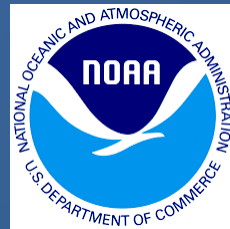


# Halibut DMRs – new aggregation and estimation methods



**NORTH PACIFIC**  
Fishery Management Council



# Action

- Review alternative estimation and application methods and make recommendations to working group, as needed, for application of alternative DMRs in 2017

# Background

- Proportion of incidentally captured halibut that do not survive after being returned to the water
- Management of groundfish fisheries
  - Projections applied for 3 years
- Halibut assessment
  - Annual DMR estimates used for bycatch mortality
- Long-term (10 year) averages of annual estimates within target fisheries
- Based on observer sampling of halibut viabilities

$$DMR_g = \frac{\hat{M}_g}{\hat{D}_g}$$

# Viabilities

**Assumed gear/condition-specific mortality probabilities for halibut in calculating DMRs.**

Gear	Condition			
	Excellent	Poor	Dead	
Trawl <sup>a</sup>	0.20	0.55	0.90	
Pot <sup>b</sup>	0.00	1.00	1.00	
	Minor	Moderate	Serious	Dead
Longline <sup>c</sup>	0.035	0.363	0.662	1.000

From <sup>a</sup> Clark et al. (1992), <sup>b</sup> Williams (1996), and <sup>c</sup> Kaimmer and Trumble (1998)

IPHC Review

16% for sub-legals in  
directed fishery  
Peltonen (1969)

# Background

- Transition in responsibility



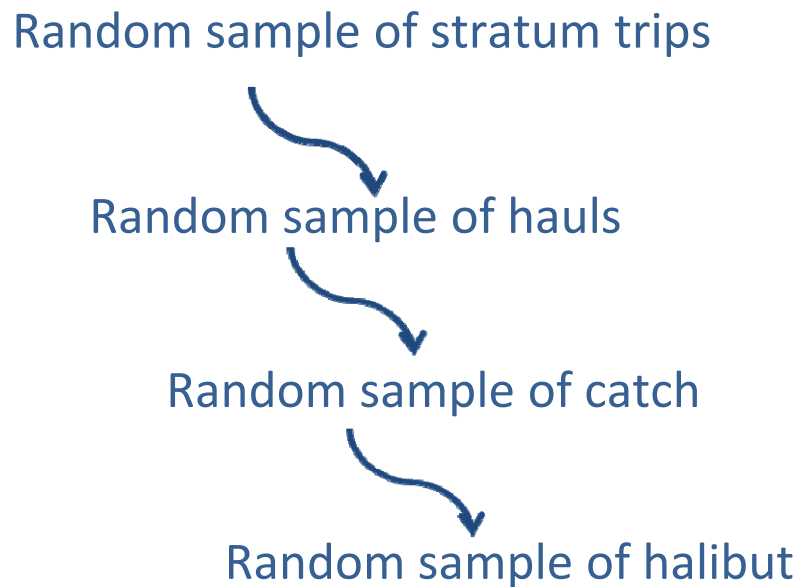
- Improvements in the methodology for calculating DMRs needed (NPFMC 2016)
  - Replication
  - Definition of Target Fishery
  - Declining viability assessments
  - DMR aggregation methods
  - Length of reference timeframe

# General Approach

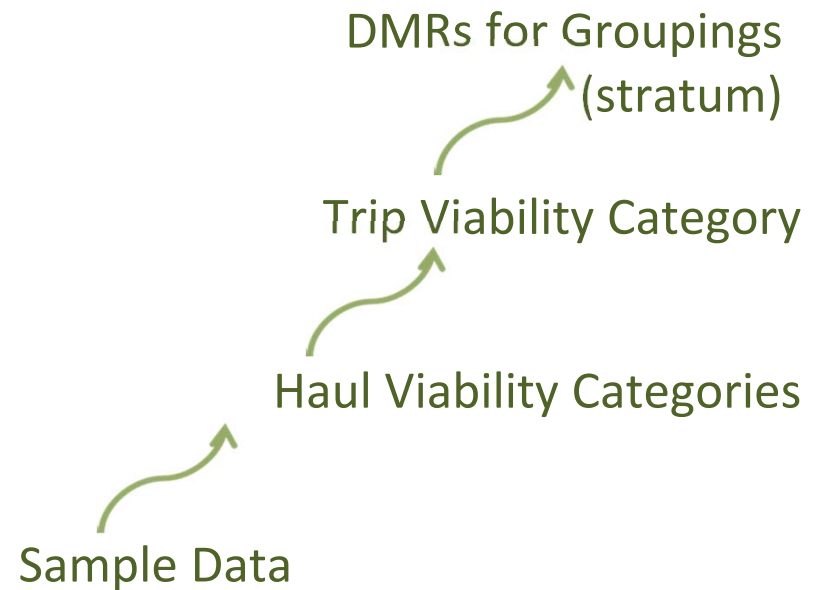
- Consistency with Observer Program sampling design
- Consistency with the operational causes of variation in DMRs

# Hierarchical Design

## Sampling



## Estimation



## Weight in Each Category and Grouping (trip)

$$\hat{D}_{ctg} = \hat{D}_{tg} \hat{p}_{ctg}$$

Category Grouping Weight = CAS Trip Discard \* Proportion

Hauls to  
Operational Groupings  
within trip



$$\hat{p}_{ctg} = \frac{\sum_{j=1}^{J_t} \hat{D}_{cjtg}}{\sum_c \sum_{j=1}^{J_t} \hat{D}_{cjtg}} = \frac{\hat{D}_{ctg}}{\hat{D}_{tg}}$$

## Weight in Each Viability Category (haul)

$$\hat{D}_{cj} = \hat{D}_j \hat{p}_{cj}$$

Category Weight = Discard \* Proportion



Halibut Discard Weight  
(observer data)

Halibut weight in each  
viability category

$$\hat{p}_{cj} = \frac{\sum_{k=1}^{K_j} w_{cjk}}{\sum_c \sum_{k=1}^{K_j} w_{cjk}} = \frac{w_{cj}}{w_j}$$

Sample Data

## DMR for each Grouping (stratum)



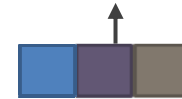
DMR = Sum (Category Mortality) / Total Discard

$$\hat{DMR}_g = \frac{\hat{M}_g}{\hat{D}_g}$$

Category Mortality = sum(Mortality Rate \* Category Grouping Weight)

IPHC Mortality

$$\hat{M}_g = \sum_c R_c \hat{D}_{cg} = \sum_c R_c \hat{D}_g \hat{p}_{cg}$$



## Weight in Each Category and Grouping (trip)

$$\hat{D}_{cg} = \hat{D}_g \hat{p}_{cg}$$

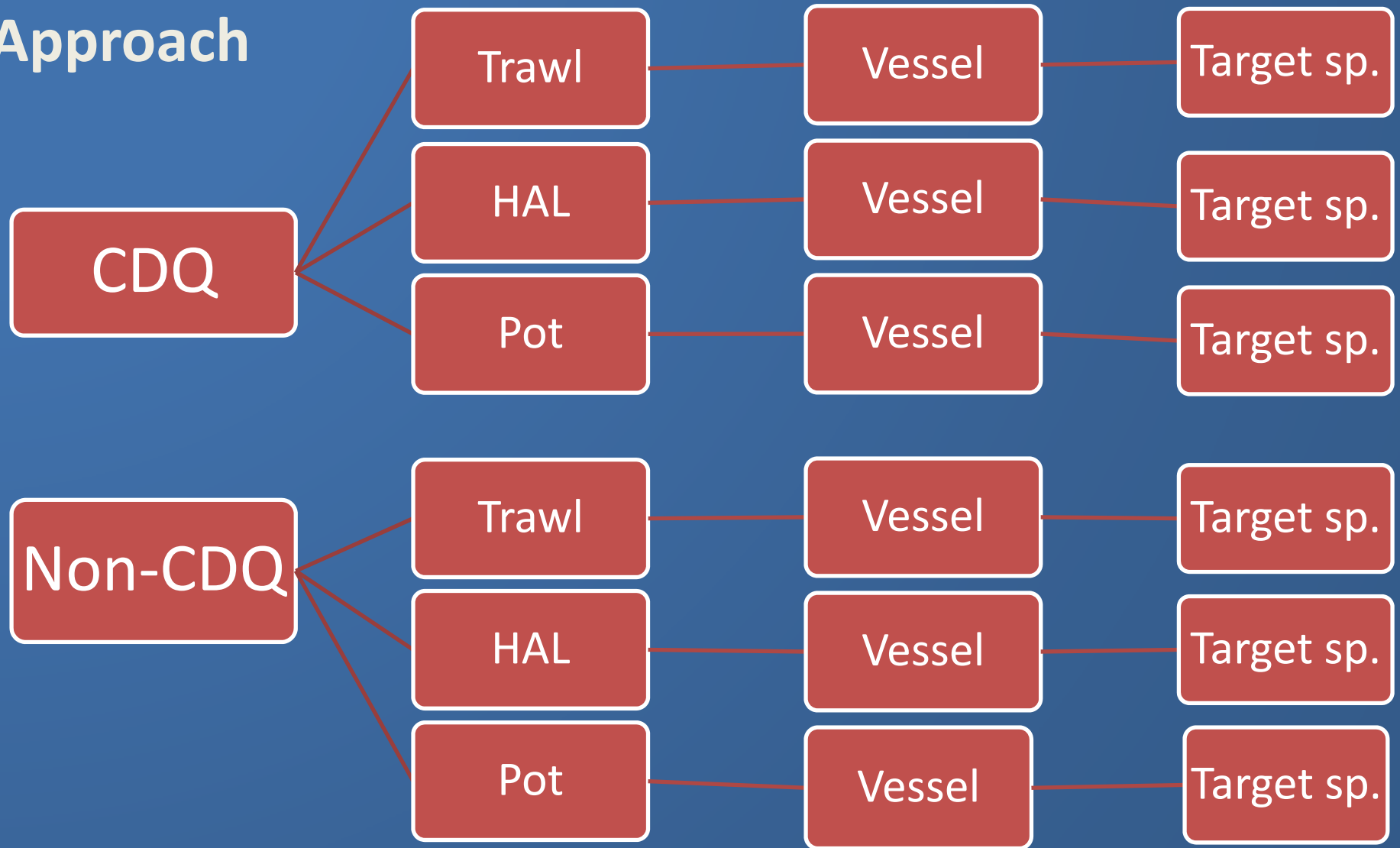
Category Grouping Weight = CAS Total Discard \* Proportion

Trip to  
Operational Groupings  
within stratum



$$\hat{p}_{cg} = \frac{\sum_{t=1}^T \hat{D}_{ctg}}{\sum_c \sum_{t=1}^T \hat{D}_{ctg}} = \frac{\hat{D}_{cg}}{\hat{D}_g}$$

## Current Approach



# Operational Causes of DMR variation

## Time out of water

Discard at rail

On deck  
sorting

Factory  
sorting

"Aging"

Shoreside  
sorting

HAL CV,  
CP

Pot CV, CP

Trawl CV

Trawl CP,  
Mothership

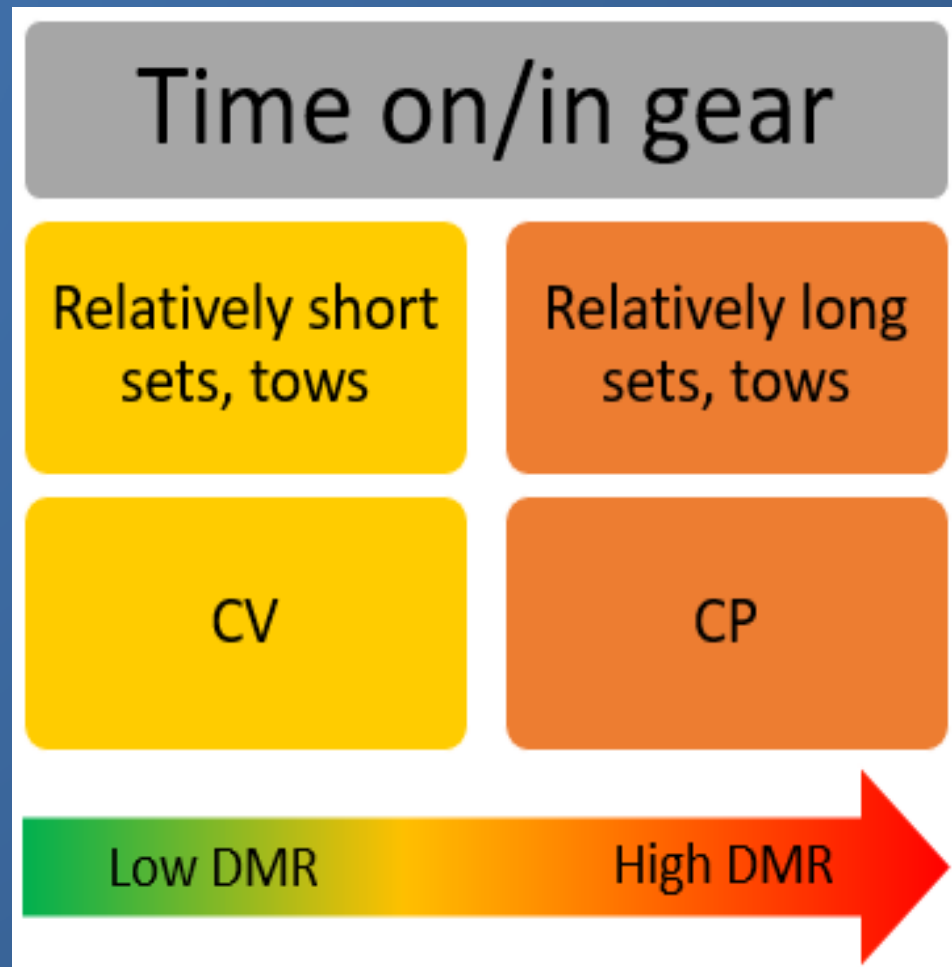
PTR  
Pollock CP

Unsorted  
Trawl CV

Low DMR

High DMR

# Operational Causes of DMR variation



# Operational Causes of DMR variation

## Occurrence of physical injury

### Gear

### Vessel

Hook injury,  
"sand fleas"

Puncture by  
fish spines

Compression,  
abrasion

Dehooking  
injury

Injury in  
factory

Injury,  
asphyxiation  
in hold

HAL CV,CP

Trawl, esp.  
RPP

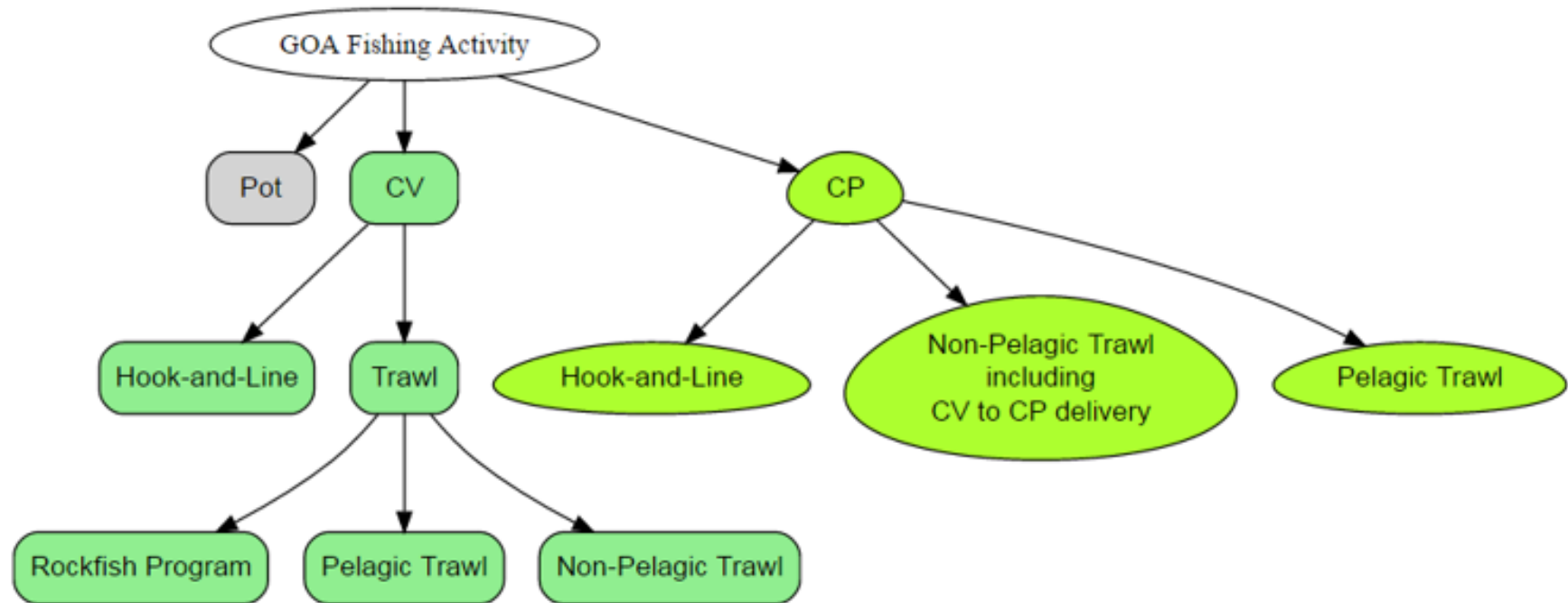
Trawl CV, CP

HAL CV, CP

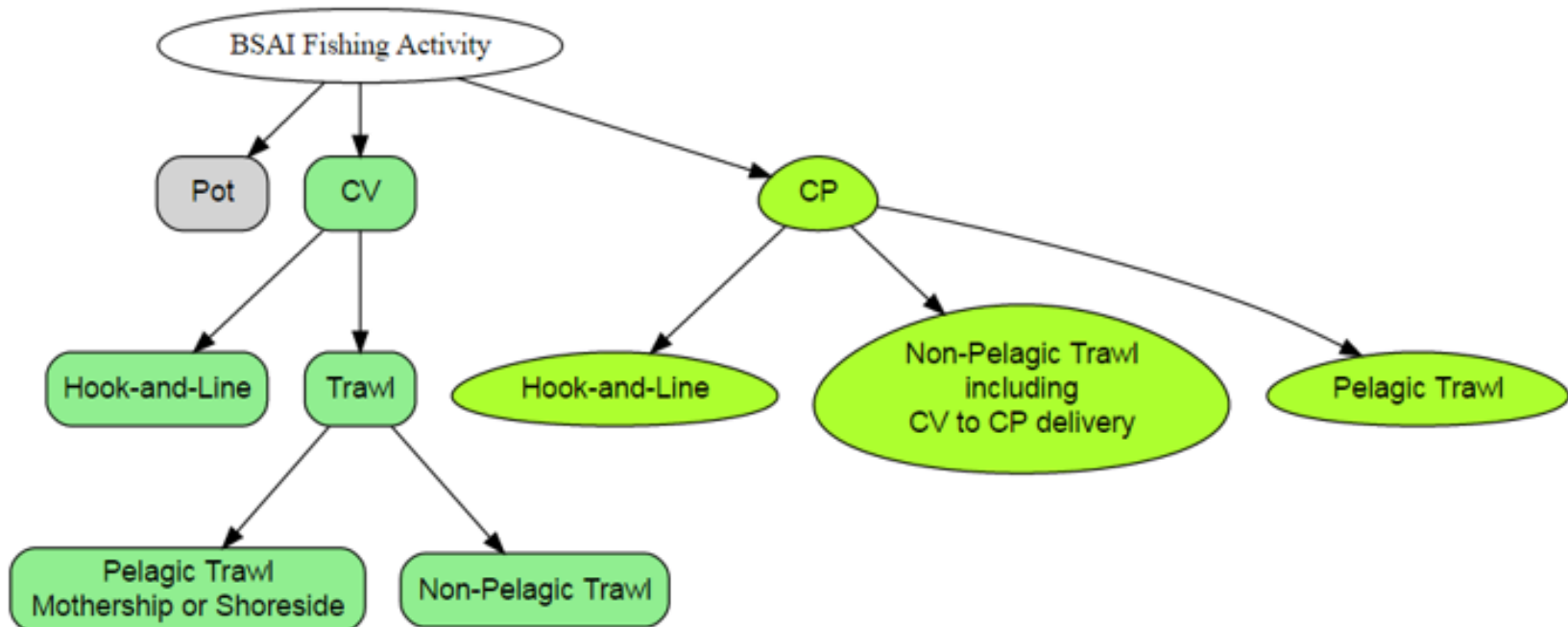
Trawl CP

RPP,  
PTR CP

# Operational Groupings



# Operational Groupings



# Results

Operational Group				Sample Size (Mean Annual N <sub>Viabilities</sub> )	Estimate DMR?	DMR
Sector	Region	Gear	Target			
CP	BSAI	PTR	pollock	6,562	N	100%
			non-pollock	1	N	100%
		NPT	all	3,625	Y	85%
		HAL	all	11,210	Y	8%
		POT	all	760 <sup>b</sup>	Y	5%
	GOA	PTR	pollock	0	N	100%
			non-pollock	0	N	100%
		NPT <sup>a</sup>	all	546	N	85%
		HAL	all	1,295	Y	11%
		POT	all	547 <sup>c</sup>	Y	10%
CV	BSAI	PTR	pollock	569	N	100%
			non-pollock	14	N	100%
		NPT	all	2,138	Y	52%
		HAL	all	62 <sup>d</sup>	Y	13%
		POT	all	760 <sup>b</sup>	Y	5%
	GOA	PTR	pollock	2	N	100%
			non-pollock	4	N	100%
		NPT	RPP	0	N	66%
			non-RPP	1,477	Y	63%
		HAL	all	490	Y	12%
		POT	all	547 <sup>c</sup>	Y	10%

# Trawl DMRS

## Results

	VIABILITIES							
	2009	2010	2011	2012	2013	2014	2015	2016
CP	22236	13797	12189	8614	9310	6139	2853	11659
BSAI	21065	13228	11286	8023	8886	5975	2852	11537
NPT	8967	7375	2363	1410	2868	1928	463	9074
PTR	12098	5853	8923	6613	6018	4047	2389	2463
GOA	1171	569	903	591	424	164	1	122
NPT	1170	569	903	591	424	164	1	122
PTR	1	0	0	0	0	0	0	0
CV	3724	4825	5899	5803	3067	3547	2552	3884
BSAI	1937	2428	4234	2921	2406	3002	2112	2503
NPT	765	2151	2972	2228	2090	2780	1977	2431
PTR	1172	277	1262	693	316	222	135	72
GOA	1787	2397	1665	2882	661	545	440	1381
NPT	1783	2369	1664	2882	657	545	440	1381
PTR	4	28	1		4	0	0	0
Grand Total	25960	18622	18088	14417	12377	9686	5405	15543

	DMRs							long term average	2013-2015 average
	2009	2010	2011	2012	2013	2014	2015		
CP									
BSAI									
NPT	88.34%	85.24%	83.08%	84.22%	86.99%	85.52%	83.65%	85%	85%
PTR	90.0%	90.0%	89.9%	89.9%	90.0%	90.0%	90.0%	90%	90%
GOA									
NPT	79.37%	82.66%	76.42%	84.61%	80.98%	86.81%	90.00%	82%	84%
PTR	20.0%							20%	NA
CV									
BSAI									
NPT	83.57%	72.12%	62.32%	68.00%	44.13%	51.58%	59.03%	63%	52%
PTR	83.8%	79.3%	87.0%	89.9%	88.0%	82.7%	79.5%	84%	83%
GOA									
NPT		60.24%	52.73%	58.23%	60.50%	65.29%	64.69%	60%	63%
PTR		20.0%			20.0%			20%	20%

# Results

## HAL DMRs

	VIABILITIES							
	2009	2010	2011	2012	2013	2014	2015	2016
<b>CP</b>	<b>11551</b>	<b>10704</b>	<b>13373</b>	<b>13156</b>	<b>15994</b>	<b>11781</b>	<b>10977</b>	<b>4465</b>
BSAI	10323	9015	11261	12837	15348	10332	9356	3658
GOA	1228	1689	2112	319	646	1449	1621	807
<b>CV</b>	<b>90</b>	<b>163</b>	<b>18</b>	<b>127</b>	<b>933</b>	<b>1236</b>	<b>1048</b>	<b>519</b>
BSAI					11	82	94	5
GOA	90	163	18	127	922	1154	954	514
<b>Grand Tot</b>	<b>11641</b>	<b>10867</b>	<b>13391</b>	<b>13283</b>	<b>16927</b>	<b>13017</b>	<b>12025</b>	<b>4984</b>

	DMRs									
	2009	2010	2011	2012	2013	2014	2015	2016	long term average	2013-2015 average
<b>CP</b>										
BSAI	9.56%	8.42%	9.83%	7.80%	8.97%	8.49%	7.86%		8.70%	8.44%
GOA	8.2%	9.3%	9.1%	8.7%	12.2%	9.5%	10.5%		9.64%	10.73%
<b>CV</b>										
BSAI	NA	NA	NA	NA	NA	21.92%	3.50%		12.71%	12.71%
GOA	NA	9.52%	5.32%	37.28%	12.66%	8.94%	15.06%		14.79%	12.22%

# Pot DMRs

	<b>VESSELS</b>						
	<b>2009</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>
BSAI	16	25	32	26	21	20	24
GOA	9	11	16	15	26	17	32
<b>Grand</b>	<b>25</b>	<b>36</b>	<b>48</b>	<b>41</b>	<b>47</b>	<b>37</b>	<b>56</b>

	<b>HAULS</b>						
	<b>2009</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>
BSAI	129	236	348	428	259	264	310
GOA	42	40	200	228	163	68	208
<b>Grand</b>	<b>171</b>	<b>276</b>	<b>548</b>	<b>656</b>	<b>422</b>	<b>332</b>	<b>518</b>

	<b>VIABILITIES</b>						
	<b>2009</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>
BSAI	231	616	1259	1502	491	498	723
GOA	78	179	1067	1070	363	179	891
<b>Grand</b>	<b>309</b>	<b>795</b>	<b>2326</b>	<b>2572</b>	<b>854</b>	<b>677</b>	<b>1614</b>

	<b>DMRs</b>								
	<b>2009</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>	<b>long term average</b>	<b>2013-2015 average</b>
BSAI	NA	23.68%	15.28%	8.60%	5.19%	3.06%	6.87%	10.45%	5.04%
GOA	NA	7.53%	4.31%	16.27%	16.20%	10.25%	2.38%	9.49%	9.61%

Non-CDQ			CDQ		
Gear	Fishery	DMR (%)	Gear	Fishery	DMR (%)
Trawl	Alaska plaice	66	Trawl		
	Arrowtooth flounder	84			
	Atka mackerel	82		Atka mackerel	82
	Flathead sole	72		Flathead sole	79
	Greenland turbot	82		Greenland turbot	89
	Non-pelagic pollock	84		Non-pelagic pollock	86
	Pelagic pollock	81		Pelagic pollock	90
	Other flatfish	88			
	Other species	63			
	Pacific cod	66		Pacific cod	87
	Rockfish	66		Rockfish	70
	Rock sole	86		Rock sole	86
	Sablefish	66			
	Yellowfin sole	84		Yellowfin sole	85
Hook and line	Greenland turbot	11	Hook and line	Greenland turbot	10
	Other species	9			
	Pacific cod	9		Pacific cod	10
	Rockfish	9			
Pot	Other species	9	Pot		
	Pacific cod	9		Pacific cod	1
				Sablefish	41

Table 6. 2016 and 2017 Pacific Halibut Discard Mortality Rates for the **GOA**, as established in the annual harvest specifications

Gear	Fishery	DMR (%)	Gear	Fishery	DMR (%)
Trawl	Arrowtooth flounder	76	Hook and line	Other fisheries <sup>1</sup>	10
	Deepwater flatfish	62		Pacific cod	10
	Flathead sole	67		Rockfish	10
	Non-pelagic pollock	58			
	Other fisheries <sup>1</sup>	62	Pot	Other fisheries <sup>1</sup>	15
	Pacific cod	62		Pacific cod	15
	Pelagic pollock	65			
	Rex sole	72			
	Rockfish	65			
	Sablefish	59			
	Shallow-water flatfish	66			

<sup>1</sup>"Other fisheries" includes all gear types for skates, sculpins, squids, octopuses, and hook-and-line sablefish.

# GOA Changes

Variable, but mostly smaller DMR  
– NPT CV

Larger DMR  
- All others

2015 Gulf of Alaska Halibut Mortality using proposed DMRs (as of August 30, 2016)

				Current		Target	New		Difference	
Gear	Sector	Program	Halibut PSC	DMR	Halibut mortality		DMR	Halibut mortality	Current minus New	PSC limit
								-	-	
NPT	CV	OA	150	0.60	90	Bottom pollock	0.63	95	(5)	
NPT	CV	OA	757	0.62	469	Pacific cod	0.63	477	(8)	
NPT	CV	OA	99	0.67	66	Shallow water flatfish	0.63	62	4	
NPT	CV	OA	0	0.66	0	Rockfish	0.63	0	0	
NPT	CV	OA	3	0.71	2	Pelagic pollock	0.63	2	0	
NPT	CV	OA	-	0.71	-	Shallow water flatfish	0.63	-		
NPT	CV	OA	488	0.73	356	Arrowtooth flounder	0.63	307	49	
NPT	CV	OA	8	0.69	5	Rex sole	0.63	5	0	
HAL	CP	OA	628	0.11	69	Pacific cod	0.11	69	-	
HAL	CP	OA	0	0.11	0	Other species	0.11	0	-	116

# GOA Changes

Variable, but mostly smaller DMR  
– NPT CV

Larger DMR  
- All others

2015 Gulf of Alaska Halibut Mortality using proposed DMRs (as of August 30, 2016)

				Current			New		Difference	
Gear	Sector	Program	Halibut PSC	DMR	Halibut mortality	Target	DMR	Halibut mortality	Current minus New	PSC limit
									-	
NPT	CP	OA	0	0.60	0	Bottom pollock	0.85	0	(0)	
NPT	CP	OA	1	0.62	1	Pacific cod	0.85	1	(0)	
NPT	CP	OA	-	0.43	-	Deep water flatfish	0.85	-	-	
NPT	CP	OA	62	0.67	41	Shallow water flatfish	0.85	53	(11)	
NPT	CP	OA	46	0.66	30	Rockfish	0.85	39		
NPT	CP	OA	4	0.65	2	Flathead sole	0.85	3	(1)	
NPT	CP	OA	0	0.71	0	Sablefish	0.85	0	(0)	
NPT	CP	OA	306	0.73	223	Arrowtooth flounder	0.85	260	(37)	
NPT	CP	OA	35	0.69	24	Rex sole	0.85	30	(6)	
NPT	CP	RPP	77	0.66	51	Rockfish	0.85	65	(15)	
NPT	CP	RPP	3	0.73	2	Arrowtooth flounder	0.85	3	(0)	
PTR	CP	OA	-	0.66	-	Rockfish	1.00	-	-	
Total			4,002		1,620			1,677	(57)	2,021
Summary										
Hook-and-line CV			1,262		139			151	(13)	145
Hook-and-line CP			628		69			69	-	116
Trawl			2,112		1,413			1,457	(44)	1,759
Total			4,002		1,620			1,677	(57)	2,020

# BSAI Changes

Variable, but mostly smaller DMR

- HAL CP
- NPT CV

Larger DMR

- All others

2015 BSAI Halibut Mortality using proposed DMRs (run on 8/30/2016, does not include decksorting EFP)

				Current			New		Difference
Gear	Sector	Program	Halibut PSC	DMR	Halibut mortality		DMR	Halibut mortality	Current minus New
HAL	CP	CDQ	221	0.10	22	Pacific cod	0.08	18	4
HAL	CP	IFQ	-	0.04	-	Rockfish	0.08	-	-
HAL	CP	OA	0	0.09	0	Bottom pollock	0.08	0	0
HAL	CP	OA	3,207	0.09	289	Pacific cod	0.08	257	32
HAL	CP	OA	2	0.09	0	Other species	0.08	0	0
HAL	CP	OA	24	0.13	3	Greenland turbot	0.08	2	1

## 2015 BSAI Halibut Mortality using proposed DMRs (run on 8/30/2016, does not include decksorting EFP)

				Current		Target	New		Difference
Gear	Sector	Program	Halibut PSC	DMR	Halibut mortality		DMR	Halibut mortality	Current minus New
NPT	CP	A80	-	0.64	-	Greenland turbot	0.85	-	-
NPT	CP	A80	51	0.71	36	Pacific cod	0.85	44	(7)
NPT	CP	A80	3	0.71	2	Alaska Plaice	0.85	2	(0)
NPT	CP	A80	-	0.71	-	Other flatfish	0.85	-	-
NPT	CP	A80	61	0.73	44	Flathead sole	0.85	51	(7)
NPT	CP	A80	58	0.76	44	Kamchatka flounder	0.85	49	(5)
NPT	CP	A80	82	0.76	62	Arrowtooth flounder	0.85	70	(7)
NPT	CP	A80	111	0.77	85	Atka mackerel	0.85	94	(9)
NPT	CP	A80	23	0.77	18	Bottom pollock	0.85	20	(2)
NPT	CP	A80	75	0.79	60	Rockfish	0.85	64	(5)
NPT	CP	A80	696	0.83	578	Yellowfin sole	0.85	592	(14)
NPT	CP	A80	559	0.85	475	Rock sole	0.85	475	-
NPT	CP	CDQ	3	0.76	3	Arrowtooth flounder	0.85	3	(0)
NPT	CP	CDQ	0	0.79	0	Flathead sole	0.85	0	(0)
NPT	CP	CDQ	0	0.80	0	Rockfish	0.85	0	(0)
NPT	CP	CDQ	1	0.83	1	Bottom pollock	0.85	1	(0)
NPT	CP	CDQ	8	0.86	7	Atka mackerel	0.85	7	0
NPT	CP	CDQ	48	0.86	42	Yellowfin sole	0.85	41	0
NPT	CP	CDQ	27	0.88	24	Rock sole	0.85	23	1
NPT	CP	CDQ	12	0.90	11	Pacific cod	0.85	10	1
NPT	CP	OA	18	0.71	13	Pacific cod	0.85	15	(2)
NPT	CP	OA	3	0.73	2	Flathead sole	0.85	3	(0)
NPT	CP	OA	1	0.77	1	Atka mackerel	0.85	1	(0)
NPT	CP	OA	0	0.77	0	Bottom pollock	0.85	0	(0)
NPT	CP	OA	66	0.83	55	Yellowfin sole	0.85	56	(1)
NPT	CP	OA	1	0.85	1	Rock sole	0.85	1	-

# BSAI Changes

Variable, but mostly smaller DMR

- HAL CP
- NPT CV

Larger DMR

- All others

2015 BSAI Halibut Mortality using proposed DMRs (run on 8/30/2016, does not include decksorting EFP)

				Current		Target		New		Difference
Gear	Sector	Program	Halibut PSC	DMR	Halibut mortality			DMR	Halibut mortality	Current minus New
PTR	CP	AFA	7	0.77	5	Bottom pollock		1.00	7	(2)
PTR	CP	AFA	78	0.88	69	Pelagic pollock		1.00	78	(9)
PTR	CP	AIP	-	0.77	-	Bottom pollock		1.00	-	-
PTR	CP	AIP	-	0.79	-	Rockfish			-	-
PTR	CP	AIP	-	0.88	-	Pelagic pollock		1.00	-	-
PTR	CP	CDQ	0	0.83	0	Bottom pollock		1.00	0	(0)
PTR	CP	CDQ	8	0.90	8	Pelagic pollock		1.00	8	(1)
Total			5,942		2,312				2,300	12

# Changes Relative to PSC Limits

## BSAI

BSAI Sector		2016 Halibut mortality			2016 Halibut PSC Limit	2015 Halibut mortality			2015 Halibut PSC Limit
		With current DMR	With proposed DMR	Current minus Proposed		With current DMR	With proposed DMR	Current minus Proposed	
Hook-and-line Pacific cod	CV	0	0	(0)	13	2	2	(1)	15
	CP	134	119	-	648	289	257	32	760
Non-trawl	CV/CP	2	1	0	49	3	2	1	58
BSAI trawl limited access	CV/CP	537	502	35	745	485	453	32	875
Amendment 80	CP	918	934	(16)	1,745	1,404	1,461	(57)	2,325
CDQ	CV/CP	110	107	3	315	130	124	6	393
Total		1,701	1,663	38	3,515	2,312	2,299	13	4,426
Does not include the 2016 trawl deck sorting Experimental Fishing Permit (EFP) halibut mortality.									
Does not include the 2015 Amendment 80 deck sorting EFP halibut mortality of 232 mt.									

## GOA

GOA Sector		2016 Halibut mortality			2016 Halibut PSC Limit	2015 Halibut mortality			2015 Halibut PSC Limit
		With current DMR	With proposed DMR	Current minus Proposed		With current DMR	With proposed DMR	Current minus Proposed	
Hook-and-line Pacific cod	CV	151	181	(30)	129	139	151	(12)	145
	CP	46	50	(4)	128	69	69	0	116
Trawl	CV/CP	1,047	1,017	30	1,706	1,413	1,457	(44)	1,760
Total		1,243	1,249	(5)	1,963	1,620	1,677	(57)	2,021

# Review/Questions for the Plan Team

## 1. General approach?

**The Teams recommend moving forward with operational groupings for estimation and application of DMRs, since the operational differences associated with these groupings represent an improvement over target fishery aggregation.**

# Review/Questions for the Plan Team

## 2. Specific operational groupings?

In general the teams .... elaborate on the rationale for these groupings.

Recommend fine tuning (work with the industry as needed).

# Review/Questions for the Plan Team

3. Are the methods for expanding viability samples into strata appropriate?

**The Teams agree that these methods are appropriate.**

# Review/Questions for the Plan Team

## 4. 2013 forward?

The Teams agree

In the future, a different rolling time frame may be used dependent on availability of data, management decision on of how much year to year change is desirable.

# Review/Questions for the Plan Team

5. Are operational groupings for which sample size is an issue appropriately addressed?

**In general, the Teams agree that the treatment of these groupings appears appropriate.**

# Review/Questions for the Plan Team

6. Can the proposed methods be used for management in 2017?

**The Teams recommend that these methods be used for 2017 harvest specifications.**

# Summary Points

- Previous process
- New process
  - Consistent with sampling design
  - Operationally based
  - Abbreviated reference timeframe
  - Interagency
  - Review at all levels
  - Transparency/Transferability
  - Feedback to Observer Program
  - Ongoing Improvements

## Next Steps (Short Term)

1. Revisions, improvements to supporting document
2. Final review by PT in November
3. Final review by SSC, AP, Council in December
4. Specification for 2017

## Next Steps (Long Term)

1. Further refinement through engagement with industry
  - a) Resolve issues with RPP CVs
  - b) Other
2. Variance estimation
3. Respond to IPHC basis review
4. Final review by SSC, AP, Council in December
5. Specification for 2017