

## **Analysis of Management Options for the Area 2C and 3A Charter Halibut Fisheries for 2017**

A Report to the North Pacific Fishery Management Council

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### **1.0 Introduction**

The International Pacific Halibut Commission (IPHC) approves catch limits for Pacific halibut each year for several regulatory areas in Alaska. In IPHC regulatory areas 2C and 3A, which roughly corresponding with Southeast and Southcentral Alaska, these catch limits are allocated between the commercial longline fishery and the sport charter fishery. The allocations are specified in the North Pacific Fishery Management Council's Halibut Catch Sharing Plan (CSP) for Areas 2C and 3A<sup>1</sup>. The allocations vary with the magnitude of the overall catch limit, such that the percentage allocated to the charter sector increases slightly as catch limits decrease. The CSP also specifies that 'wastage,' or discard mortality, of halibut from the charter and commercial sectors will count toward each sector's allocation. The CSP further specifies that, effective in 2014, charter harvest accounting is to be based on numbers of halibut reported harvested in Alaska Department of Fish and Game (ADF&G) charter logbooks.

The charter fishery in Areas 2C and 3A is managed under regulations reviewed and recommended each year by the North Pacific Fishery Management Council, and approved and published by the IPHC as annual management measures. As the first step in this process, the Council's Charter Halibut Management Committee met October 24, 2016 to develop alternative management measures to be analyzed by the ADF&G for the 2017 season. ADF&G staff provided preliminary estimates of charter harvest and release mortality for the 2016 season to committee members prior to the meeting.

In Area 2C, an estimated 66,286 halibut were harvested in the charter fishery, with an average weight of 11.95 lb. The number of halibut harvested was 5.5% lower than the harvest forecast of 70,165 and average weight was about 1.4% higher than the predicted average weight of 11.79 lb. The Area 2C preliminary estimate of charter removals was 0.844 million pounds (M lb), including an estimated release mortality of 0.052 M lb of O26 (fish over 26 inches). The preliminary estimated removals were 3.8% less than the 0.877 M lb removal predicted for 2016, and 6.9% less than the allocation of 0.906 M lb. In Area 3A, an estimated 155,032 halibut were harvested with an average weight of 12.67 lb. The number of fish harvested was 7.1% greater than the forecast of 144,810, and average weight was 3.5% higher than the predicted average weight of 12.24 lb. The preliminary estimate of charter removals for Area 3A was 1.981 M lb, including 0.016 M lb of O26 release mortality. The preliminary estimate was 10.1% greater than the predicted removal of 1.799 M lb and 9.2% greater than the allocation of 1.814 M lb. The preliminary estimates were based on logbook data for trips through July 31, 2016, and will be finalized once all logbook data are received, entered, and edited.

The charter committee considered the performance of last year's measures, and in light of recent trends in effort, average weight, halibut abundance, and economic considerations, identified the following measures for analysis for 2017:

Area 2C (all options include a one-fish bag limit):

- 1) Reverse slot limit<sup>2</sup> (status quo), potentially combined with an annual limit,

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<sup>1</sup> Catch Sharing Plan regulations are at: <https://alaskafisheries.noaa.gov/sites/default/files/finalrules/78fr75844.pdf>

<sup>2</sup> "Reverse slot limit" refers to a protected slot, where anglers can harvest fish that are smaller than or larger than the protected range of lengths.

- 2) Maximum size limit, potentially combined with an annual limit, and

Area 3A (all options include two-fish bag limit, one vessel-trip per permit per day, and Wednesday closure):

- 1) One fish of any size and maximum size limit on one fish ranging from 26 to 30 inches, potentially combined with an annual limit no lower than 4 fish,
- 2) Closure of an additional day of the week from July 1 through Aug 15,
- 3) A reverse slot limit on one fish and a maximum size limit of 28 inches on the second fish, and
- 4) If possible to analyze, status quo measures (one fish of any size plus a second fish with a maximum size limit of 28 inches) plus:
  - a) A one-fish bag limit for the month of July, and
  - b) A one-fish bag limit from mid-June to mid-August.

This analysis provides information to stakeholders and the Council to assist them in selecting management measures, or combinations of measures, that are likely to constrain total charter removals in each regulatory area to catch limits to be determined by the IPHC at their annual meeting in January 2017. The catch limits will not be known when the Council is expected to make its recommendations in December 2016. However, the Council may base recommendations on the Blue Line FCEYs<sup>3</sup> and include contingencies to accommodate adoption of higher or lower FCEYs.

At the Interim Meeting on November 29, 2016, the IPHC announced Blue Line FCEYs of 4.08 M lb for Area 2C and 9.41 M lb for Area 3A. The CSP specifies that in Area 2C, when the FCEY is less than 5 M lb the charter allocation is 18.3% of the FCEY. In Area 3A, the charter allocation is 18.9% of the FCEY when the FCEY is less than 10 M lb. Therefore, the corresponding charter allocations under the Blue Line alternative are 0.747 M lb for Area 2C and 1.778 M lb for Area 3A.

The IPHC also highlighted an FCEY corresponding to the recent three-year average spawning potential ratio (SPR) of the halibut stock. The IPHC is considering accounting for all sizes of halibut removals under an SPR approach. The FCEY levels that maintain the status quo SPR are 4.69 M lb in Area 2C and 10.72 M lb in Area 3A, corresponding with charter allocations of 0.858 M lb in Area 2C and 1.890 M lb in Area 3A.

This analysis projects total charter fishery removals (harvest plus O26 release mortality) under the status quo regulations in each regulatory area. As shown below, the projected charter removal for Area 2C in 2017 under status quo measures is 0.859 M lb, which is 112,000 lb (15%) greater than the Blue Line allocation of 0.747 M lb. The projected removal for Area 3A under status quo measures is 1.951 M lb, which is 173,000 lb (10%) greater than the Blue Line allocation. The differences between projected removals and the status quo SPR allocations are much smaller -- less than 1% in Area 2C and 3% in Area 3A.

Area	Projected Status Quo Charter Removals (M lb)	2017 Blue Line		Maintain Status Quo SPR	
		Charter Allocation (M lb)	Projected Difference M lb (%)	Charter Allocation (M lb)	Projected Difference M lb (%)
2C	0.859	0.747	0.112 (15%)	0.858	0.001 (<1%)
3A	1.951	1.778	0.173 (10%)	1.890	0.061 (3%)

<sup>3</sup> The "Blue Line" FCEY (fishery constant exploitation yield) for Areas 2C and 3A is the combined commercial and charter harvest limit associated with the harvest rates and selectivities specified in the current IPHC harvest policy.

This analysis also projects charter removals over a range of proposed alternative management measures. Whenever possible, the analysis covers a range of alternatives or combinations of measures to allow stakeholders, the Council, and the IPHC to select the desired measures to meet management targets for each area. Where applicable, results will highlight candidate measures that result in projected charter removals that are within the Blue Line or status quo SPR allocation options. However, the IPHC is not limited to these options when setting catch limits. The Council recommendation for each area should include contingencies for higher or lower catch limits and may include buffers for uncertainty in the projected harvests.

## **2.0 General Methods**

### **2.1 Estimation of Removals, Definitions**

Throughout this analysis, the term “harvest” means the number of halibut killed and landed in the charter fishery. “Yield” is the harvest expressed in units of weight. “Release mortality,” or “discard mortality” refers to halibut that die as a result of stress or injury following release in the fishery, and is expressed in units of weight. Finally, “removals” refers to all halibut killed in the sport fishery, including harvest and release mortality, and is measured in units of weight. Removals are generally calculated from harvest, average weight, and release mortality as follows:

$$Yield(lb) = Harvest \times AverageWeight(lb), \text{ and}$$

$$Removals(lb) = Yield(lb) \times r$$

where  $r$  is the release mortality inflation factor, calculated as:

$$r = 1 + [ReleaseMortality(lb)/Yield(lb)].$$

Average net weight (headed and gutted) was calculated from length measurements using the current IPHC length-weight relationship (Clark 1992). Although all calculations and results in this report are in net weight, a table is provided for conversion to round weights, which is how anglers tend to regard halibut harvested in the sport fishery (Table 1).

### **2.2 Calculations by Subarea**

All calculations for Area 2C and Area 3A were done by subarea and then summed to obtain yield estimates for each regulatory area. Analyses were done at the subarea level because most of the variables analyzed (harvest, effort, average weight, etc.) vary substantially by subarea.

There are six subareas in Area 2C and eight subareas in Area 3A (Table 2). With few exceptions, the subareas correspond to ADF&G sport fishery management areas as well as the reporting areas used for the statewide postal survey of sport fishing, or Statewide Harvest Survey (SWHS). The Juneau and Haines/Skagway areas were combined because the Haines/Skagway area is not sampled for average weight and harvests are quite small. The SWHS Area J is split into three subareas: Eastern Prince William Sound (EPWS), Western Prince William Sound (WPWS), and the North Gulf coast (NG). Likewise, Cook Inlet (SWHS Area P) is split into Central Cook Inlet (CCI) and Lower Cook Inlet (LCI) subareas. These SWHS areas were split into subareas such that the landings in each subarea could be matched to estimates of average weight from port sampling. ADF&G collected length data from harvested halibut and interviewed anglers and charter captains in at least one port in each subarea.

### **2.3 Harvest Forecasts**

In past analyses of alternative charter management measures, harvest was typically projected using time series forecasts. Time series forecasts are inherently uncertain because they rely only on past data, which are not necessarily indicative of future trends. On the other hand, charter halibut harvest does not typically deviate much from year to year. Simple and double exponential smoothing models have been used to forecast effort (bottomfish angler-days) and harvest-per-angler-day (HPUE) from logbook data using

SAS/ETS<sup>TM</sup><sup>4</sup> software. Meyer and Powers (2015) describe the rationale and recent history for using exponential smoothing models. Simple exponential models have a single parameter representing the level of the estimates and typically fit best to data without a clear trend. Double exponential models have a parameter for level and a parameter for trend, and typically fit best to data with a trend. Both models contain a smoothing weight, the value of which determines how much weight is given to more recent observations. The smoothing weights are optimized to minimize one-step-ahead prediction errors. Generally, the stronger the trend and lower the variability, the higher the smoothing weight and the more emphasis is placed on recent observations.

For Area 2C, the 2017 harvests were calculated for each subarea as the product of the effort and HPUE forecasts. Simple exponential and double exponential forecasts were made for effort and HPUE using data for 2006-2016 (Table 3), and the forecast with the smallest AICc value (Akaike Information Criterion, corrected for small sample size) was selected. A one-fish bag limit has been in place since 2010, with relatively minor changes in size limits since 2012. Time series forecasts were considered suitable for Area 2C because the minor regulatory changes were likely to have a consistent effect on trends in effort or HPUE.

In Area 3A, on the other hand, there have been substantial and incremental changes in regulations over the last three years that likely affected effort and HPUE. In 2014, a limit of one trip per charter vessel was put into place, along with a maximum size limit of 29 inches on one fish under a two-fish bag limit. In 2015, additional restrictions included closing one day per week from June 15 through August 31 and a five-fish annual limit per angler. In 2016, the maximum size limit on one fish was decreased to 28 inches and the annual limit was dropped to four fish per angler. There was an immediate drop in effort in 2014, especially in Central Cook Inlet, the subarea where it was most common for charter boats to make two trips per day (Table 4). In addition, starting in 2014 there was a marked drop in the proportion of the charter halibut harvest made up of second fish in the bag limit. The largest decreases were at ports with the highest average weights. In other words, at ports with large halibut available, fewer anglers bothered with harvesting a second fish, and instead focused efforts on harvesting one large fish. This caused HPUE to decrease in several subareas. There was another drop in HPUE at several ports when the annual limit of five fish was put into place in 2015, and yet another when the size limit on the second fish was lowered to 28 inches and the annual limit lowered to 4 fish in 2016 (Table 4).

Because recent regulations appear to have had marked effects on effort and HPUE, these changes could bias the time series forecasts. Therefore, harvest for Area 3A was projected using more of an empirical data approach, rather than time series forecasts. This allowed incorporation of observed effects of recent regulations changes directly in the projections under alternative size limits. Harvest was calculated for each subarea as the product of effort and HPUE, as above. The 2016 effort values for each subarea were adopted as status quo effort forecasts for 2017. Because HPUE varied in response to size limits, the observed HPUEs under the 28-inch size limit were used for 26- through 28-inch size limits, the 2014-2015 average HPUEs were used for 29-inch size limits, and the 2014 HPUEs were used for 30-inch size limits.

## **2.4 Projecting Harvest under Annual Limits**

The effects of various annual limits on harvest were estimated using charter logbook data that summarized the distribution of annual harvests by individual anglers. The analysis for Area 2C used 2015 data, and the analysis for Area 3A used 2014 data; these are the most recent complete data from each area without an annual limit. Logbook data were not compiled for youth anglers (under 16) because they are not required to be licensed, and therefore logbook data cannot be used to identify individual youth anglers. Youth effort accounted for a very steady 4.4% of charter effort in Area 2C and 5.3% of charter effort in Area 3A during the years 2012-2015. Because the proportion of youth effort was steady and

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<sup>4</sup> SAS/ETS<sup>TM</sup> software, Version 9.3, SAS System for Windows, Copyright © (2002-2010), SAS Institute, Inc.

relatively low, we assume that the effects of annual limits on harvest is estimated adequately using only data from licensed anglers.

For each subarea, harvests under each proposed annual limit were estimated by truncating the annual harvest of each angler at the annual limit. For example, if 500 anglers harvested five fish each in the base year (2,500 fish total), then under an annual limit of four fish, that group of 500 anglers would only harvest 2,000 fish. The number of anglers that would be affected by each annual limit was calculated as the number of anglers that harvested more than the annual limit in the base year. In the example above, all 500 anglers harvested more than four fish and would be affected by a four-fish annual limit, but anglers that harvested four or fewer fish would be unaffected. Using this approach, the annual harvest by licensed anglers was calculated over a range of annual limits and the percentage reduction in harvest was calculated by comparison to their total harvest without an annual limit. The percentage reductions for each subarea were applied to the projected harvest of all anglers in each subarea without an annual limit, and these were summed to obtain the harvests under each annual limit in Areas 2C and 3A.

Doing the calculations by subarea is inherently conservative because the effect of an annual limit is underestimated for anglers that fish in multiple subareas within a year. For example, if an individual angler caught four fish in each of two subareas in 2014, the analysis by subarea would indicate that a four-fish annual limit would have no effect on that angler's annual harvest in either subarea. In reality, the limit would cut that angler's annual harvest by 50 percent. The degree of underestimation depends on how many anglers fished multiple subareas in a year. By underestimating the percent reductions in harvest associated with each annual limit, the harvest under each annual limit is slightly overestimated. The magnitude of this error was evaluated by comparing the percentage harvest reductions estimated from subarea and areawide data. For 2015, doing calculations by subarea underestimated the percentage reductions in harvest for Area 2C overall by 0.1 to 1.4 percentage points over annual limits of 1 to 5 fish. For an annual limit of 3 halibut in Area 2C, this corresponded to an overestimate of harvest by 0.6%. Likewise, using 2014 data, the subarea method underestimated the percentage reductions in harvest for Area 3A by 0.1 to 4.1 percentage points over annual limits ranging from 1 to 10 fish. For an annual limit of 4 halibut, harvest would be overestimated by 1.5%.

## **2.5 Accounting for Release Mortality of Halibut Over 26 Inches (O26)**

Under the CSP, the charter halibut allocation includes total removals by the charter sector, including directed harvest and estimated release mortality. The CSP rule is vague with respect to sizes of fish to include in this waste. Only the release mortality of halibut  $\geq 26$  inches in length (O26) is included for consistency with treatment of commercial discard mortality by the IPHC. Release mortality has been estimated by size class (O26, U26) for 2013-2016 using methods described in Meyer (2014) for inclusion in the IPHC annual stock assessment as part of sport fishery removals.

The numbers and average weight of released fish are expected to vary with the types of size or bag limits implemented. For example, anglers would be expected to release more fish under a one-fish bag limit than a two-fish bag limit as they search for the largest fish possible to retain. The average weight of released fish would be expected to be higher under maximum size limits or reverse slot limits than under a minimum size limit, because most or all of the released fish would be larger than the retained fish. On the other hand, the number of fish released is likely to be higher under a minimum size limit than a maximum size limit because smaller fish are relatively more abundant and more likely to be caught. Under annual limits on the number of halibut retained, both the number of fish and average weight of released fish would be likely to increase as annual limits are made more restrictive.

In Area 2C, the ratio of release mortality to charter yield (in pounds) was 0.048 under the U45O68 reverse slot limit in 2013, 0.056 under the U44O76 size limit in 2014, 0.060 under the U42O80 size limit in 2015, and 0.065 (preliminary) under the U43O80 size limit in 2016. Although the number of halibut reported released has declined from about 37,000 to 27,000, the estimated average weight of released fish has increased every year and almost doubled since 2013. Because release mortality shows an increasing trend

annually in spite of size limit changes, this ratio was projected for 2017 from the linear trend in 2013-2016 estimates. Therefore, charter fishery removals in Area 2C under a maximum size limit or reverse slot limit were projected by expanding yield by the factor 1.07 to account for release mortality.

In Area 3A, the ratio of release mortality to charter yield has generally decreased over time, mostly due to a decrease in the number of released fish rather than to changes in the average weight of released fish. The ratio was 0.015 in 2013, 0.017 in 2014, 0.013 in 2015, and 0.008 (preliminary) in 2016. The fishery operated under a two-fish bag limit with maximum size limit of 29 inches on one of the fish (if two fish were kept) in 2014 and 2015, and a maximum size limit of 28 inches in 2016. Given the uncertainty in regulations for 2017 and relatively low level of release mortality in Area 3A, projected charter yields for 2017 were expanded by a factor of 1.015 to predict total charter removals. This value was rounded up from the 2013-2016 average ratio of 1.013.

### **3.0 Area 2C Management Measures**

#### **3.1 Status Quo Harvest Forecast**

Status quo measures for Area 2C include a one-fish bag limit and U43O80 reverse slot size limit. The prohibition on retention of halibut by captains and crew is a default measure under the CSP and cannot be changed on an annual basis. There were upward trends in angler effort in four of the six subareas of Area 2C in recent years (Table 3, Figure 1). Recent trends in HPUE were essentially level or declining in all subareas. The 2017 status quo effort forecast for Area 2C is 99,526 angler-trips, the weighted average HPUE forecast is 0.69 halibut per angler-day, and the harvest forecast is 68,724 halibut, with a 95% margin of error ( $\pm 2$  standard errors) of about  $\pm 14,900$  (Table 5). This is up slightly from the preliminary harvest estimate for 2016 of 66,286 halibut (Meyer et al. 2016).

#### **3.2 Harvests under Various Annual Limits**

Harvests were projected under annual limits ranging from 1 to 5 halibut in Area 2C. The areawide estimated harvest reductions associated with annual limits ranged from about 50% under an annual limit of one fish to less than 1% under an annual limit of five fish (Table 6). A three-fish annual limit would decrease harvest by about 7%, while a two-fish annual limit would decrease harvest by about 23%.

#### **3.3 Reverse Slot Limit With and Without Annual Limit**

Reverse slot size limits have been used to manage the Area 2C charter fishery since 2012. The goal of the reverse slot limit is to reduce the average weight of the harvest by requiring retained fish to be either below a lower size limit or above an upper size limit. The reverse slot limit functions mostly as a maximum size limit, while still preserving the opportunity for anglers to retain exceptionally large fish. The charter industry and the Council have recommended reverse slot size limits because they effectively control average weight without severely impacting angler demand under a one-fish bag limit, thus preserving charter revenues in the face of restrictions.

Average weight under reverse slot limits was predicted using the same algorithm used to analyze management measures for 2014-2016. Briefly, this procedure fixes the proportion of harvest above the upper size limit equal to the proportion in 2010, the last year without a size limit. The proportion of harvest below the lower size limit is assigned the remainder. Average weight is then estimated as a weighted mean of the average weight of fish above and below the upper and lower limits, where the weighting factors are the respective proportions of harvest above and below those limits.

Using data from 2010 assumes that the length-frequency distributions from that year represent the current harvest length distribution in the absence of a size limit. This assumption grows more tenuous with the passage of time because of changes in the population size structure due to recruitment, mortality, and movement of halibut between areas and subareas. As in recent years, the average weights from past years (2012-2016) were compared to the algorithm-predicted average weights for the same size limits and harvests by subarea. All fish sampled each year were included in the estimated average weights, including

illegally harvested fish in the protected size slot between the lower and upper size limits. Illegal-size fish represented 0.7% to 1.8% of the length sample each year. Errors in predicted average weights ranged from -13% to +43% for individual subareas, and from +10% to +16% for Area 2C overall (average = 12%). Predicted average weight for individual subareas tended to be either underestimated or overestimated; other than that, there appeared to be no consistent pattern in the errors related to the size limits in place each year. Therefore, correction factors based on the average errors from 2012-2016 were incorporated in the predicted average weights for each subarea. These correction factors ranged from 0.74 to 1.08 among subareas.

Total charter removals were projected for a range of reverse slot limits with lower limits ranging from 35 to 50 inches and upper limits ranging from 50 to 80 inches. Tables of projected total removals were generated for 2017 harvest forecasts without an annual limit, and for annual limits ranging from one to five halibut (Table 7). A single level of harvest is associated with each sub-table of Table 7 because it was assumed that the size limits by themselves have no effect on the number of fish harvested. Projections of charter removals include the correction factors for bias in estimation of average weight as well as an additional 7% for predicted release mortality. For reference, the most liberal combinations of size limits and annual limits for which the projected removals are within the Blue Line allocation and the status quo SPR allocation are highlighted in Table 7.

The projected charter removal under the status quo size limit of U43O80 is 0.859 M lb. That is a little higher than the removals under this size limit in 2016, because effort and HPUE are both forecasted to increase slightly. Without implementation of an annual limit, the lower size limit (floor of the protected slot) would have to be dropped to 38 inches (move to U38O80) to stay within the Blue Line allocation.

### **3.4 Maximum Size Limit With and Without Annual Limit**

Maximum size limits have been considered by the Council as a measure to control the average weight of halibut harvested in the charter sector. A 37-inch maximum size limit was implemented in the Area 2C halibut fishery in 2011 by the IPHC. Since then, the charter industry and the Council have recommended reverse slot limits (under a one-fish bag limit) for the Area 2C fishery for reasons listed in the previous section. Nevertheless, the charter industry is still interested in maximum size limits as a possible regulatory option.

Yields under maximum size limits were calculated as the product of forecasted harvest and predicted average weight. Average weights corresponding to various maximum size limits were estimated simply as the average weight of the portion of the charter harvest that was less than or equal to that length during 2010, the last year in which there was no size limit in Area 2C. Average weight was predicted for each subarea and the overall average weight for each regulatory area was calculated as a weighted mean, where the harvest forecasts in each subarea were the weighting factors.

As with reverse slot limits, the accuracy of average weight predictions was evaluated by comparing the predicted and observed (final estimated) subarea average weights for Area 2C for 2011 when the fishery was managed under a 37" maximum size limit. The same comparison was also done for 2012-2016, years when the fishery was under reverse slot size limits (U45O68 in 2012-2013, U44O76 in 2014, U42O80 in 2015, and U43O80 in 2016). Under reverse slot size limits, the lower limit essentially functions as a maximum size limit for the majority of harvest. Therefore, comparisons were made for maximum size limits of 37, 45, 44, 42, and 43 inches. For each comparison, the empirical average weight was calculated using fish below the size limit as well as any sampled fish of illegal size up to within 2 inches of the upper length limit.

There was considerable variation in the predicted average weights among subareas and years. Prediction errors ranged from -23% to +29% among subareas and years, and from +2% to +9% for Area 2C overall among years. Average weight was overestimated for Area 2C by 5% on average. Correction factors

ranging from 0.90 to 1.11 among subareas were applied to predicted average weights to correct for the net overestimation of average weight.

Total charter removals were projected for maximum size limits ranging from 30 to 55 inches, and under annual limits from one to five fish. Projections included the correction factors for estimation of average weight as well as an additional 7% for predicted release mortality. In the case of no annual limit, projected removals range from 0.462 M lb under a 30-inch maximum size limit to 1.219 M lb under a 55-inch maximum size limit (Table 8). The corresponding average weights range from 6.28 to 16.57 pounds. The most liberal combinations of size limits and annual limits for which projected removals are within the Blue Line and status quo SPR allocations are highlighted in the table.

Projected removals (Table 8) vary primarily in proportion to the projected harvest under each annual limit. It is possible that implementation of an annual limit would provide additional incentive for anglers to select for larger fish in the harvest (high-grade). The degree to which this may happen is unknown and was not incorporated into the projections.

#### **4.0 Area 3A Management Measures**

##### **4.1 Status Quo Harvest Forecast**

Recent trends in effort and HPUE have been mixed among subareas (Table 4, Figure 2). Effort declined during the economic downturn in the late 2000s in the larger road-accessible fisheries, such as CCI, LCI, and the North Gulf. After that, effort was relatively stable in all subareas. Trip limits and size limits are presumably responsible for the drop in effort in 2014 in Cook Inlet fisheries, but there were no similar decreases in effort in other subareas. However, the lack of visible declines in angler effort does not mean that trip limits, size limits, or daily closures did not have an effect – effort may have been higher without those measures in place. There is more consistency among subareas when it comes to recent trends in HPUE. All subareas had a decrease in HPUE in 2014, but the drops were most pronounced in subareas with the highest average weights, namely Glacier Bay, Yakutat, and Eastern and Western Prince William Sound. This was mainly the result of anglers foregoing harvest of a second fish, and instead focusing on harvest of one “good-size” halibut.

The status quo measures for Area 3A included a two-fish bag limit with a maximum size limit of 28 inches on one of the fish, an annual limit per angler of four halibut, a limit of one vessel-trip per permit per day, and no retention of halibut on Wednesdays all year. As explained earlier, the status quo forecast was equal to the preliminary estimates, or empirical data on effort and HPUE from 2016, rather than time series models. As a result the 2017 status quo harvest is equal to the preliminary estimate for 2016. The status quo effort forecast for Area 3A for 2017 is 111,187 angler-trips, and the harvest forecast is 155,032 halibut (Table 9). The weighted average HPUE forecast for Area 3A overall is about 1.39 halibut per angler-trip.

##### **4.2 Harvests under Various Annual Limits**

As stated earlier, the effect of annual limits on harvest were estimated from logbook data on annual harvests by individual anglers. Because projections were necessary for more liberal annual limits than the status quo four-fish annual limit, calculations had to be based on data from 2014, the most recent year without an annual limit.

For 2017, the status quo harvest forecasts for each subarea were inflated by removing the estimated effect of a four-fish annual limit. This provided the forecast of harvest in the absence of an annual limit. Projected harvests under all other annual limits were then calculated by applying the estimated percent reduction to the harvests without an annual limit. All harvest projections for 2017 still include other status quo measures, including the charter vessel trip limit and Wednesday closure for the entire year.

Although the Charter Halibut Management Committee requested analysis of annual limits from four upward, we included analysis of annual limits ranging from two to ten fish per year to show a wider range



of effects of annual limits. As in Area 2C, the effects of annual limits varied by subarea, with the largest percentage effects in the Kodiak subarea (Table 10). Areawide, application of annual limits to the harvest without an annual limit would result in harvest reductions from 19% under a two-fish annual limit to less than 1% under a ten-fish limit. Lowering the annual limit under other status quo measures to three fish is estimated to reduce the harvest from 155,032 to 144,842 halibut, a decrease of nearly 7%.

#### **4.3 Maximum Size Limit on One Fish Combined with an Annual Limit**

This regulatory mechanism is essentially the status quo, except that other size limits and annual limits were explored as directed by the charter committee. Charter removals were projected under size limits ranging from 26 to 30 inches under no annual limit, and under annual limits ranging from two to ten fish (Table 11). The committee asked for analysis of annual limits ranging from four fish and up, but the analysis was extended down to two fish to identify options that would keep the charter harvest within the Blue Line allocation. Projected removals include a 1.5% inflation factor to account for release mortality. These projections include all other status quo measures, including the charter vessel trip limit and the Wednesday closure all year.

For this year's analysis, the effects of size limits on the proportion of harvest made up of second fish and HPUE were incorporated into the projections. This is reflected in three sets of harvest projections that vary by size limit (center section of Table 11). Although the same effort was used for each harvest projection, different HPUEs were used, depending on the size limit.

Average weight was calculated as a weighted mean of the average weight for each fish in the bag limit. The average weight for the fish of any size was assumed to be the overall mean weight in 2013, the last year without a size limit in Area 3A. The average weight for size-restricted fish was calculated as the average weight of fish less than or equal to the specified size limit in 2013. These average weights were then weighted by the proportions of harvest made up of "first" and "second" fish in angler's bag limits. The projections for 26- to 28-inch size limits used the empirical proportions of second fish from 2016 (under 28-inch size limit), the projections for 29-inch size limits used the average proportions from 2014-2015, and the projections for the 30-inch size limit used the 2014 proportions. The terms 'first' and 'second' do not refer to the order in which the fish were caught, but rather to whether the fish came from limits of one or two fish. For example, if an angler kept only one halibut on a trip, the fish was designated a "first" fish. If an angler kept two halibut, one was designated "first" and the other "second."

The predicted average weights for 28- and 29-inch maximum size limits were compared to observed average weights by subarea under these limits in 2014, 2015, and 2016. Errors in predicted weights ranged from -42% to +5% for individual subareas, and the average errors ranged from -34% to -4% among subareas. The errors varied from year to year among subareas without any clear pattern, but were nearly always negative. To account for the underestimation of average weight, correction factors based on the 2014-2016 average errors for each subarea were applied to the predicted average weights. The correction factors ranged from 1.05 to 1.31 among subareas.

With no annual limit, projected removals range from 1.963 M lb with a 26-inch maximum size limit to 2.344 M lb under a 30-inch maximum size limit (Table 11). The status quo projection with a 28-inch maximum size limit and 4-fish annual limit is 1.951 M lb, which is 0.173 M lb above the Blue Line allocation of 1.778 M lb. The most liberal combinations of maximum size limits and annual limits that result in projected removals less than or equal to the Blue Line or status quo SPR allocations are highlighted in Table 11.

#### **4.4 Additional Day of the Week Closure**

Status quo regulations in Area 3A include a closure of the charter fishery on Wednesdays. The potential effect of closing additional days of the week was analyzed for the period July 1 – August 15 only. The analysis used nearly complete logbook data for 2016 (all data entered as of Nov 29, 2016) to estimate the percentage of the total annual harvest that occurred on each day of the week during that period. The

percentage of harvest that occurred each day of the week is assumed to represent the maximum reduction in harvest if the fishery were closed that day.

Excluding Wednesdays, the fraction of annual harvest that occurred on each day of the week during the period July 1- August 15 varied considerably among subareas, ranging from 5.0% to 12.8%. For Area 3A overall, the fraction of harvest taken each day ranged from 8.3% to 9.3%. During the period examined in 2016, there were seven Sundays, Mondays, Fridays, and Saturdays, and only six Tuesdays and Thursdays. This may explain the generally higher percentage of harvest on days adjacent to the weekend. The frequency of days of the week will be similar in 2017; there will be seven Sundays, Mondays, and Saturdays, and six of the other days of the week.

The Area 3A estimate is a weighted average of the subareas, so these results are specific to the allocation of harvest among subareas that occurred in 2016. If an additional day closure is combined with other measures that have a differential effect among subareas, such as an annual limit or size limit, the subarea effects should be taken into account when projecting annual harvests.

#### **4.5 Reverse Slot Limit Combined with a Maximum Size Limit**

This measure would combine a reverse slot limit on one fish, as is in place in Area 2C, with the status quo maximum size limit of 28 inches on the second fish. The idea is that it would be similar to a maximum size limit on both fish, with the exception that an angler could potentially harvest one halibut of exceptional size per day. A reverse slot limit on both fish was analyzed for the 2015 season (Meyer and Powers 2014). Analysis of a combined reverse slot limit and maximum size limit was also requested but not analyzed because of time constraints, and because the reverse slot limit results indicated there would be little benefit to combining these regulations. Meyer and Powers (2014) assumed that the lower limit of the protected slot and the maximum size limit on the second fish would be the same for regulatory clarity and enforcement. This analysis does not make that assumption.

The reverse slot limit projections used the status quo harvest forecast, which assumes that the proportions of first and second fish making up the harvest are the same as in 2016. This may not be the case, however, if imposition of this regulation were to affect effort. Average weight of the first fish (under a reverse slot limit) was calculated using the same algorithm used in Area 2C, but used data from 2013, the last year without a size limit in Area 3A. Average weight of the second fish (28-inch maximum) was equal to the observed average weight of fish less than or equal to 28 in 2016. Projections were made for lower size limits ranging from 28-60 inches (U28-U60), and for upper limits ranging from 60-80 inches (O60-O80). The projections include harvest of one fish subject to the reverse slot limit as well as the second fish subject to the 28-inch maximum size limit.

A reverse slot size limit has never been implemented in Area 3A. Therefore, there are no empirical data on average weights that can be used to correct for errors in the projected average weights. It was also not appropriate to assume that the correction factors applied in Area 2C would be applicable to Area 3A because of differences in size composition between areas, and because the Area 3A projections include a second fish with a maximum size of 28 inches. However, the projected yield under a U60O60 reverse slot limit should approximately equal the projected yield under the status quo 28-inch maximum size limit on one fish because it would allow retention of one fish of any size. Therefore, the projected yields were all adjusted for the ratio between the projected U60O60 yield and the projected yield under the status quo size limit in Area 3A.

The yield projections were inflated 5% to account for release mortality. This factor is larger than for a maximum size limit, but smaller than the value used for Area 2C. The number was selected arbitrarily, as there were no data upon which to base an estimate. However, we know from reverse slot limits in Area 2C that the release of fish in the protected slot will increase the number and average weight of released fish.

Reverse slot limits that result in projected removals that are within the Blue Line allocation ranged from U42O60 to U48O80 (Table 13). Reverse slot limits that would work for the status quo SPR allocation ranged from U50O60 to U56O80. In other words, the protection of fish in these size ranges is estimated to reduce the harvest enough for the charter removals to be within their allocation.

#### **4.6 One-Fish Bag Limit for Part of the Year Combined with Status Quo Max Size Limit**

This measure would combine a one fish bag limit for part of the year with the status quo regulations for the remainder of the year. Two options were requested to be analyzed:

1. One fish bag limit during the month of July, and
2. One-fish bag limit from mid-June to mid-August.

The charter industry has expressed interest in projections of harvest under a one-fish bag limit in the past. The biggest challenge is estimation of the average weight under such a regulation. When the Area 2C charter fishery went from a two-fish bag limit with a maximum size limit on one fish (32 inches) to a one-fish bag limit with no size limit in 2009, the average weight jumped 20% from the previous year, and increased another 13% in 2010 under the same regulation. The total increase in average weight over those two years was 36%. Under a one-fish bag limit, anglers will high-grade to get the largest fish possible; the increase in average weight will offset the decrease in the number of fish harvested.

There may be many ways of predicting the average weight, and they would all likely result in different estimates with no clear way to decide which is best. The method chosen assumed that, under a one-fish bag limit, the average weight will equal the average weight of the “first” fish harvested under the recent maximum size limits, i.e., the fish of any size. Under status quo size limits, it is assumed that anglers are already high-grading as much as possible.

It is not possible to tell from biological sampling data which fish were caught by which angler. Length data are obtained from fish or their filleted carcasses, where the fish from different anglers are mixed and the anglers are not present or can’t tell which fish belong to whom. Instead, an assumption was made that the “first” fish from each charter trip are the n-largest fish, where n is the number of anglers on board. For example, if 5 anglers harvested 9 halibut, the 5 largest fish are considered “first” fish. If the number of fish harvested is less than the number of clients, then all fish are “first” fish. This assumption is only an approximation, as there may have been charter trips where some anglers harvested two fish over the maximum size limit but others caught two fish under the size limit. However, as a method to estimate average weight, it seems as good as any for generating a plausible estimate. The biological data can identify the fishing vessel, but not the number of anglers that were onboard. Therefore, the number of anglers was obtained by merging the biological data and logbook or interview data. Once merged, the “first” (n-largest) fish were identified and the average weights calculated.

The harvest in each subarea under each option, and the proportion of harvest made up of “first” fish were obtained from 2015 logbook data. Logbook data contain the reported number of halibut harvested by each individual angler. The harvest reduction during the period of the one fish limit was then estimated from these data, and applied to the 2017 status quo harvest forecast for Area 3A (155,032 halibut). Likewise, biological data from 2015 were used to estimate average weights. Because the maximum size limit on one fish was 29 inches in 2015, the average weight of “first” fish may be slightly overestimated relative to what it might be if the maximum size limit on one fish were 28 inches. The 2015 data had to be used to match charter vessel information in the 2015 logbook.

Under Option 1 (July only), the average weights of “first” fish were 3-128% larger among subareas than the average weights for the entire year. Under Option 2 (Jun 16 – August 15), they were 2-73% larger than the average weights for all of 2015. In both scenarios, the largest differences were observed in Cook Inlet (CCI and LCI) and Kodiak. The smallest differences were in the Glacier Bay subarea, where most anglers only keep one fish anyway and already high-grade.

The projected charter removals with a one-fish bag limit for part of the year were 1.868 M lb under Option 1 and 1.760 under Option 2 (Table 14). These projections should be considered plausible, but not definitive, predictions of harvest under this type of regulation. There has never been a one-fish bag limit in Area 3A, so there are no empirical data on which to model average weight. In addition, as is the case with closures of days of the week, we cannot predict angler behavior. For example, we cannot predict how many anglers would avoid the one-fish bag limit by booking charter trips outside of the one-fish bag limit period. Implementing a one-fish limit would likely have different effects on angler behavior among subareas. There may be little impact in subareas where most anglers already choose to harvest only one fish, but in Cook Inlet or Seward, where anglers rely on harvesting two halibut per day, a one-fish bag limit may discourage some anglers from booking a trip during the summer months, or at all.

#### **4.7 Additional Combinations of Measures**

The combinations of maximum size limits and annual limits listed in Table 11 for Area 3A provide few options that would constrain charter harvest within likely allocations for 2017. Combining the status quo measure with an additional daily closure should offer more combinations of size limits and annual limits that will work, but the precise effect of an additional daily closure could not be estimated with available information. Should the Council wish to pursue this combination, ADF&G will be prepared to use an assumed value for the overall effect on harvest and recalculate Table 11. This was the approach taken for Council recommendations in 2015 and 2016.

### **5.0 Implementation Considerations**

#### **5.1 Size Limits**

There are no anticipated problems associated with implementation of a reverse slot limit or maximum size limit in Area 2C or Area 3A. Size limits have been used successfully in both areas for several years now. However, mixture of a reverse slot limit with the existing maximum size limit on the second fish in Area 3A could result in a complex regulation that some anglers or charter operators might have trouble understanding.

Maximum size limits and reverse slot limits are implemented for the charter halibut fishery to control the average weight of harvested fish, but also increase release mortality. Not only do these size limits generate additional regulatory (versus voluntary) discards and increase the average weight of released fish. Although release mortality is higher under size limits, it is included in the estimates of removals, and is accounted for in the charter sector allocation.

The relative impact of size limits, in terms of release mortality and angler satisfaction, is expected to vary by subarea due to variation in the availability of large fish in the catch. For example, clients fishing in subareas where large fish are commonly caught would end up releasing more fish above the maximum size limit or in the protected slot.

#### **5.2 Annual Limits**

Annual limits were implemented in Area 3A in 2015 (5 fish) and 2016 (4 fish). If annual limits are recommended for the charter fishery in either area, it will be crucial for enforcement purposes to ensure that the regulation be accompanied by a recording requirement similar to that implemented in 2016. Specifically, immediately upon retaining a halibut, charter anglers must record, in ink, the date, location (IPHC area), and species (halibut) on their harvest record. The harvest record is located on the back of the State of Alaska fishing license. For anglers not required to be licensed, a harvest card can be obtained from the ADF&G web site<sup>5</sup> or from local offices. Enforcement of the annual limit consists of checking anglers with halibut to make sure the harvest is recorded. It is expected that Guided Angler Fish (GAF) taken under the CSP would be exempt from the recording requirement as these harvests accrue toward the

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<sup>5</sup> [http://www.adfg.alaska.gov/static/license/sportlicense/pdf/sf\\_harvest\\_record\\_card.pdf](http://www.adfg.alaska.gov/static/license/sportlicense/pdf/sf_harvest_record_card.pdf)

IFQ fishery allocation. Under the CSP, GAF must be recorded in the logbook immediately upon capture. When checking anglers at sea or dockside, enforcement personnel should be able to deduct GAF from fish that count toward an angler's annual limit.

The license or harvest card is not submitted at the end of the year. Halibut harvest accounting by individual anglers would continue to be implemented through ADF&G charter logbooks. Logbooks require reporting of the number of halibut kept and released by individual angler, as well as the angler's name and fishing license number. For anglers fishing under the authority of an ADF&G Permanent Identification (PID) or Disabled American Veteran (DAV) card, the PID or DAV number must be recorded. No number can be recorded for youth anglers not required to be licensed. Under the CSP, all anglers (including youth) are required to certify in the logbook that the reported number of halibut kept and released is correct.

Concerns have been expressed in previous years regarding effective enforcement and compliance with halibut annual limits. A chief concern is that unscrupulous anglers will obtain duplicate or multiple licenses. Once a harvest record is full, these anglers could print another copy of their license and thereby comply with the reporting requirement yet still violate the annual limit. However, ADF&G can merge licensing and logbook data to examine the number of fish harvested by individual anglers, regardless of the number of licenses, duplicates, PIDs, or DAVs they may have held. Although ADF&G is not responsible for enforcement of the annual limit, this capability allows us to evaluate and report on compliance with halibut annual limits to the Council or to enforcement agencies.

Implementation of a recording requirement is expected to reduce the number of violations of the annual limit. The 5-fish annual limit in 2015 was implemented without a recording requirement. That year, 68,800 unique licensed anglers harvested 163,632 halibut in Area 3A. Of those anglers, 659 anglers (1%) appeared to have violated annual limits, based on license numbers and harvest reported in charter logbooks. These anglers harvested from 6 to 13 halibut each, but 543 of them (82%) harvested six fish. They harvested a total of 875 halibut in addition to their 5-fish annual limit. Halibut harvested in excess of the 5-fish annual limit represented 0.5% of the total charter halibut harvest. In 2016, the 4-fish annual limit was implemented with a recording requirement. Comparing logbook data through July of each year to complete data for the year, we estimate that in 2016 about 350 anglers violated the annual limit, and attribute the lower rate to the recording requirement and enforcement efforts in 2016.

Another concern with annual limits is that compliance may be low among youth anglers. Anglers under the age of 16 are not required to be licensed, but are still required to complete a harvest record upon harvesting a halibut. Although enforcement in the field would be no different for youth anglers, their annual harvests cannot be evaluated post-season using logbook data. However, youth anglers have made up only 4-5% of angler-trips in Areas 2C and 3A in recent years. As stated earlier, all unlicensed youth anglers would be required to report each halibut on a harvest record. Youth typically fish on charter boats with parents or other adults, who, along with the guide or deck hand, would be expected to remind them of recording requirements. It is likely the proportion of youth that violate annual limits is small.

### **5.3 Additional Daily Closure (Area 3A)**

As mentioned earlier, the primary issue with daily closures is that the effect cannot be precisely predicted or evaluated. Daily closures are expected to reduce effort, and therefore their effect is confounded with any factors that affect effort (e.g., trip limits, economic trends). This analysis could only estimate the maximum potential reduction in halibut harvest but cannot predict possible changes in angler behavior, such as anglers booking alternate days. However, with one day per week already closed, adding another closed day could result in a larger effect than achieved by a single day closure. With each additional day closed, there would be fewer charters available to take the displaced anglers.

Another impact of daily closures is the potential increase in the harvest of state-managed species such as salmon, rockfishes, and lingcod. Some charter businesses are able to book anglers to catch other species, particularly salmon. Increases in exploitation will likely intensify conservation concerns for these stocks.

Another consideration for daily closures that are only for a portion of the season is the potential effect on estimation of the current year's halibut harvest. Daily closures for a portion of the year may alter the distribution of harvest within the year. The preliminary estimates of harvest for the current year are based on logbook data for trips through July 31. The harvest through that date is expanded using the proportion of harvest through that date in prior years, typically around 70%. If closure of a day of the week reduces harvest in a manner that is not proportional to harvest over the entire season, the harvest expansion factor will be inaccurate. If there was no displacement of harvest from the closed day to other days of the week, about 66% of the harvest would occur prior to August 1.

#### **5.4 One-fish Bag Limit for a Portion of the Year (Area 3A)**

Caution is recommended with regard to the projections of harvest under a one-fish bag limit for part of the year. Area 3A has never had a one-fish bag limit, so there are no empirical data from which to estimate the effects on effort or average weight in the harvest. Implementing a reduced bag limit for only the peak season would likely result in a shift of effort to the shoulder seasons, but there are no data to predict the magnitude of shift that may occur. As with daily closures, a reduced bag limit during the peak of the season could shift the distribution of harvest within the year, potentially hampering estimation of the current year's harvest, particularly in the first year after implementation. Again, it would be best to select dates such that about 70% of the harvest savings occur before August 1. If there was no displacement of harvest to the shoulder seasons, about 62% of the harvest would occur before August 1. Likewise, a one-fish bag limit from June 16 to August 15 would be expected to result in about 65% of harvest occurring before August 1. The effect of displacement of harvest to the shoulder seasons would be unknown.

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Table 1. Estimated average net weight (headed and gutted) and round weight of Pacific halibut by length. Estimates use based on the current International Pacific Halibut Commission length-weight relationships<sup>6</sup>.

Length (Inches)	Net Weight (lb)	Round Weight (lb)	Length (Inches)	Net Weight (lb)	Round Weight (lb)
20	2.3	3.1	51	48.3	64.3
21	2.7	3.6	52	51.5	68.5
22	3.2	4.2	53	54.8	72.8
23	3.7	4.9	54	58.2	77.4
24	4.2	5.6	55	61.7	82.1
25	4.8	6.4	56	65.5	87.1
26	5.4	7.2	57	69.3	92.2
27	6.2	8.2	58	73.3	97.5
28	6.9	9.2	59	77.5	103.1
29	7.8	10.3	60	81.9	108.9
30	8.7	11.5	61	86.4	114.9
31	9.6	12.8	62	91.0	121.1
32	10.7	14.2	63	95.9	127.5
33	11.8	15.7	64	100.9	134.2
34	13.0	17.3	65	106.1	141.1
35	14.3	19.0	66	111.5	148.3
36	15.6	20.8	67	117.0	155.7
37	17.1	22.7	68	122.8	163.3
38	18.6	24.8	69	128.7	171.2
39	20.3	27.0	70	134.9	179.4
40	22.0	29.3	71	141.2	187.8
41	23.8	31.7	72	147.8	196.5
42	25.8	34.3	73	154.5	205.5
43	27.8	37.0	74	161.5	214.8
44	30.0	39.9	75	168.7	224.3
45	32.2	42.9	76	176.1	234.2
46	34.6	46.0	77	183.7	244.3
47	37.1	49.3	78	191.5	254.7
48	39.7	52.8	79	199.6	265.5
49	42.5	56.5	80	207.9	276.5
50	45.3	60.3			

(continued at right)

<sup>6</sup> IPHC length-weight relationships are  $NetWt(lb) = 6.921 \times 10^{-6} ForkLength(cm)^{3.24}$  and  $RndWt(lb) = 9.205 \times 10^{-6} ForkLength(cm)^{3.24}$  from Clark (1992).

Table 2. Subareas of IPHC Areas 2C and 3A, ports where ADF&G creel surveys and halibut sampling occur, and subarea abbreviations used in tables and figures in this report.

IPHC Area	Subarea (sampled ports)	Ports With Sampling and Angler Interviews	Abbreviations
2C	Ketchikan	Ketchikan	Ketch
	Prince of Wales Island	Craig, Klawock	PWI
	Petersburg/Wrangell	Petersburg, Wrangell	Pburg
	Sitka	Sitka	Sitka
	Juneau, Haines, Skagway	Juneau	Jun
	Glacier Bay (2C portion)	Gustavus, Elfin Cove	GlacB, G2C
3A	Glacier Bay (3A portion)	Gustavus, Elfin Cove	GlacB, G3A
	Yakutat	Yakutat	Yak
	Eastern Prince William Sound	Valdez	EPWS
	Western Prince William Sound	Whittier	WPWS
	North Gulf	Seward	NGulf
	Lower Cook Inlet	Homer	LCI
	Central Cook Inlet	Anchor Point, Deep Creek	CCI
	Kodiak/Alaska Peninsula	Kodiak	Kod



Table 3. Charter logbook effort, harvest per unit effort, and harvest of halibut in IPHC Area 2C, 2006-2016. Estimates for 2016 are preliminary, based on logbook data for charter trips through July 31, 2016, entered as of October 13, 2016.

Year	Subarea						Total 2C
	Ketch	PWI	Pburg	Sitka	Jun	GlacB	
Effort (angler-trips) <sup>a</sup>							
2006	11,148	26,409	4,441	34,298	8,445	12,499	97,240
2007	13,359	27,906	4,754	36,066	7,990	15,912	105,987
2008	11,672	27,369	4,528	33,928	7,766	18,002	103,265
2009	10,283	17,273	3,489	22,883	7,314	13,186	74,428
2010	10,595	17,981	3,283	24,027	8,472	13,625	77,983
2011	10,552	16,015	2,257	24,038	8,771	11,301	72,934
2012	11,886	18,242	2,675	24,881	7,803	9,976	75,463
2013	13,582	20,180	3,029	24,470	9,288	11,206	81,755
2014	14,680	21,491	2,839	28,638	10,375	12,390	90,413
2015	16,685	21,931	3,071	31,113	11,391	10,613	94,804
2016	17,343	22,735	3,280	30,726	12,624	10,282	96,989
Halibut Harvest per Angler-Trip (HPUE)							
2006	0.981	1.441	1.240	1.004	1.121	0.998	1.140
2007	0.877	1.507	1.244	0.944	1.167	1.084	1.135
2008	0.736	1.390	1.204	0.868	1.031	0.945	1.032
2009	0.435	0.758	0.644	0.695	0.666	0.791	0.685
2010	0.408	0.690	0.651	0.583	0.596	0.705	0.610
2011	0.355	0.752	0.640	0.667	0.613	0.829	0.658
2012	0.440	0.767	0.653	0.672	0.628	0.819	0.673
2013	0.494	0.833	0.696	0.706	0.698	0.792	0.713
2014	0.486	0.801	0.729	0.761	0.678	0.789	0.719
2015	0.465	0.744	0.691	0.759	0.675	0.768	0.693
2016	0.521	0.747	0.632	0.772	0.617	0.648	0.683
Harvest (number of halibut) <sup>b</sup>							
2006	10,933	38,053	5,505	34,430	9,471	12,468	110,860
2007	11,719	42,044	5,912	34,056	9,325	17,251	120,307
2008	8,595	38,047	5,452	29,465	8,004	17,016	106,579
2009	4,471	13,097	2,246	15,896	4,873	10,433	51,016
2010	4,322	12,403	2,138	14,010	5,051	9,612	47,536
2011	3,746	12,045	1,444	16,022	5,377	9,365	47,999
2012	5,234	13,985	1,748	16,711	4,903	8,175	50,756
2013	6,711	16,810	2,107	17,265	6,487	8,880	58,260
2014	7,138	17,214	2,071	21,798	7,034	9,781	65,036
2015	7,762	16,322	2,121	23,611	7,687	8,153	65,656
2016	9,043	16,981	2,073	23,731	7,794	6,664	66,286

<sup>a</sup> – Effort is defined as angler-trips with bottomfish effort or harvest of at least one halibut. All effort is client-only except 2014-2016 data includes any reported effort by crew that retained halibut.

<sup>b</sup> – Harvest is client-only except 2014-2016 data which includes all reported crew harvest even though prohibited.

Table 4. Charter logbook effort, harvest per unit effort, and harvest of halibut in IPHC Area 3A, 2006-2016. Estimates for 2016 are preliminary, based on logbook data through July 31, 2016, entered as of October 13, 2016.

Year	Subarea								Tot 3A
	GlacBay	Yak	EPWS	WPWS	NGulf	CCI	LCI	Kod	
Effort (angler-trips) <sup>a</sup>									
2006	91	3,164	6,571	2,939	30,381	34,915	50,850	12,030	140,941
2007	137	2,996	6,692	3,326	35,359	36,870	52,301	13,965	151,646
2008	413	3,156	5,414	3,642	32,945	34,013	45,495	12,574	137,652
2009	220	2,201	5,134	3,364	25,591	27,516	36,801	10,059	110,886
2010	161	2,449	5,156	3,753	28,431	27,824	40,573	10,084	118,431
2011	922	2,485	3,855	3,020	27,848	27,565	41,634	10,481	117,810
2012	1,030	2,681	3,440	3,507	30,154	26,238	40,561	10,036	117,647
2013	1,264	2,919	3,618	3,736	29,872	27,741	40,615	9,313	119,078
2014	1,424	3,315	3,576	3,435	29,613	20,633	37,111	9,927	109,034
2015	1,852	3,323	3,638	3,616	32,276	19,994	33,467	9,308	107,474
2016	2,024	3,487	3,920	4,050	34,827	16,648	37,004	9,227	111,187
Halibut Harvest per Angler-Trip (HPUE)									
2006	0.945	1.032	1.396	1.326	1.478	1.889	1.842	1.382	1.685
2007	1.095	1.011	1.387	1.105	1.530	1.891	1.888	1.393	1.702
2008	1.194	1.081	1.299	1.254	1.533	1.890	1.828	1.417	1.680
2009	1.273	1.382	1.376	1.254	1.569	1.915	1.885	1.385	1.720
2010	0.882	1.371	1.400	1.290	1.587	1.907	1.873	1.331	1.715
2011	1.054	1.107	1.537	1.326	1.639	1.919	1.887	1.377	1.742
2012	1.262	1.279	1.440	1.359	1.495	1.916	1.883	1.334	1.697
2013	1.132	1.301	1.506	1.524	1.488	1.878	1.851	1.328	1.684
2014	0.791	1.034	1.225	1.314	1.430	1.866	1.824	1.245	1.599
2015	0.746	0.966	1.181	1.282	1.435	1.792	1.766	0.950	1.523
2016	0.760	0.915	1.163	1.043	1.190	1.703	1.717	0.887	1.394
Harvest (number of halibut) <sup>b</sup>									
2006	86	3,266	9,176	3,896	44,888	65,958	93,652	16,624	237,546
2007	150	3,028	9,284	3,674	54,109	69,708	98,730	19,452	258,135
2008	493	3,413	7,032	4,567	50,508	64,277	83,165	17,822	231,277
2009	280	3,042	7,066	4,220	40,165	52,704	69,361	13,934	190,772
2010	142	3,357	7,219	4,843	45,116	53,074	75,986	13,418	203,155
2011	972	2,751	5,925	4,006	45,635	52,904	78,572	14,437	205,202
2012	1,300	3,430	4,954	4,766	45,094	50,281	76,381	13,388	199,594
2013	1,431	3,798	5,450	5,695	44,447	52,107	75,181	12,370	200,479
2014	1,126	3,429	4,379	4,514	42,337	38,507	67,701	12,358	174,351
2015	1,381	3,210	4,296	4,635	46,321	35,834	59,110	8,845	163,632
2016	1,538	3,192	4,558	4,225	41,443	28,352	63,542	8,182	155,032

<sup>a</sup> – Effort is defined as angler-trips with bottomfish effort or harvest of at least one halibut. All effort is client-only except 2014-2016 data includes any reported effort by crew that retained halibut.

<sup>b</sup> – Harvest is client-only except 2014-2016 data which includes all reported crew harvest even though prohibited.

Table 5. Forecasts of effort, halibut harvest per unit effort (HPUE), and harvest (numbers of halibut) for Area 2C in 2017 under status quo regulations, with associated standard errors. Status quo regulations include a one-fish bag limit and U43O80 reverse slot size limit.

Subarea	Effort (angler-trips)	Std Error	HPUE	Std Error	Harvest (no. halibut)	Std Error
Ketch	18,659	1,402	0.554	0.108	10,341	2,155
PWI	22,732	3,466	0.747	0.209	16,979	5,352
Pburg	3,280	525	0.632	0.180	2,073	671
Sitka	30,726	3,944	0.785	0.077	24,107	3,884
Jun	13,554	848	0.617	0.129	8,369	1,828
GlacBay	10,575	2,260	0.648	0.094	6,855	1,759
Area 2C	99,526	5,969	0.691	NA	68,724	7,434

Table 6. Estimated effects of annual limits of one to five halibut on Area 2C charter anglers and projected harvest for 2017. Effects were estimated using 2015 logbook data from licensed anglers. The percent of affected anglers is the portion of individual anglers that harvested more than the specified annual limit in 2015.

Annual Limit	Subarea						Area 2C
	Ketch	PWI	Pburg	Sitka	Jun	GlacB	
Estimated percent of anglers affected by the annual limit:							
1	26.0%	71.2%	52.8%	69.4%	46.6%	55.2%	57.5%
2	10.0%	42.3%	28.6%	38.7%	30.0%	37.4%	33.1%
3	2.2%	10.2%	11.7%	9.0%	14.6%	20.2%	10.1%
4	0.6%	1.9%	2.7%	1.3%	5.6%	9.2%	2.7%
5	0.1%	0.5%	0.4%	0.3%	1.8%	2.9%	0.8%
Estimated percent change in harvest:							
1	-28.1%	-55.8%	-49.2%	-54.3%	-49.8%	-56.3%	-50.2%
2	-9.4%	-24.4%	-22.5%	-22.6%	-26.4%	-32.2%	-22.5%
3	-2.2%	-5.7%	-7.9%	-5.0%	-11.4%	-15.9%	-6.7%
4	-0.6%	-1.1%	-2.0%	-0.8%	-4.0%	-7.0%	-1.9%
5	-0.2%	-0.3%	-0.6%	-0.2%	-1.2%	-3.0%	-0.6%
Projected harvest (number of halibut):							
1	7,435	7,501	1,052	11,010	4,200	2,995	34,194
2	9,372	12,843	1,608	18,647	6,157	4,647	53,274
3	10,116	16,019	1,909	22,913	7,419	5,768	64,143
4	10,279	16,786	2,032	23,905	8,033	6,374	67,410
5	10,321	16,928	2,061	24,051	8,269	6,651	68,282
None	10,341	16,979	2,073	24,107	8,369	6,855	68,724

Table 7. Projected charter removals (M lb) for Area 2C in 2017 under reverse slot limits ranging from U35O50 to U50O80 and annual limits ranging from no limit to five fish. Shaded values represent projections that do not exceed the 0.747 M lb allocation associated with the Blue Line FCEY. Outlined values highlight projections that are within the status quo SPR allocation of 0.858 M lb. All values in the table include corrections for errors in estimation of average weight and an additional 7.0% release mortality by weight.

**No annual limit, harvest = 68,724 halibut**

Lower Limit (in)	Upper Length Limit (in)															
	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
35	1.223	1.141	1.079	1.012	0.963	0.919	0.856	0.795	0.762	0.734	0.706	0.689	0.663	0.649	0.647	0.636
36	1.257	1.176	1.116	1.049	1.001	0.957	0.895	0.835	0.802	0.774	0.746	0.729	0.704	0.689	0.688	0.677
37	1.278	1.198	1.139	1.072	1.025	0.981	0.919	0.859	0.826	0.798	0.771	0.753	0.728	0.714	0.713	0.701
38	1.309	1.231	1.172	1.107	1.060	1.016	0.955	0.896	0.863	0.835	0.808	0.791	0.766	0.751	0.750	0.739
39	1.332	1.255	1.197	1.132	1.085	1.042	0.981	0.922	0.890	0.862	0.835	0.818	0.793	0.779	0.777	0.766
40	1.351	1.275	1.218	1.153	1.107	1.064	1.004	0.945	0.912	0.885	0.858	0.841	0.816	0.802	0.801	0.790
41	1.375	1.300	1.244	1.180	1.134	1.092	1.031	0.973	0.941	0.914	0.887	0.870	0.845	0.831	0.829	0.819
42	1.390	1.316	1.260	1.197	1.152	1.109	1.049	0.992	0.959	0.933	0.906	0.889	0.864	0.850	0.848	0.838
43	1.407	1.334	1.279	1.216	1.171	1.130	1.070	1.013	0.980	0.954	0.927	0.910	0.885	0.871	0.870	0.859
44	1.432	1.360	1.305	1.243	1.199	1.157	1.098	1.041	1.009	0.983	0.956	0.939	0.915	0.901	0.899	0.888
45	1.458	1.387	1.334	1.272	1.228	1.187	1.129	1.072	1.040	1.014	0.987	0.971	0.946	0.932	0.931	0.920
46	1.475	1.406	1.353	1.292	1.248	1.208	1.149	1.093	1.061	1.035	1.009	0.992	0.968	0.954	0.952	0.941
47	1.499	1.431	1.379	1.319	1.276	1.236	1.177	1.122	1.090	1.064	1.038	1.021	0.997	0.983	0.982	0.971
48	1.516	1.449	1.397	1.338	1.295	1.255	1.197	1.142	1.111	1.085	1.059	1.042	1.018	1.004	1.002	0.992
49	1.544	1.478	1.427	1.369	1.326	1.287	1.230	1.175	1.144	1.118	1.092	1.075	1.051	1.038	1.036	1.025
50	1.564	1.499	1.449	1.391	1.349	1.310	1.253	1.199	1.168	1.142	1.117	1.100	1.076	1.062	1.061	1.050

**5-fish annual limit, harvest = 68,282 halibut**

Lower Limit (in)	Upper Length Limit (in)															
	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
35	1.213	1.131	1.071	1.003	0.955	0.911	0.849	0.789	0.756	0.728	0.701	0.683	0.658	0.644	0.643	0.632
36	1.247	1.167	1.107	1.041	0.993	0.950	0.888	0.829	0.795	0.768	0.741	0.723	0.699	0.684	0.683	0.672
37	1.268	1.189	1.129	1.063	1.016	0.973	0.911	0.853	0.819	0.792	0.765	0.748	0.723	0.709	0.707	0.697
38	1.299	1.221	1.163	1.098	1.051	1.008	0.947	0.889	0.856	0.829	0.802	0.785	0.760	0.746	0.744	0.734
39	1.322	1.245	1.188	1.123	1.077	1.034	0.973	0.915	0.883	0.856	0.829	0.812	0.787	0.773	0.771	0.761
40	1.341	1.265	1.208	1.144	1.098	1.056	0.996	0.938	0.905	0.879	0.852	0.835	0.810	0.796	0.795	0.784
41	1.364	1.290	1.234	1.170	1.125	1.083	1.023	0.966	0.934	0.907	0.880	0.863	0.839	0.825	0.823	0.813
42	1.379	1.306	1.250	1.187	1.142	1.101	1.041	0.984	0.952	0.925	0.899	0.882	0.858	0.844	0.842	0.831
43	1.396	1.324	1.269	1.206	1.162	1.121	1.061	1.005	0.973	0.946	0.920	0.903	0.879	0.865	0.863	0.853
44	1.420	1.349	1.295	1.233	1.189	1.148	1.089	1.033	1.001	0.975	0.949	0.932	0.908	0.894	0.892	0.882
45	1.446	1.376	1.323	1.262	1.219	1.178	1.120	1.064	1.032	1.006	0.980	0.963	0.939	0.925	0.924	0.913
46	1.463	1.394	1.342	1.281	1.238	1.198	1.140	1.085	1.053	1.027	1.001	0.984	0.960	0.947	0.945	0.934
47	1.487	1.420	1.368	1.308	1.266	1.226	1.168	1.113	1.082	1.056	1.030	1.013	0.990	0.976	0.974	0.964
48	1.504	1.438	1.386	1.327	1.285	1.245	1.188	1.133	1.102	1.076	1.051	1.034	1.010	0.996	0.995	0.984
49	1.532	1.466	1.416	1.358	1.316	1.277	1.220	1.166	1.135	1.109	1.084	1.067	1.043	1.030	1.028	1.018
50	1.551	1.487	1.437	1.380	1.339	1.300	1.243	1.190	1.159	1.134	1.108	1.092	1.068	1.054	1.053	1.042

(continued)

Table 7. (continued)

**4-fish annual limit, harvest = 67,410 halibut**

Lower Limit (in)	Upper Length Limit (in)															
	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
35	1.195	1.115	1.055	0.988	0.941	0.898	0.837	0.778	0.745	0.718	0.691	0.674	0.649	0.635	0.634	0.623
36	1.229	1.150	1.091	1.026	0.979	0.936	0.875	0.817	0.784	0.757	0.731	0.713	0.689	0.675	0.673	0.663
37	1.249	1.171	1.113	1.048	1.002	0.959	0.898	0.840	0.808	0.781	0.755	0.738	0.713	0.699	0.698	0.687
38	1.280	1.204	1.146	1.082	1.036	0.994	0.934	0.876	0.843	0.817	0.791	0.774	0.749	0.736	0.734	0.724
39	1.303	1.227	1.170	1.107	1.061	1.019	0.959	0.902	0.870	0.844	0.817	0.800	0.776	0.762	0.761	0.750
40	1.321	1.247	1.191	1.127	1.082	1.041	0.981	0.925	0.892	0.866	0.840	0.823	0.799	0.785	0.784	0.773
41	1.345	1.271	1.216	1.153	1.109	1.068	1.009	0.952	0.920	0.894	0.868	0.851	0.827	0.813	0.812	0.801
42	1.359	1.287	1.232	1.170	1.126	1.085	1.026	0.970	0.938	0.912	0.886	0.870	0.845	0.832	0.830	0.820
43	1.376	1.305	1.250	1.189	1.145	1.104	1.046	0.990	0.958	0.933	0.907	0.890	0.866	0.853	0.851	0.841
44	1.400	1.330	1.276	1.215	1.172	1.132	1.074	1.018	0.987	0.961	0.935	0.919	0.895	0.881	0.880	0.869
45	1.426	1.357	1.304	1.244	1.201	1.161	1.104	1.049	1.017	0.992	0.966	0.950	0.926	0.912	0.911	0.900
46	1.443	1.375	1.323	1.263	1.221	1.181	1.124	1.069	1.038	1.013	0.987	0.971	0.947	0.933	0.932	0.922
47	1.466	1.399	1.348	1.289	1.247	1.208	1.151	1.097	1.066	1.041	1.016	0.999	0.976	0.962	0.961	0.950
48	1.483	1.417	1.366	1.308	1.267	1.228	1.171	1.117	1.086	1.061	1.036	1.020	0.996	0.983	0.981	0.971
49	1.510	1.446	1.396	1.338	1.297	1.259	1.202	1.149	1.118	1.093	1.068	1.052	1.029	1.015	1.014	1.004
50	1.529	1.466	1.417	1.360	1.319	1.281	1.225	1.172	1.142	1.117	1.092	1.076	1.053	1.039	1.038	1.028

**3-fish annual limit, harvest = 64,143 halibut**

Lower Limit (in)	Upper Length Limit (in)															
	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
35	1.134	1.058	1.001	0.938	0.893	0.852	0.794	0.738	0.707	0.681	0.657	0.640	0.617	0.604	0.602	0.592
36	1.166	1.092	1.036	0.973	0.929	0.889	0.831	0.775	0.744	0.719	0.694	0.678	0.654	0.642	0.640	0.630
37	1.186	1.112	1.056	0.994	0.951	0.910	0.853	0.798	0.767	0.742	0.717	0.701	0.677	0.664	0.663	0.653
38	1.215	1.142	1.088	1.026	0.983	0.943	0.886	0.831	0.801	0.776	0.751	0.735	0.712	0.699	0.698	0.688
39	1.237	1.165	1.111	1.050	1.007	0.968	0.911	0.856	0.826	0.801	0.777	0.761	0.737	0.724	0.723	0.713
40	1.254	1.183	1.130	1.070	1.027	0.988	0.932	0.878	0.847	0.822	0.798	0.782	0.759	0.746	0.745	0.735
41	1.276	1.207	1.154	1.094	1.052	1.013	0.957	0.904	0.873	0.849	0.825	0.809	0.786	0.773	0.771	0.762
42	1.290	1.221	1.169	1.110	1.068	1.030	0.974	0.921	0.890	0.866	0.842	0.826	0.803	0.790	0.789	0.779
43	1.306	1.238	1.186	1.128	1.087	1.048	0.993	0.940	0.909	0.885	0.861	0.845	0.822	0.810	0.808	0.799
44	1.329	1.262	1.211	1.153	1.112	1.074	1.019	0.966	0.936	0.912	0.888	0.873	0.850	0.837	0.836	0.826
45	1.353	1.288	1.237	1.180	1.140	1.102	1.047	0.995	0.965	0.941	0.918	0.902	0.879	0.867	0.865	0.856
46	1.369	1.305	1.255	1.198	1.159	1.121	1.067	1.015	0.985	0.961	0.938	0.922	0.899	0.887	0.885	0.876
47	1.392	1.328	1.280	1.224	1.184	1.147	1.093	1.042	1.012	0.988	0.965	0.949	0.927	0.914	0.913	0.903
48	1.408	1.345	1.297	1.242	1.202	1.166	1.112	1.061	1.031	1.008	0.984	0.969	0.946	0.933	0.932	0.923
49	1.434	1.372	1.325	1.270	1.231	1.195	1.141	1.091	1.062	1.038	1.015	0.999	0.977	0.964	0.963	0.954
50	1.452	1.391	1.345	1.290	1.252	1.216	1.163	1.113	1.084	1.060	1.037	1.022	1.000	0.987	0.986	0.976

(continued)

Table 7. (continued)

**2-fish annual limit, harvest = 53,274 halibut**

Lower Limit (in)	Upper Length Limit (in)															
	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
35	0.940	0.876	0.829	0.777	0.740	0.707	0.658	0.612	0.586	0.565	0.545	0.532	0.512	0.501	0.500	0.492
36	0.967	0.904	0.858	0.806	0.771	0.737	0.689	0.643	0.617	0.596	0.576	0.563	0.544	0.533	0.532	0.524
37	0.983	0.921	0.875	0.824	0.788	0.755	0.707	0.662	0.636	0.615	0.595	0.582	0.563	0.552	0.551	0.543
38	1.008	0.947	0.901	0.851	0.816	0.783	0.735	0.690	0.665	0.644	0.624	0.611	0.592	0.581	0.580	0.572
39	1.026	0.966	0.921	0.871	0.836	0.803	0.756	0.711	0.686	0.665	0.645	0.632	0.613	0.603	0.601	0.594
40	1.041	0.981	0.937	0.887	0.853	0.821	0.774	0.729	0.704	0.683	0.663	0.650	0.631	0.621	0.620	0.612
41	1.059	1.001	0.957	0.908	0.874	0.842	0.795	0.751	0.726	0.705	0.686	0.673	0.653	0.643	0.642	0.634
42	1.071	1.013	0.970	0.921	0.887	0.855	0.809	0.765	0.740	0.719	0.700	0.687	0.668	0.657	0.656	0.649
43	1.084	1.027	0.984	0.936	0.902	0.871	0.824	0.780	0.755	0.735	0.716	0.703	0.684	0.674	0.672	0.665
44	1.103	1.047	1.005	0.957	0.924	0.892	0.846	0.803	0.778	0.758	0.739	0.726	0.707	0.697	0.695	0.688
45	1.123	1.068	1.027	0.979	0.947	0.916	0.870	0.827	0.802	0.782	0.763	0.750	0.731	0.721	0.720	0.712
46	1.137	1.083	1.042	0.995	0.962	0.932	0.886	0.843	0.819	0.799	0.780	0.767	0.748	0.738	0.737	0.729
47	1.156	1.103	1.062	1.016	0.984	0.953	0.908	0.866	0.841	0.822	0.803	0.790	0.771	0.761	0.760	0.752
48	1.170	1.117	1.077	1.031	0.999	0.969	0.924	0.882	0.858	0.838	0.819	0.806	0.787	0.777	0.776	0.769
49	1.191	1.139	1.100	1.054	1.023	0.993	0.949	0.907	0.883	0.863	0.844	0.832	0.813	0.803	0.802	0.794
50	1.206	1.155	1.116	1.071	1.040	1.011	0.967	0.925	0.901	0.882	0.863	0.850	0.832	0.822	0.820	0.813

**1-fish annual limit, harvest = 34,194 halibut**

Lower Limit (in)	Upper Length Limit (in)															
	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
35	0.602	0.560	0.530	0.497	0.475	0.454	0.422	0.392	0.376	0.363	0.350	0.342	0.329	0.323	0.322	0.317
36	0.620	0.579	0.549	0.516	0.495	0.474	0.442	0.413	0.397	0.383	0.371	0.363	0.350	0.344	0.343	0.338
37	0.630	0.590	0.560	0.528	0.506	0.485	0.454	0.425	0.409	0.396	0.383	0.375	0.362	0.356	0.355	0.350
38	0.647	0.607	0.578	0.546	0.524	0.504	0.473	0.444	0.428	0.415	0.402	0.394	0.381	0.375	0.374	0.370
39	0.658	0.619	0.590	0.559	0.538	0.517	0.486	0.457	0.442	0.428	0.416	0.408	0.395	0.389	0.388	0.384
40	0.668	0.629	0.601	0.569	0.549	0.528	0.498	0.469	0.453	0.440	0.427	0.420	0.407	0.401	0.400	0.395
41	0.680	0.642	0.614	0.583	0.562	0.542	0.512	0.484	0.468	0.455	0.442	0.434	0.422	0.416	0.415	0.410
42	0.688	0.650	0.622	0.591	0.571	0.551	0.521	0.492	0.477	0.464	0.451	0.444	0.431	0.425	0.424	0.419
43	0.696	0.659	0.631	0.601	0.580	0.561	0.531	0.502	0.487	0.474	0.462	0.454	0.441	0.435	0.434	0.430
44	0.709	0.672	0.645	0.615	0.595	0.575	0.545	0.517	0.502	0.489	0.476	0.469	0.456	0.450	0.449	0.445
45	0.722	0.686	0.659	0.629	0.610	0.590	0.561	0.533	0.517	0.504	0.492	0.485	0.472	0.466	0.465	0.461
46	0.731	0.695	0.669	0.639	0.620	0.600	0.571	0.543	0.528	0.515	0.503	0.495	0.483	0.477	0.476	0.472
47	0.743	0.708	0.682	0.653	0.634	0.615	0.586	0.558	0.543	0.530	0.518	0.510	0.498	0.492	0.491	0.487
48	0.752	0.718	0.692	0.663	0.644	0.625	0.596	0.569	0.554	0.541	0.529	0.521	0.509	0.503	0.502	0.497
49	0.766	0.732	0.707	0.678	0.659	0.640	0.612	0.584	0.569	0.557	0.545	0.537	0.525	0.519	0.518	0.514
50	0.775	0.742	0.717	0.689	0.670	0.651	0.623	0.596	0.581	0.569	0.557	0.549	0.537	0.531	0.530	0.526

Table 8. Projected charter removals for Area 2C for 2017 under maximum size limits ranging from 30 to 55 inches, and with no annual limit as well as annual limits ranging from one to five fish. Table A contains the total projected removals and Table B contains the predicted average weights associated with each size and annual limit. Shaded values represent projections that do not exceed the 0.747 M lb allocation associated with the Blue Line FCEY. Outlined values highlight projections that are within the status quo SPR allocation of 0.858 M lb. All values in the table include corrections for errors in estimation of average weight and an additional 7.0% release mortality by weight.

A. Projected total removals including release mortality (M lb).							B. Projected average weight in the harvest (lb).					
Size limit (inches)	Annual Limit (number of fish per year)						Annual Limit (number of fish per year)					
	1	2	3	4	5	No Limit	1	2	3	4	5	No Limit
30	0.229	0.358	0.431	0.453	0.459	0.462	6.27	6.28	6.28	6.28	6.28	6.28
31	0.247	0.384	0.463	0.486	0.492	0.495	6.74	6.74	6.74	6.74	6.74	6.74
32	0.268	0.417	0.502	0.527	0.534	0.537	7.32	7.31	7.31	7.31	7.31	7.31
33	0.283	0.439	0.529	0.555	0.563	0.566	7.73	7.71	7.70	7.70	7.70	7.70
34	0.300	0.466	0.560	0.589	0.596	0.600	8.20	8.17	8.16	8.16	8.16	8.16
35	0.313	0.486	0.584	0.614	0.622	0.626	8.55	8.52	8.51	8.51	8.51	8.51
36	0.335	0.519	0.623	0.655	0.664	0.668	9.14	9.10	9.08	9.08	9.08	9.08
37	0.348	0.539	0.647	0.681	0.689	0.694	9.50	9.45	9.43	9.43	9.44	9.44
38	0.368	0.569	0.684	0.719	0.729	0.734	10.05	9.99	9.96	9.97	9.97	9.98
39	0.382	0.592	0.711	0.747	0.757	0.762	10.45	10.38	10.35	10.36	10.36	10.36
40	0.395	0.611	0.734	0.771	0.782	0.787	10.79	10.72	10.69	10.70	10.70	10.71
41	0.411	0.635	0.762	0.801	0.812	0.818	11.22	11.13	11.10	11.11	11.12	11.12
42	0.420	0.650	0.781	0.821	0.833	0.839	11.49	11.40	11.38	11.39	11.40	11.40
43	0.431	0.667	0.802	0.843	0.855	0.861	11.79	11.71	11.68	11.69	11.71	11.71
44	0.447	0.691	0.830	0.874	0.886	0.892	12.22	12.13	12.10	12.11	12.13	12.13
45	0.464	0.717	0.861	0.906	0.919	0.926	12.68	12.58	12.55	12.57	12.58	12.59
46	0.475	0.735	0.883	0.929	0.942	0.949	12.99	12.90	12.86	12.88	12.89	12.90
47	0.491	0.760	0.912	0.960	0.973	0.980	13.43	13.32	13.29	13.30	13.32	13.33
48	0.503	0.777	0.932	0.981	0.995	1.002	13.74	13.62	13.58	13.60	13.61	13.63
49	0.520	0.804	0.965	1.016	1.030	1.038	14.21	14.10	14.07	14.09	14.10	14.12
50	0.533	0.824	0.990	1.042	1.057	1.065	14.57	14.46	14.43	14.45	14.47	14.49
51	0.547	0.846	1.016	1.070	1.085	1.093	14.96	14.84	14.80	14.83	14.85	14.87
52	0.567	0.876	1.053	1.108	1.124	1.133	15.50	15.38	15.34	15.36	15.38	15.40
53	0.579	0.896	1.076	1.133	1.149	1.157	15.83	15.71	15.67	15.70	15.72	15.74
54	0.595	0.921	1.106	1.165	1.181	1.190	16.27	16.16	16.12	16.15	16.17	16.19
55	0.609	0.943	1.133	1.192	1.209	1.219	16.65	16.54	16.50	16.53	16.55	16.57



Table 9. Projected effort, halibut harvest per unit effort (HPUE), and harvest (numbers of halibut) for Area 3A in 2017 under status quo regulations, with associated standard errors. Status quo regulations include a two-fish bag limit with a maximum size limit of 28" on one of the fish, vessel trip limit, an annual limit of four fish per year, and no retention of halibut on Wednesdays.

Subarea	Effort (angler-trips)	Std Error	HPUE	Std Error	Harvest no. fish)	StdError
CCI	16,648	365	1.703	NA	28,352	626
EPWS	3,920	269	1.163	NA	4,558	326
GlacBay	2,024	293	0.760	NA	1,538	241
Yak	3,487	254	0.915	NA	3,192	246
LCI	37,004	927	1.717	NA	63,542	1,780
NGulf	34,827	1,369	1.190	NA	41,443	1,910
Kod	9,227	411	0.887	NA	8,182	393
WPWS	4,050	316	1.043	NA	4,225	303
Tot 3A	111,187	1,776	1.394	NA	155,032	2,771

Table 10. Estimated effects of annual limits of two to ten halibut on Area 3A anglers and projected harvest for 2017 under a 28-inch maximum size limit on one of two fish in the bag limit, vessel trip limit, and Wednesday closure. Effects were estimated using 2014 logbook data from licensed anglers. The percent of affected anglers is the portion of individual anglers that harvested more than each specified annual limit in 2014. For reference, the bold text represents the status quo harvest projections also shown in Table 9.

Annual	Subarea								Area 3A
Limit	CCI	EPWS	GlacBay	Yak	LCI	NGulf	Kod	WPWS	
Estimated percent of anglers affected by an annual limit:									
2	18.0%	9.7%	16.3%	21.3%	19.1%	12.3%	40.8%	9.0%	17.6%
3	16.3%	6.3%	5.1%	10.1%	17.2%	9.5%	30.5%	4.6%	14.6%
4	5.0%	1.3%	0.5%	4.0%	4.2%	2.8%	18.9%	0.5%	4.5%
5	4.3%	0.6%	0.0%	1.3%	3.6%	1.9%	12.9%	0.0%	3.5%
6	1.5%	0.2%	0.0%	0.8%	1.1%	0.7%	8.4%	0.0%	1.4%
7	1.3%	0.1%	0.0%	0.6%	0.9%	0.4%	6.1%	0.0%	1.1%
8	0.6%	0.0%	0.0%	0.1%	0.3%	0.2%	2.9%	0.0%	0.4%
9	0.5%	0.0%	0.0%	0.0%	0.2%	0.1%	1.8%	0.0%	0.3%
10	0.3%	0.0%	0.0%	0.0%	0.1%	0.1%	0.5%	0.0%	0.2%
Estimated percent change in harvest:									
2	-19.9%	-10.4%	-12.9%	-20.1%	-19.6%	-13.3%	-41.0%	-8.0%	-18.6%
3	-12.6%	-4.9%	-3.3%	-8.9%	-11.7%	-7.5%	-27.5%	-2.9%	-11.1%
4	-5.9%	-1.3%	-0.3%	-3.6%	-4.5%	-3.1%	-17.4%	-0.3%	-4.9%
5	-3.8%	-0.5%	0.0%	-1.4%	-2.8%	-1.7%	-11.1%	0.0%	-3.0%
6	-2.0%	-0.2%	0.0%	-0.7%	-1.3%	-0.9%	-6.8%	0.0%	-1.6%
7	-1.4%	-0.1%	0.0%	-0.3%	-0.8%	-0.5%	-4.0%	0.0%	-1.0%
8	-0.9%	0.0%	0.0%	0.0%	-0.5%	-0.3%	-2.0%	0.0%	-0.6%
9	-0.7%	0.0%	0.0%	0.0%	-0.4%	-0.2%	-1.0%	0.0%	-0.4%
10	-0.5%	0.0%	0.0%	0.0%	-0.2%	-0.2%	-0.5%	0.0%	-0.3%
Projected harvest (number of halibut):									
2	24,107	4,138	1,343	2,645	53,506	37,052	5,839	3,899	132,527
3	26,333	4,393	1,492	3,016	58,784	39,531	7,180	4,114	144,842
4	28,352	4,558	1,538	3,192	63,542	41,443	8,182	4,225	155,032
5	28,967	4,593	1,542	3,262	64,703	42,006	8,805	4,237	158,116
6	29,499	4,609	1,542	3,285	65,702	42,384	9,230	4,238	160,490
7	29,681	4,615	1,542	3,299	65,995	42,520	9,507	4,238	161,396
8	29,838	4,617	1,542	3,309	66,231	42,609	9,706	4,238	162,090
9	29,907	4,618	1,542	3,310	66,315	42,644	9,801	4,238	162,374
10	29,965	4,618	1,542	3,310	66,384	42,670	9,859	4,238	162,586
None	30,114	4,618	1,542	3,310	66,549	42,750	9,904	4,238	163,025

Table 11. Area 3A projected removals (upper table), harvest (center table), and average weights (lower table) for 2017 under a range of maximum size limits on one fish in the bag limit and for annual limits ranging from no limit down to two fish per year. Projected removals assume the status quo vessel trip limit and Wednesday closure all year. Shaded values represent projections that do not exceed the 1.778 M lb allocation associated with the Blue Line FCEY. Outlined values highlight projections that are within the status quo SPR allocation of 1.890 M lb. All values in the table include corrections for errors in estimation of average weight and an additional 1.5% release mortality by weight.

**Projected Removals (M lb)**

Size Limit (in)	Annual Limit (number of halibut)									No Limit
	2	3	4	5	6	7	8	9	10	
26	1.606	1.756	1.872	1.908	1.934	1.945	1.953	1.956	1.958	1.963
27	1.632	1.785	1.903	1.939	1.966	1.977	1.985	1.988	1.991	1.995
28	1.673	1.829	1.951	1.988	2.016	2.027	2.035	2.038	2.041	2.046
29	1.835	2.006	2.139	2.181	2.211	2.223	2.233	2.236	2.239	2.245
30	1.912	2.091	2.232	2.276	2.308	2.322	2.332	2.336	2.339	2.344

**Projected Harvest (number of halibut)**

Size Limit (in)	Annual Limit (number of halibut)									No Limit
	2	3	4	5	6	7	8	9	10	
26-28	132,527	144,842	155,032	158,116	160,490	161,396	162,090	162,374	162,586	163,025
29	147,040	160,681	171,915	175,370	178,011	179,039	179,822	180,145	180,383	180,867
30	149,630	163,652	175,185	178,779	181,519	182,602	183,426	183,767	184,018	184,515

**Projected Average Net Weight (lb)**

Size Limit (in)	Annual Limit (number of halibut)									No Limit
	2	3	4	5	6	7	8	9	10	
26	11.941	11.944	11.898	11.889	11.874	11.871	11.869	11.867	11.866	11.863
27	12.136	12.139	12.093	12.085	12.070	12.068	12.065	12.064	12.063	12.059
28	12.440	12.443	12.398	12.389	12.375	12.372	12.369	12.368	12.367	12.364
29	12.293	12.297	12.258	12.250	12.238	12.235	12.233	12.232	12.230	12.228
30	12.589	12.591	12.551	12.542	12.529	12.526	12.523	12.522	12.521	12.518

Table 12. Percent of the annual charter halibut harvest in each subarea of Area 3A taken on specific days of the week during the period July 1-August 15, 2016. The percent of harvest that occurred each day represents the maximum expected percent reduction in the total annual harvest associated with a closure of that day during that period.

Subarea	Sun	Mon	Tue	Wed	Thu	Fri	Sat
CCI	8.2%	10.3%	9.0%	0.1%	8.2%	7.8%	8.4%
EPWS	7.5%	9.0%	8.6%	0.4%	9.6%	11.6%	12.8%
G	10.0%	11.4%	7.9%	0.0%	8.9%	7.9%	7.9%
H	5.5%	5.0%	6.1%	0.0%	6.8%	6.4%	5.0%
LCI	9.0%	8.9%	7.5%	0.1%	8.2%	9.5%	8.6%
NG	8.1%	9.5%	9.2%	0.0%	9.3%	10.0%	10.8%
QR3A	9.0%	10.1%	9.5%	0.2%	8.9%	9.3%	7.1%
WPWS	6.9%	7.8%	6.3%	0.2%	9.3%	10.0%	8.0%
Area 3A	8.5%	9.3%	8.3%	0.1%	8.6%	9.3%	9.1%

Table 13. Projected charter removals (M lb) for Area 3A in 2017 under reverse slot limits on one fish ranging from U28O60 to U60O80, and a maximum size limit on the other fish of 28 inches. Projections are for the status quo harvest forecast of 155,032 halibut, and include the one-trip limit and four-fish annual limit per angler. Projections also include a 5% inflation factor for release mortality, and a correction for error in estimating the average weight. Shaded values represent projections that do not exceed the 1.778 M lb allocation associated with the Blue Line FCEY. Outlined values highlight projections that are within the status quo SPR allocation of 1.890 M lb.

Lower Limit (in)	Upper Length Limit (in)										
	60	62	64	66	68	70	72	74	76	78	80
28	1.275	1.258	1.237	1.220	1.209	1.204	1.199	1.196	1.193	1.190	1.184
29	1.323	1.307	1.285	1.269	1.258	1.253	1.248	1.245	1.242	1.238	1.233
30	1.395	1.380	1.358	1.342	1.331	1.326	1.321	1.318	1.315	1.311	1.306
31	1.446	1.430	1.408	1.392	1.382	1.376	1.372	1.369	1.366	1.362	1.357
32	1.509	1.494	1.472	1.456	1.446	1.441	1.436	1.433	1.430	1.426	1.421
33	1.548	1.533	1.511	1.495	1.485	1.480	1.475	1.472	1.469	1.466	1.460
34	1.592	1.576	1.555	1.539	1.529	1.523	1.519	1.516	1.513	1.509	1.504
35	1.621	1.606	1.585	1.569	1.559	1.553	1.549	1.546	1.543	1.539	1.534
36	1.659	1.644	1.623	1.607	1.597	1.592	1.587	1.584	1.581	1.578	1.573
37	1.678	1.663	1.642	1.626	1.616	1.611	1.606	1.603	1.600	1.597	1.592
38	1.703	1.688	1.667	1.652	1.641	1.636	1.632	1.629	1.626	1.622	1.617
39	1.726	1.710	1.690	1.674	1.664	1.659	1.654	1.651	1.649	1.645	1.640
40	1.742	1.727	1.707	1.691	1.681	1.676	1.671	1.668	1.666	1.662	1.657
41	1.759	1.744	1.723	1.708	1.698	1.692	1.688	1.685	1.682	1.678	1.673
42	1.771	1.756	1.736	1.720	1.710	1.705	1.700	1.697	1.695	1.691	1.686
43	1.790	1.776	1.755	1.740	1.730	1.724	1.720	1.717	1.714	1.711	1.706
44	1.801	1.786	1.766	1.750	1.740	1.735	1.731	1.728	1.725	1.721	1.716
45	1.814	1.799	1.779	1.764	1.754	1.748	1.744	1.741	1.738	1.735	1.730
46	1.823	1.808	1.788	1.773	1.763	1.757	1.753	1.750	1.747	1.744	1.739
47	1.838	1.823	1.803	1.788	1.778	1.773	1.769	1.766	1.763	1.759	1.754
48	1.847	1.832	1.812	1.797	1.787	1.782	1.778	1.775	1.772	1.768	1.764
49	1.866	1.852	1.832	1.816	1.807	1.801	1.797	1.794	1.791	1.788	1.783
50	1.881	1.866	1.846	1.831	1.822	1.816	1.812	1.809	1.806	1.803	1.798
51	1.895	1.881	1.861	1.846	1.836	1.831	1.827	1.824	1.821	1.818	1.813
52	1.910	1.896	1.876	1.862	1.852	1.847	1.842	1.839	1.837	1.833	1.828
53	1.920	1.907	1.887	1.872	1.862	1.857	1.853	1.850	1.847	1.844	1.839
54	1.938	1.924	1.905	1.890	1.880	1.875	1.871	1.868	1.865	1.862	1.857
55	1.946	1.932	1.913	1.898	1.888	1.883	1.879	1.876	1.873	1.870	1.865
56	1.959	1.946	1.926	1.912	1.902	1.897	1.893	1.890	1.887	1.884	1.879
57	1.976	1.962	1.943	1.928	1.918	1.913	1.909	1.906	1.904	1.900	1.895
58	1.989	1.975	1.956	1.942	1.932	1.927	1.922	1.919	1.917	1.913	1.909
59	2.003	1.989	1.970	1.956	1.946	1.941	1.937	1.934	1.931	1.928	1.923
60	2.018	2.005	1.986	1.971	1.962	1.957	1.952	1.949	1.947	1.943	1.939

Table 14. Projected charter harvest in Area 3A in 2017 under a one-fish bag limit for part of the year and status quo regulations for the remainder of the year. Projections are shown for two options, including a one-fish bag limit (1) during the month of July, and (2) from June 16 through August 15.

Option	One-Fish Bag Limit		Remainder of the Year (max 28" second fish)		Total Removals for the Year				
	Harvest	Average Wt (lb)	Harvest	Average Wt (lb)	Harvest	Average Wt (lb)	Yield (M lb)	RelMort (M lb)	Removals (M lb)
July	31,491	19.29	99,330	12.41	130,820	14.07	1.840	0.028	1.868
Jun 16 – Aug 15	58,570	18.77	50,972	12.45	109,543	15.83	1.734	0.026	1.760

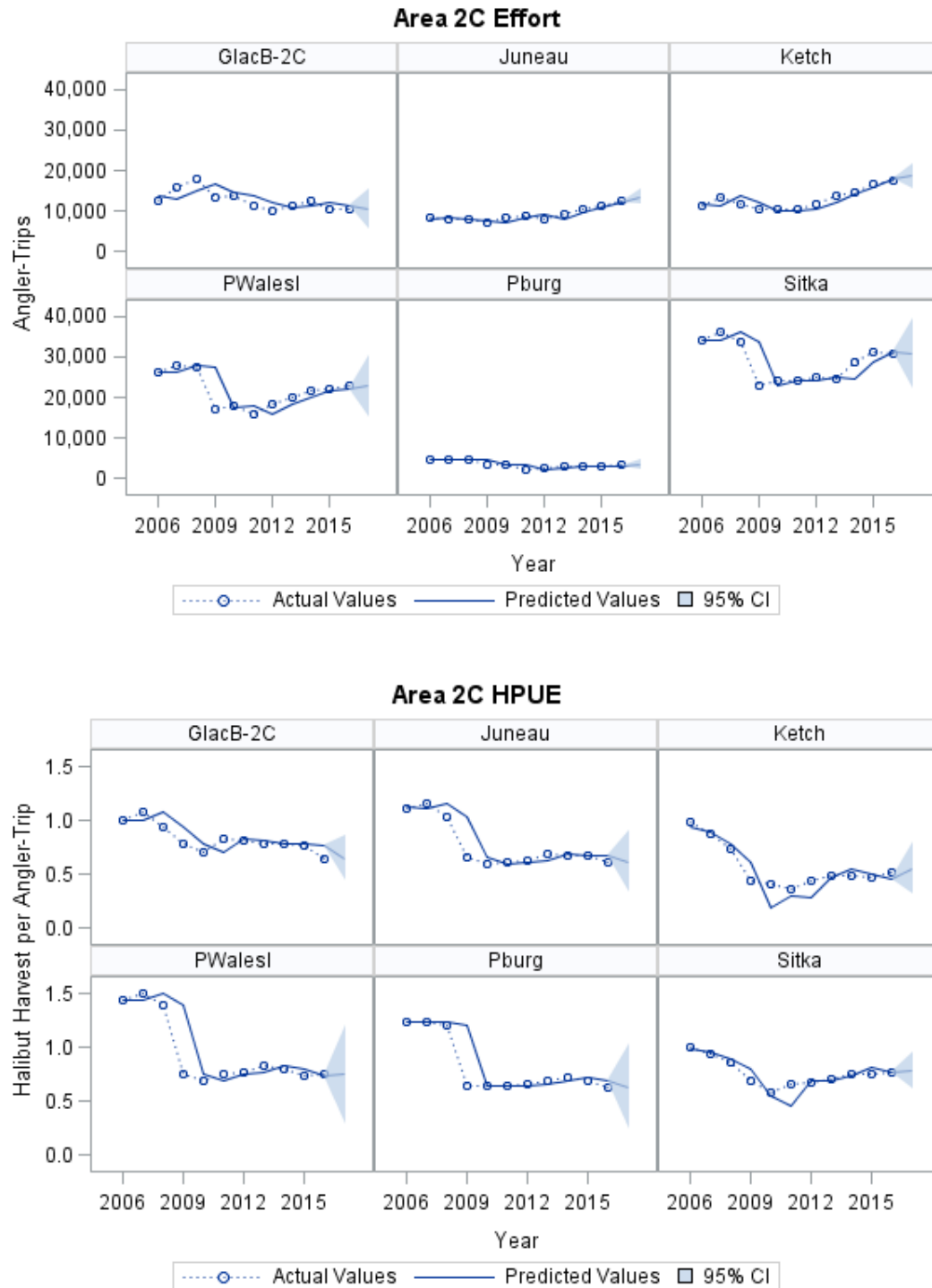


Figure 1. Time series of logbook effort (upper) and HPUE (lower) for subareas of Area 2C with predicted values and forecasts for 2017 from either simple or double exponential smoothers (whichever had the lowest AICc). Blue bands indicate 95% confidence intervals for the 2017 forecasts.

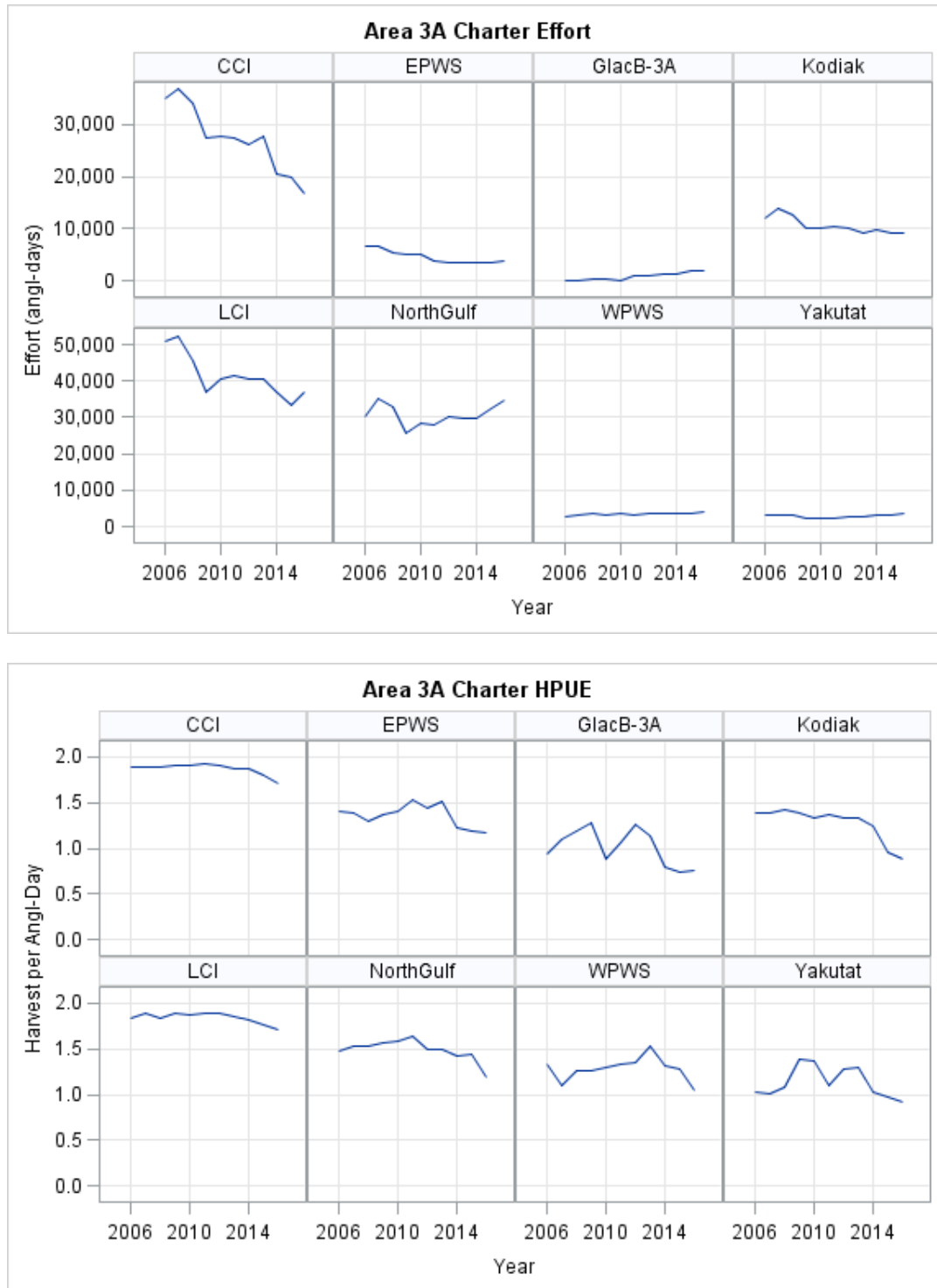


Figure 2. Time series of charter effort (upper) and HPUE (lower) by subarea of Area 3A, derived from charter logbook data.