•					○		
Kodiak	○	●	•			•	●	
Petersburg	○				●			
Sand Point	•	•				○		
Unalaska	○		●			●	●	●

Note: the only Alaska communities not included in the table that have BSAI groundfish values in the ranges shown are Anchor Point and Juneau, with hook-and-line catcher vessel participation in the 1.0-2.9 and 0.5-0.9 annual average vessel categories, respectively.

KEY for Table 4-206

Type/Level of Engagement		•	○	●
Community Size	2010 population =	less than 1,000	1,000 – 9,999	10,000 or more
BSAI Groundfish Catcher Vessel Participation	2008-13 annual avg. =	0.5 – 0.9 vessels	1.0 – 2.9 vessels	3.0 or more vessels
BSAI Groundfish Catcher Processor Participation	2008-13 annual avg. =	0.5 – 0.9 vessels	1.0 – 2.9 vessels	3.0 or more vessels
BSAI Groundfish Shore-Based Processing Participation	2008-13 annual avg. =	0.5 – 0.9 plants	1.0 – 1.9 plants	2.0 or more plants
BSAI Halibut Catcher Vessel Participation	2008-13 annual avg. =	1.0 – 4.9 vessels	5.0 – 9.9 vessels	10.0 or more vessels
BSAI Halibut Shore-Based Processing Participation	2008-13 annual avg. =	0.5 – 0.9 plants	1.0 – 1.9 plants	2.0 or more plants

Unalaska and Akutan

In 2008 to 2013, on an annual average basis, shore-based processors in Unalaska and Akutan combined accounted for 94.9 percent of all BSAI groundfish deliveries accepted by all shore-based processors in Alaska as measured by ex-vessel gross revenues. During 2011 to 2013, Unalaska and Akutan shore-based processors earned combined annual average BSAI groundfish first wholesale gross revenues of $544 million out of $753 million first wholesale gross revenues for processing all areas and species fisheries combined. As discussed elsewhere, however, impacts to shore-based processors would largely be driven by potential reductions in trawl-caught deliveries of Pacific cod, which accounted for approximately 8.1 percent of all first wholesale gross revenues. Depending on the Alternative 2 Option 2 PSC limit reduction level chosen and behavioral adaptations of the trawl catcher vessel fleet, some lesser or greater portion of Pacific cod first wholesale gross revenues would be at risk. Unalaska, with its relatively well-developed fishery support service sector and its role as the major shipping port in the region, could experience impacts through a decline in economic activity from the various catcher vessel and/or catcher processor fleets if port calls were to decline; however, there is no straightforward way to quantify these impacts.

Adak

While of a smaller scale than the Unalaska and Akutan shore-based processing plants, the shore-based processor in Adak has historically processed substantial amounts of BSAI groundfish. Revenue data for the plant are confidential, but earlier released data suggest a very high dependence on Pacific cod. Adak has also been the focus a continuing effort to grow the fishery (and shipping) support service sector of the local economy, and BSAI groundfish vessel port calls constitute an important economic driver for this sector. The plant does not currently have an operator, but the following discussion would apply if the plant is reopened. Adak would appear particularly vulnerable to adverse impacts related to BSAI halibut PSC limit reductions under Alternative 2 Option 2, but this vulnerability may be minimized by differences in halibut bycatch rates between the Aleutian Islands and Bering Sea subareas. With historically lower halibut bycatch rates, BSAI groundfish trawl catcher vessels may have an incentive to concentrate more heavily on the Aleutian Islands subarea, which would likely benefit the community of Adak, assuming an overarching BSAI halibut PSC limit is not reached in the earlier-occurring Pacific cod effort in the Bering Sea subarea, effectively shutting down efforts in the Aleutian Islands subarea. Adak could experience indirect impacts through a decline in support service activity related to the various catcher vessel and/or catcher processor fleets if port calls were to decline as a result of the implementation of Alternative 2. Potential impacts could be a part of larger cumulative impacts on local fisheries and support sectors, especially if reduced BSAI halibut PSC limits functioned to cause early closures of the Pacific cod fishery effort in Aleutian Islands subarea. If the type of high and adverse impacts that may accrue to Adak under an early Pacific cod shut-down scenario were to occur, environmental justice issues may be of concern for Adak as well, based on the demographics of the local processing population[62].

Petersburg

Alaska resident ownership of active BSAI groundfish hook-and-line catcher processors was largely concentrated in Petersburg, with a secondary concentration in Anchorage. During 2010 to 2013, on an annual average basis 4.5 Petersburg resident-owned hook-and-line catcher processors participated in the BSAI groundfish fishery, with $20.0 million in BSAI groundfish first wholesale gross revenues out of $24.1 million in total first wholesale gross revenues, for an 83.0 percent dependence on BSAI groundfish. Given this high degree of dependence, impacts could be substantial at the operational level, depending on the BSAI halibut PSC limit revision Alternative 2 options or reduction levels selected. During this same time, Petersburg's catcher processors BSAI groundfish first wholesale gross revenues represented 21.8 percent of the community's total combined resident-owned catcher vessel ex-vessel gross revenues and resident-owned catcher processor first wholesale gross revenues. Alternative 2 Options 3a and 3b are non-constraining, but greater reductions under Options 3c through 3g could adversely impact Petersburg hook-and-line catcher processors, with the level of impact depending on the specific reduction level chosen and the individual behavioral responses of the engaged vessels. Given the community's relative overall dependence on commercial fishing, and the proportion of local fishing gross revenues attributable to the BSAI groundfish hook-and-line catcher processor sector, these impacts of these reductions could potentially be felt at the community level, depending on the magnitude of the reductions in combination with the patterns of revenue flow from these vessels, which are unknown.

Kodiak

Alaska resident ownership of active BSAI groundfish trawl catcher vessels has been concentrated in Kodiak. For 2009 and 2011 to 2013, on an annual average basis, 6.3 Kodiak resident-owned vessels participated in the BSAI groundfish fishery, with $5.5 million in BSAI groundfish ex-vessel gross revenues out of $14.1 million in total ex-vessel gross revenues for these same vessels from all area, species, and gear fisheries combined, for 39.2 percent dependence on BSAI groundfish for these vessels. Given this high dependence, impacts to Kodiak resident-owned trawl catcher vessels could be substantial at the operational level, depending on the Alternative 2 Option 2 level of PSC limit reduction selected. From a community level perspective, however, during these same years all Kodiak resident-owned vessels had annual average total ex-vessel gross revenues of $124.2 million, for a 4.4 percent dependence on BSAI groundfish for the "community fleet." This relatively low community-level catcher vessel fleet dependency makes adverse

[62] See footnote 59 on page 362.

sector or community-level impacts unlikely for Kodiak, no matter which Alternative 2 options or reduction levels are chosen.

Anchorage

For Anchorage, the relatively modest level of engagement in the BSAI groundfish fishery combined with the size of the community and the size and relative diversity of the local economy makes adverse community-level impacts from Alternative 2 unlikely. However, Anchorage's engagement in the fishery has been expanding in recent years. Whether the Alternative 2 would influence this apparent trend of greater Anchorage involvement in the BSAI groundfish fishery is unknown.

CDQ Communities

As described in Section 4.4.6 in the RIR, CDQ communities participate in the BSAI groundfish fishery in multiple ways, not only through quota ownership but through investment in direct fishery participation in a variety of sectors as well, with specific direct fishery and sector participation engagement and dependency varying by CDQ group. Depending on specific patterns of investment in direct participation, individual CDQ groups and their communities could be impacted by any of the Alternative 2 options, suboptions, and level of BSAI halibut PSC reduction in ways similar to other direct fishery participants; for the CDQ fishery itself, reductions of 10 to 30 percent (Alternative 2 Options 6a through 6c) are non-restricting, based on historical catch levels, but groups could be affected by reductions of 35 percent or higher (Options 6d through 6g) as noted earlier.

4.13.2.4 Pacific Northwest Communities and the BSAI Groundfish Fishery

Outside of Alaska, substantial engagement in the BSAI groundfish fisheries is highly concentrated in the Seattle Metropolitan Statistical Area (Seattle MSA), with a secondary concentration in the BSAI groundfish trawl catcher vessel fleet in Newport, Oregon. The Seattle MSA is the community most substantially engaged in the BSAI groundfish fishery (as measured by absolute participation numbers of vessels and crew, as well as volume and value of landings from those vessels). Conversely, the Seattle MSA is among the least substantially dependent of the engaged communities on those fisheries based on the relative number of fishing jobs and economic value of those fisheries when compared to the size of the overall Seattle MSA labor pool and the scale, diversity, and resilience of its economy. While community-level dependence is not a salient issue for the Seattle MSA or Newport, potential adverse impacts of some of the Alternative 2 options and suboptions would be profound in terms of potential loss of revenues to individual operations and sectors and potential loss of income and/or employment to relatively large numbers of individuals.

- In the BSAI groundfish trawl catcher vessel sector, on an average annual basis 2008 to 2013, Washington and Oregon residents owned 91.6 percent of all vessels in the sector. Seattle MSA vessels accounted for 80.7 percent of all ex-vessel gross revenues of all BSAI groundfish trawl catcher vessels, with a 93.8 percent dependency on BSAI groundfish as measured by a percentage of all ex-vessel gross revenues for these same vessels.
- In the BSAI groundfish trawl catcher processor sector, for the years 2008 to 2013, on an average annual basis, Seattle MSA resident-owned vessels accounted 89.0 percent of all the vessels in the sector and for 92.2 percent of all BSAI groundfish trawl catcher processor sector first wholesale gross revenues. Among Seattle MSA BSAI groundfish trawl catcher processors, BSAI groundfish first wholesale gross revenues accounted for 94.7 percent of the total first wholesale gross revenues for these same vessels for all area, species, and gear fisheries combined.
- In the BSAI groundfish hook-and-line catcher processor sector, for the years 2008 to 2013, on an average annual basis, Washington resident-owned vessels accounted for 82.4 percent of all vessels

> in the sector and for 68.2 percent of all BSAI groundfish hook-and-line catcher processor sector first wholesale gross revenues. Among Seattle MSA BSAI groundfish hook-and-line catcher processors, BSAI groundfish first wholesale gross revenues accounted for 84.1 percent of the total first wholesale gross revenues for these same vessels for all area, species, and gear fisheries combined.

Additionally, the Seattle MSA is the location of regional or company headquarters for a number of the processing firms engaged in the BSAI groundfish fisheries. It is also the assumed ownership base for inshore floating processors and floating domestic motherships that do not have ownership location assigned in the 2008 to 2013 primary database used for this analysis. Further, the Seattle MSA has extensive fishery support services available, including some types or scale of services unavailable anywhere in Alaska.

Given the degree of centralization of ownership of the directly engaged BSAI groundfish fishery sectors in the Seattle MSA and the centralization of the support services provided by Seattle-based firms, potential adverse impacts associated with proposed BSAI halibut PSC limit revisions overall would largely accrue to the Seattle MSA in particular and the Pacific Northwest in general under Alternative 2. Given the type of high and adverse impacts that may accrue to some sectors within the Seattle MSA, environmental justice issues may be of concern as well, based on industry-supplied data that indicate high proportions of minority employees in the catcher processor sector[63].

4.14 Management and Enforcement Considerations

4.14.1 Cost recovery

Halibut PSC management actions recommended by the Council, and implemented by NMFS, could affect the total amount harvested by the AFA, Amendment 80, and CDQ Programs (Table 2-2). NMFS anticipates that these programs will be subject to cost recovery fees under section 304(d) of the Magnuson-Stevens Act beginning in 2016[64]. Halibut PSC measures could reduce the ex-vessel and wholesale value of fisheries subject to cost recovery and could increase the fee percentage due. Overall, the impact of this action on the fee percentages due is likely to be limited for several reasons. First, changes in groundfish TACs and ex-vessel and wholesale prices are likely to be the greatest factors affecting the total revenue and therefore the percentage of fees paid.

Second, even if this action were to result in reduced harvests and therefore result in a higher percentage of fees to pay for management costs, Section 304(d) limits total fees to 3 percent of the ex-vessel value for a fishery. The analysis prepared for the cost recovery program estimated that fees for the AFA, Amendment 80, and CDQ Programs would not reach the 3 percent limit. Fee estimates ranged from 0.23% to 1.77% of ex-vessel value for the affected fisheries. The potential impact of this action on cost recovery fees due for AFA, Amendment 80, and CDQ Programs will vary based on the proportion of catch in each of these programs that would be limited by halibut PSC restrictions. It is not possible to quantitatively estimate the potential impact of this action on cost recovery fee percentages given the variable factors that affect the amount of fee percentages due (i.e., costs incurred by NMFS, TACs, ex-vessel prices, and specific fleet responses to this action are variable and can change simultaneously). Generally, it is reasonable to assume that the higher the PSC reduction, the greater the potential impact on harvests and ex-vessel value, and the higher the cost recovery fee due up to the statutory 3 percent limit. A detailed description of the costs and potential fees associated with the AFA, Amendment 80, and CDQ Programs is available in the proposed rule and the analysis to implement cost recovery fees and is incorporated by reference[65].

---

[63] See footnote 62 on page 337.
[64] See proposed rule published on January 7, 2015, at http://www.regulations.gov/#!documentDetail;D=NOAA-NMFS-2014-0031-0001.
[65] See analysis at http://www.regulations.gov/#!documentDetail;D=NOAA-NMFS-2014-0031-0002.

4.14.2 IFQ loan response

NMFS' Financial Services Division currently administers a halibut and sablefish IFQ loan program. To the extent that the level of halibut PSC limits affects the viability of harvest opportunities in the directed halibut fisheries for borrowers under the program, the analysis considers whether these borrowers could continue to make their required payments to NMFS without PSC reductions. Staff at NMFS' Financial Services Division provided the following data to assess the potential impact of the proposed action on the halibut and sablefish IFQ loan program[66]. Currently, NMFS has not recorded any defaults from its 177 outstanding loans used to purchase halibut and sablefish QS. The total outstanding balance of these loans is approximately $22.3 million.

Loans have been provided to borrowers to purchase halibut and sablefish QS throughout the BSAI and GOA. The distribution of loans is roughly proportional to the overall distribution of quota in the BSAI and GOA. That is, a large proportion of the loans have been provided for the purchase of halibut and sablefish QS in the GOA. This proposed action could provide additional harvest opportunities in the Area 4 halibut fishery, but would have a de minimis impact on overall revenue to halibut fisheries in the GOA halibut fishery over the long term (Table 2-3). Therefore, this document assesses the potential impact on borrowers who hold Area 4 quota share.

Of the 177 outstanding loans, only 14 loans were used to fund the purchase of Area 4 quota share. All of these loans were used to fund the purchase of Area 4A quota share. One of these 14 loans also provided funding for the purchase of a limited amount of Area 4C quota share. The total current principal balance on these loans is $1.47 million. No borrower is delinquent in their payments. NMFS estimates that the collateral value of these Area 4 quota share loans at $1.24 million.

The principal balances of Area 4 quota share loans are slightly greater than the estimated current market value of the underlying quota. If borrowers are unable to continue to meet the payment for these loans, and default occurs, NMFS may not be able to rely on the value of the underlying quota to completely recover the principal of the loan depending on the balance and sale value of a specific loan at the time of default. NMFS Financial Services Division has limited lending for halibut and sablefish quota share in recent years to reduce the risk of defaults because the decreasing sablefish TAC and halibut catch limits have resulted in declining revenue for borrowers.

Although reducing halibut PSC limits may provide additional harvest opportunity, and additional revenue to halibut IFQ borrowers in Area 4, the potential impact of halibut PSC reductions on the ability for borrowers to receive additional revenue is limited. Under this proposed action, over 64 percent of the likely additional harvest opportunity from reducing halibut PSC limits would occur in Area 4CDE (Table 2-2). NMFS has only one outstanding loan for a small amount of Area 4C quota share. Less than 33 percent of the additional harvest opportunity would occur in Area 4A (Table 2-2). The possible change in harvest opportunities in Area 4A under any of the alternatives and options is limited relative to the current and anticipated catch limits in Area 4A.

There are other factors unrelated to this proposed action that are likely to have a much greater impact on the ability borrowers with loans for Area 4 quota share to meet their loan obligations. Changes in the overall abundance of halibut, the apportionment of halibut among regulatory areas, allocation decisions made by the IPHC, ex-vessel prices, vessel operating costs, revenue from other fisheries, and other personal financial situations unrelated to fishing operations affect a borrower's ability to meet their financial obligations to

[66] Earl Bennett, NMFS Financial Services Division, personal communication, April 2015.

NMFS. Data are not available to assess the overall impact of these other factors on a borrower's ability to meet their financial obligations to NMFS.

The proposed action would be expected to have a de minimis impact on the overall solvency of the halibut and sablefish IFQ loan program or on the ability of borrowers holding Area 4 quota share to meet their debt obligations. This conclusion is based on the available data on the current status of loan payments, the overall value of Area 4 quota share loans relative to the total principal balance of outstanding loans, and the limited impact of PSC reductions on overall harvest opportunities where NMFS has the greatest exposure to the risk of default (Area 4A).

4.14.3 Vessel safety

None of the proposed alternatives or options would change safety requirements for fishing vessels. The proposed action to reduce halibut PSC limits is not likely to affect safety for vessels that operate in the CV hook-and-line Pacific cod fishery and CV/CP hook-and-line other targets fishery because none of the analyzed options would constrain groundfish harvest in these fisheries (Table 2-2). The proposed action also is not likely to affect safety for vessels that operate in a rationalized fishery (Amendment 80, hook-and-line CP Pacific cod, and CDQ fisheries). These vessels have the ability to coordinate within the sector to respond to reduced PSC limits by reducing groundfish harvests or by using other methods to reduce halibut PSC use.

The proposed action to reduce halibut PSC limits may increase competition for PSC among vessels that operate in a non-rationalized fishery (BSAI TLA). These vessels do not coordinate operations across the entire sector, and PSC limit reductions may result in a race for harvesting groundfish TACs that are limited by PSC. To the extent that vessel operators take more risks, e.g., fishing in marginal weather, increasing competition for halibut PSC may marginally impact the safety of human life at sea.

4.14.4 Enforcement Considerations

A reduction in halibut PSC limits may create an incentive to bias an observer’s data. The prosecution of two individuals and Unimak Fisheries in 2005 and of the vessel operator and Rebecca Irene Fisheries in 2006 for biasing observer data and underreporting of halibut PSC during groundfish fisheries demonstrates this incentive. Since that time, monitoring requirements implemented with the Amendment 80 Program have reduced the likelihood of an observer’s data being biased for the Amendment 80 fisheries. These requirements include electronic bin monitoring, a prohibition on mixing hauls, a requirement to weigh all catch on an approved flowscale, and an increase to 200% observer coverage. However, recent reporting trends identified by Alaska Division of NOAA OLE indicate a significant increase in reports of harassment, intimidation, hostile work environment and other attempts to bias observer samples of prohibited species catch in the Amendment 80, AFA, and hook-and-line CP fleet. A further reduction of the halibut PSC limit for these sectors may result in additional coercive behavior and attempts to bias observer samples. NOAA OLE continues to investigate complaints that include pressuring observers to expedite delivery of haul composition data to the vessel captain more frequently than the data are transmitted to NMFS, intimidating or coercive attempts to influence observer sample collection with the intent to lower PSC catch estimates, and other attempts to remove prohibited species from an observer’s sample. The proposed action to reduce halibut PSC limits will likely increase these complaints.

5 Initial Regulatory Flexibility Analysis

5.1 Introduction

This Initial Regulatory Flexibility Analysis (IRFA) addresses the statutory requirements of the Regulatory Flexibility Act (RFA) of 1980, as amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (5 U.S.C. 601-612). This IRFA evaluates the potential adverse economic impacts on small entities directly regulated by the proposed action.

The RFA, first enacted in 1980, was designed to place the burden on the government to review all regulations to ensure that, while accomplishing their intended purposes, they do not unduly inhibit the ability of small entities to compete. The RFA recognizes that the size of a business, unit of government, or nonprofit organization frequently has a bearing on its ability to comply with a federal regulation. Major goals of the RFA are: (1) to increase agency awareness and understanding of the impact of their regulations on small business, (2) to require that agencies communicate and explain their findings to the public, and (3) to encourage agencies to use flexibility and to provide regulatory relief to small entities.

The RFA emphasizes predicting significant adverse economic impacts on small entities as a group distinct from other entities, and on the consideration of alternatives that may minimize adverse economic impacts, while still achieving the stated objective of the action. When an agency publishes a proposed rule, it must either 'certify' that the action will not have a significant adverse economic impact on a substantial number of small entities, and support that certification with the 'factual basis' upon which the decision is based; or it must prepare and make available for public review an IRFA. When an agency publishes a final rule, it must prepare a Final Regulatory Flexibility Analysis, unless, based on public comment, it chooses to certify the action.

In determining the scope, or 'universe', of the entities to be considered in an IRFA, NMFS generally includes only those entities that are directly regulated by the proposed action. If the effects of the rule fall primarily on a distinct segment, or portion thereof, of the industry (e.g., user group, gear type, geographic area), that segment would be considered the universe for the purpose of this analysis.

5.2 IRFA Requirements

Until the North Pacific Fishery Management Council (Council) makes a final decision on a preferred alternative, a definitive assessment of the proposed management alternatives cannot be conducted. In order to allow the agency to make a certification decision, or to satisfy the requirements of an IRFA of the preferred alternative, this section addresses the requirements for an IRFA. Under 5 U.S.C., section 603(b) of the RFA, each IRFA is required to contain:

- A description of the reasons why action by the agency is being considered;
- A succinct statement of the objectives of, and the legal basis for, the proposed rule;
- A description of and, where feasible, an estimate of the number of small entities to which the proposed rule will apply (including a profile of the industry divided into industry segments, if appropriate);
- A description of the projected reporting, record keeping, and other compliance requirements of the proposed rule, including an estimate of the classes of small entities that will be subject to the requirement and the type of professional skills necessary for preparation of the report or record;
- An identification, to the extent practicable, of all relevant federal rules that may duplicate, overlap, or conflict with the proposed rule;

- A description of any significant alternatives to the proposed rule that accomplish the stated objectives of the proposed action, consistent with applicable statutes, and that would minimize any significant economic impact of the proposed rule on small entities. Consistent with the stated objectives of applicable statutes, the analysis shall discuss significant alternatives, such as:
    1. The establishment of differing compliance or reporting requirements or timetables that take into account the resources available to small entities;
    2. The clarification, consolidation, or simplification of compliance and reporting requirements under the rule for such small entities;
    3. The use of performance rather than design standards;
    4. An exemption from coverage of the rule, or any part thereof, for such small entities.

In preparing an IRFA, an agency may provide either a quantifiable or numerical description of the effects of a proposed action (and alternatives to the proposed action), or more general descriptive statements, if quantification is not practicable or reliable.

5.3 Definition of a Small Entity

The RFA recognizes and defines three kinds of small entities: (1) small businesses, (2) small non-profit organizations, and (3) small government jurisdictions.

Small businesses. Section 601(3) of the RFA defines a ‘small business’ as having the same meaning as ‘small business concern’, which is defined under Section 3 of the Small Business Act (SBA). ‘Small business’ or ‘small business concern’ includes any firm that is independently owned and operated and not dominant in its field of operation. The SBA has further defined a “small business concern” as one “organized for profit, with a place of business located in the United States, and which operates primarily within the United States or which makes a significant contribution to the U.S. economy through payment of taxes or use of American products, materials or labor…A small business concern may be in the legal form of an individual proprietorship, partnership, limited liability company, corporation, joint venture, association, trust or cooperative, except that where the firm is a joint venture there can be no more than 49 percent participation by foreign business entities in the joint venture.”

The SBA has established size criteria for all major industry sectors in the United States, including fish harvesting and fish processing businesses. Effective July 22, 2013, a business involved in *finfish harvesting* is a small business if it is independently owned and operated and not dominant in its field of operation (including its affiliates) and if it has combined annual gross receipts not in excess of $19.0 million for all its affiliated operations worldwide. A business involved in *shellfish harvesting* is a small business if it is independently owned and operated and not dominant in its field of operation (including its affiliates) and if it has combined annual gross receipts not in excess of $5.0 million for all its affiliated operations worldwide. A *seafood processor* is a small business if it is independently owned and operated, not dominant in its field of operation, and employs 500 or fewer persons on a full-time, part-time, temporary, or other basis, at all its affiliated operations worldwide. A business that *both harvests and processes* fish (i.e., a catcher processor) is a small business if it meets the criteria for the applicable fish harvesting operation (i.e., finfish or shellfish). A wholesale business servicing the fishing industry is a small business if it employs 100 or fewer persons on a full-time, part-time, temporary, or other basis, at all its affiliated operations worldwide.

The SBA has established “principles of affiliation” to determine whether a business concern is “independently owned and operated.” In general, business concerns are affiliates of each other when one concern controls or has the power to control the other, or a third party controls or has the power to control both. The SBA considers factors such as ownership, management, previous relationships with or ties to another concern, and contractual relationships, in determining whether affiliation exists. Individuals or firms that have identical or substantially identical business or economic interests, such as family members, persons with common investments, or firms that are economically dependent through contractual or other relationships, are treated as one party with such interests aggregated when measuring the size of the concern in question. The SBA counts the receipts or employees of the concern whose size is at issue and those of all its domestic and foreign affiliates, regardless of whether the affiliates are organized for profit, in determining the concern's size. However, business concerns owned and controlled by Indian Tribes, Alaska Regional or Village Corporations organized pursuant to the Alaska Native Claims Settlement Act (43 U.S.C. 1601), Native Hawaiian Organizations, or Community Development Corporations authorized by 42 U.S.C. 9805 are not considered affiliates of such entities, or with other concerns owned by these entities solely because of their common ownership.

Affiliation may be based on stock ownership when (1) a person is an affiliate of a concern if the person owns or controls, or has the power to control 50 percent or more of its voting stock, or a block of stock which affords control because it is large compared to other outstanding blocks of stock, or (2) if two or more persons each owns, controls or has the power to control less than 50 percent of the voting stock of a concern, with minority holdings that are equal or approximately equal in size, but the aggregate of these minority holdings is large as compared with any other stock holding, each such person is presumed to be an affiliate of the concern.

Affiliation may be based on common management or joint venture arrangements. Affiliation arises where one or more officers, directors, or general partners, controls the board of directors and/or the management of another concern. Parties to a joint venture also may be affiliates. A contractor and subcontractor are treated as joint venturers if the ostensible subcontractor will perform primary and vital requirements of a contract or if the prime contractor is unusually reliant upon the ostensible subcontractor. All requirements of the contract are considered in reviewing such relationship, including contract management, technical responsibilities, and the percentage of subcontracted work.

<u>Small organizations.</u> The RFA defines "small organizations" as any not-for-profit enterprise that is independently owned and operated, and is not dominant in its field.

<u>Small governmental jurisdictions.</u> The RFA defines "small governmental jurisdictions" as governments of cities, counties, towns, townships, villages, school districts, or special districts with populations of fewer than 50,000.

5.4 Reason for Considering the Proposed Action

Consistent with the MSA's National Standard 1 and National Standard 9, the Council and NMFS use halibut PSC mortality limits to minimize halibut bycatch (halibut PSC) in the groundfish fisheries to the extent practicable, while achieving, on a continuing basis, the optimum yield from the groundfish fisheries. The groundfish fisheries cannot be prosecuted without some level of halibut interception. Although fishermen are required by regulation to avoid the capture of any prohibited species in groundfish fisheries, the use of halibut PSC limits in the groundfish fisheries provides an additional constraint on halibut PSC mortality, and promotes conservation of the halibut resource. Halibut PSC limits provide a regulated upper limit to mortality resulting from halibut interceptions, as continued groundfish fishing is prohibited once a halibut PSC limit has been reached for a particular sector and/or season. This management tool is intended to balance the optimum benefit to fishermen, communities, and U.S. consumers which depend on both halibut and groundfish resources.

The halibut resource is fully allocated. The IPHC accounts for incidental halibut removals in the groundfish fisheries, recreational and subsistence catches, and other sources of halibut mortality before setting commercial halibut catch limits each year. Declines in the exploitable biomass of halibut since the late 1990s, and decreases in the Pacific halibut catch limits set by the IPHC for the directed BSAI halibut fisheries (IPHC Area 4)), especially beginning in 2012 for the directed fishery in the northern and eastern Bering Sea (Area 4CDE), have raised concerns about the levels of halibut PSC mortality by the commercial groundfish trawl and hook-and-line sectors. Reductions in BSAI halibut PSC mortality have not been proportional to the reductions in Area 4 directed halibut harvest limits since 2011. The Council acknowledges that BSAI halibut PSC mortality levels have declined in some sectors since the current PSC limits were implemented and that PSC mortality does not reach the established sector limits in most years. The Council also recognizes efforts by the groundfish industry to reduce total halibut PSC mortality in the BSAI, but these efforts have had the unintended effect of concentrating groundfish fishing effort in Area 4CDE, and increasing the proportion of Area 4CDE halibut exploitable biomass taken as PSC since 2011. In 2015, the levels of halibut PSC in Area 4CDE increased relative to 2014. Based on the stated IPHC harvest policy and the estimates of exploitable biomass and PSC, the 2015 directed fishery harvest limit for halibut in Area 4CDE could have been reduced to a level that the halibut industry deemed was not sufficient to maintain an economically viable fishery in some communities.

The Council does not have authority to set harvest limits for the commercial halibut fisheries, and halibut PSC mortality in the groundfish fisheries is only one of the factors that affects harvest limits for the commercial halibut fisheries. Nonetheless, halibut removals in the groundfish fisheries are a significant portion of total mortality in BSAI IPHC areas, and have the potential to affect harvest limits for the directed fisheries in Area 4 under the current IPHC harvest policy.

Under National Standard 8, the Council must provide for the sustained participation of and minimize adverse economic impacts on fishing communities. BSAI coastal communities are affected by reduced catch limits for the directed halibut fishery, especially in IPHC Area 4CDE. The Council must balance these communities’ involvement in and dependence on halibut with community involvement in and dependence on the groundfish fisheries that rely on halibut PSC in order to operate, and with National Standard 4, which states that management measures shall not discriminate between residents of different states. National Standard 4 also requires allocations of fishing privileges to be fair and equitable to all fishery participants.

The proposed action would reduce the halibut PSC limits in the BSAI, which are established for the BSAI trawl and fixed gear sectors in Federal regulation, and in some cases, in the BSAI Groundfish FMP. Overall halibut PSC limits can be modified only through an amendment to the regulations and the FMP, although seasonal and some target fishery apportionments of those PSC limits would continue to be set annually through the BSAI groundfish harvest specifications process.

One purpose of the proposed action is to minimize halibut PSC mortality in the commercial groundfish fisheries to the extent practicable, while preserving the potential for the optimum harvest of the groundfish total allowable catches (TACs) assigned to the trawl and hook-and-line sectors. The proposed action aims to minimize halibut PSC mortality to the extent practicable in consideration of the regulatory and operational management measures currently available to the groundfish fleet, and the need to ensure that catch in the trawl and hook-and-line fisheries contributes to the achievement of optimum yield in the groundfish fisheries. Minimizing halibut PSC mortality to the extent practicable is necessary to maintain a healthy marine ecosystem, ensure long-term conservation and abundance of halibut, provide optimum benefit to fishermen, communities, and U.S. consumers that depend on both halibut and groundfish resources, and comply with the Magnuson-Stevens Act and other applicable Federal law.

Another purpose of this action is to provide additional harvest opportunities in the directed halibut fishery, especially in Area 4CDE for western Alaska and Pribilof Island coastal communities. Halibut savings that would occur from reducing halibut PSC mortality below current levels would provide additional harvest opportunities to the directed halibut fisheries in both the near term and long term. Near term benefits to BSAI halibut fisheries would result from the PSC mortality reductions of halibut that are over 26 inches in length (O26). These halibut would be available to the commercial halibut fishery in the area and year that the PSC mortality is foregone, or when the fish reach the legal size limit for the commercial halibut fishery (greater than or equal to 32 inches in total length). Longer term benefits to the directed halibut fisheries would accrue throughout the distribution of the halibut stock, from a reduction of halibut PSC mortality from fish that are less than 26 inches (U26). Benefits from reduced mortality of these smaller halibut would occur both in the Bering Sea and elsewhere as they migrate and recruit into the directed halibut fisheries.

5.5 Objectives of Proposed Action and its Legal Basis

Under the authority of the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act), the Secretary of Commerce (NMFS Alaska Regional Office) and the North Pacific Fishery Management Council have the responsibility to prepare fishery management plans and associated regulations for the marine resources found to require conservation and management. NMFS is charged with carrying out the Federal mandates of the Department of Commerce with regard to marine fish, including the publication of Federal regulations. The Alaska Regional Office of NMFS, and Alaska Fisheries Science Center, research, draft, and support the management actions recommended by the Council. The Bering Sea and Aleutian Islands (BSAI) groundfish fisheries are managed under the Fishery Management Plan for Groundfish of the BSAI Management Area. The proposed action represents an amendment, as required, to the fishery management plan, as well as amendments to associated Federal regulations.

Principal objectives of the FMP amendment and proposed regulations are to minimize bycatch to the extent practicable and provide additional harvest opportunities in the directed halibut fishery.

5.6 Number and Description of Directly Regulated Small Entities

This section provides estimates of the number of harvesting vessels that are considered small entities. These estimates may overstate the number of small entities (and conversely, understate the number of large entities). The RFA requires a consideration of affiliations between entities for the purpose of assessing if an entity is small. The estimates do not take into account all affiliations between entities. There is not a strict one-to-one correlation between vessels and entities; many persons and firms are known to have ownership interests in more than one vessel, and many of these vessels with different ownership, are otherwise affiliated with each other. For example, vessels in the American Fisheries Act (AFA) catcher vessel sectors are categorized as “large entities” for the purpose of the RFA under the principles of affiliation, due to their being part of the AFA pollock cooperatives. However, vessels that have other types of affiliation, (i.e., ownership of multiple vessel or affiliation with processors), not tracked in available data, may be misclassified as a small entity.

The entities directly regulated by this action are those entities that harvest groundfish from the trawl and hook and line Federal fisheries of the Bering Sea and Aleutian Islands, except for the sablefish target fishery. An exhaustive description of list of small entities will be included in the secretarial review draft.

5.7 Recordkeeping and Reporting Requirements

To be completed once a preferred alternative has been selected.

5.8 Federal Rules that may Duplicate, Overlap, or Conflict with Proposed Action

To be completed once a preferred alternative has been selected.

5.9 Description of Significant Alternatives to the Proposed Action that Minimize Economic Impacts on Small Entities

To be completed once a preferred alternative has been selected.

6 Magnuson-Stevens Act and Pacific Halibut Act Considerations

6.1 Magnuson-Stevens Act National Standards

Below are the 10 National Standards as contained in the Magnuson-Stevens Fishery and Conservation Act (Magnuson-Stevens Act). In recommending a preferred alternative, the Council must consider how to balance the national standards. For each of the national standards, a reference is provided to areas in the analysis that are particularly relevant to the consideration of the national standard, although they may not be the only information that is relevant to the issue. The Council may also wish to consult the national standard guidelines, issued by NMFS, which can be found at 50 C.F.R. 600.310 et seq.

National Standard 1 — Conservation and management measures shall prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery.

- Sections 4.8 through 4.12 describe the harvest impacts from the Alternative 2 options on groundfish fishery yield, as well as halibut fishery yield. These results are summarized across all sectors and options in Section 4.13.
- Optimum yield reflects ecological, social, and economic considerations. Ecological impacts of the proposed action are discussed in the Environmental Assessment in Chapter 3, particularly impacts to Pacific halibut in Section 3.1, and groundfish species in Section 3.2. The Alternative 2 summary section (4.13) synthesizes social and economic considerations with respect to the proposed action.

National Standard 2 — Conservation and management measures shall be based upon the best scientific information available.

- This analysis uses the best scientific information available throughout.

National Standard 3 — To the extent practicable, an individual stock of fish shall be managed as a unit throughout its range, and interrelated stocks of fish shall be managed as a unit or in close coordination.

- Section 3.1 describes the range of the Pacific halibut stock, which extends coastwide, and the analysis takes into account effects throughout the range (as summarized in Section 4.13.1.2). With the exception of sablefish, which is not subject to this action, all groundfish species are assessed at the scale of the BSAI FMP (Section 3.2), which is the geographic scope of the proposed action (Section 1.5).

National Standard 4 — Conservation and management measures shall not discriminate between residents of different states. If it becomes necessary to allocate or assign fishing privileges among various U.S. fishermen, such allocation shall be (A) fair and equitable to all such fishermen, (B) reasonably calculated to promote conservation, and (C) carried out in such a manner that no particular individual, corporation, or other entity acquires an excessive share of such privileges.

- A description of participants in each fishery and sector, including residency information, is included in Sections 4.4.1 through 4.4.6 for the groundfish fishery sectors, and Section 4.5 for halibut. Community engagement is analyzed in Appendix C. Section 4.13 provides additional summaries of Alternative 2 impacts in terms of residents and communities.

National Standard 5 — Conservation and management measures shall, where practicable, consider efficiency in the utilization of fishery resources, except that no such measure shall have economic allocation as its sole purpose.

- Sections 4.8 through 4.12 describe the impacts from the Alternative 2 options, including efficient utilization of the fishery resources.

National Standard 6 — Conservation and management measures shall take into account and allow for variations among, and contingencies in, fisheries, fishery resources, and catches.

- The model used to generate the impacts analysis for the Alternative 2 options includes interannual variability, as described in Section 4.6. The impacts are provided in Sections 4.8 through 4.12.

National Standard 7 — Conservation and management measures shall, where practicable, minimize costs and avoid unnecessary duplication.

- Sections 4.8 through 4.12 describe the impacts from the Alternative 2 options, including costs of PSC limits as a management measure.

National Standard 8 — Conservation and management measures shall, consistent with the conservation requirements of this Act (including the prevention of overfishing and rebuilding of overfished stocks), take into account the importance of fishery resources to fishing communities in order to (A) provide for the sustained participation of such communities, and (B) to the extent practicable, minimize adverse economic impacts on such communities.

- A detailed community engagement and dependency analysis for groundfish and halibut fisheries is provided in Appendix C, and summarized in Sections 4.13.1.3, 4.13.2.3, and 4.13.2.4.

National Standard 9 — Conservation and management measures shall, to the extent practicable, (A) minimize bycatch, and (B) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch.

- Sections 4.8 through 4.12 describe the impacts from the Alternative 2 options on halibut PSC. These results are summarized across all sectors and options in Section 4.13. Section 4.13.2.2 specifically describes efforts other than reducing groundfish fishing effort that would help to minimize PSC mortality.

National Standard 10 — Conservation and management measures shall, to the extent practicable, promote the safety of human life at sea.

- Section 4.14.3 addreses safety.

6.2 Section 303(a)(9) Fisheries Impact Statement

Section 303(a)(9) of the Magnuson-Stevens Act requires that a fishery impact statement be prepared for each FMP amendment. A fishery impact statement is required to assess, specify, and analyze the likely effects, if any, including the cumulative conservation, economic, and social impacts, of the conservation and management measures on, and possible mitigation measures for (a) participants in the fisheries and fishing communities affected by the plan amendment; (b) participants in the fisheries conducted in adjacent areas under the authority of another Council; and (c) the safety of human life at sea, including whether and to what extent such measures may affect the safety of participants in the fishery.

The EA/RIR/IRFA prepared for this plan amendment constitutes the fishery impact statement. The likely effects of the proposed action are analyzed and described throughout the EA/RIR/IRFA. The effects on participants in the fisheries and fishing communities are analyzed in the RIR/IRFA sections of the analysis (Sections 4 and 4.9). The effects of the proposed action on safety of human life at sea are evaluated in

Section 4. Based on the information reported in this section, there is no need to update the Fishery Impact Statement included in the FMP.

The proposed action directly regulates the groundfish fisheries in the EEZ off Alaska, which are under the jurisdiction of the North Pacific Fishery Management Council. The proposed action may also affect participants in halibut fisheries, conducted both under the North Pacific Council jurisdiction, and in adjacent areas under the jurisdiction of the Pacific Fishery Management Council.

6.3 Pacific Halibut Act

The fisheries for Pacific halibut are governed under the authority of the Northern Pacific Halibut Act of 1982 (Halibut Act, 16 U.S.C. 773-773k). For the United States, the Halibut Act gives effect to the Convention between the United States and Canada for the Preservation of the Halibut Fishery of the North Pacific Ocean and Bering Sea. The Halibut Act also provides authority to the Regional Fishery Management Councils, as described in § 773c:

> *(c) Regional Fishery Management Council involvement*
>
> *The Regional Fishery Management Council having authority for the geographic area concerned may develop regulations governing the United States portion of Convention waters, including limited access regulations, applicable to nationals or vessels of the United States, or both, which are in addition to, and not in conflict with regulations adopted by the [International Pacific Halibut Commission]. Such regulations shall only be implemented with the approval of the Secretary, shall not discriminate between residents of different States, and shall be consistent with the limited entry criteria set forth in section 1853(b)(6) of this title. If it becomes necessary to allocate or assign halibut fishing privileges among various United States fishermen, such allocation shall be fair and equitable to all such fishermen, based upon the rights and obligations in existing Federal law, reasonably calculated to promote conservation, and carried out in such manner that no particular individual, corporation, or other entity acquires an excessive share of the halibut fishing privileges.*

While the reduction of PSC limits as proposed in this analysis does not directly regulate halibut fishermen, there is nonetheless an indirect effect on halibut fisheries as a result of this action, and therefore it is prudent for the Council to consider the directions in the Halibut Act about the regulations that may result from this action. Much of the direction listed in § 773c(c) is duplicative with the Magunson-Stevens Act's National Standard 4, requiring that regulations not discriminate between residents of different States, and directing that if halibut fishing provileges are allocated or assigned among fishermen, such allocation shall be fair and equitable. The relationship between this analysis and National Standard 4 is discussed above in Section 6.1. The Halibut Act also directs regulations to be consistent with the limited entry criteria set forth in the Magnuson-Stevens Act. These are criteria that the Council and the Secretary must take into account when establishing a limited access system for a Magnuson-Stevens Act fishery. The criteria are listed below. For each of the criteria, a reference is provided to areas in the analysis that are particularly relevant to the consideration of that criterion, although they may not be the only information that is relevant to the issue.

(A) present participation in the fishery;
(B) historical fishing practices in, and dependence on, the fishery;
(C) the economics of the fishery;
(D) the capability of fishing vessels used in the fishery to engage in other fisheries;
(E) the cultural and social framework relevant to the fishery and any affected fishing communities;

(F) the fair and equitable distribution of access privileges in the fishery; and
(G) any other relevant consider ations.

- Sections 4.4.1 through 4.4.6 for the groundfish fishery sectors provide a description of participants in each fishery and sector, including residency information, as well as the historical fishing practices of participants in these fisheries, the economics of the fisheries, and the vessels' diversification into other fisheries. Similar information is provided in Section 4.5 for halibut.
- The engagement, social and cultural framework, and dependency of communities on the groundfish and halibut fisheries are analyzed in Appendix C.
- Sections 4.8 through 4.12 evaluate the impacts from the Alternative 2 options with respect to these considerations, and Section 4.13 summarizes Alternative 2 impacts.

7 Preparers and Persons Consulted

Preparers

Diana Evans, North Pacific Fishery Management Council
Marcus Hartley, Northern Economics Inc.

Contributors

Alaska Department of Fish and Game

Karla Bush, Nicole Kimball

Alaska Fisheries Information Network

Michael Fey

International Pacific Halibut Commission

Heather Gilroy, Bruce Leaman, Ian Stewart

National Marine Fisheries Service - Alaska Region, Sustainable Fisheries Division

Rachel Baker, Mary Furuness, Jason Gasper, Gretchen Harrington, Josh Keaton, Mary Alice McKeen, Glenn Merrill, Peggy Murphy, Julie Scheurer, Steve Whitney

National Marine Fisheries Service – Office of Law Enforcement

Nathan Lagerwey, Alicia Miller (contractor), Jaclyn Smith (contractor)

North Pacific Fishery Management Council

Chris Oliver, David Witherell

AECOM

Mike Downs, Stev Weidlich

Northern Economics, Inc

Gary Eaton, Hannah Foreman, Michelle Humphrey, Terri McCoy

Persons *(and Agencies)* Consulted

Alaska Department of Fish and Game
International Pacific Halibut Commission

8 References

Abbott, J.K. et al. 2014. "Hidden Flexibility: Institutions, Incentives, and the Hidden Margins of Selectivity in Fishing" Land Economics, Volume 91, issue 1, 2015.

Allen, B. M., and R. P. Angliss. 2014. Alaska marine mammal stock assessments, 2013. U.S. Dep. Commer., NOAA Tech. Memo. NMFS-AFSC-277, 304 p.

CFEC. 2013. Permit & Fishing Activity by Year, State, Census Area, or City. Data for 2008–2012. Available at http://www.cfec.state.ak.us/gpbycen/mnu_down.htm. Most recently accessed October 7, 2013.

Fall, J.A. and D.S. Koster. Subsistence Harvests of Pacific Halibut in Alaska, 2012. Technical Paper No. 388. Alaska Department of Fish and Game. January 2014.

Fey, Michael. 2014. AKFIN Data Manager. Catch Accounting System data provided to Northern Economics by Special Request.

Fey, Michael. 2014. Personal communication via telephone between Marcus Hartley (NEI) and Mike Fey (AKFIN Data Manager). May 2015.

Furuness, Mary, 2014. Personal communication via telephone between Marcus Hartley (NEI) and Mary Furuness (NMFS Alaska Region, Division of Sustainable Fisheries). November, 2014.

Furuness, Mary, 2015. Personal communication via telephone between Marcus Hartley (NEI) and Mary Furuness (NMFS Alaska Region, Division of Sustainable Fisheries). May, 2015.

Gauvin, J. G. 2010. Final report on EFP 09-02: Best Use Coalition's Halibut Deck Sorting EFP, Best Use Coalition: 41.

Gauvin, J. G. 2014. Final report on EFP 12-01: Halibut deck sorting experiment to reduce halibut mortality on Amendment 80 catcher processors, Alaska Seafood Cooperative: 24.

Gilroy, H. 2014a. The Pacific Halibut Fishery, 2013. In IPHC 2014 Annual Meeting Bluebook. Available online at http://www.iphc.int/publications/bluebooks/IPHC_bluebook_2014.pdf.

Gilroy, H.L. and I.J.Stewart. 2015. Incidental mortality of halibut in the commercial halibut fishery (Wastage). IPHC Report of Assessment and Research Activities 2014. Pp 47-54.

Gilroy, H.L. and G.H.Williams. 2015. The personal use harvest of Pacific halibut through 2014. IPHC Report of Assessment and Research Activities 2014. Pp 55-59.

Goodman, D., T. Quinn, G. Thompson, M. Mangel, T. Smith, G. Parks, V. Restrepo, K. Stokes. 2002. Scientific Review of the Harvest Strategy Currently Used in the BSAI and GOA Groundfish Fishery Management Plans.

Hare, S.R. 2011. Potential modifications to the IPHC harvest policy. IPHC Report of Assessment and Research Activities 2010. Pp 177-200.

International Pacific Halibut Commission [IPHC]. 2012a. Halibut Terminology – What You May Hear. IPHC 2012 Annual Meeting Infosheet #3. Available at http://www.iphc.int/documents/annmeet/2012/infosheets/3-Terminology.pdf.

IPHC. 2012b. How are Halibut Catch Limits Determined? IPHC 2012 Annual Meeting Infosheet #5. Available at http://www.iphc.int/documents/annmeet/2012/infosheets/5-CatchLimits.pdf.

IPHC. 2014a. IPHC's methodology for estimating bycatch in federal fisheries off Alaska. Attached to email from Bruce Leaman to Glenn Merrill, December 15, 2014.

IPHC. 2014b. Summary of the 2014 stock assessment, apportionment, and catch tables. Presentation at IPHC Interim Meeting, December 2, 2014. Available: http://iphc.int/meetings/2014im/Assessment_IM2014b.pdf

Kaimmer, S. 2015. 2014 halibut sport fisheyr review. IPHC Report of Assessment and Research Activities 2014. Pp 37-46.

Leaman, B. I. Stewart, S. Martell. 2015. Considerations Concerning Bycatch Control and Abundance-based Prohibited Species Catch Limits for Pacific Halibut in the Bering Sea/Aleutian Islands. https://npfmc.legistar.com/View.ashx?M=F&ID=3481061&GUID=5E87A9E8-8CAB-4E5F-9982-4C8936CC4176.

NMFS [National Marine Fisheries Service]. 2004. Programmatic Supplemental Environmental Impact Statement for the Alaska Groundfish Fisheries Implemented Under the Authority of the Fishery Management Plans for the Groundfish Fishery of the Gulf of Alaska and the Groundfish of the Bering Sea and Aleutian Islands Area. NMFS Alaska Region, P.O. Box 21668, Juneau, AK 99802-1668. June 2004. Available at http://www.alaskafisheries.noaa.gov/sustainablefisheries/seis/intro.htm.

NMFS. 2006. Biological assessment of the Alaska Groundfish Fisheries and NMFS managed Endangered Species Act listed marine mammals and sea turtles. NMFS Alaska Regional Office, P.O. Box 21668, Juneau, Alaska, April. Available: http://www.alaskafisheries.noaa.gov/sustainablefisheries/sslmc/agency_documents/BA4-6-06.pdf.

NMFS. 2007. Environmental impact statement for the Alaska groundfish harvest specifications. January 2007. National Marine Fisheries Service, Alaska Region, P.O. Box 21668, Juneau, Alaska 99802-1668. Available: http://www.alaskafisheries.noaa.gov/index/analyses/analyses.asp.

NMFS. 2010. ESA Section 7 Biological Opinion on the Alaska Groundfish Fisheries. November 2010. NMFS Alaska Region, P.O. Box 21668, Juneau, AK 99802-1668.

NMFS. 2013. Regulatory Impact Review/Initial Regulatory Flexibility Analysis to Amend Regulations for Participants in the Bering Sea/Aleutian Islands Regulatory Areas. Cost Recovery from Amendment 80, Groundfish and Halibut/Sablefish Community Development Quota, American Fisheries Act and Aleutian Islands Pollock Quota Recipients, and the Freezer Longline Coalition. Second Review Draft. Juneau, AK. Available online at http://www.npfmc.org/wp-content/PDFdocuments/MISC/costrecovery913.pdf.

NMFS. 2014a. Alaska Groundfish Harvest Specifications Supplementary Information Report. National Marine Fisheries Service, Alaska Region, Sustainable Fisheries Division, P.O. Box 21668, Juneau, Alaska 99802-1668, January 2014, 32 p. Available at http://alaskafisheries.noaa.gov/analyses/groundfish/041014bsaigoaspecssir.pdf.

NMFS. 2014b. Aleutian Islands Groundfish Fishery Biological Opinion, National Marine Fisheries Service, Alaska Region, P.O. Box 21668, Juneau, Alaska 99802-1668, April 2014. Available: http://alaskafisheries.noaa.gov/protectedresources/stellers/esa/biop/2014/final0414.pdf

NMFS. 2014c. Final Environmental Impact Statement for steller sea lion protection measures for groundfish fisheries in the Bering Sea and Aleutian Islands Management Area, National Marine Fisheries Service, Alaska Region, P.O. Box 21668, Juneau, Alaska 99802-1668, May 2014. Available: http://alaskafisheries.noaa.gov/sustainablefisheries/sslpm/eis/default.htm

NMFS. 2014d. The Pacific Halibut and Sablefish IFQ Report Fishing Year 2012 (Report to the Fleet), National Marine Fisheries Service, Alaska Region, Sustainable Fisheries Division, P.O. Box 21668, Juneau, Alaska 99802-1668, November 2014, 42 p. Available: http://alaskafisheries.noaa.gov/ram/ifq/rtf12.pdf.

NMFS. 2014e. Seabird Bycatch Estimates for Alaskan Groundfish Fisheriess, 2007-2013. December 2014. http://www.afsc.noaa.gov/refm/reem/Seabirds/Seabird%20bycatch%202007%20to%202013_Alaskan%20Gndfish_Dec2014.pdf

NMFS. 2014f. Alaska Groundfish Harvest Specifications. Available online at http://alaskafisheries.noaa.gov/sustainablefisheries/specs14_15/.

NMFS. 2015. Pacific Halibut Discard Mortality Rates for the BSAI. Available online at http://alaskafisheries.noaa.gov/sustainablefisheries/specs14_15/.

NPFMC. 2012. Fishing Fleet Profiles. Anchorage, AK. Available online at http://www.npfmc.org/wp-content/PDFdocuments/resources/FleetProfiles412.pdf.

NPFMC. 2013a. Fishing Fleet Profiles. 2012 Addendum. Anchorage, AK. Available online at http://www.AKFIN.org/wp-content/uploads/2013/09/Fishery_Fleet_Profile2012_Addendum.pdf.

NPFMC. 2013b. Regulatory Impact Review/Initial Regulatory Flexibility Analysis for a Proposed Amendment to the Fishery Management Plan for Bering Sea and Aleutian Islands King and Tanner Crabs. Revising Freezer Longline Gulf of Alaska Pacific Cod Sideboards. Public Review Draft. Anchorage, AK. Available online at http://www.npfmc.org/wp-content/PDFdocuments/catch_shares/Pcod/FLLGOAPcodSideboard613.pdf.

NPFMC [North Pacific Fishery Management Council]. 2014. Stock Assessment and Fishery Evaluation Report for the Groundfish Resources of the Bering Sea/Aleutian Islands Regions. NPFMC. 605 West 4th Ave., Suite 306, Anchorage, Alaska 99501. Available: http://www.npfmc.org/safe-stock-assessment-and-fishery-evaluation-reports/.

Northern Economics, Inc. 2001. Sector and Regional Profiles of the North Pacific Groundfish Fisheries—2001. Prepared for North Pacific Fishery Management Council. Anchorage, AK. Available online at http://www.npfmc.org/wp-content/PDFdocuments/resources/SectorProfiles/NorthernEconomics1.htm.

Northern Economics, 2014. Five- year Review of the Effects of Amendment 80. Prepared for the North Pacific Fishery Management Council. Available online at. http://www.npfmc.org/amendment-80-cooperatives/.

Sadorus, L., R. Lauth, and A. Ranta. 2015. Size and age composition of Pacific halibut in NMFS Bering Sea shelf trawl surveys. IPHC Report of Assessment and Research Activities 2014. Pp 627-633.

Stewart, I. 2014d. Personal Communication via telephone and email between Marcus Hartley (NEI) and Ian Stewart (IPHC) regarding the translation of NMFS 3-digit areas to IPHC subareas and future use of fishery specific ratios for O26 halibut PSC calculations. October, 2014.

Stewart, I.J. 2015a. Overview of the data sources for the Pacific halibut stock assessment and related analyses. IPHC Report of Assessment and Research Activities 2014. p. 87-160.

Stewart, I.J. 2015b. Regulatory area harvest policy calculations and catch tables. IPHC Report of Assessment and Research Activities 2014. p. 195-212.

Stewart, I. J., and S. Martell. 2014. Assessment of the Pacific halibut stock at the end of 2013. IPHC Report of Assessment and Research Activities 2013. p. 169-196.

Stewart, I.J., S.J.D. Martell, B.M. Leaman, R.A. Webster, L.L. Sadorus. 2014a. Report to the North Pacific Fishery Management Council on the status of Pacific halibut in the Bering Sea and Aleutian Islands and the impacts of Prohibited Species Catch. Available: https://npfmc.legistar.com/View.ashx?M=F&ID=3093393&GUID=19570543-A2A1-41D5-B935-3D5D62387BD5

Stewart, I.J., B.M. Leaman, and S.J.D. Martell. 2014b. Accounting for and Managing All Pacific Halibut Removals. Available at: http://iphc.int/documents/research/Total_Mortality_report_final.pdf

Trumble, R.J. 2009. Evaluation of the maintaining the IPHC Closed Area in the Bering Sea. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 2008: 243-248.

Valero, J. L., and R. A. Webster. 2012. Current understanding of Pacific halibut migration patterns. IPHC Report of assessment and research activities 2011. p. 341-380.

Waters, E., et al. 2014. Measuring the multiregional economic contribution of an Alaska fishing fleet with linkages to international markets. Marine Policy. 50:238-248. Available online at http://www.sciencedirect.com/science/article/pii/S0308597X14001778.

Webster, R.A. 2015. Trawl tag releases of small halibut in the Bering Sea. IPHC Report of Assessment and Research Activities 2014. p. 475-510.

Webster, R., & Stewart I. 2013a. Apportionment and Regulatory Area Harvest Calculations. In IPHC Report of Assessment and Research Activities – 2013 (RARA). Available online at http://www.iphc.int/publications/rara/2013/rara2013_13_2013apportionment.pdf.

Webster, R.A. and I.J. Stewart. 2014. Apportionment and regulatory area harvest calculations. IPHC Report of Assessment and Research Activities 2013. p. 197-216.

Wilderbuer, T. K., G. E. Walters, and R. G. Bakkala 1992. Yellowfin sole, *Pleuronectes asper*, of the eastern Bering Sea: biological characteristics, history of exploitation, and management. Marine Fisheries Review 54(4):1-18.

Wilderbuer, T. K., D. G. Nichol, and J. Ianelli. 2014. Assessment of the yellowfin sole stock in the Bering Sea and Aleutian Islands. *In* Stock Assessment and Fishery Evaluation Document for Groundfish Resources in the Bering Sea/Aleutian Islands Region. North Pacific Fishery Management Council, P. O. Box 103136, Anchorage, AK 99510. Available: http://www.afsc.noaa.gov/REFM/Docs/2014/BSAIyfin.pdf

Williams G. 2013a. The Personal Use Harvest of Pacific Halibut through 2013. In IPHC Report of Assessment and Research Activities – 2013 (RARA). Available online at http://www.iphc.int/publications/rara/2013/rara2013_06_2013personaluse.pdf.

Williams G. 2013b. 2013 Halibut Sport Fishery Review. In IPHC Report of Assessment and Research Activities – 2013 (RARA). Available online at http://www.iphc.int/publications/rara/2013/rara2013_06_2013personaluse.pdf.

Williams, G.H. 2015. Retention of U32 halibut in the 2014 Area 4D/4E CDQ halibut fisheries. IPHC Report of Assessment and Research Activities 2014. Pp 61-63.

Appendix A Additional discussion items requested by the Council

In the Council's June 2014 motion, there were several additional items that the Council requested be included in the analytical package for addressing BSAI halibut PSC mortality. These were considered by the Council at initial review in February 2015, and are addressed below as individual discussion items.

- PSC limit for IFQ sablefish: Whether a halibut PSC limit would be appropriate to limit halibut bycatch in the directed sablefish IFQ fishery.
- Biomass-based PSC limits: The range of potential approaches to establishing a halibut PSC limit based on projections of total biomass, projected spawning biomass, or other appropriate indices of abundance and productivity.
- Halibut PSC rollovers: Current protocols for rolling unused halibut between sectors, and the effect of those protocols on the achievement of OY and/or reductions in overall halibut PSC mortality
- Directed halibut fishery: Fishing practices that reduce halibut bycatch in the directed halibut fishery
- Amendment 80 measures: Evaluate the potential for the Amendment 80 flatfish flexibility program to reduce halibut PSC mortality; evaluate the potential of a change to the Amendment 80 trawl season opening date from Jan 20 to Jan 1 to reduce halibut PSC mortality; evaluate the potential of changes to the current Amendment 80 area closures to reduce halibut PSC mortality
- Seasonal apportionment: Evaluate whether seasonal apportionment in the BSAI trawl limited access fishery could reduce halibut PSC mortality
- Halibut deck-sorting on Amendment 80 trawl catcher processors: Discuss progress with developing opportunities for deck sorting of halibut, or other handling practices that may provide an opportunity to reduce mortality of halibut that cannot be avoided.

A.1 PSC limit for IFQ sablefish

History of the halibut PSC limit and the exemption for the IFQ sablefish fishery

In 1994, management agencies and industry representatives raised concerns that current regulations imposed halibut bycatch restrictions on the GOA and BSAI hook-and-line gear fisheries for sablefish that could prevent achievement of important goals of the halibut and sablefish IFQ program: reduced competition within the fleet and a slower paced fishery, with reduced bycatch of undersized fish and prohibited species.

The first halibut and sablefish IFQ fisheries opened March 1995. Although it was acknowledged that halibut bycatch in the sablefish hook-and-line fishery would continue under the IFQ program, overall halibut discard mortality was expected to decrease for two reasons. First, operators of vessels with halibut quota shareholders on board must retain all legal-sized halibut. Second, persons issued sablefish quota share are anticipated to fish in a manner that would optimize revenue for a given amount of quota share. This would mean fishing in prime sablefish fishing grounds at depths where halibut, though uncommon, are predominantly of legal size. Without the IFQ program, the sablefish fishery likely would have continued to be a fast paced fishery with high halibut bycatch rates as fishermen attempted to harvest their sablefish before the hook-and-line fishery for sablefish closed due to reaching a halibut PSC limit. Preventing the need to race for fish was one of the objectives of the IFQ program. In addition, some halibut that would have been counted as PSC in an open access fishery is retained under the IFQ program. The remaining halibut PSC was not likely to be any greater than it was under open access management.

At its April and September 1994 meetings, the Council responded to the above concerns by requesting NMFS to prepare a rule that would: (1) Revise the management of seasonal bycatch allowances in the BSAI nontrawl fisheries, and (2) either exempt the GOA and BSAI sablefish hook-and-line gear fisheries from halibut PSC limits or specify a separate halibut PSC limit for those fisheries during the annual groundfish harvest specification process.

In 1995, NMFS implemented a final rule (43 FR 12149, March 6, 1995) to separately define the BSAI groundfish jig gear fishery and the BSAI sablefish hook-and-line gear fishery under § 675.21(b)(2)(ii) so that these fisheries annually either receive a separate halibut bycatch allowance or are exempted from halibut bycatch restrictions. Since 1995 the Council has recommended that the GOA and BSAI sablefish hook-and-line gear fisheries be exempt from halibut PSC limits. After consulting with the Council, NMFS in the harvest specifications exempts pot gear, jig gear, and the sablefish IFQ hook-and-line gear fishery categories from halibut bycatch restrictions for the following reasons: (1) the pot gear fisheries have low halibut PSC mortality; (2) NMFS estimates halibut mortality for the jig gear fleet to be negligible because of the small size of the fishery and the selectivity of the gear; and (3) the IFQ program requires legal-size halibut to be retained by vessels using hook-and-line gear if a halibut IFQ permit holder or a hired master is aboard and is holding unused halibut IFQ (subpart D of 50 CFR part 679). Most vessels in the jig gear fleet are exempt from observer coverage requirements. As a result, observer data are not available on halibut bycatch in the jig gear fishery. However, as mentioned above, NMFS estimates the jig gear sector will have a negligible amount of halibut PSC mortality because of the selective nature of jig gear and the low mortality rate of halibut caught with jig gear and released.

During the 1995 harvest specifications process the Council reduced the halibut PSC limit for the GOA nontrawl sector, except for demersal shelf rockfish fishery category, to 290 mt from 740 mt in 1994. From 1995 through 2013, 290 mt has been the nontrawl halibut PSC limit and 10 mt has been the demersal shelf rockfish halibut PSC limit. In 2014 the GOA halibut PSC limits were reduced by Amendment 95 (79 FR 9625, February 20, 2014). In the BSAI, the 900 mt halibut PSC limit for the BSAI nontrawl fishery category was not reduced during the 1995 harvest specifications and remains at 900 mt. However, as described above the Council added two fishery categories for nontrawl PSC limit in the BSAI: groundfish jig gear and sablefish hook-and-line gear. In 1998, another change in the BSAI nontrawl halibut PSC limits occurred with the implementation of the multi-species CDQ program. The Council apportioned 67 mt of the 900 mt BSAI nontrawl halibut PSC limit for use by the multi-species CDQ Program. The remaining 833 mt (900 mt minus 67 mt) is further apportioned to the non-trawl fisheries categories as shown in Table 1.

Table 1 Final 2014 and 2015 prohibited species catch allowances for non-trawl fisheries

Non-trawl fisheries	**Catcher/processor (mt)**	**Catcher vessel (mt)**
Pacific cod -Total	760	15
January 1 - June 10	455	10
June 10 - August 15	190	3
August 15 - December 31	115	2
Other non-trawl -Total	58	
May 1 - December 31	58	
Groundfish pot and jig	Exempt	
Sablefish hook-and-line	Exempt	
Total non-trawl PSC mortality	**833**	

Currently, separate halibut bycatch allowances may be established for the BSAI and GOA sablefish hook-and-line gear fisheries under the annual harvest specification process if halibut discard mortality in these fisheries is determined to need further reductions. If the Council determines that a separate halibut PSC limit is necessary for the sablefish hook-and-line fishery category, then the Council will need to decide how to fund the new halibut PSC limit. The Council could chose to add a halibut PSC limit and increase the overall halibut PSC limit of 900 mt. This action would require a regulatory amendment because the current 900 mt non-trawl halibut PSC limit is set in regulations. Also, the Council may recommend reducing the halibut PSC limits of other fishery categories and add a halibut PSC limit for sablefish during the harvest specification process. Currently in the BSAI, the nontrawl halibut PSC limit is apportioned by three fishery categories (A, B, and F listed below) including Pacific cod hook-and-line catcher vessel fishery, Pacific cod hook-and-line catcher/processor, and other nontrawl fisheries. The apportionments for these fishery categories may change during the harvest specifications process, but since 2008 they have remained at 15 mt for CVs and 760 mt for C/Ps. Prior to 2008, the CV and C/P sectors were combined in the Pacific cod fishery category. The other nontrawl fishery category mainly supports the Greenland turbot fishery and has been apportioned 58 mt since 2002. Also, there are three more fisheries categories, (C through E listed below), including sablefish hook-and-line fishery, that are not currently receiving halibut PSC limit apportionments as recommended by the Council and approved by NOAA Fisheries as discussed above.

For purposes of apportioning the nontrawl halibut PSC limit among fisheries, the following fishery categories are specified and defined in terms of round-weight equivalents of those BSAI groundfish species for which a TAC has been specified under § 679.20.

(A) Pacific cod hook-and-line catcher vessel fishery.
(B) Pacific cod hook-and-line catcher/processor fishery.
(C) Sablefish hook-and-line fishery.
(D) Groundfish jig gear fishery.
(E) Groundfish pot gear fishery.
(F) Other nontrawl fisheries. This means fishing for groundfish with nontrawl gear during any weekly reporting period which results in a retained catch of groundfish and does not qualify as any of the fisheries A through E. The main target in this category is the hook-and-line catcher/processor Greenland turbot target.

Table 2 shows that the three nontrawl fisheries categories with halibut PSC limits are not reaching their combined 833 mt halibut PSC limit. Therefore the Council could choose to reduce the halibut PSC limit for one or more of these fisheries categories to fund the halibut PSC limit for the sablefish hook-and-line fishery category.

Table 2 BSAI halibut PSC mortality for non-trawl fishery categories not exempt from halibut PSC limits

Year	Other Non-trawl			Pacific cod hook-and-line C/P			Pacific cod hook-and-line CV			Total		
	PSC	Limit	Remaining	PSC	Limit	Remaining	PSC	Limit	Remaining	PSC	Limit	Remaining
2008	1	58	57	564	760	196	5	15	10	570	833	263
2009	6	58	52	556	760	204	3	15	12	565	833	268
2010	10	58	48	489	760	271	2	15	13	501	833	332
2011	4	58	54	477	760	283	1	15	14	483	833	350
2012	6	58	52	550	760	210	2	15	13	557	833	276
2013	1	58	57	458	760	302	3	15	12	463	833	370
2014*	1	58	57	314	760	446	6	15	9	322	833	511

Source: NOAA, Alaska Region, Catch Accounting System
* 2014 is through October 25, 2014

Retention and regulatory discards in the IFQ sablefish fishery

Participants in the IFQ halibut fishery are prohibited from discarding halibut or sablefish caught with fixed gear from any catcher vessel when any IFQ permit holder on board holds unused halibut or sablefish IFQ for that vessel category and the IFQ regulatory area in which the vessel is operating, unless halibut discarding is required for other reasons such as halibut below the legal size limit (50 CFR 679.7(f)(11)). Regulatory discards during trips where halibut was retained (wastage, in IPHC terminology) were minimal in 2013 and 2014 (372 and 1,477 net weight pounds of halibut mortality, respectively). This same requirement does not apply to the halibut CDQ allocations. In other words, the operator of a vessel using fixed gear to fish on behalf of a CDQ group is not required to retain halibut CDQ if the CDQ group has unused halibut CDQ. If a participant does not have an IFQ permit holder with available IFQ on board, then catch of halibut must be treated as a prohibited species. After allowing for sampling by an observer, (if an observer is on board), catch must be sorted immediately after retrieval of the gear and, halibut must be returned to the sea immediately, with a minimum of injury, regardless of its condition.

Catch accounting for Halibut PSC in the IFQ sablefish fishery

Since 1995 when the sablefish hook-and-line fishery was exempted from halibut PSC limits, NMFS has contined to refine the programming in the Alaska Region's catch accounting system (CAS) to more accurately estimate halibut PSC on sablefish hook-and-line trips. Currently, the CAS assumes that if the catch report (e.g., observer haul information, landing report, or production report) shows retained halibut, then an IFQ permit holder with unused halibut IFQ was on board the vessel. NMFS will use the reported retained halibut to accrue to the IFQ halibut account in the NMFS IFQ database and also will estimate from observer data the amount of halibut discard (i.e., halibut wastage). No estimate of halibut PSC will be calculated. If a catch report shows no retained halibut, then the CAS assumes that no IFQ permit holder with unused IFQ halibut was on board. If there was no retained halibut, then halibut discards will be not be estimated, and instead only halibut PSC will be estimated. Halibut PSC is estimated by using observer data (on observed trips) or using observer data to generate a halibut PSC rate and applying those rates to unobserved trips.

However, there are still some limitations and situations with halibut accounting that make it difficult to determine if IFQ halibut discards or halibut PSC should be estimated. In the CAS, it is not possible to know if an IFQ permit holder with unused halibut IFQ was on board a vessel if no halibut was retained. In addition, the CAS cannot account for halibut PSC on trips during which the vessel had available IFQ and retained halibut during the first part of the trip, but during the second part of the trip the vessel reached its IFQ limit and starting discarding halibut as PSC, nor on trips that span the end of the IFQ season after which halibut IFQ cannot be retained. That being said, NMFS estimated halibut PSC mortality in the sablefish fishery to be 1 mt in 2013, and 8 mt in 2014.

Vessels that participate in both IFQ halibut and sablefish fisheries

Although halibut and sablefish IFQ are allocated to a person and not the vessel, it may be informative to look at the number of vessels that participate in both fisheries. Figure 3.13 from the 2012 Report to the Fleet (NMFS 2014d) shows the numbers of vessels fishing in both the halibut and sablefish IFQ fisheries from 1995 through 2012. Based on this figure the number of vessels with both halibut and sablefish IFQ landings (of the total number of vessels with IFQ landings) has increased from 28 percent in 1995 to 31 percent in 2012. Note, this is a statewide figure; there is far less overlap between sablefish and halibut vessels fishing in the BSAI.

A.2 Biomass-based halibut PSC limits

The Council asked for a discussion of possible methods for establishing biomass-based limits, how each method could work within Council process (e.g., how would the Council initially select a threshold, and how would the limit fluctuate with changing biomass), and the relative pros/cons of switching to biomass-based thresholds. For the February 2015 Council meeting, IPHC staff prepared a discussion paper for the Council (Leaman et al. 2015) which concluded that direct scaling of halibut bycatch limits to available metrics of abundance of halibut does not appear to offer a viable framework for setting PSC limits. The relationships of PSC mortality to direct measures of juvenile or adult abundance are either lacking, or are temporally and spatially inconsistent. The paper suggest that an alternative framework for abundance-based PSC limits could be to use the stock assessment, and its Spawning Potential Ratio framework, as an indirect index of abundance. While the IPHC has been exploring the use of SPR-based total mortality management, this framework has not yet been adopted, and the IPHC is undertaking a Management Strategy Evaluation of this approach which may be informative to the Council's considerations. The other challenge is that the assessment is for the coastwide stock, and the Council would want to index PSC limits specifically for the BSAI. The Council requested further evaluation of this issue, and a further discussion paper is currently scheduled to come before the Council in October 2015.

A.3 Halibut PSC Limit Rollovers

Currently, unused halibut PSC limit allocations to the BSAI trawl limited access sector may be reallocated to the Amendment 80 sector. Since the implementation of the Amendment 80 program in 2008, this has happened in 2010, 2013, and 2014. As stated in § 679.91(f)(2), in the decision for a reallocation from one sector to the other, the Regional Administrator may consider the biological harm to a species or species group, current and historic catches, and PSC use in both the Amendment 80 and BSAI trawl limited access sectors, and harvest capacity and stated intent of both sectors.

The reallocations generally occur later in the year when the remainder of the year's fishing patterns are easier to predict. The Regional Administrator has not reallocated halibut PSC limits if there was any likelihood that the reduced PSC limit would become constraining to the BSAI trawl limited access sector. In 2010 and 2013, the halibut PSC limit reallocations were made in conjunction with other species groups (yellowfin sole and crab PSC limits) that were not likely to be harvested or used by the BSAI trawl limited access sector. In 2014, the halibut PSC limit reallocation was a standalone action. Since halibut PSC and Pacific cod tend to be the most common limiting species for the Amendment 80 sector, halibut PSC is more likely to become limiting when Pacific cod stocks and quotas are large, as they have been in recent years.

When the Regional Administrator decides that a reallocation of halibut PSC limited is warranted, the Regional Administrator will reallocate to the Amendment 80 sector 95% of the amount of halibut PSC limit allocation deducted from the BSAI trawl limited access sector. The remaining 5% of halibut PSC limit allocation will no longer be available to support any directed fisheries. The halibut PSC limit reallocated to the Amendment 80 sector will be further reallocated between the Amendment 80 cooperatives. This will be done in proportion to the Amendment 80 halibut PSC limit allocated to each cooperative for that calendar year.

If the Council were to eliminate the reallocation of the unused halibut PSC limit from BSAI trawl limited access sector to the Amendment 80 sector, the impact would probably vary depending on the amounts of groundfish species allocated each year. In years with lower Pacific cod TAC, halibut PSC has not been overly constraining to the Amendment 80 sector. In these years, the elimination of reallocations would likely not add additional constraints on the sector. However, there has been some recent experimentation with Pacific cod excluders by some of the Amendment 80 catcher/processors. If these Pacific cod excluders prove to be effective, halibut PSC and not Pacific cod may become the primary limiting species for the Amendment 80 sector in most years.

Another factor in halibut PSC use is the size of the annual pollock TACs. In years with large pollock TACs, the flatfish TACs tend to be smaller. Conversely, when pollock TACs are smaller, the 2 million metric ton BSAI TAC limit is not constraining, and flatfish TACs may be larger. Since halibut PSC primarily limits flatfish fishing in the Amendment 80 sector, it is likely that in years of high Pacific cod abundance and low pollock abundance, any reduction in halibut PSC limits available to the Amendment 80 sector will reduce the amount of flatfish that the sector will be able to harvest. Since the quota share allocation of halibut PSC limits is not homogenous across the permits in the Amendment 80 sector, the impact will be different between cooperatives, and among different Amendment 80 companies. Generally, the impact will be more severe to those entities with a higher ratio of flatfish allocations to halibut PSC limits than to those with a lower ratio of flatfish allocations to halibut PSC limits. The Amendment 80 sector usually targets yellowfin sole at the end of the year when halibut PSC rates are lower. However, in some years the halibut PSC rate may be higher and prevent the Amendment 80 sector from fully harvesting their yellowfin sole allocations or other groundfish species that they target at the end of the year.

Currently, the Amendment 80 sector is working on methods to reduce their halibut PSC rates (see Section 0 of this analysis). If these efforts are successful, the impact from eliminating halibut PSC reallocations could be reduced.

A.4 Fishing practices to reduce bycatch (wastage) in the directed halibut fishery

The Council's motion asked for a short discussion of fishing practices that reduce halibut bycatch in the commercial halibut fishery. During testimony at the June 2014 meeting, the Council heard some suggestions from participants in the Area 4 halibut fisheries, such as education to fishermen regarding halibut release methods, and improving safe release mechanisms. This is also a subject area that the IPHC is pursuing. At the IPHC annual meeting in January 2015, there was also discussion about lowering the minimum size limit for the commercial fishery, which would reduce regulatory wastage by allowing fishermen to keep more of the smaller fish that would otherwise be discarded. No action was taken at the 2015 meeting, but IPHC staff is continuing to evaluate this suggestion.

A.5 Amendment 80 measures

In the June 2014 motion, the Council asked for an evaluation of three measures with respect to their potential to reduce halibut PSC mortality– moving the Amendment 80 start date, fleatifsh specifications flexibility, and changes to the current Amendment 80 area closures. These measures are discussed below.

Moving the Amendment 80 start date

The last year that the BSAI and GOA trawl gear groundfish fisheries opened on January 1 was 1991. In 1992, BSAI and GOA trawl gear groundfish fisheries opened on January 20. NMFS implemented this delay in 1992 to assure that trawl groundfish fisheries would open when sea lion protection measures, Amendments 20 and 25, became effective on January 20, 1992 (57 FR 381, January 6, 1992). The purpose of the Steller sea lion protection measures was to minimized potential adverse effects of trawl gear groundfish fisheries on Steller sea lion foraging activity in sensitive habitat areas. Since 1993, BSAI and GOA trawl gear groundfish fisheries have opened January 20 as a method of reducing halibut and salmon bycatch rates under Amendments 19 and 24 (57 FR 39137, August 28, 1992). January 20 was proposed as an opening date by an industry group that represented various components of the trawl fishery.

Reasons for January 20 trawl gear season opening date in 1992

Reduced Halibut and Salmon PSC– The analysis for Amendments 19 and 24 provided some evidence that a delay in the BSAI and GOA trawl gear fisheries opening dates could reduce average halibut and salmon bycatch rates in some groundfish fisheries. In 1990 and 1991, when trawl gear opened on January 1, the highest Chinook salmon PSC rates in the BSAI occurred in the first few weeks of the year. Also, there was substantial bycatch of salmon in the first few weeks of the year in the GOA. At that time there were halibut PSC limit to help decrease halibut PSC, but no salmon PSC limits in the BSAI and GOA to help decrease salmon PSC.

Competition between BSAI and GOA – Another reason for delaying the trawl gear opening date for the GOA until January 20 was to limit competition between the BSAI and GOA fisheries. Concurrent season openings in the BSAI and GOA were needed to decrease the opportunity for vessels that fish principally in the BSAI to also fish in the GOA from January 1 to 20.

Allowed for TAC to be harvested – The analysis for Amendments 19 and 24 considered whether a delay of two to three weeks would have an adverse effect on the fisheries and concluded that total annual catch would not change if the fisheries were delayed. There was sufficient harvesting and processing capacity to allow most TACs to be fully utilized in fisheries that last much less than 12 months. In an open access fishery, each fishing operations has an incentive to begin fishing as soon as possible, even if it is in the best interest of the fleet as a whole to delay the start of a fishery. Therefore, by delaying the start of a fishery to a mutually beneficial date, the Council provided benefits that the fleet would not have otherwise received.

Currently, many of the BSAI trawl vessels are in a catch share program and if the cooperative exceeds its PSC limits it is an enforcement violation. Other BSAI trawl vessels are working together to decrease their halibut and salmon PSC use. As part of this action, the Amendment 80 sector proposed changing their 80 season opening date from January 20 to January 1 to allow for maximum flexibility as discussed below.

Reasons to continue the January 20 trawl gear season opening date

Gear conflict in the Bering Sea – Currently the season for non-trawl gear (hook-and-line, pot, and jig) opens on January 1 in the BSAI and GOA. Several fisheries for Pacific cod using pot gear occur in early January in the same locations where the non-pelagic trawl C/Ps fish after January 20. Over the years there have been anecdotal reports of gear conflict when the fisheries for these gear types overlap. Table 3 shows that in some years the BSAI pot Pacific cod fisheries close before or around January 20, but in some years they remain open longer. In 2014, 45 vessels using pot gear fished between January 1 and 20 and 25 C/Ps using non-pelagic trawl gear (including 10 AFA C/Ps) fished starting January 20. Changing the Amendment 80 season opening date from January 20 to January 1 may exacerbate gear conflicts in areas of the Bering Sea where pot and non-pelagic trawl fisheries occur.

Table 3 BSAI pot gear Pacific cod A season closure dates

Year	CVs greater than 60 ft using pot gear	CP	CVs less than or equal to 60 ft using pot / hook-and-line gear
2014	January 24	January 26	February 4
2013	January 22	January 28	February 7
2012	January 20	January 23	February 17
2011	January 21	January 24	March 8
2010	January 28	February 23	March 25

Fair start for trawl fisheries – Changing the opening date for the Amendment 80 sector would be unfair to the GOA trawl and BSAI trawl limited access sectors because those sectors would still have a January 20 opening date. Changing the season opening date for the Amendment 80 sector may enable the Amendment 80 sector to market their incidental catch of pollock prior to when the AFA sector starts fishing on January 20. Therefore, the AFA sector also would likely ask for a January 1 opening date. At their December 2005 meeting, the Council received a discussion paper about changing the AFA pollock opening date to as early as January 15 and decided not to continue consideration at that time.

Steller sea lion protection measures – Sea lion protection measures implemented under the 2015 final rule (79 FR 70286, November 25, 2014) are intended to minimize potential adverse effects of the groundfish fisheries on sea lion foraging activity in sensitive habitat areas. The measures include closure of areas around specified sea lion rookeries, together with spatial and temporal restrictions. The EIS and Biological Opinion (NMFS 2014c, 2014b) for these protection measures analyzed the opening date of January 20 for Pacific cod, pollock, and Atka mackerel. NMFS Sustainable Fisheries and Protected Resources would consult on the effects of the modified opening date on threatened and endangered species under section 7 of the ESA.

No stand-down between years – Currently, the Amendment 80 sector has at least a 20 day stand down from fishing from the end of the fishing year, December 31, until January 20. A January 1 opening date would allow continuous fishing from the end of one year into the next year. This 20-day stand down may be beneficial to the resource.

Reasons to change the January 20 trawl gear season opening date to January 1

Flexibility – An opening date of January 1 would increase the Amendment 80 sector's flexibility in their fishing seasons. Individual fishing operations have many different reasons for determining their optimal fishing seasons. Also, the Amendment 80 sector operates in cooperatives that are prohibited from exceeding their PSC limits and are continuously trying to lower PSC rates and discards. If a January 1 date allows for further reductions of PSC and discards, then the Council may want to support this date change.

Annual variability of seasonal bycatch rates – It is difficult to identify a January 1 opening date as being clearly preferable in terms of its effects on bycatch. The effects of a January 1 opening date on bycatch will vary from year to year. Therefore, it is difficult to know with any certainty what bycatch by species will be as the result of a specific opening date.

Flatfish specifications flexibility and Amendment 80 closures

With increased flexibility, the Amendment 80 fleet will be better able to respond to constraining halibut PSC limits while optimizing groundfish catch.

Flatfish specifications flexibility, which was implemented in 2015, allows Amendment 80 cooperatives, and CDQ groups, the opportunity to exchange their quota share of one of three species (flathead sole, rock sole, and/or yellowfin sole) for an equivalent amount of another of thre three species, within limits that ensure that neither the ABCs for these species will not be exceeded, nor the BSAI groundfish fishery optimum yield limit of 2 million mt. Under Amendment 105, which is effective as of October 23, 2014, an ABC reserve is specified for the three flatfish species, which will be allocated to CDQ groups and Amendment 80 cooperatives using the same formulas that are used in the annual harvest specifications process. The ABC reserve for each species will be specified by the Council, by evaluating the ABC surplus for the species (i.e., the difference between the ABC and TAC), considering whether the amount needs to be reduced by a discretionary buffer amount based on social, economic, or ecological considerations. The Council will annually designate some, all, or none of the ABC surplus as the ABC reserve.

Although the fleet has not yet had the opportunity to fish under the flatfish flexibility program, the amendment was developed to allow the fleet to maximize flatfish TAC utilization, to the extent that additional constratints in targeting flatfish could be resolved through inseason flexibility in the choice of a flatfish target. The flexibility to exchange quota among target species allows the fleet to shift between targets when unexpected changes occur, including changing environmental and/or market conditions. In the same manner, this tool may be helpful to the Amendment 80 sector in responding to areas of higher halibut interception, by allowing them an opportunity to continue fishing by switching to a different flatfish target.

With respect to the Amendment 80 closures, the fleet is currently constrained by the Red King Crab Savings Area and the *Chinoceates Opilio* Bycatch Limitation Zone (COBLZ) (see Figure 3-17, on page 75), as they are sometimes required to move out of areas that may otherwise have low halibut PSC in order to comply with these regulatory closure areas. These closures were put into effect prior to the implementation of cooperatives for the Amendment 80 sector, in order to protect BSAI crab. Figure 3-18, on page 76, provides the spatial distribution of groundfish catch and halibut PSC by the Amendment 80 fleet. A detailed analysis would be required to evaluate the degree to which adjusting these closures might be effective for halibut PSC reduction, and assessing the degree to which these closures continue to provide protection to crab PSC species. Such an evaluation has not been attempted at this time.

A.6 Seasonal apportionment of halibut PSC limits

Through 2007, BSAI trawl halibut PSC limits were apportioned for all trawl sectors (except CDQ) and were seasonally apportioned for the fishery categories: yellowfin sole (four seasons), rock sole/other flatfish/flathead sole (three seasons), and rockfish (one season; see 2007 example in Table 4). In 2008, with implementation of the Amendment 80 Program, halibut PSC limits for Amendment 80 cooperatives were no longer apportioned by fishery category or season. Rather, the cooperative is apportioned a single halibut PSC limit as a hard cap, the attainment of which shuts down the cooperative from all fishing. Halibut PSC limits continue to be apportioned to the BSAI trawl limited access sector, and the Amendment 80 limited access sector through 2010. Since 2011, all Amendment 80 vessels have joined one of two cooperatives, and there is no Amendment 80 limited access sector.

Table 4 2007 Halibut PSC mortality allowances for the BSAI trawl fisheries

Trawl Fisheries	**BSAI Halibut mortality (mt)**				
	Total	**Seasonal allowances**			
Yellowfin sole	936	Jan 20 - April 1	April 1 - May 21	May 21 - July 1	July 1 - Dec 31
		312	195	49	380
Rock sole/other flat/flathead sole[2]	829		April 1 - July 1		July 1 - Dec 31
			164		167
Turbot/arrowtooth/sablefish[3]	n/a				
Rockfish	69				July 1 - Dec 31
Pacific cod	1,334				
Midwater trawl pollock	n/a				
Pollock/Atka mackerel/other[4]	232				
Total trawl PSC mortality	**3,400**				

[2] "Other flatfish" for PSC monitoring includes all flatfish species, except for halibut (a prohibited species), Greenland turbot, rock sole, yellowfin sole and arrowtooth flounder.
[3] Greenland turbot, arrowtooth flounder, and sablefish fishery category.
[4] Pollock other than pelagic trawl pollock, Atka mackerel, and "other species" fishery category.

Section 679.21(e)(3) requires, after subtraction of PSQ reserves for the CDQ Program, that halibut trawl PSC limit be apportioned between the BSAI trawl limited access sector and Amendment 80 sector. Table

35 to part 679 lists the amount of halibut PSC limit assigned to the BSAI trawl limited access sector as 875 mt and to the Amendment 80 sector as 2,325 mt (reduced from 2,525 mt in 2008 by Amendment 80). Pursuant to § 679.21(e)(1)(iv) and 679.91(d) through (f), trawl halibut PSC limit assigned to the Amendment 80 sector is then sub-allocated to Amendment 80 cooperatives as PSC cooperative quota (CQ) and to the Amendment 80 limited access fishery. The PSC CQ assigned to Amendment 80 cooperatives is not allocated to specific fishery categories. However, § 679.21(e)(3)(i)(B) requires the apportionment of each trawl PSC limit to the BSAI trawl limited access and Amendment 80 limited access into PSC limits for seven specified fishery categories. As discussed above, since 2011 all Amendment 80 vessels have joined a cooperative, so there has been no Amendment 80 limited access sector.

The BSAI trawl fishery categories are:

1. Yellowfin sole
2. Rock sole/other flatfish/flathead sole (other flatfish for PSC monitoring includes all flatfish species, except for halibut (a prohibited species), Greenland turbot, rock sole, yellowfin sole, arrowtooth flounder, and Kamchatka flounder
3. Greenland turbot/arrowtooth flounder/sablefish (includes Kamchatka flounder)
4. Rockfish
5. Pacific cod
6. Midwater trawl pollock
7. Pollock/Atka mackerel/other species

The BSAI trawl limited access sector does not receive apportionments of the 875 mt halibut PSC limit for the rock sole/flathead sole/other flatfish or Greenland turbot/arrowtooth flounder/sablefish fisheries categories for several reasons. First, the sector does not receive allocations of rock sole and flathead sole groundfish under the Amendment 80 Program. Therefore, no halibut PSC limit needs to support directed fisheries for these two species. Second, the sector does not target Alaska plaice, other flatfish, Greenland turbot, arrowtooth flounder, Kamchatka flounder, or sablefish. (For trawl PSC accounting, Kamchatka flounder is in the Greenland turbot/arrowtooth flounder/sablefish category and Alaska plaice is in the rock sole/flathead sole/other flatfish category.) The BSAI trawl limited access sector includes a large portion of American Fisheries Act (AFA) vessels which are managed under AFA sideboard limits. Most of the sideboard limits for these species are not large enough to support directed fisheries and directed fishing is closed. All 16 trawl C/Ps fishing in the BSAI trawl limited access sector are AFA vessels and have sideboard limits for these groundfish species. From 2008 through 2014, the average number of trawl CVs fishing in the BSAI was 106, with 93 AFA CVs and 13 non-AFA CVs. Other reasons that the non-AFA vessels may choose to not target these species is the difficulty in locating trawlable amounts, the amount of halibut PSC needed to prosecute the target fishery, or the lack of a market. However, if this sector ever was allowed and chose to target these fisheries then during the harvest specifications process the Council could recommend halibut and crab PSC limits for the appropriate fishery category.

The BSAI trawl limited access sector does receive apportionments of the 875 mt halibut PSC limit to the rockfish, Pacific cod, pollock/Atka mackerel/other species, and yellowfin sole fisheries categories. For 2008 and 2009, the BSAI trawl limited access sector’s halibut PSC limits had no seasonal apportionments. From 2010 through 2014, the rockfish fishery category has had one halibut PSC limit seasonal allowance of 5 mt from April 15 through December 31. This allows the directed fishery for rockfish to open at noon, Alaska local time, April 15 when the halibut PSC limit becomes available. The Council recommended this seasonal allowance after public testimony from the BSAI trawl limited access sector participants that target Pacific ocean perch (POP) in the Aleutian Islands. The start date of April 15 allows for a fair start by all participants since the BSAI trawl limited access sector’s POP fishery is still prosecuted under a race for fish by a few vessels. Unless the BSAI trawl limited access sector’s allocation of POP was further allocated by vessel or there were other changes to the BSAI rockfish fisheries it is expected that the halibut PSC limit for the rockfish fishery category will continue to have a seasonal allowance for April 15 through December 31. No other fishery category has a season allowance of the halibut PSC limit.

The BSAI trawl limited access sector has allocations of Atka mackerel, Pacific cod, and pollock. These groundfish species, Atka mackerel, Pacific cod, and pollock, all have season allowances of their TACs for all trawl sectors (Table 5). The seasons were developed for Steller sea lion protections measures and these seasonal allowances control when the TAC for species are caught. Therefore, it may not be necessary to have an additional seasonal apportionment of the halibut PSC limit.

Table 5 BSAI groundfish species with seasonal allowances

Species	Season dates and proportional allowances[1]					
	A season		B season		C season	
Atka mackerel	Jan 20 – June 10	50%	June 10 – Dec 31	50%	n/a	
Pacific cod						
Catcher vessels	Jan 20 – April 1	74%	April 1 – Sep 1	11%	Sep 1 – Nov 1	15%
Catcher processors	Jan 20 – April 1	75%	April 1 – Sep 1	25%	Sep 1 – Nov 1	0
Amendment 80 and CDQ	Jan 20 – Dec 31	100%	n/a		n/a	
Pollock	Jan 20 – June 10	40%	June 10 – Dec 31	60%	n/a	

[1]In 2015, season dates changed with implementation of the revised Steller sea lion protection measures for Atka mackerel to December 31 and Pacific cod for CDQ and Amendment 80 to December 31.

The fishery category "other species" includes skates, sculpins, sharks, squids, and octopuses. These "other species" are not open for directed fishing for any gear type. Therefore, no halibut PSC limit is needed to support an "other species" directed fishery.

Yellowfin sole is the only species with a BSAI trawl limited access sector allocation, developed directed fishery, and no seasonal allocation of the TAC. Yellowfin sole is not one of the primary prey species for Steller sea lions and no protection measure to spatially and temporally distribute the catch of yellowfin sole have been developed. From 2008 through 2011, yellowfin sole was reallocated to the Amendment 80 cooperative(s) as the BSAI trawl limit access sector did not catch its allocation of the TAC, see Table 6. Since 2013, the BSAI trawl limited access sector has caught its full allocation of the yellowfin sole TAC. In 2013, the sector was closed due to reaching its yellowfin sole TAC allocation. In 2014, the halibut PSC limit was a limiting factor. The BSAI trawl limited access sector was projected reached the halibut PSC limit assigned to the yellowfin sole fishery category and directed fishing closed on May 18, 2014. At their June 2014 meeting, the Council recommended and NMFS approved, a reallocation of the BSAI trawl limited access sector's halibut PSC limits. This increased the yellowfin sole halibut PSC limit from 167 mt to 227 mt, and NMFS opened directed fishing for BSAI yellowfin sole by the BSAI trawl limited access sector on June 25, 2014. See Section 4 for explanation of the reallocation of BSAI trawl limited access sector halibut PSC limits.

Table 6 BSAI trawl limited access sector yellowfin sole in the yellowfin sole target by year

Year	Initial allocation	Reallocation	Final Allocation	Total Catch	% Caught	# of Vessels
2008	44,512	(6,000)	38,512	19,382	50	15
2009	39,514	(6,000)	33,154	10,394	31	9
2010	42,369	(20,000)	22,369	19,485	87	9
2011	34,153	(2,000)	32,153	25,375	79	12
2012	36,297	-	36,297	28,501	79	15
2013	34,868	-	34,868	34,786	100	13
2014	29,707	-	29,707	26,952	91	13

Source: Alaska Region Catch Accounting System. 2014 catch is as of November 24, 2014.

Section 679.21(e)(5) authorizes NMFS, after consultation with the Council, to establish seasonal apportionments of PSC amounts in order to maximize the ability of the fleet to harvest the available groundfish TAC and to minimize bycatch. The factors to be considered are:

(1) seasonal distribution of prohibited species,
(2) seasonal distribution of target groundfish species,
(3) PSC bycatch needs on a seasonal basis relevant to prohibited species biomass,
(4) expected variations in bycatch rates throughout the year,
(5) expected start of fishing effort, and
(6) economic effects of seasonal PSC apportionments on industry sectors.

The BSAI trawl limited access sector's yellowfin sole fishery category may benefit from a seasonal allowance of the halibut PSC limit. The six factors listed above are further discussed below. See Section 3.1.1 for information on factor 1, the seasonal distribution of Pacific halibut.

For factor 2 above, the 2014 SAFE report provides some information on the seasonal distribution of yellowfin sole. The yellowfin sole (*Limanda aspera*) is one of the most abundant flatfish species in the eastern Bering Sea (EBS) and is the target of the largest flatfish fishery in the world. They inhabit the EBS shelf and are considered one stock. Abundance in the Aleutian Islands region is negligible. Yellowfin sole are distributed in North American waters from off British Columbia, Canada, to the Chukchi Sea and south along the Asian coast to off the South Korean coast in the Sea of Japan. Adults exhibit a benthic lifestyle and occupy separate winter, spawning and summertime feeding distributions on the eastern Bering Sea shelf. From over-winter grounds near the shelf margins, adults begin a migration onto the inner shelf in April or early May each year for spawning and feeding. The directed fishery has typically occurred from late winter through autumn (Wilderbuer et al. 1992). Yellowfin sole are managed as a single stock in the BSAI management area as there is presently no evidence of stock structure (Wilderbuer et al. 2014).

Table 7 shows the total catch of yellowfin sole by season if there was an A season and B season allocation. From 2008 through 2010 for this sector as the yellowfin sole total catch increases so does the catch in the B season.

Table 7 BSAI trawl limited access yellowfin sole total catch in the yellowfin sole target by season (catch is in metric tons)

Year	A season[1]		B season[1]		Total
	Total catch	Percent of Total	Total catch	Percent of Total	
2008	17,022	88	2,360	12	19,382
2009	9,824	95	570	5	10,394
2010	19,485	100	-	0	19,485
2011	17,740	70	7,635	30	25,375
2012	16,697	59	11,804	41	28,501
2013	29,090	84	5,696	16	34,786
2014	17,084	63	9,868	37	26,952

[1]A season is January 20 to June 10, B season is June 10 to December 31.
Source: Alaska Region Catch Accounting System. 2014 catch is through November 24, 2014.

For items 3 and 4 in the list above, Table 8 shows that halibut PSC can vary from year to year and season to season.

Table 8 BSAI Trawl Limited Access halibut PSC mortality in the yellowfin sole target by season (in metric tons)

Year	A season[1]		B season[1]		Total
	PSC mortality	Percent of Total	PSC mortality	Percent of Total	
2008	116	75	39	25	155
2009	95	96	4	4	99
2010	27	100	-	0	27
2011	24	30	57	70	81
2012	40	28	103	72	143
2013	127	69	58	31	185
2014	150	84	29	16	179

[1]A season is January 20 to June 10, B season is June 10 to December 31.
Source: Alaska Region Catch Accounting System. 2014 catch is through October 25, 2014.

For item 5 above, Table 9 shows for the BSAI trawl limit access sector that the first week of yellowfin sole catch is the first week that trawl gear opens (January 20), and the last week of yellowfin sole catch varies from year to year. However, from 2011 through 2013, the catch has continued into November and December.

Table 9 BSAI trawl limited access timing of yellowfin sole catch in the yellowfin sole target

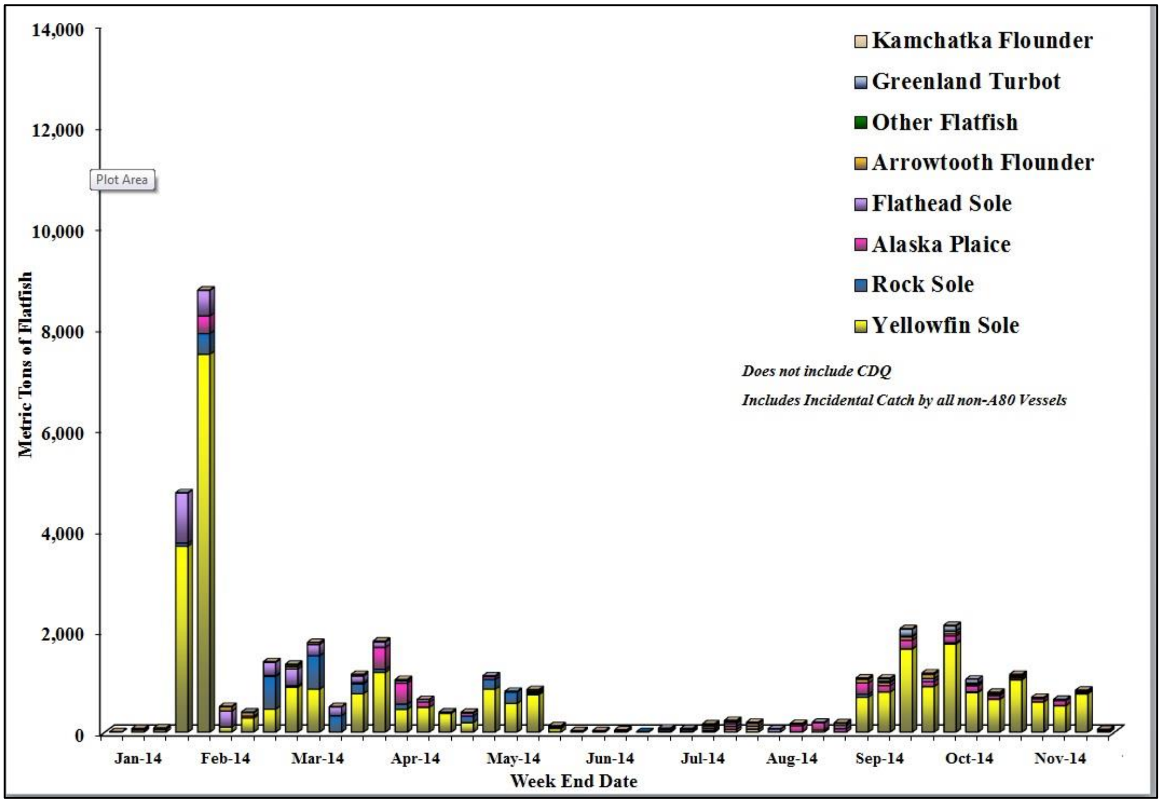
Year	First week of catch	Last week of catch	# of days
2008	26-Jan-08	29-Nov-08	308
2009	24-Jan-09	29-Aug-09	217
2010	23-Jan-10	20-Mar-10	56
2011	22-Jan-11	26-Nov-11	308
2012	21-Jan-12	01-Dec-12	315
2013	26-Jan-13	16-Nov-13	294
2014	25-Jan-14	n/a	n/a

Source: Alaska Region Catch Accounting System

As shown in Figure 1, the non-Amendment 80 sector catches most of the yellowfin sole at the start of the A season and after the B season for pollock. The figure includes all non-Amendment 80 yellowfin sole by all gear and targets, for confidentiality reasons.

For factor 6, the economic effects of seasonal PSC apportionments on the BSAI trawl limited access sector may not be too large since most of the yellowfin sole is caught early in the A season, and the sector does not target yellowfin sole from June through August.

Figure 1 BSAI flatfish catch by non-Amendment 80 vessels in 2014



A.7 Halibut Deck Sorting

The Alaska Seafood Cooperative (AKSC) operates under Amendment 80 to the BSAI FMP. Amendment 80 allocates target species allowances and prohibited species catch limits to cooperatives. Regulations on PSC, and particularly the halibut PSC limits, have traditionally constrained yields in flatfish fisheries and other non-pollock Bering Sea trawl fisheries. The potential for halibut PSC mortality to limit the Amendment 80 sector increased to some extent with the program's implementation because the halibut PSC mortality available to the sector was reduced by 50 mt per year over a four-year period. One goal of the AKSC is to minimize prohibited species bycatch through research collaborations on gear modification and bycatch reduction programs so that available yields of target fish can be maximized.

Cooperative members have been using two approaches to reduce halibut bycatch rates. First, all member vessels participate in the co-op's bycatch avoidance program. Second, AKSC members have developed gear modifications to flatfish nets called halibut "excluders" that use sorting grates installed in the trawl intermediate to allow halibut to escape while retaining a high fraction of the target flatfish. Although significant progress has been made to control halibut bycatch with excluders, the AKSC is seeking methods to further reduce halibut bycatch and halibut mortality.

In addition to gear modifications to avoid halibut bycatch, modifications to fishing practices such as reducing haul sizes and tow times may improve the viability of halibut that are caught; however, changes to fishing practices alone would not result in improvements to halibut mortality rates; regulatory changes would also be required. One of the key factors affecting halibut viability is the amount of time the fish spend out of water prior to being sampled by observers and returned to the sea. Current catch handling regulations for Amendment 80 fisheries require that all halibut be delivered to the factory for sampling by an observer. While these procedures are currently needed to ensure that all catch is accounted for, the downside is that some halibut remain out of the water for up to several hours and consequently suffer higher mortality rates. Any viability gains from reducing haul sizes and tow times are lost by the time observers sample and discard halibut. Changes to fishing practices combined with modified catch handling regulations are necessary to make meaningful, cost-effective improvements in halibut bycatch survival.

Industry has suggested that if halibut could be sorted on deck and returned to the sea sooner, discard mortality rates could be reduced. Two exempted fishing permits (EFPs)[67] have been issued, and research under those permits has been completed to evaluate how modified fishing practices and deck sorting might be combined to reduce halibut PSC mortality. The AKSC is developing a third EFP proposal to build upon what has been learned from the first two. A summary of the two previous EFPs follows.

2009 Exempted Fishing Permit (#09-02)

In May 2009, the AKSC conducted a pilot study under EFP #09-02 to evaluate a set of alternative fishing practices in combination with changes in trawl catcher processor catch handling procedures to help the industry learn about both the operational feasibility of these modifications and their effectiveness for minimizing halibut PSC mortality. The 2009 EFP focused on a discrete set of summer fisheries considered to have the highest chances of success due to favorable weather conditions, ability to work with relatively small catch amounts per haul, and other operational factors. In this study, an average mortality rate of 45% was achieved for halibut sorted on deck, compared to the published mortality rates of approximately 75-80% in the factory for the fisheries that were the subject of this study. The 2009 EFP recommended that further research should explore a broader range of target fisheries, seasonal weather conditions, and vessel sizes to obtain a more realistic assessment of the feasibility of the alternative fishing practices and procedures for sorting and accounting for halibut on deck.

The final report for EFP #09-02 (Gauvin 2010) is available on the NMFS website at http://alaskafisheries.noaa.gov/ram/efp.htm.

2012 Exempted Fishing Permit (#12-01)

EFP #12-01 expanded upon EFP #09-02 to explore the feasibility of deck sorting of halibut. The 2012 EFP tested a wider subset of Amendment 80 fisheries, vessel sizes, and weather conditions over a longer time span, and sought to develop an improved and more efficient sampling protocol. One out of five deck-sorted halibut were randomly selected for length and viability assessment instead of the census approach used in 2009. The 2009 census approach was suspected to have upwardly biased mortality rates on some tows in the 2009 EFP. Primary target fisheries tested in this EFP included yellowfin sole (in “fall” fishing mode), arrowtooth flounder, flathead sole, and rock sole, and to a lesser extent, Pacific cod, bottom pollock, and rex sole. The “fall mode” yellowfin sole fishery tends to catch more and larger halibut than the spring fishery. The bottom pollock fishery is a non-pelagic trawl fishery with a mixed catch composition, primarily pollock.

Results from EFP#12-01 showed that across all vessels and target fisheries, more than 80% of the halibut were sorted out of the catch on deck (less than 20% had to be sorted in the factory). The average halibut mortality rate for the deck-sorted halibut was approximately 57%, higher than in 2009. This increase may be the result of testing deck sorting procedures over a wider variety of fisheries with larger hauls and higher rates of halibut bycatch than those tested in 2009. Halibut mortality was shown to increase with

[67] An exempted fishing permit is a permit issued by the Alaska Region of NMFS to allow groundfish fishing activities that would otherwise be prohibited under regulations for groundfish fishing. These permits are issued for limited experimental purposes to support projects that could benefit the groundfish fisheries and the environment. Examples of past projects supported by an EFP include the development of new gear types for an underutilized fishery and development of devices that reduce prohibited species bycatch.

time out of water, with 20-30 minutes being the critical time window for effective mortality reduction. The sampling protocols implemented in this EFP reduced handling times relative to the 2009 EFP.

The general consensus from interviewed skippers and vessel personnel was that halibut deck sorting to reduce mortality would be more practical in fisheries with relatively smaller haul sizes (≤ 30 mt) and where larger, hence easier to sort, halibut are encountered. Deck sorting in high volume fisheries with high halibut bycatch (e.g., rock sole) could be feasible and likely beneficial with some modifications to the EFP protocols. Deck sorting in high volume fisheries with low bycatch (e.g., yellowfin sole) would not likely be worthwhile because the large amount of effort and personnel required for deck sorting would yield only small savings of halibut PSC mortality. Interviewees also noted that harsh weather conditions could restrict the on-deck duties of sea samplers or observers to quantify and assess deck-sorted halibut. This would negatively affect fishing operations.

Results from the 2012 EFP identified several priority areas where further research is needed:

(1) Focus deck sorting efforts on lower catch rate fisheries (e.g., flathead sole, bottom pollock, Pacific cod, arrowtooth flounder, rex sole);
(2) Explore how deck sorting could be allowed in the higher catch rate target fisheries (e.g., rock sole and possibly yellowfin sole), while simultaneously allowing fish to be passed over the factory flow scale to speed processing;
(3) Consider ways to allow deck sorting during the critical time window for any Amendment 80 fisheries in which halibut PSC mortality is constraining, by applying a separate halibut mortality rate to halibut sorted on deck and a default IPHC rate to those accounted for in the factory;
(4) Design vessel decks for future rebuilds that allow for better catch accounting and reduced handling of deck-sorted halibut while providing more sheltered areas and safer deck conditions for observers; and
(5) Develop electronic monitoring (EM) technology to quantify deck-sorted halibut within the critical time window to reduce the need for sea samplers and observers on deck. EM could also be used in the factory to ensure that halibut are not discarded while the observer or sea sampler is performing on-deck duties.

The final report for EFP #12-01 (Gauvin 2014) is available on the NMFS website at http://alaskafisheries.noaa.gov/ram/efp.htm.

2016 Exempted Fishing Permit

In June 2014, the Council requested as part of this EA/RIR/IRFA the analysis of an alternative for implementing management measures that would allow deck sorting of halibut for Amendment 80 sector to reduce halibut mortality. In October 2014, the Council received an update from NMFS and Amendment 80 sector representatives indicating that further research is needed before management measures can be developed that would allow deck sorting of halibut to occur with sufficient accountability. To wait for the results of this research for inclusion as an alternative in this analysis would likely delay the implementation of any of the other alternatives for PSC mortality reductions. The Council acknowledged that a new EFP that builds upon the results of EFPs #09-02 and 12-01 to further explore deck sorting may be necessary and that this alternative should be considered in a separate action. The following section summarizes progress in development of a new EFP, and the objectives for that proposed study.

The purpose of a new EFP would be to refine appropriate sampling protocols and monitoring requirements, evaluate the durability of the technology over two years of fishing, and test whether and in which fisheries the deck sorting protocol would be preferentially used by vessels. The AKSC is working with NMFS to develop another EFP to conduct an operational test of motion-compensated scales and electronic monitoring on the decks of multiple Amendment 80 vessels. To date, AKSC has conducted proof of concept testing using both a stereo camera and motion-compensated scale, in addition to their previous EFPs discussed above. The AKSC expects to present its EFP application to the Council by June 2015 and fishing under the EFP would commence in 2016.

The EFP would allow participating vessels to be exempted from having to use the single fish handling protocol available to Amendment 80 vessels currently. No additional halibut PSC mortality allowance would be requested for this EFP. Previous studies indicate that fishing under the EFP will result in immediate savings of halibut PSC mortality. The exemption and other aspects of the EFP would allow participants to have the option of handling halibut under an alternative fish handling protocol designed to accurately account for the halibut catch and its viability while rapidly returning halibut sorted on deck to the sea so as to minimize mortality. All participating EFP vessels would have a sea sampler meeting the requirements of the EFP on board whenever EFP catch handling procedures are occurring. The principle duties for the sea sampler would be halibut mortality accounting and viability sampling based on a random sampling design that provides adequate information about viability relative to the default rate used to account for halibut mortality usage during the EFP. Additionally, all participating vessels would be required to have 1) an approved motion-compensated conveyor scale, and 2) an approved deck monitoring video system in operation whenever EFP catch handing activities are occurring. The EFP shall occur over a two-year period with periodic reporting of results to NMFS and the Council during that time to assess whether the EFP is accomplishing its objectives. A default halibut mortality rate would be used to strike a balance between incentivizing fishermen to minimize halibut mortality and leaving a portion of those savings “in the water” as part of the Council’s efforts to improve management of halibut PSC mortality in groundfish fisheries of the Bering Sea.

2015 Expedited Exempted Fishing Permit

At the December 2014 Council meeting, in response to the IPHC staff recommendations for a very low directed halibut fishery in Area 4CDE because of high bycatch in the BSAI groundfish fisheries in that area, industry informed the Council that they intended to apply for an expedited EFP that would be operable in 2015, in order to reduce halibut mortality from groundfish fisheries in 2015. In order to put a program on the water as expeditiously as possible, industry members proposed to mimic the procedures used in the 2012 halibut deck sorting EFP, which used on deck sea samplers, as this methodology has already been reviewed by the agency, and would likely result in a quicker approval process. On December 24, 2014, NMFS received an application from Mr John Gauvin on behalf of the Alaska Seafood Cooperative (AKSC) for an exempted fishing permit. The EFP would allow operators of non-pelagic trawl CP vessels to sort halibut on deck rather than routing halibut over the flow scale and below deck. The purpose of the experiment is to continue to test methods that reduce halibut mortality in fisheries for flatfish by reducing the amount of halibut handling and time out of water. The goal of the EFP is to reduce mortality of halibut bycatch in the Amendment 80 sector in 2015**.**

On January 12, 2015, the AFSC found the EFP application constitutes a valid fishing experiment appropriate for further consideration. The objectives for the EFP are to: (1) assess the reduction in halibut mortality when deck sorting is available as an optional catch handling procedure; (2) evaluate the frequency of tows where deck sorting is used relative to the existing catch handling procedures; (3) evaluate the percentage of a participating vessel’s halibut catch that is sorted on deck; and (4) evaluate the utility of deck sorting in the context of the rules and constraints of the FEP. The EFP would exempt participating AKSC CPs from selected prohibitions and monitoring and observer requirements otherwise in regulation for Amendment 80 fisheries. The EFP was issued in March 2015, and will continue until the end of 2015.

Appendix B Mitigation of PSC Reduction Impacts

Prepared by National Marine Fisheries Service, Alaska Region

Table of Contents

B.1 Overview

This Appendix assesses several methods to estimate the potential for participants in the Amendment 80 sector, trawl limited access fishery, and hook-and-line catcher processor sector to modify actions onboard their vessels to mitigate the impact of proposed reductions in halibut PSC limits. This Appendix analyzes specific patterns of halibut PSC rates by vessel, by target fishery, and by area using observer data gathered on a haul-by-haul basis. This Appendix notes that the lack of complete haul-by-haul data in the trawl limited access fishery limits the use of this particular method in that sector. This Appendix is focused on halibut PSC rates in fisheries operating in the Bering Sea (Approximately equivalent to IPHC Areas 4A, and 4CDE) and not the Aleutian Islands (Area 4B) given the substantially greater harvest, and overall greater amount of halibut PSC and higher PSC rates in the Bering Sea. This Appendix is also focused on comparing halibut PSC rates as measured in total halibut PSC usage, and not mortality (unless otherwise stated) given the complexities of assigning a specific halibut mortality to the range of fisheries over the years considered in this analysis.

This Appendix notes that there are patterns of halibut PSC rates that suggest that participants in these fisheries, primarily the Amendment 80 sector, could reduce halibut PSC use by applying several modifications in fisheries operations. First, this Appendix suggests that applying more stringent standards for moving, or otherwise changing fisheries operations, when relatively high halibut PSC rates are observed in immediately preceding hauls could reduce halibut PSC rates overall. Second, observer data suggest that the Amendment 80 sector could reduce halibut PSC rates by limiting harvests of arrowtooth flounder and the flathead sole, which have higher halibut PSC rates relative to other fisheries. Third, this Appendix indicates that there is a pattern of relatively higher halibut PSC rates in the Amendment 80, trawl limited access fishery, and hook-and-line catcher processor sector at the end of the year. This suggests an additional area where operational improvements could be made. Finally, this Appendix describes the geographic distribution of areas where a higher proportion of the hauls have halibut PSC rates that exceed specific threshold levels. These data suggest that operations that avoid specific areas, some corresponding to particular fisheries, could limit halibut PSC rates relative to others.

This Appendix notes that there are several challenges in quantifying the amount of halibut PSC savings that could accrue from adopting, or more fully implementing a number of the suggestions contained herein. This is due to the complex nature of the fisheries that could offset or limit potential responses of the fleet, and the lack of certainty about the potential responses of specific participants in these fisheries. Nevertheless, the potential mitigating management responses described in this Appendix could be practically implemented and are likely to offset some, but not all, of the adverse impacts of halibut PSC reductions in these sectors. Even without precise quantifiable data, it is reasonable to conclude that these management responses would be most likely to mitigate the effects of halibut PSC reductions at lower levels of halibut PSC reductions with potentially limited impacts on overall groundfish harvests.

B.2 Amendment 80

Vessel operators typically change how they operate as they seek to maximize profits under new constraints. As noted in earlier sections of this analysis, Amendment 80 vessel operators were able to alter their catch composition and PSC through changes in behavior after implementation of Amendment 80 in 2008. These changes allowed these vessels to maximize target species catch without reaching their halibut PSC limits. However, it is important to note that since implementation of Amendment 80, halibut PSC limits were not always a primary constraint to these vessel operators. Pacific cod allocations may also be constraining, as well as other market conditions, or other operational factors that could serve to limit the ability or need for vessel operators to consider halibut PSC rates in the operational decisions. These factors are addressed briefly here and are also noted in other sections of this analysis. However, certain fishing behaviors may be able to be modified to maximize halibut PSC avoidance and mitigate the impacts of potential halibut PSC limit reductions. The potential mitigating impact of these changes in fishing behavior may vary from year to year due to factors that may be unique to that vessel operation, suite of target species, area, and time of fishing activities.

Formal programs or simulation models allowing analysts to project these changes are not available. Therefore, analysts have approached this issue qualitatively, by reviewing historic data and successful PSC avoidance tactics that have been adopted by operators in the past. This allowed analysts to identify areas for improvement in halibut PSC avoidance. Analysts are unable to precisely quantify the extent to which these changes may offset groundfish losses and are unable to estimate the cost of implementing these changes.

While this section is focused on the Amendment 80 vessels in the Bering Sea, similar halibut PSC avoidance improvements could be adopted by other vessels (e.g., trawl limited access fishery). These improvements focus on using tools and information already available to vessel operators. These improvements include avoidance of high PSC rates through reaction to very high rates, avoiding certain areas, and using flatfish flexibility to maximize PSC reduction.

B.2.1 Halibut PSC Rates and High PSC Rate Avoidance

Determining a high PSC rate is somewhat arbitrary and is influenced by many factors. The temporal and spatial scale of the halibut PSC rate being evaluated influences whether that halibut PSC rate is considered high. In this analysis, halibut PSC rates were calculated at the individual haul level as this is the information that is readily available to vessel operators.

Because Amendment 80 cooperative halibut PSC limits are not allocated to specific fishery categories, this analysis designates a halibut PSC rate as “high” in relation to all fishing by Amendment 80 vessels in the Bering Sea on an annual basis. Percentile ranks were calculated for each year for all hauls in the Bering Sea by Amendment 80 vessels from 2008 through 2014. Because this analysis is focused on the operation of Amendment 80 vessels, this analysis combines hauls that were made under Amendment 80 sector allocations, as well as hauls made by Amendment 80 vessels harvesting allocations made to the CDQ Program. Overall, this combination of hauls is not expected to unduly affect this analysis because Amendment 80 vessels fishing under the Amendment 80 Program and the CDQ Program are operating in the same locations and times of years. Moreover, even if there are differences in halibut PSC rates between these two programs, the overall allocation to the CDQ Program represents only a small proportion of total hauls made by Amendment 80 vessels (approximately only 5.4% of the total hauls made by Amendment 80 vessels on an annual basis during the period examined 2008 through 2014). Therefore, even if there are slight differences between halibut PSC rates for vessels operating in the Amendment 80 Program or the CDQ Program, the effect of differences in the rates of those hauls is minimal on the overall sample.

Table 1 shows the halibut PSC rate, represented as kilogram (kg) of halibut per metric ton (mt) of groundfish in the Bering Sea for Amendment 80 vessels with the hauls associated with various percentile ranks. A rate of 10 kg/mt is equivalent to a halibut catch rate of 1%. As noted earlier, these are estimates of halibut bycatch and do not include mortality.

Table 1 Percentile Ranks of Amendment 80 Bering Sea Halibut PSC Rates (kg/mt) from 2008 to 2014

	2008	2009	2010	2011	2012	2013	2014	2011-2014
75th	14.61	17.20	17.01	9.88	11.75	12.87	12.83	12.04
76th	15.69	18.41	17.91	10.80	12.71	13.74	13.55	12.79
77th	16.82	19.37	18.82	11.56	13.71	14.57	14.20	13.67
78th	18.09	20.48	19.96	12.55	14.55	15.50	14.90	14.48
79th	19.32	21.72	21.19	13.45	15.74	16.60	15.59	15.40
80th	20.54	23.08	22.49	14.56	16.84	17.69	16.48	16.44
81st	21.85	24.35	23.83	15.59	17.99	18.72	17.52	17.57
82nd	23.56	25.89	25.23	16.90	19.12	19.86	18.52	18.68
83rd	25.28	27.45	27.04	18.17	20.37	21.21	19.71	19.89
84th	27.10	29.12	28.42	19.53	22.04	22.68	20.75	21.18
85th	29.10	30.77	30.20	20.93	23.90	24.14	21.96	22.65
86th	31.03	32.70	32.02	22.55	25.59	25.74	23.10	24.34
87th	33.52	34.84	34.54	24.73	27.44	27.43	24.67	25.97
88th	36.09	37.39	37.02	26.67	29.58	29.49	25.99	27.78
89th	39.02	40.25	39.36	28.89	32.27	31.80	27.77	29.93
90th	**41.91**	**43.82**	**42.26**	**31.45**	**35.02**	**34.08**	**29.50**	**32.41**
91st	46.25	47.95	45.97	34.48	38.27	36.47	31.80	34.99
92nd	50.90	51.52	50.74	38.29	42.19	39.79	34.19	38.33
93rd	55.70	55.72	55.82	43.08	46.88	43.63	37.41	42.21
94th	62.91	61.47	61.45	48.59	52.46	48.97	40.71	47.21
95th	71.68	69.24	70.45	54.55	59.50	55.19	45.13	53.02
96th	82.39	81.59	80.08	63.38	67.39	62.33	50.60	60.76
97th	96.30	96.80	96.64	74.43	80.32	72.01	59.54	70.84
98th	117.19	122.80	118.75	95.05	99.90	87.03	73.21	87.69
99th	160.84	174.09	175.48	134.26	137.79	125.74	100.73	125.66

As Table 1 shows, there is some annual variation of halibut PSC rates (i.e., a halibut rate representing the 95th percentile of all halibut PSC rates in the Amendment 80 sector can vary from year to year), but rates at different percentile ranks are generally similar in years after 2011. Higher halibut PSC rates prior to 2011 is likely due to differential management in the sector. Prior to 2011, some vessels operated in the Amendment 80 limited access sector and not in a cooperative. Previous research has indicated that the vessels that belong to an Amendment 80 cooperative have lower PSC rates than those that do not (Abbott et al. 2015). A notable exception to the trend in halibut PSC rates, is the substantial decline in rates in 2014 at higher percentiles relative to previous years. This could be due to a range of factors that the analysts did not have an opportunity to explore.

For the purpose of this analysis, a halibut PSC rate above the 90th percentile of all halibut PSC rates for the combined years of 2011 - 2014 was used to indicate a high rate. Although the designation of a the 90th percentile rate as a “high” rate is a choice, it reflects a rate that in the professional judgment of the analyst represents a rate that would be considered a high rate by vessel operators and managers when reviewing the total range of halibut PSC limits. This analysis establishes this 90th percentile threshold to assess the potential impact to halibut PSC rates if vessel operators sought to avoid these high rates once they were achieved. This analysis analyzes the potential impact on halibut PSC rates if a vessel established a threshold rate of 32 kg of halibut per mt of groundfish (3.2%) to trigger some operational decision (e.g., move location, modify the time or depth of hauls, modify the timing of towing, etc.). The years 2011 through 2014 were used because all vessels were operating in Amendment 80 cooperatives during that period.

This analysis notes that a 90th percentile rate for a current year is not known to vessel operators. Therefore, this analysis assumes that using an average value from multiple recent prior years would be a reasonable substitute if vessel operators sought to “trigger” specific responses once a threshold rate is observed. This assumption appears supported by the relatively limited variation in the 90th percentile rate among years. This analysis assumes that if operators in the Amendment 80 sector were to establish a threshold rate at the beginning of the year, this threshold would inform the vessel operator that action is warranted to reduce the halibut rate.

The use of threshold levels to trigger operational choices by vessel operators is not a new concept in the North Pacific fisheries. Similar threshold levels have been successfully used as bycatch avoidance measures have been employed in other fisheries. A salient example is from the cooperatives in the Central GOA Rockfish Fishery. In that program, cooperative use a “red”, “yellow”, “green” light approach to monitoring their halibut PSC on a haul by haul basis. Any rate less than a threshold rate specified by a cooperative is assigned a green light, indicating that the vessel may continue fishing. The first threshold rate is a warning or yellow light. For example, this “yellow light” rate would be the 85th percentile, a rate of around 23 kg/mt (2.3%), indicating to the vessel operator that the rate is approaching high rates and should look to decrease halibut PSC through modifying their operations by moving location of modifying fishing practices. A rate that exceeded the 90th percentile, (e.g., 32 kg/mt (3.2%)), is the “red light” indicating to the vessel operator should immediately look to reduce that rate. Reaction to a rate does not guarantee that a vessel will find a lower rate, but it does indicate that the vessel is actively seeking to find a lower rate. There is also an unknown cost to this reaction due to the potential for increased fuel to move to new locations, or other changes to operations that could affect harvest rates of groundfish. However, the well-established low halibut PSC rates since the implementation in the GOA Rockfish Program indicates that reacting to high rates has been shown to be successful in reducing bycatch (Alaska Groundfish Databank 2014).

B.2.2 Prevalence of high rates; Reaction analysis

Recent published research indicates that changes in behavior to avoid halibut PSC were found to be used by Amendment 80 vessel operators in early parts of the year when halibut PSC limit needs were unknown, but that vessel operators relaxed their halibut avoidance measures later in the year as they identified that their halibut PSC limit would not be met (Abbott et al. 2015). Abbott et. al., found that from 2008 through 2010 Amendment 80 vessels did react to certain rates to reduce halibut PSC. The probability of greater movement distances after encountering a rate greater than 10% (e.g., 100 kg of halibut per mt of groundfish) was found to be statistically significant, indicating reactionary avoidance. This 10% rate is equivalent to an amount slightly greater than the 98th percentile in Table 1. While Abbott et al., identified movement at lower rates, (i.e., between 5% and 10%, or approximately between the 95th and 98th percentile), it was not found to be significant. This reactionary movement was also not consistent throughout the year. Abbott et al., found that there was little statistical evidence of reactionary movement in the last four months of the year. This could be due to a lesser incentive to avoid halibut later in the year when the individual vessels knew they had enough of their halibut PSC limit remaining to support ongoing fishing activity (Abbott et al. 2015).

While the Abbott et al. analysis was unable to be replicated in the time available, haul data from 2008 through 2014 were analyzed to attempt to detect reaction or lack of reaction to certain rates. For purposes of this analysis, an assumption was made that the rate in subsequent hauls could be used to detect reaction to a rate in the first haul. There are many reasons why this is not optimal (e.g., random events that lead to repeated prevalence of high rates in spite of movement or other operational choices); however, this assumption may allow the analyst to identify if the vessel is using reactionary avoidance measures to reduce PSC.

To conduct this analysis, North Pacific Observer haul data was used and individual haul rates were calculated using the extrapolated observed halibut for the haul divided by total groundfish weight. This is the standard method used to calculate halibut PSC rates (Cahalan et al. 2010). Each haul was flagged if it exceeded a given threshold rate. This allows the analyst to determine hauls that exceeded a given threshold rate.

Observer hauls were ordered by vessel, haul date, and time. If a haul was identified as exceeding a threshold rate, the subsequent two hauls were analyzed to determine if the rate was less than the established threshold rate. These subsequent hauls were screened to make sure they belonged to the same vessel, same trip, and occurred in the same general geographic area. If the second haul after a specific halibut PSC rate was observed to be lower than the threshold rate, this was assumed to be a reaction to the rate. If the rate was higher then it was assumed to be a no reaction. The analysts are aware that this assumption may not adequately address situations in which random events caused rates to decrease, or increase, two hauls after a specific halibut PSC rate was observed. In future analysis, different methods could provide a more robust analysis of reaction.

To aid the reader in understanding this methodology, it may be helpful to think as a vessel operator. Assume that the observer has provided information that you have a specific rate that exceeds a threshold level. You may have already set the net for the subsequent haul or believe that this rate was a random occurrence. Therefore you continue to fish as before. The second haul also has the same or higher rate. If you continue to fish without any change on the third haul (two hauls after encountering a specific rate), there is a higher likelihood you will get more similar rates and therefore have effectively made a decision that the halibut rate is “acceptable”. Otherwise you would attempt to change behavior to reduce the rate after the second haul came back with similar rates as the first haul.

Table 2 shows the total number of hauls rates in each threshold level. This was expanded to include lower threshold levels. These data show that as the rate gets higher there is more reaction as was identified in prior research (Abbott et al. 2015). These data suggest that vessel operators generally establish rates that are not acceptable by vessel operators and they try and reduce the rate.

Table 2 Amendment 80 hauls at specific halibut PSC rates, and the number of rates two hauls after a halibut PSC rate was observed that was lower -- indicating a reaction to high rates

	75th			80th			85th		
	Total	Reaction	%	Total	Reaction	%	Total	Reaction	%
2008	3,503	1,768	50%	2,941	1,634	56%	2,356	1,457	62%
2009	3,239	1,644	51%	2,686	1,530	57%	2,123	1,335	63%
2010	3,354	1,777	53%	2,766	1,594	58%	2,142	1,373	64%
2011	2,359	1,372	58%	1,924	1,210	63%	1,471	986	67%
2012	2,434	1,330	55%	2,008	1,159	58%	1,561	979	63%
2013	2,959	1,749	59%	2,396	1,537	64%	1,821	1,274	70%
2014	3,057	1,951	64%	2,320	1,640	71%	1,675	1,278	76%
	90th			95th			98th		
	Total	Reaction	%	Total	Reaction	%	Total	Reaction	%
2008	1,693	1,142	67%	947	729	77%	456	386	85%
2009	1,472	1,056	72%	792	640	81%	370	315	85%
2010	1,476	1,050	71%	808	641	79%	374	315	84%
2011	1,018	747	73%	553	449	81%	235	206	88%
2012	1,082	727	67%	585	434	74%	252	210	83%
2013	1,214	937	77%	605	513	85%	218	201	92%
2014	1,009	840	83%	423	360	85%	160	144	90%

Overall, Table 2 indicates that as halibut PSC rates increases so does the probability of an observed reaction to that halibut PSC rate by the third haul. As mentioned earlier, a more robust statistical analysis could provide more information about the statistical significance of these results. Overall, there appears to be a higher percentage of “reactions” to the halibut PSC rates analyzed in Table 2 after 2013 than prior to 2013. There are many reasons why a vessel operator may decide to continue to fish with a higher rate. Prior research has indicated that a vessel operator makes these decisions when they understand that the higher rate is not likely to make them exceed their limit (Abbott et al. 2015). It is also possible that halibut PSC avoidance may not be the sole, or even primary concern to vessel operators in a variety of fishing situations. Vessel operators are continually striving to make decisions that ensure the profitability of their vessels, other species available to a vessel operative can also be constraining and vessel operators are likely to be balancing these constraints with the costs and risks of halibut PSC avoidance. Several examples of these details follow:

- End of trip/ end of season. A vessel operator may choose to not move because there is no guarantee that the operator would find good fishing with lower halibut rates elsewhere.
- Pacific cod is a more limiting species. Vessel operators may have more incentive to avoid Pacific cod to avoid exceeding a cooperative allocation or an apportionment to a specific vessel or company within a cooperative. This constrain could create conditions that lead a vessel operator to accept higher halibut PSC rates.
- Economic value of the current area. For example, rock sole roe recovery and quality is very good in a current area and halibut PSC starts to increase. A vessel operator may accept higher halibut PSC rates in exchange for this economic advantage.

With any change in behavior there is likely a tradeoff. Prioritizing halibut avoidance may cause a vessel to increase incidental catch in another species like crab. Pacific cod is often mentioned as a more limiting species than halibut at current halibut PSC limits and prioritizing halibut avoidance may come at a cost of increased Pacific cod catch which will impact the vessels ability to harvest flatfish species. Similarly, there are costs for vessels to move locations, or otherwise modify their fishing operations. These impacts on specific vessel operators are unable to be quantified at this time.

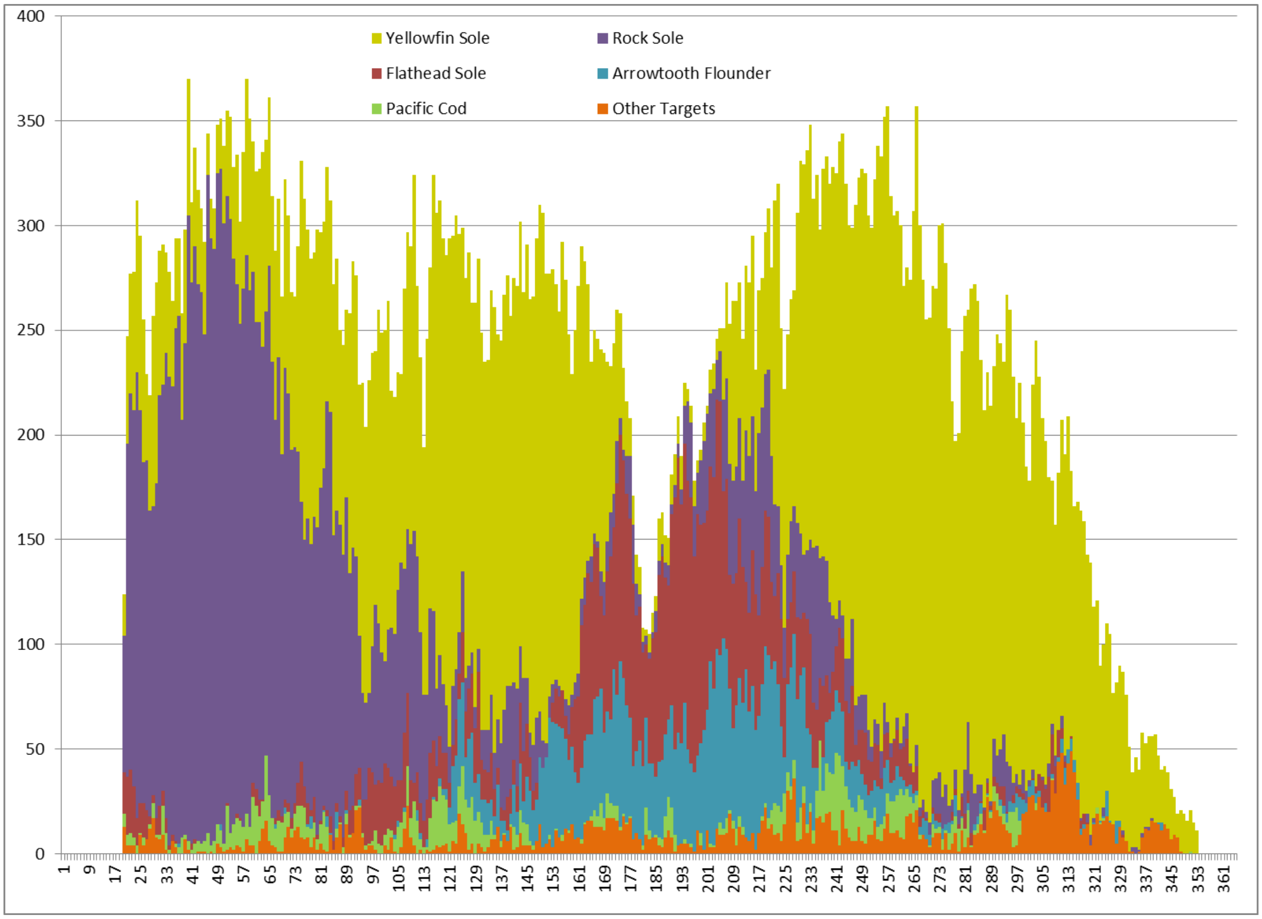
As Abbott et al. note, the Amendment 80 fleet has demonstrated that they do react to high rates at a certain threshold and do this more consistently at certain times a year. Expanding the reaction (i.e., increasing the proportion of hauls that show a lower rate two hauls after a specific rate is observed) to a lower threshold rate (e.g., an 80th or 85th percentile rate) that triggers a reaction and more consistent use of these measures throughout the year would likely mitigate some of the impacts of a PSC reduction. The precise amount of halibut PSC savings from reducing the proportion of hauls that are consistently at a given rate is not possible to quantify at this time because it would depend on the threshold rate selected and the potential for random events (e.g., a vessel moved and encountered a higher rate) that could offset potential gains

B.2.3 Prevalence of high rates; temporal analysis

The Bering sea Amendment 80 targets can be simplified into 6 general fisheries; Yellowfin sole, Rock sole, Flathead sole, Arrowtooth/Kamchatka flounder, Pacific cod, and “Other target” fisheries. Some trip targets are able to be grouped together. For example, Alaska plaice is most commonly caught while a vessel is directed fishing for yellowfin sole so these targets were grouped. Similarly, “other flatfish” is most commonly caught while a vessel is directed fishing for flathead sole, and Greenland turbot and Sablefish is most commonly caught while a vessel is directed fishing for Arrowtooth/Kamchatka flounder. Pacific cod is a limiting species and most A80 vessels do not target Pacific Cod, however it is kept as a distinct target. The “Other target” category includes Bering Sea Atka Mackerel and pollock that are not directed fisheries and linking these targets to a specific directed fisheries is problematic because they do not consistently occur in specific directed fisheries, therefore these species were grouped together as Other targets.

Figure 1 shows the typical temporal pattern of fishing in the Bering Sea fisheries by Amendment 80 vessels. This is represented as total number of hauls per day to show intensity of fishing. In the early months, rock sole (purple) is the primary target. This spike is between days 30 and 70, February and early March, when the rock sole roe season is underway. Vessels then move to yellowfin sole (yellow) until around day 160, the beginning of June. The decrease in effort in the Bering Sea around day 180 corresponds with activity in the GOA rockfish fisheries, when vessels leave the Bering Sea to fish other targets. From day 160, June, to around day 230, mid-August, Arrowtooth/Kamchatka Flounder (blue) and Flathead sole (red) are the dominant targets in the Bering Sea before resuming the yellowfin sole target. The yellowfin sole fishery is dominant until the end of fishing by Amendment 80 vessels typically around the first weeks of December (approximately day 350).

Figure 1 **Number of hauls per day and target fishery in the Amendment 80 Sector from 2011 through 2014**



There are two ways to look at halibut PSC rate data in specific fisheries. One is the proportion of high rate hauls (i.e., hauls at the 90th percentile) relative to total hauls and another is the proportion of no reaction hauls (to high rate hauls i.e., hauls where the third haul has a rate at the 90th percentile after a 90th percentile rate haul was observed). The proportion of high rate hauls to total hauls indicates fisheries or times of year with higher rates of halibut PSC. The proportion of no reaction to the total high rate hauls may indicate the acceptance level of a higher rate. The years 2011-2014 were combined to protect confidentiality.

Figure 2 shows the proportion of hauls with a high rate as defined by a rate in excess of the 90th percentile. The y-axis shows the proportion of hauls on a given day that had a given percentage of the total hauls with at least a 90th percentile rate of halibut PSC (approximately 32 kg of halibut PSC/mt of groundfish). Figure 2 indicates that there are two time periods that have a higher prevalence of high rates. The first coincides with the summer arrowtooth flounder and flathead sole fishery and the second occurs at the end of the year.

Previous research had indicated a shift away from halibut avoidance in the latter part of the year in 2008 through 2010 (Abbott et al. 2015). This pattern continues to exist in the data reported here (from 2011 through 2014). Fishing effort continues to decrease after day 320 (see Figure 1), the beginning of November, yet the proportion of hauls with halibut PSC rates higher than the 90th percentile continues to increase. The pattern of increasing rates starts in October but is very noticeable in November and December. One possible explanation for this is that vessel operators will know if they have enough halibut PSC to cover fishing for the remainder of the year and may have less incentive to avoid high halibut PSC rates. Halibut PSC from November to the end of year accounts for roughly 15% of the Amendment 80 vessels total halibut PSC in the Bering Sea on average during the years analyzed. Halibut PSC from October to end of year accounts for up to 24% of the total halibut PSC in the Bering Sea on average during the years analyzed.

Figure 2 Proportion of hauls in the Amendment 80 sector with high halibut PSC rates relative to the total hauls by day (average 2011 through 2014)..

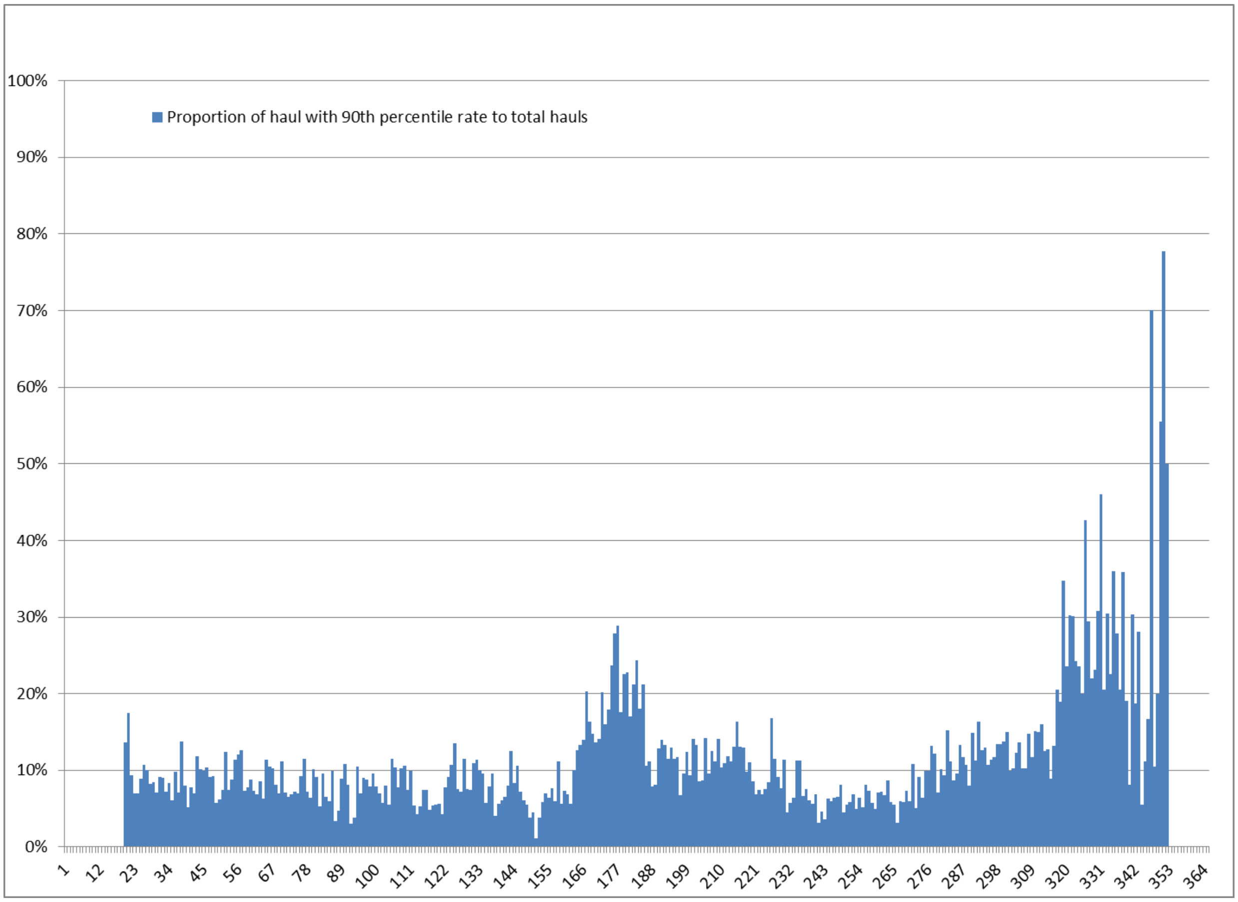
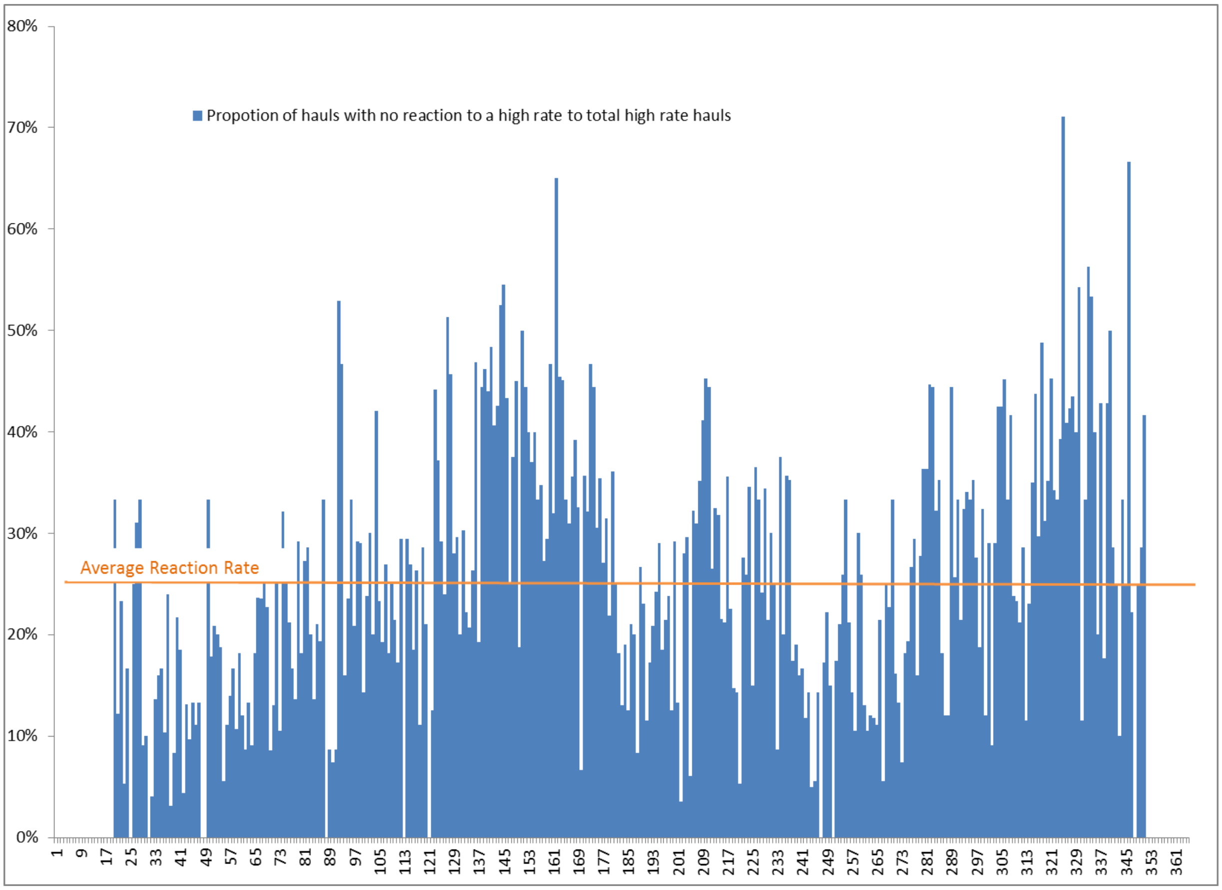


Figure 3 shows the proportion of high rate hauls in which there was no reaction to a high rate. This metric may indicate acceptance level of a high rate. The orange line indicates the average no reaction rate between 2011 and 2014. Proportions above this line may indicate periods during the year in which vessel operators may have chosen to accept a high rate. Figure 3 does not show the same clear pattern as observed in Figure 2. However, it does appear that there is a greater proportion of hauls that do not demonstrate a reaction during the middle and latter part of the year.

Figure 3 **Proportion of high halibut PSC rate hauls in the Amendment 80 sector with no reaction to a high rate**



Reducing groundfish fishing or changing behavior during the two time periods identified may help mitigate some of the impacts of a halibut PSC limit reduction. The mid-year increase corresponds with arrowtooth/Kamchatka flounder and flathead sole fisheries. Not fishing these species at this time of the year may result in reduced groundfish; however there may be options to fish other flatfish targets with lower rates during that period, or potentially shift the timing of location of these fisheries. There may be limitations in the ability for vessels to shift the timing of some of these fisheries due to fishery dynamics, and regulations currently limit the timing of the arrowtooth/Kamchatka flounder fisheries prior to May 1.

Focusing on reducing halibut PSC rates at the end of the year may be possible without significantly impacting overall groundfish catch if they overall rate of bycatch in the earlier portion of the year can be maintained in the latter half of the year. As shown in Figure 1, the groundfish catch composition in latter two months of the year does not appear to be appreciably different than the stock composition of catch in the months immediately preceding it. This suggests that the higher halibut PSC rates may be more an artifact of operational choices by vessel operators as they realize they have adequate halibut PSC remaining to support their operations and other factors (e.g., fishing in areas that require less transit fuel costs and that have higher catch rates) become more important to their operational choices.

B.2.4 Prevalence of high rates; target fishery analysis

Table 3 shows the proportion of high rate hauls to total hauls by target fishery. This analysis focuses only on the 4 largest target fisheries in the Amendment 80 sector. Table 3 clearly shows that there are certain target fisheries that have a higher proportion of high halibut PSC rates over the years analyzed, primarily arrowtooth flounder and flathead sole targets.

A management action that recently became available to the Amendment 80 sector is flatfish flexibility, Amendment 105 (79 FR 56671, September 23, 2014). This amendment enables Amendment 80 cooperatives to exchange flathead sole, rock sole, and yellowfin sole quotas while maintaining catch below ABC. In most years these flatfish TACs are set well below the ABCs. It is possible that Amendment 80 cooperatives could mitigate some of the impacts of a PSC reduction by exchanging flathead sole which has a greater risk of high halibut rates with yellowfin sole or rock sole that have lower risk of high halibut rates. During 2008 through 2014, approximately 8% of halibut PSC in the Bering Sea in the Amendment 80 sector was associated with flathead sole targets.

Arrowtooth flounder is not an Amendment 80 allocated species and therefore not a flatfish flexibility species. During 2008 through 2014, approximately 5% of the total groundfish harvest in the Amendment 80 sector in the Bering Sea and approximately 10% of the total halibut PSC from the Amendment 80 sector in the Bering Sea can be attributed to arrowtooth/Kamchatka flounder targets. Simply put, given the high rates of halibut PSC observed in the arrowtooth/Kamchatka flounder fishery, using the same amount of halibut PSC in pursuit of other flatfish targets would net nearly double the amount of groundfish. This statement assumes that vessel operators would be able to substitute other flatfish targets for the lost opportunity in the arrowtooth/Kamchatka flounder fisheries.

Table 3 Proportion of high rate hauls in the Amendment 80 sector to total hauls by target fishery; 90th percentile

	Arrowtooth Flounder	Flathead Sole	Rock Sole	Yellowfin Sole
2008	29%	19%	18%	10%
2009	33%	19%	20%	10%
2010	25%	17%	18%	13%
2011	21%	27%	10%	8%
2012	49%	37%	6%	8%
2013	29%	19%	12%	9%
2014	19%	10%	9%	8%

B.2.5 Prevalence of high rates; Vessel specific analysis

Table 4 shows the proportion of Bering Sea flatfish hauls with a high rate (in excess of the 90^{th} percentile) by vessel. Vessels were assigned a random letter and reordered to protect confidentiality. These data allow the identification of vessels that have higher or lower performance in avoiding high rates of halibut. One vessel, H, stands out as proportionally having fewer instances of high rates. Other vessels that appear to have slightly higher performance include vessels A, M, P, and Q.

Several vessels appear to have more instances of higher rates. These include vessels D, F, and L. There are many reasons why a vessels performance may be lower and these include how much time they spend in those fisheries that have prevalence for higher halibut PSC rates, or other operational choices or constraints on a specific vessel.

Table 4 Proportion of Bering Sea hauls by Amendment 80 vessels with a halibut PSC rate in excess of the 90th percentile rate

Vessel	2008	2009	2010	2011	2012	2013	2014
A	4%	10%	11%	10%	10%	8%	9%
B	12%	9%	13%	10%	9%	5%	11%
C	8%	12%	9%	8%	18%	9%	7%
D	23%	28%	19%	14%	17%	15%	11%
E	12%	11%	9%	10%	16%	14%	7%
F	18%	19%	24%	20%	10%	17%	13%
G	13%	21%	15%	12%	8%	18%	5%
H	17%	10%	13%	6%	3%	5%	4%
I	10%	12%	12%	11%	10%	13%	11%
J	19%	16%	16%	9%	11%	16%	10%
K	10%	16%	14%	10%	10%	10%	10%
L	16%	27%	30%	13%	19%	17%	15%
M	13%	10%	10%	7%	8%	10%	7%
N	17%	5%	8%	5%	11%	8%	11%
O	11%	16%	8%	10%	12%	10%	9%
P	7%	11%	12%	5%	8%	9%	8%
Q	9%	12%	10%	9%	10%	9%	10%
R	18%	20%	31%	16%	5%	21%	8%

Table 5 shows the reaction to high rates (in excess of the 90th percentile) by vessel. Like Table 4 the vessels were assigned a random letter to protect confidentiality and the vessel's letter is the same in Table 4 and Table 5. These data allow identification of vessels that appear to react more consistently to high rates when compared to other vessels. The yearly reaction to high rates as identified in Table 2 varied from year to year but was approximately 75% at the 90th percentile. In Table 4, vessel H has the highest performance in avoiding high halibut rates. In Table 5 this same vessel reacted to high rates over 94% of the time from 2012 through 2014. This would indicate that this vessel has changed behavior to avoid halibut the majority of the time.

The same holds true with some of those vessels that had lower performance in avoiding high rates of halibut. These vessels, F and L, have some of the lowest overall reaction to higher rates. This makes sense because less reaction would result in higher prevalence of these high rates.

Table 5 Proportion of Bering Sea hauls showing reactions by Amendment 80 vessels to halibut PSC rates in excess of 90th percentile

Vessel	2008	2009	2010	2011	2012	2013	2014
A	100%	79%	100%	82%	70%	80%	88%
B	78%	81%	80%	84%	76%	93%	84%
C	73%	75%	81%	71%	63%	86%	87%
D	52%	66%	76%	63%	63%	89%	80%
E	79%	71%	83%	78%	53%	73%	84%
F	60%	64%	54%	55%	72%	67%	50%
G	72%	61%	70%	75%	68%	70%	82%
H	58%	63%	73%	88%	94%	100%	97%
I	74%	82%	78%	73%	61%	82%	82%
J	69%	68%	71%	83%	72%	67%	71%
K	76%	75%	74%	77%	69%	78%	84%
L	48%	66%	44%	71%	71%	48%	69%
M	73%	84%	81%	84%	77%	82%	95%
N	55%	90%	92%	67%	68%	78%	84%
O	74%	78%	81%	72%	70%	80%	94%
P	83%	68%	69%	89%	63%	87%	89%
Q	71%	72%	73%	71%	72%	80%	86%
R	73%	63%	46%	59%	100%	75%	67%

There appear to be differences in halibut avoidance performance among the Amendment 80 vessels. If all vessels could operate similar to vessel H, this would result in halibut PSC reduction for the sector overall. This analysis did not attempt to analyze the specific fishery operations undertaken by vessel H (a "good" performer) relative to vessel F (a "poor" performer) given the time available.

B.2.6 Prevalence of high rates; spatial analysis

Figure 4Figure shows data from 2011 through 2014, cells (20 nm hexagons)where there is a greater proportion of hauls with greater than 33 kg/mt of halibut (90th percentile). Cells with less than 10 hauls during this entire time period were removed to preserve confidentiality. The colors represent the proportion of total hauls with a specific percentage ranges that hauls in that cell were over or under the 90th percentile (e.g., white indicates that less than 2.5 % of all the hauls in that cell were over the 90th percentile) and the numbers in each cell represent the total number of hauls from 2011 through 2014. This allows for comparison of effort in a cell with the proportion of high rate hauls.

Several areas show a high percentage of high rate hauls, colored in red. Of more concern are those areas shaded red that have a high number of hauls. These areas are northeast of Unalaska, just west of the Pribilof Islands and areas near Zhemchug Canyon.

These areas have high proportions of hauls in the 90th percentile of all halibut PSC rates. These areas also correspond to locations where arrowtooth and Kamchatka flounder fisheries typically operate. Avoiding these areas would likely result in some PSC reduction but likely at the cost of arrowtooth flounder catch. Figure 5 shows the areas where arrowtooth/Kamchatka flounder has been harvested in 2011 through 2014. Most areas have high halibut rates; however there appears to be lower rates along the shelf break between Unalaska and Pribilof Islands and in the north at Navarin Canyon. Fishing arrowtooth/Kamchatka flounder in these areas may result in PSC reduction.

The area immediately to the west of St. Paul Island, in Figure 4, is an area with high halibut rates. This area corresponds with the flathead sole target as seen in Figure 6. Unlike arrowtooth/Kamchatka flounder, this area is not the only area known for flathead sole. Avoiding this area would likely result in halibut PSC reduction with little cost to total groundfish harvest as there are other areas immediately to the North where flathead sole can be targeted with a lower risk of high halibut rates.

Finally Figure 4 also shows areas that are high effort areas with little to no risk of high halibut rates. The area in Bristol Bay is known for good yellowfin sole catch rates in May/June with little to no halibut as shown in this figure. Under regulation, this area is only open from April 1 to June 15. Other areas on the shelf also show low risk of high halibut rates. Concentrating fishing in these areas may mitigate some of the impacts of PSC limit reductions.

Figure 4 Spatial analysis of 90th percentile hauls for Amendment 80 vessels from observer data

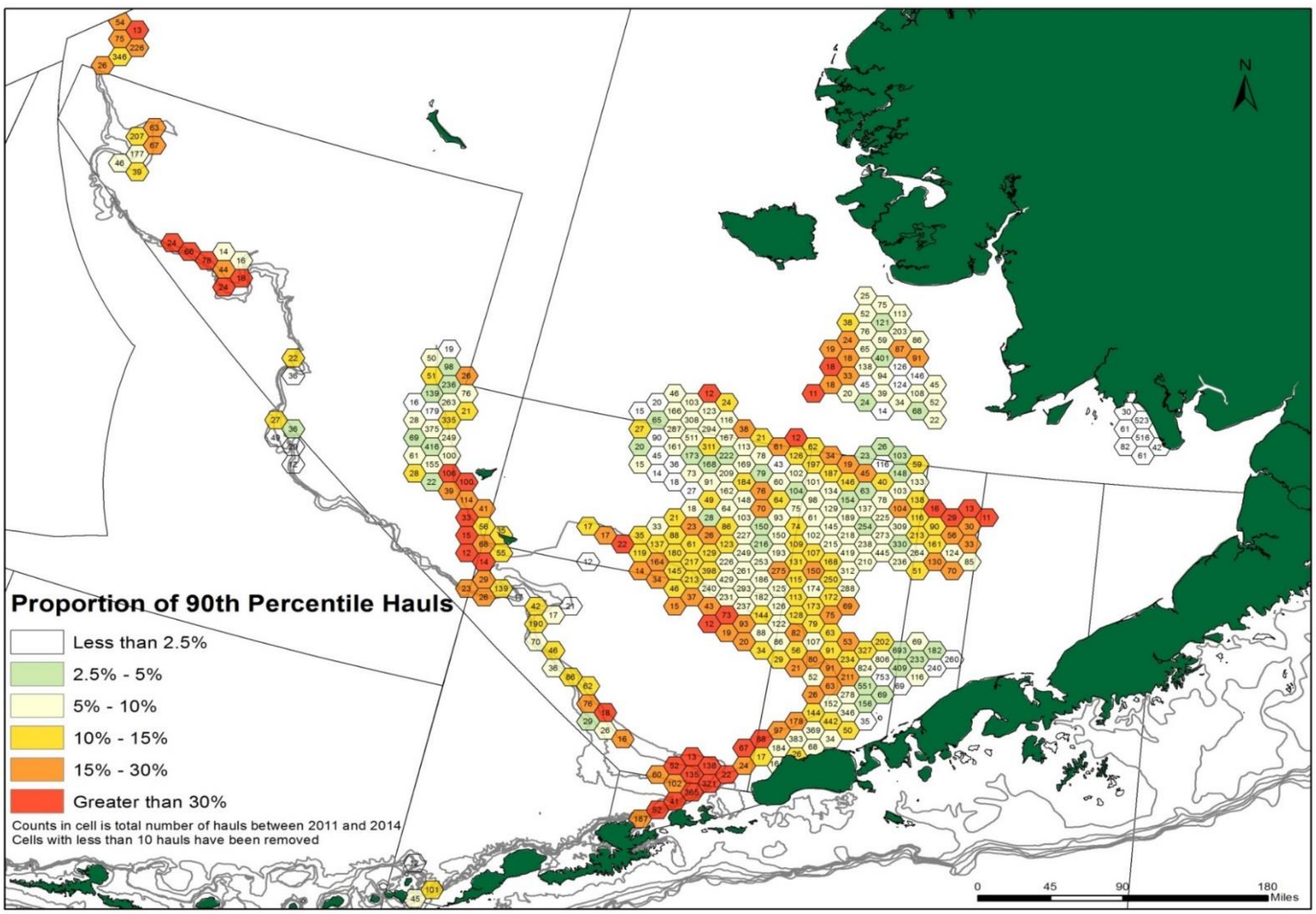


Figure 5 Arrowtooth and Kamchatka Flounder Areas for Amendment 80 vessels from observer data.

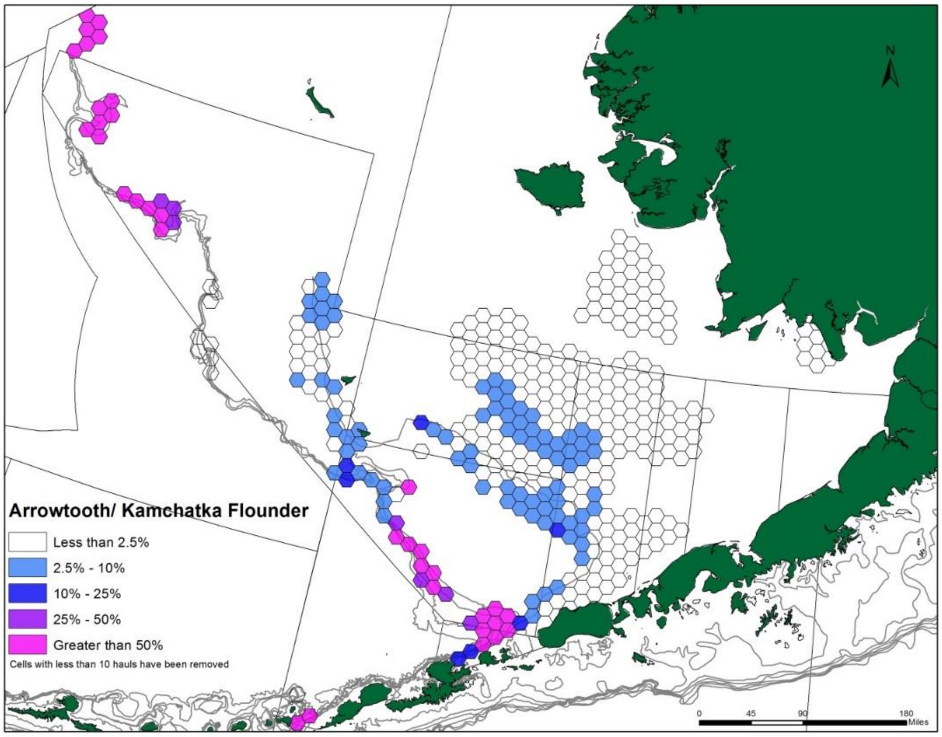
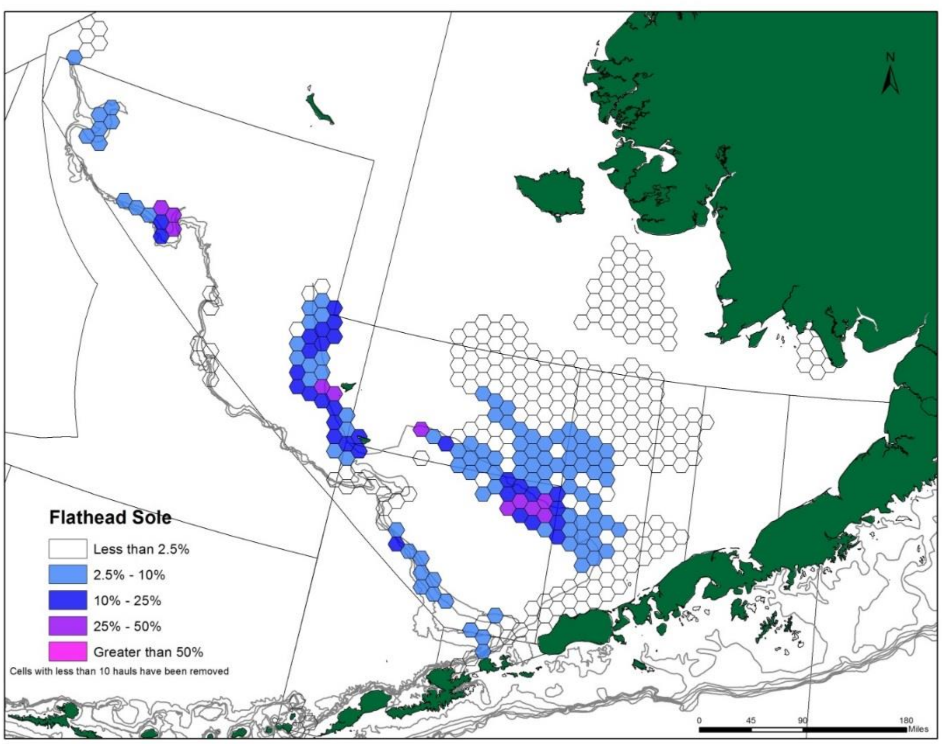


Figure 6 Flathead Sole Areas for Amendment 80 vessels from observer data.



B.3 Bering Sea Trawl limited access: Yellowfin Sole, Catcher/Processor only

The Bering Sea trawl limited access sector (TLAS) fisheries directed fish for pollock, yellowfin sole, and Pacific cod. Pollock is harvested by catcher vessels and catcher processors. Pacific cod is mostly harvested by catcher vessels and yellowfin sole is mostly harvested by catcher processors and catcher vessels delivering to motherships. The methods used to analyze the Bering Sea trawl limited access fishery are similar to the method used with Amendment 80 vessels. However, unlike Amendment 80 cooperatives, this sector's halibut PSC is allocated to specific fishery categories and these halibut PSC allocations are actively managed by NMFS' Inseason Management Branch. NMFS does not have comprehensive haul-by-haul data for all of the fisheries in this sector. Because the pollock fishery would not be constrained by this proposed action, this analysis focuses on the one portion of this fishery for which NMFS has applicable haul-by-haul data, catcher/processors targeting flatfish, almost exclusively yellowfin sole, and to a very limited extent, Pacific cod, in the Bering Sea. The reader is referred to Section 2 for specific details on methodology.

B.3.1 Halibut PSC rates and High Rate avoidance

Table 6 shows the halibut rate, represented as kg of halibut per metric tons of groundfish for Bering Sea trawl limited access flatfish hauls by catcher/processors associated with various percentile ranks. A rate of 10 kg/mt is equivalent to a halibut catch rate of 1%. As noted earlier, these estimates do not include mortality, this section focusses on total halibut catch.

There is more annual variation of halibut PSC rates in the BSAI trawl limited access sector relative to other sectors. The reason for each variation is somewhat unclear, but it is likely related to less participation by certain vessels in a given year or participation by specific vessels at different times of the year. For example, this sector had low halibut PSC rates in 2010. While overall the total amount of hauls in 2010 were similar to 2008 and 2009 and less in later years, four catcher/processors did not participate in yellowfin sole fisheries in 2010 and there was a shift in the timing and location of this fishery. The 2010 fishery occurred solely within the January/February, with no participation in summer months like other years.

Table 6 **Percentile Ranks of Bering Sea Trawl Limited Access Catcher Processor Flatfish Halibut Rates (kg/mt) from 2008 to 2014 (Rates in total halibut, not mortality)**

	2008	2009	2010	2011	2012	2013	2014	2011-2014
75th	8.49	14.45	0.00	3.61	5.64	7.62	9.72	7.12
76th	9.34	15.61	0.00	4.59	6.32	8.43	10.36	7.85
77th	9.98	16.60	0.00	5.34	6.96	8.95	11.13	8.64
78th	10.66	17.45	0.00	5.93	8.00	9.73	11.88	9.32
79th	11.28	18.22	0.00	6.34	9.13	10.60	12.45	10.22
80th	11.70	20.14	0.00	7.49	10.11	11.36	13.28	11.22
81st	12.32	21.43	0.00	8.43	10.76	12.00	14.06	11.96
82nd	13.32	23.92	0.00	9.72	11.98	12.82	14.77	12.89
83rd	14.71	25.16	0.00	11.18	12.78	13.55	15.45	13.95
84th	15.61	26.09	0.00	12.57	14.86	14.30	16.28	14.86
85th	16.36	26.91	0.00	14.02	16.12	15.45	17.09	15.95
86th	17.31	30.35	0.00	15.77	16.95	16.65	18.01	17.01
87th	19.46	31.82	0.74	17.53	18.73	17.61	19.22	18.29
88th	21.18	32.99	1.23	19.58	20.02	18.99	20.37	19.62
89th	23.60	35.62	1.61	21.57	21.38	20.68	21.45	21.15
90th	25.28	38.01	2.58	23.36	23.32	22.08	23.57	22.97
91st	27.50	39.70	4.00	24.95	25.65	24.09	26.53	25.24
92nd	29.77	44.77	6.58	26.86	27.68	25.78	28.81	27.22
93rd	32.74	47.28	9.22	29.41	31.01	28.01	31.13	30.07
94th	36.64	50.18	12.41	34.08	34.04	33.07	34.31	33.89
95th	39.06	52.93	13.58	38.60	41.23	36.71	37.03	37.90
96th	42.09	58.43	19.21	43.37	48.95	43.03	42.05	43.60
97th	48.06	71.28	27.65	58.85	55.49	54.15	47.94	54.52
98th	64.33	81.02	41.60	75.50	69.63	69.25	61.24	68.34
99th	89.72	116.42	55.16	121.69	99.31	101.84	96.82	104.55

The analysis of high rate avoidance assumes that a vessel will established a threshold rate that would trigger a response (move fishing location) to try and get a lower rate. For the purpose of this analysis, the halibut rate of above the 90th percentile for the combined years of 2011 - 2014 was used to indicate a high rate. Any rate over 23 kg/mt or 2.3% would trigger a reaction.

B.3.2 Prevalence of high rates; reaction analysis

The nature of the BSAI trawl limited access fishery prevented the same analysis of reaction as was done for the Amendment 80 sector. Several of the catcher/processors active in this sector have only limited participation in the yellowfin sole fishery and only target yellowfin sole for short periods of time before moving to AFA pollock. There is also inconsistency in processing type as some of these catcher/processors act as motherships concurrently with catcher/processor activity. Trying to screen these activities and generate a similar analysis was problematic and presented challenges in protecting confidentiality. Therefore, this analysis does not include a reaction analysis for catcher/processors in this sector.

B.3.3 Prevalence of high rates; temporal analysis

As mentioned above, the Bering Sea trawl limited access sector that was analyzed is primarily a one target fishery, yellowfin sole, with some limited effort in Pacific cod. Figure 7 shows the typical temporal pattern of non-pollock fishing by catcher/processors in the Bering Sea trawl limited access sector catcher/processors. Figure 7 display the total number of hauls per day to show intensity of fishing.

A first spike in effort starts on January 20, day 20, when several AFA catcher/processors start the fishing year targeting yellowfin sole before fishing their A season pollock allocations. The decrease in effort corresponds to the shift to the pollock fishery. The second spike in effort occurs when these vessels finish their A season pollock allocation and go back to fishing yellowfin sole. The rest of the fishing effort after day 120 is primarily due to the effort from a few vessels catcher/processors that continue to fish throughout the year with sporadic effort by more catcher/processors throughout the latter part of the year.

Figure 7 2011 – 2014 number of hauls per day and target fishery; Bering Sea Trawl Limited Access Catcher Processors

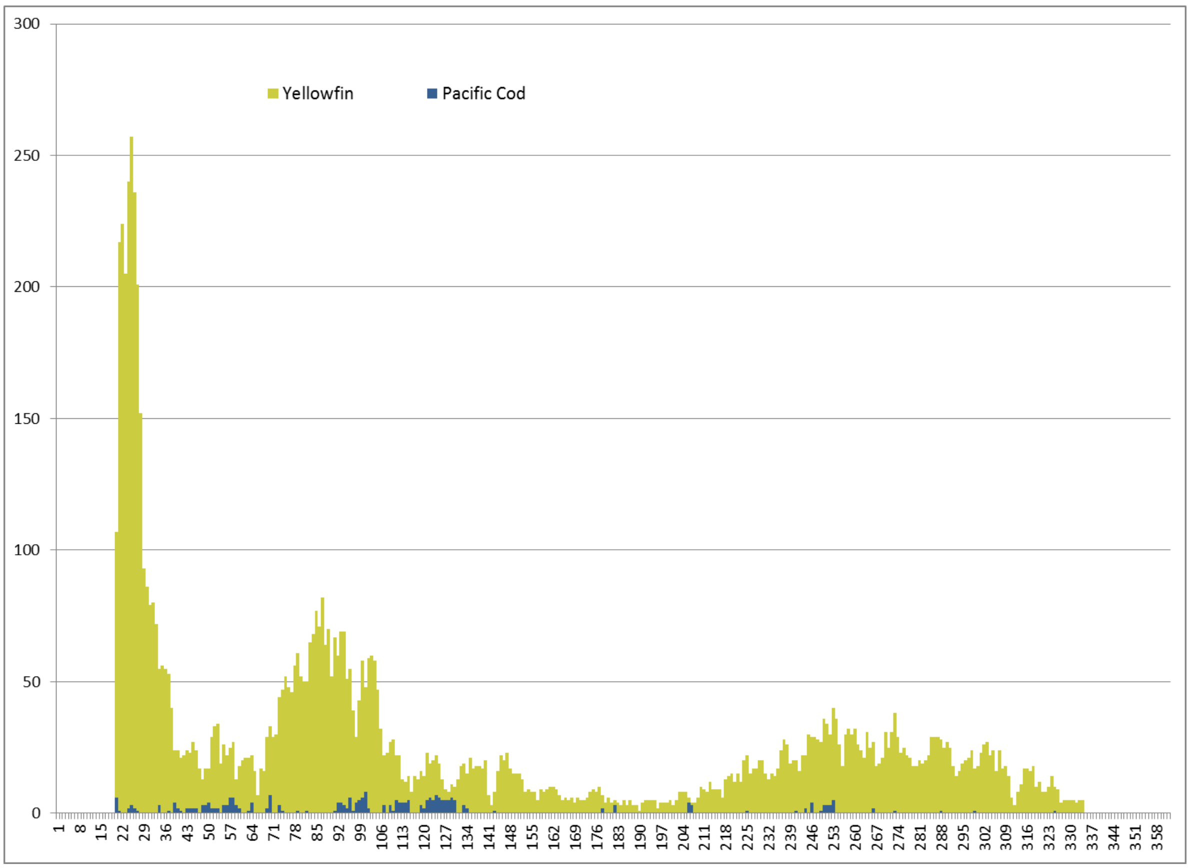
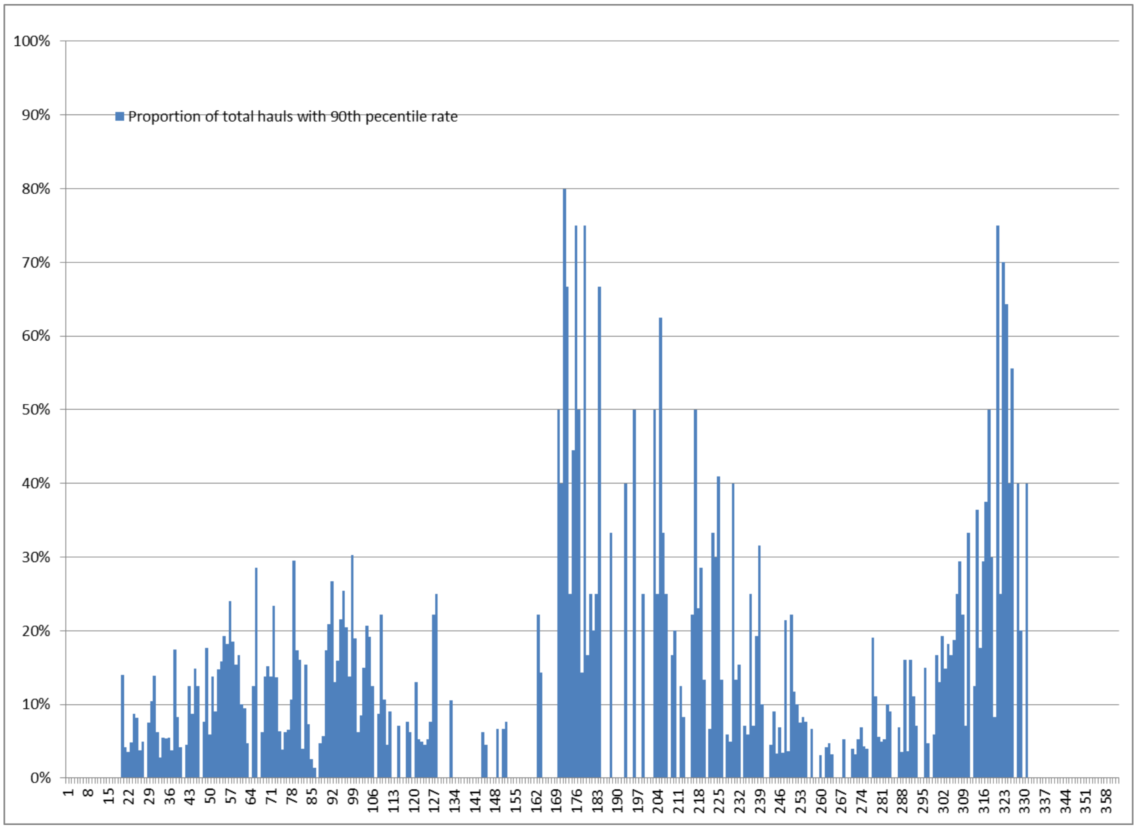


Figure 8 shows the proportion of total hauls with a high rate (90th percentile rate) by day. Figure 8 shows that these high rate hauls occur throughout the year but more prominently in the summer months and the end of the year.

Figure 8 Proportion of total hauls with a 90th percentile rate or higher; Bering Sea Trawl Limited Access Catcher Processors



Reducing groundfish fishing or changing behavior during the time periods with higher halibut rates may result in some mitigation of the impacts of a reduction in halibut PSC limits. Fishing earlier in the year would appear to result in lower halibut PSC rates. As with the Amendment 80 fishery, there appears to be a significant increase in the proportion of hauls with high halibut PSC rates at the end of the year.

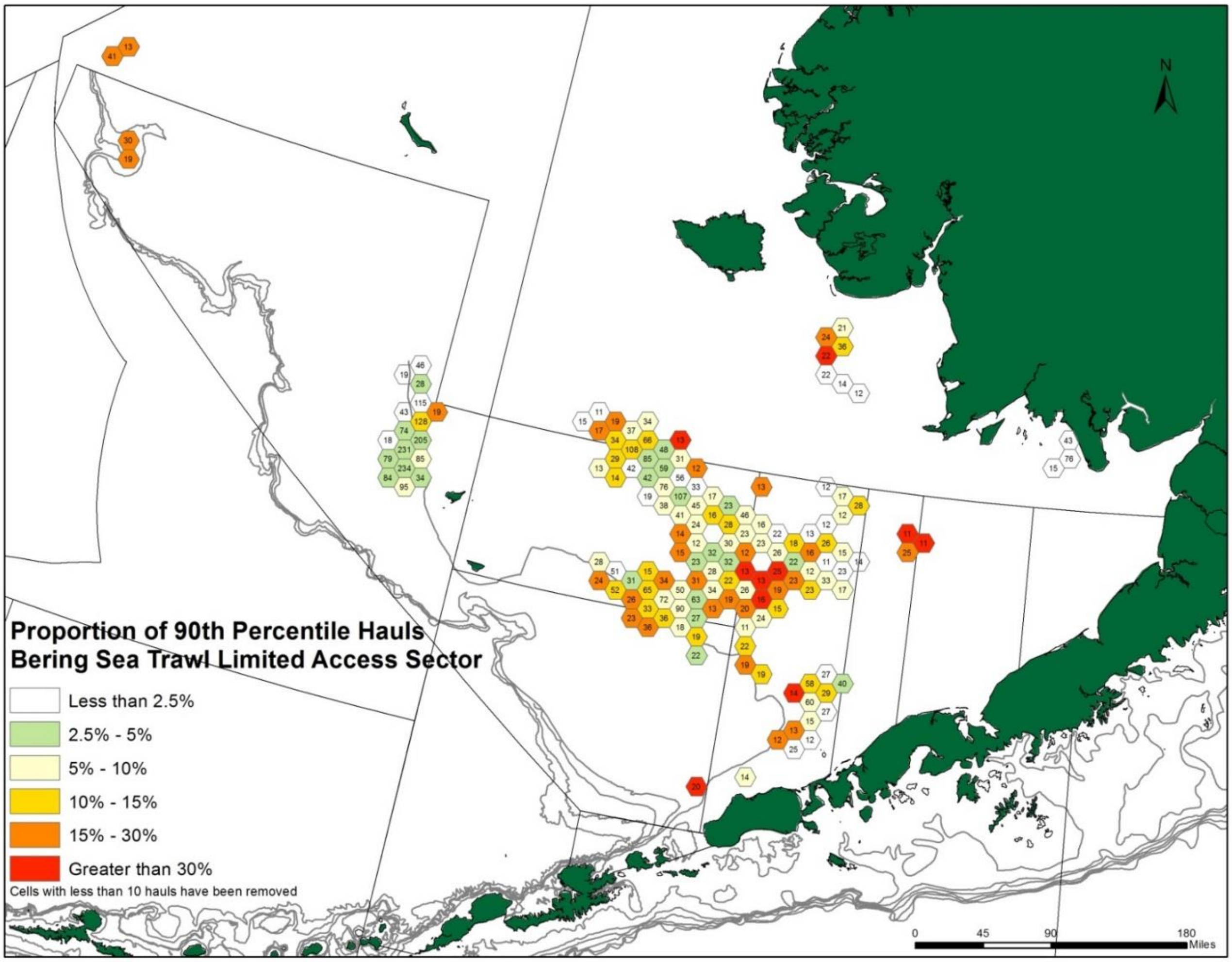
B.3.4 Prevalence of high rates; Vessel specific analysis

A table similar to Table 4 was created to show the proportion of Bering Sea trawl limited access catcher/processor non-pollock hauls with a high halibut PSC rate (in excess of the 90th percentile) by vessel. However, due to confidentiality concerns, the table cannot be shown without potentially releasing confidential fishery data. Like the Amendment 80 sector, some vessels appear to have very high performance in avoiding halibut PSC, however not in every year. Other vessels consistently rank lower than other vessels however not at a rate that is substantially higher than average performance overall.

B.3.5 Prevalence of high rates; spatial analysis

Figure 9 shows where there is a greater proportion of hauls with halibut PSC rates of more than 23 kg/mt of halibut (90th percentile). To preserve confidentiality, cells with less than 10 hauls were removed and the data represents all hauls from 2011 through 2014. The colors represent the proportion of total hauls and the numbers in each cell represent the total number of hauls from 2011 through 2014. This figure allows a comparison between effort in a cell with the proportion of high rate hauls. While some cells show with a darker hue or red/orange, which may indicate a hotspot of high halibut rates, the number of total hauls in those cells indicates that the area is not consistently fished.

Figure 9 Spatial analysis of 90th percentile hauls; Bering Sea Trawl Limited Access Catcher/Processors.



B.4 Hook-and-Line Catcher/Processors

The hook-and-line catcher/processors directed fish for Pacific cod primarily, and to a much more limited extent Greenland turbot. The methods for analyzing this sector is similar to the method used with Amendment 80 vessels. The methodology used in this sector is effectively the same as that used for the Amendment 80 sector, and the reader is referred to Section 2 for specific details.

B.4.1 Halibut PSC rates and High Rate avoidance

Table 7 shows the halibut rate, represented as kg of halibut per metric tons of groundfish for hook-and-line catcher/processors associated with various percentile ranks. While the halibut catch rate is higher than trawl gear, this is total halibut, not halibut mortality. The discard mortality rate currently used in hook-and-line Pacific cod fisheries is approximately 9% compared to trawl discard mortality rates which average between 75% and 85%.

Table 7 shows that every year since 2008, this sector appears to have improved its performance in avoiding halibut PSC. A large change occurred between 2010 and 2011. This is the year that hook-and-line catcher/processors formed a voluntary cooperative and started fishing throughout the year. There is more annual variation of rates than other sectors but it is consistently toward one direction, a reduction in rates. The analysts did not have time to examine the potential reasons for these consistently lower halibut PSC rates.

Table 7 Percentile Ranks of Bering Sea Hook-and-Line Catcher Processor Halibut Rates (kg/mt) from 2008 to 2014 (Rates in total halibut, not mortality)

	2008	2009	2010	2011	2012	2013	2014	2011-2014
75th	83.74	72.64	73.27	57.11	58.37	56.36	49.33	54.71
76th	87.28	75.06	76.52	59.42	60.33	57.96	51.16	56.88
77th	90.99	78.01	80.31	61.53	62.65	60.21	53.09	58.83
78th	94.94	80.92	83.47	63.69	64.95	62.27	55.03	61.15
79th	98.47	84.56	85.92	66.35	67.56	64.52	57.16	63.40
80th	102.67	87.70	89.10	69.18	70.76	66.40	59.37	65.72
81st	107.29	91.29	92.74	72.12	73.48	68.62	61.70	68.30
82nd	111.43	95.18	96.53	75.35	76.39	71.12	64.11	71.09
83rd	116.25	98.47	101.22	78.80	79.41	74.20	66.72	74.06
84th	121.03	102.28	105.80	82.32	83.18	77.69	69.27	77.31
85th	127.57	106.64	110.81	86.44	87.18	80.85	72.27	80.74
86th	133.61	111.87	116.15	91.76	91.03	83.61	75.44	84.26
87th	140.21	116.80	122.92	96.81	95.79	87.07	78.92	88.45
88th	147.40	122.73	129.06	101.66	100.51	91.61	82.78	93.02
89th	157.72	128.41	135.52	107.64	105.61	96.00	87.13	98.17
90th	**167.51**	**135.25**	**143.66**	**115.38**	**111.74**	**101.26**	**91.43**	**103.83**
91st	177.25	144.39	152.61	122.54	119.18	107.58	97.43	110.19
92nd	190.86	155.28	160.93	131.00	126.99	114.31	103.54	118.15
93rd	205.20	164.66	170.51	141.48	139.46	122.09	111.20	127.01
94th	225.09	175.28	182.14	153.14	151.50	131.49	121.18	137.69
95th	248.51	190.87	195.58	170.50	164.23	143.49	132.45	151.22
96th	273.16	210.43	223.17	190.91	183.00	158.02	144.58	168.76
97th	308.26	237.17	250.70	222.95	213.98	178.01	168.60	191.57
98th	362.16	281.83	293.04	265.30	254.34	210.95	200.03	232.68
99th	481.86	369.30	377.60	346.26	338.42	261.25	253.33	299.74

B.4.2 Prevalence of high rates; Reaction analysis

The nature of hook-and-line gear fishing presents significant problems in doing a reaction analysis as done for the Amendment 80 sector. Multiple sets of gear are deployed and are fished at the same time. Ordering these sets to detect a reaction based on the halibut PSC rate from one set presents significant challenges that impede analysis. For example, a vessel may have up to five sets of gear in the water in an area. Even if the operator tried to react to a high rate observed on one set of gear, the other sets still need to be retrieved. Depending on the order in which these sets were retrieved and the halibut PSC rates observed in those sets, the vessel could be shown as having no reaction, even when the vessel operator had chosen to move to another area on the basis of the halibut PSC rate from the first set of gear. These factors limit the applicability of the assumption that a lower rate in next two sets equals a reaction and prevents the analyst from detecting reaction this way. Similarly, using distance between sets to designate a reaction can also present a problem for the analyst. Sets of gear are typically spread out over a larger geographic area to prevent gear entanglement. Due to these confounding factors, a reaction analysis was not conducted for the hook-and-line catcher/processors.

B.4.3 Prevalence of high rates; temporal analysis

As mentioned above, the hook-and-line catcher/processors primarily target Pacific cod with some effort in Greenland turbot. Figure 10 shows the typical temporal pattern for hook-and-line catcher/processors. This is represented as total number of hauls per day to show intensity of fishing.

Fishing begins on day 1 and continues throughout the year. The distribution in hauls with two peaks shows the seasonal split of Pacific cod into an A and B season. Greenland turbot is typically harvested in mid to late summer. In recent years, due to agreements with the Amendment 80 sector, Greenland turbot fishing has stretched into the fall months. The decrease in effort mid-year corresponds to the time of year when the fleet reaches their A season Pacific cod allocation limit.

Figure 10 2011 – 2014 number of hauls per day and target fishery; Hook-and-line Catcher Processors

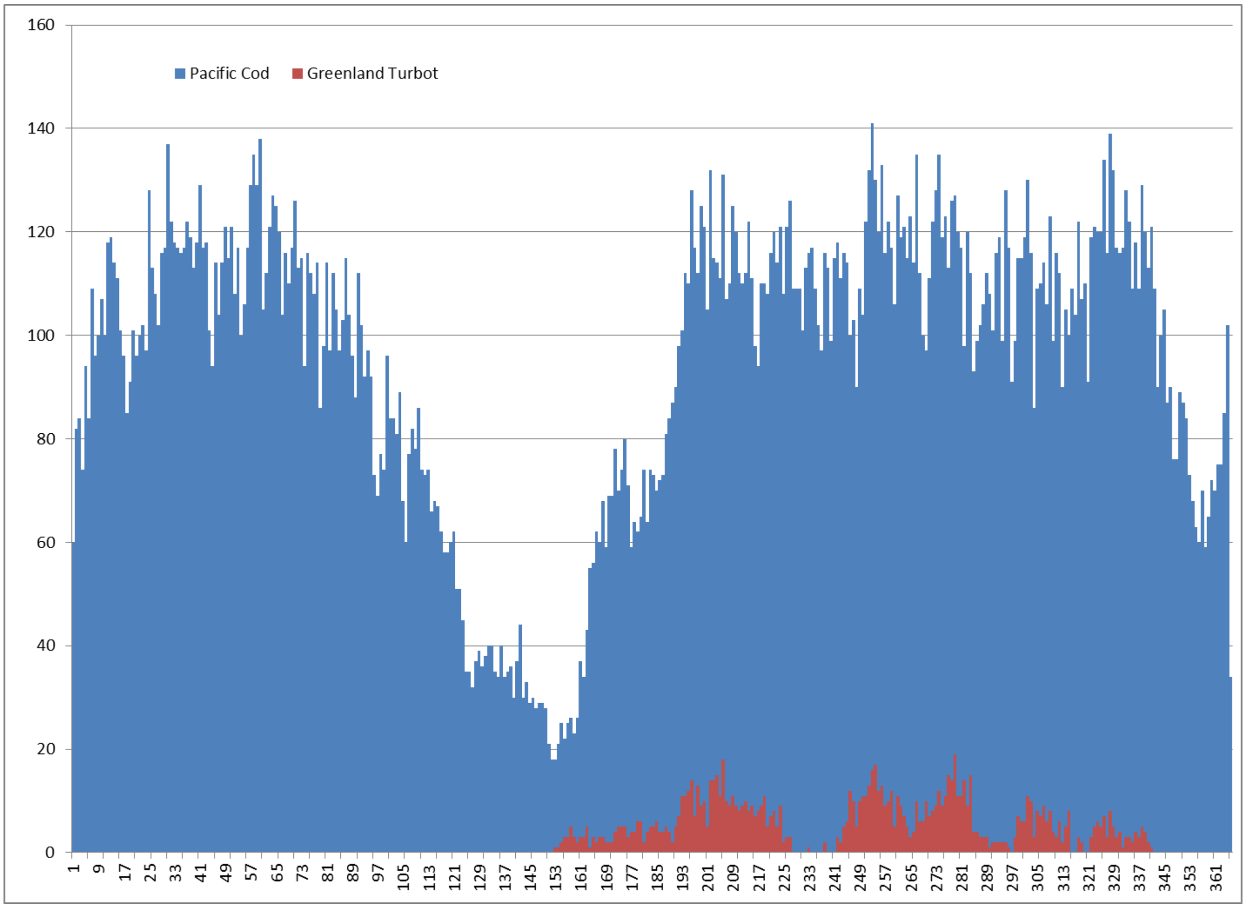
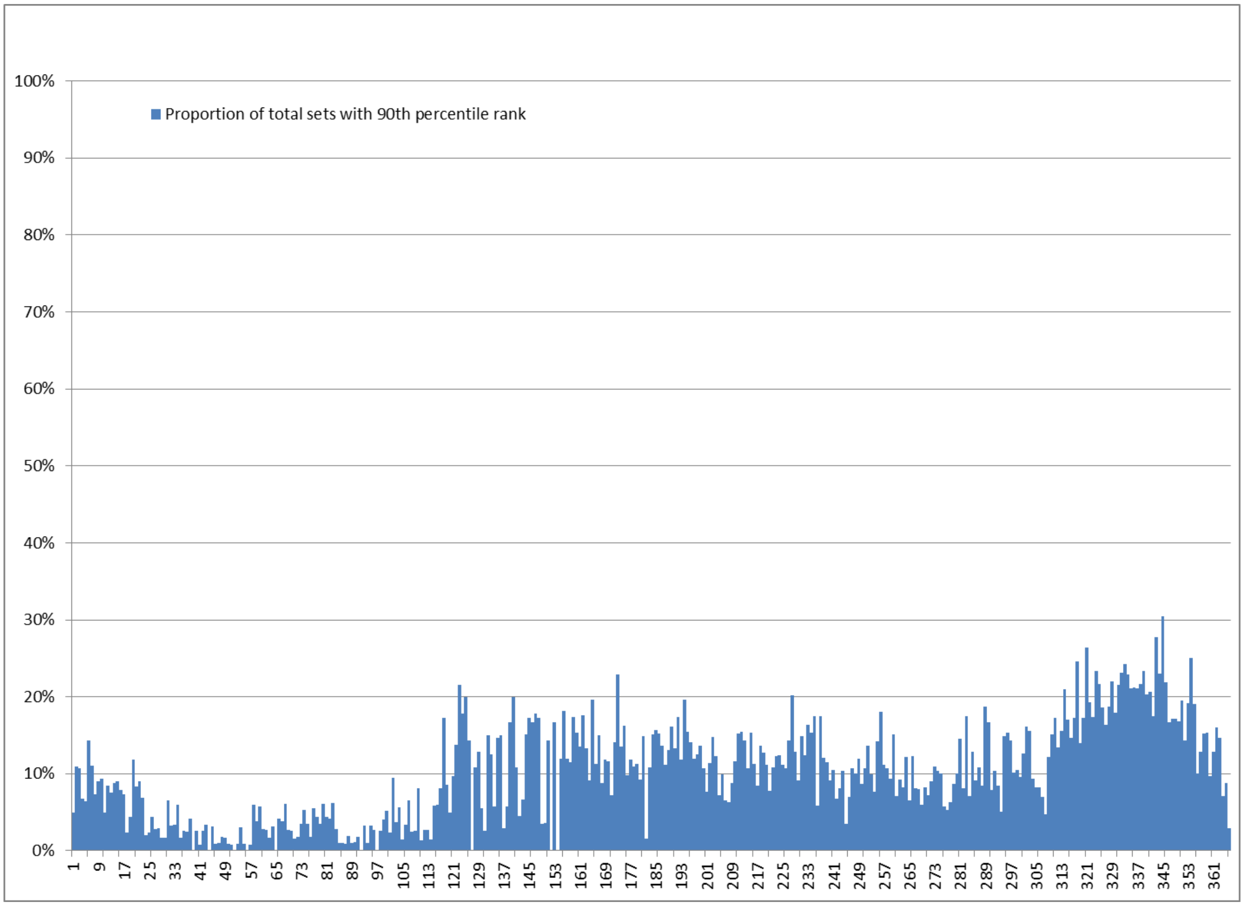


Figure 11 shows the proportion of total sets with a high rate (90th percentile rate) by day. Days with proportions above 10% indicate periods of time where halibut PSC is higher. Figure 11 shows that high halibut PSC rate sets tend to occur at a fairly consistent rate throughout the year with a slight increase toward the end of the year. NMFS did not specifically research potential reasons for a greater proportion of slightly higher halibut PSC rates toward the end of the year.

Figure 11 Proportion of total hauls with a 90th percentile rate or higher; Hook-and-line Catcher Processors



Reducing fishing or changing behavior during the time periods with higher halibut PSC may result in some mitigation of the impacts of a PSC reduction. Fishing that occurs earlier in the year trends towards lower halibut PSC. However, this sector's Pacific cod allocation is seasonally split 50% for the A season and 50% for the B season. Therefore, there are likely practical limitations in the amount of catch that could be shifted to earlier periods of the year under current management. However, the prevalence of higher rates at the end of year could indicate changes in operational decisions made by the hook-and-line catcher/processor fleet as it becomes clear that halibut PSC limits will not be constraining.

B.4.4 Prevalence of high rates; Vessel specific analysis

Table 8 shows the proportion of sets with a high rate (in excess of the 90th percentile) by vessel. To protect confidentiality, vessels were assigned a random letter and reordered. These data allow the identification of vessels that have higher or lower performance in avoiding high rates of halibut Vessels that have not participated in all of the years analyzed were removed. This fleet has undergone considerable consolidation in recent years and vessel participation is more sporadic than in other fleets. Vessel X and Y were blacked out to prevent release of confidential information because these vessels did not participate in one of the years from 2008 through 2014. The data from these vessels was used in the calculation of rates because the vessels are otherwise consistently active.

Some vessels, B, Q, and R have very high performance in avoidance of high rates of halibut, while other vessels, M, P, and Z have difficulty in avoiding high rates. Those vessels with lower performance in earlier years have higher performance in recent years, possibly indicating a change in behavior to avoid high rates of halibut.

Table 8 Proportion of high rates by vessel; Hook-and-line Catcher Processors

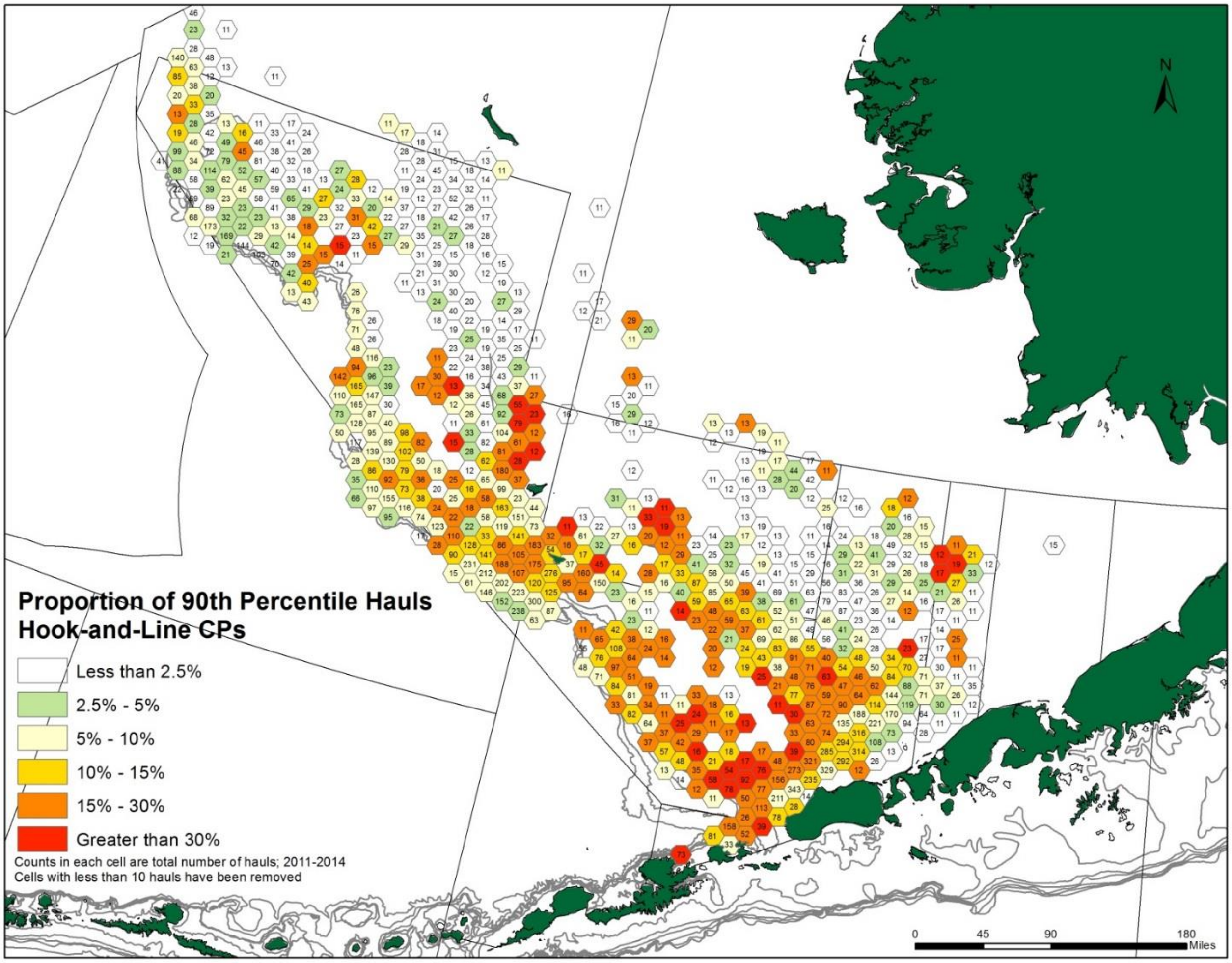
	2008	2009	2010	2011	2012	2013	2014
A	15%	12%	7%	10%	7%	12%	17%
B	7%	3%	4%	1%	5%	10%	3%
C	22%	23%	6%	17%	5%	8%	5%
D	18%	32%	19%	2%	4%	2%	10%
E	39%	12%	22%	8%	14%	4%	7%
F	8%	3%	3%	7%	15%	12%	9%
G	7%	11%	0%	8%	3%	16%	14%
H	12%	21%	40%	3%	10%	16%	8%
I	38%	15%	10%	12%	15%	6%	8%
J	3%	20%	12%	25%	20%	8%	3%
K	45%	18%	39%	12%	10%	3%	7%
L	8%	13%	10%	4%	6%	12%	4%
M	45%	28%	42%	19%	22%	8%	5%
N	21%	17%	26%	0%	5%	11%	6%
O	21%	14%	11%	14%	14%	7%	5%
P	36%	21%	26%	26%	29%	15%	11%
Q	6%	8%	3%	3%	3%	11%	1%
R	2%	12%	14%	3%	10%	2%	3%
S	23%	9%	16%	22%	9%	14%	9%
T	0%	0%	0%	9%	14%	17%	8%
U	14%	11%	13%	17%	12%	13%	4%
V	10%	17%	13%	26%	7%	4%	27%
W	10%	9%	1%	16%	9%	14%	9%
X	[redacted]						
Y	[redacted]						
Z	21%	22%	29%	16%	25%	2%	11%

B.4.5 Prevalence of high rates; spatial analysis

Figure 12 shows where there is a greater proportion of hauls with halibut rates more than 103 kg/mt of halibut (90th percentile). To preserve confidentiality, cells with less than 10 hauls were removed and the data represents all hauls from 2011 through 2014. The colors represent the proportion of total hauls and the numbers in each cell represent the total number of hauls from 2011 through 2014. This allows for comparison between the effort in a cell with the proportion of high rate hauls.

As is clear from Figure 12, the area north of Unimak Island had high halibut PSC rates relative to other areas with substantial fishing effort. The area immediately north of the Pribilof Islands and an area west of St George also showed higher halibut PSC rates. More northerly and easterly areas tend to show lower halibut PSC rates. The importance of areas with relatively high halibut PSC rates is not is not available for this analysis, however, the dispersion of fishing effort outside of these areas could be a method the fleet could use to further reduce halibut PSC rates.

Figure 12 Spatial analysis of 90th percentile hauls; Hook-and-line Catcher Processors



B.5 References

Abbott, J., Haynie, A. & Reimer, M., 2015. Hidden Flexibility: Institutions, Incentives, and the Margins of Selectivity in Fishing. *Land Economics*. Available at: http://le.uwpress.org/content/91/1/169.short [Accessed May 2, 2015].

Alaska Groundfish Databank, 2014. *Final Report Rockfish Cooperatives, 2014*, Available at: http://www.npfmc.org/wp-content/PDFdocuments/catch_shares/CoopRpts2014/2014CatcherVesselRockfish.pdf.

Cahalan, J., Mondragon, J. & Gasper, J., 2010. *Catch sampling and estimation in the federal groundfish fisheries off Alaska*, Available at: https://www.afsc.noaa.gov/Publications/AFSC-TM/NOAA-TM-AFSC-205.pdf [Accessed May 11, 2015].