

# **Analysis of Management Options for the Area 2C and 3A Charter Halibut Fisheries for 2018**

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 correspond 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 will 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 10, 2017 to develop alternative management measures to be analyzed by the ADF&G for the 2018 season. ADF&G staff provided preliminary estimates of charter harvest and release mortality for the 2017 season to committee members prior to the meeting.

In Area 2C, the 2017 preliminary harvest estimate for the charter fishery was 71,711 halibut with an average weight of 12.31 lb (Meyer et al. 2017). The number of halibut harvested was 4.3% higher than the harvest forecast of 68,724 and average weight was about 1.9% higher than the predicted average weight of 12.08 lb. The Area 2C preliminary estimate of charter removals was 0.921 million pounds (Mlb), including an estimated 0.039 Mlb of release mortality of O26 fish (over 26 inches). The preliminary estimate of charter removals was 3.7% greater than the 0.888 Mlb removal predicted for 2017, and exceeded the 0.915 Mlb allocation by 0.7%.

In Area 3A, an estimated 143,654 halibut were harvested with an average weight of 14.48 lb (Meyer et al. 2017). The number of fish harvested was 3.5% less than the forecast of 148,893, but average weight was 16.8% greater than the predicted average weight of 12.40 lb. The preliminary estimate of charter removals for Area 3A was 2.093 Mlb, including 0.014 Mlb of O26 release mortality. The preliminary estimate was 11.7% greater than the predicted removal of 1.874 Mlb and 10.7% greater than the allocation of 1.890 Mlb. The preliminary estimates were based on logbook data for trips through July 31, 2017, 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 2018:

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

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

- 1) Status quo (reverse slot limit allowing the harvest of a fish less than or equal to 44 inches or greater than or equal to 80 inches, and
- 2) Additional reverse slot limits, with lower limits of the protected slot ranging from 35 to 50 inches and upper limits ranging from 50 to 80 inches.

Area 3A (all options include, unless otherwise noted, the status quo two-fish bag limit with 28-inch maximum size limit on one fish, 4-fish annual limit, one trip per vessel and one trip per permit per day, Wednesday closure all year, closure of three Tuesdays in July and August:

- 1) Status quo,
- 2) Additional Tuesday closures during the months June through August,
- 3) A bag limit of one fish of any size for the entire year, and
- 4) A 28-inch maximum size limit on one fish and a reverse slot limit on the second fish (analyze lower limits of 35-60 inches and upper limits of 60-80 inches).

This analysis provides information to stakeholders and the Council to assist them in selecting management measures, or combinations of measures, that are likely to keep total charter removals within their allocations. The allocations are derived from catch limits determined by the IPHC at their annual meeting in January 2018. The charter allocations will not be known when the Council is expected to make its recommendations in December 2017. However, the Council may base recommendations on the allocations determined from the combined commercial-charter catch limits associated with maintaining the IPHC’s reference level of spawning potential ratio (SPR), as identified in IPHC preliminary catch tables for Areas 2C and 3A (Stewart 2017). It is also recommended that the Council include contingencies to accommodate adoption of higher or lower combined catch limits.

At the Interim Meeting on November 28, 2017, the IPHC announced the combined commercial-charter catch limits (FCEYs) associated with the reference level of SPR (SPR<sub>46%</sub>): 3.76 Mlb for Area 2C and 9.01 Mlb for Area 3A. The CSP specifies that in Area 2C, when the combined catch limit is less than 5 Mlb the charter allocation is 18.3%. In Area 3A, the charter allocation is 18.9% when the combined catch limit is less than 10 Mlb. Therefore, the corresponding charter allocations associated with maintaining the reference SPR are 0.69 Mlb for Area 2C and 1.70 Mlb for 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 2018 under status quo measures is 0.97 Mlb, which is 280,000 lb higher than the reference SPR allocation of 0.69 Mlb. The projected removal for Area 3A under status quo measures is 1.86 Mlb, which is 160,000 lb greater than the reference SPR allocation.

Area	Projected Status Quo Charter Removals (Mlb)	Charter Allocation (Mlb)	Difference (Mlb)
2C	0.97	0.69	0.28
3A	1.86	1.70	0.16

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 reference SPR allocations. 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 Definitions and Basic Calculations**

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” refer 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 projected from harvest, average weight, and release mortality as follows:

$$\text{Harvest}(\text{no. fish}) = \text{Effort}(\text{angler trips}) \times \text{HPUE}(\text{harvest per angler trip}),$$

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

$$\text{Removals}(\text{lb}) = \text{Yield}(\text{lb}) \times r$$

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

$$r = 1 + [\text{ReleaseMortality}(\text{lb})/\text{Yield}(\text{lb})].$$

Average net weight (headed and gutted) is estimated for the harvest 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 many 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 mail 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 obtained length measurements from harvested halibut and interviewed anglers and charter captains in at least one port in each subarea.

### **2.3 Harvest Forecasts**

Simple time series methods are used to forecast effort, harvest per unit effort (HPUE), and other components of the harvest forecasts under certain situations. Time series forecasts are inherently uncertain because they rely only on past data, which are not necessarily indicative of future trends. They can't be used in all instances because they assume that the same underlying processes are in place as those that generated the historical estimates. Therefore, recent regulation changes may bias a forecast, or render it unsuitable for other regulatory scenarios. Time series methods used in this report include simple and double exponential smoothing models using SAS/ETS<sup>TM</sup> software. 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

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<sup>2</sup> SAS/ETS<sup>TM</sup> software, Version 9.3, SAS System for Windows, Copyright © (2002-2010), SAS Institute, Inc.

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 over the entire time series. Generally, the stronger the trend and lower the variability, the higher the smoothing weight and the more emphasis is placed on recent observations. Both simple and double exponentials were run for each time series, and the forecasts with the smallest AICc value (Akaike Information Criterion, corrected for small sample size) were selected.

For Area 2C, the 2018 harvest forecasts were calculated for each subarea as the product of the effort and HPUE forecasts. Simple exponential and double exponential forecasts were generated for effort and HPUE using logbook data for 2009-2017 (Table 3, Figure 1). Although logbook data are available since 2006, the first three years were excluded because the bag limit was changed from two to one fish in 2009, causing poor fit of projections to the time series. Exclusion of the earlier data had little effect on the simple or double exponential forecasts, but did affect the fit of past forecasts, which determined which type of forecast was selected. Time series forecasts were considered suitable for Area 2C because the small changes in size limits made in recent years were unlikely to have a significant effect on trends in effort or HPUE.

In Area 3A, on the other hand, there were substantial and incremental changes in regulations over the last three years that appear to have had an effect on 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 reduced to four fish per angler. There was an immediate decline 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, Figure 2). If the decline in effort in recent years is due to incremental changes in regulations, the exponential smoothing forecasts may overestimate the decline due to changes in the underlying process. Therefore, the 2017 preliminary estimate of effort in 3A was assumed as the status quo effort level for 2018.

In addition, implementation of the first size limits in Area 3A in 2014 resulted in a marked decline in the proportion of the charter halibut harvest made up of second fish in the bag limit (Figure 3). The largest decreases were in subareas with the highest average weights (Glacier Bay and Yakutat). In other words, at ports with large halibut available, fewer anglers harvested a second fish, preferring instead to focus on harvesting one large fish. The decrease in retention of a second fish by anglers caused HPUE to decline as well (Figure 2). However, the proportion of second fish retained continued to decline every year through 2017, even though changes in size limits and annual limits were quite minor (no change to either in 2017). It appears the decrease in the proportion of second fish is more related to the presence of maximum size limits and annual limits than to what those limits are. Therefore, exponential smoothing models were used to forecast HPUE for 2018 in order to capture the declining trend.

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

The Charter Halibut Management Committee did not specifically request analysis of annual limits in either Area 2C or Area 3A, but it was unclear whether that was an oversight – past analyses of reverse slot limits, maximum size limits, and other measures in both areas have consistently been combined with annual limits. Therefore, this analysis included options for annual limits in both areas in order to provide the Council with comparable flexibility to select management measures.

The effects of various annual limits on harvest were estimated using charter logbook data that summarized the distribution of annual harvests by individual licensed anglers from a previous base year. The base years were 2016 for Area 2C and 2014 for Area 3A; these are the years with the most recent complete data without an annual limit. Calculations of annual harvests could not be done for youth anglers (under 16) because they are not required to be licensed, and therefore harvest cannot be assigned to individuals. Youth accounted for a relatively steady average of 4.4% of charter effort in Area 2C and

5.4% of charter effort in Area 3A during the years 2014-2016. Because the proportion of youth effort was steady and relatively low, we assume that leaving youth anglers out of the calculations did not bias estimates of the effects of implementing annual limits.

For each subarea, harvests under each proposed annual limit were estimated by truncating the annual harvest of each angler during the base year 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. All calculations were done by subarea and summed to obtain the harvests under each annual limit in Areas 2C and 3A.

Doing the calculations by subarea slightly underestimates the harvest reductions associated with annual limits because some anglers fish in multiple subareas within a year. For example, if an individual angler caught four fish in each of two subareas in the base year, 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. The magnitude of this error was evaluated by comparing the percentage harvest reductions estimated from subarea and areawide data. For Area 2C, the estimated reductions in harvest based on subarea data were underestimated by 0.4 to 0.1 percentage points for annual limits from 1 to 5 fish. For Area 3A, the subarea method underestimated the reductions in harvest by 3.7 to 0.5 percentage points for annual limits from 2 to 6 fish. For both areas, the underestimation caused by anglers fishing multiple areas was considered to be negligible.

## **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 2013-2017 for inclusion in the IPHC annual stock assessment as part of sport fishery removals. Estimation methods are documented in Meyer (2014) and in ADF&G's annual reports to the IPHC<sup>3</sup>.

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 than maximum size limit because smaller fish are relatively more abundant and more likely to be caught. Under reverse slot limits, the amount of release mortality would be expected to vary with the sizes and range of the protected slot. A wide protected slot would likely result in more released fish than a narrow slot, and a higher protected slot would result in a higher average weight of released fish. Under annual limits, both the number of fish and average weight of released fish would be likely to increase as annual limits are made more restrictive.

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<sup>3</sup> The ADF&G annual reports to the IPHC are available for download at <https://www.npfmc.org/halibut-charter-management>. For example, the October 2017 report is at: [https://www.npfmc.org/wp-content/PDFdocuments/halibut/ADFG\\_sport\\_fishery\\_report\\_IPHC\\_2017.pdf](https://www.npfmc.org/wp-content/PDFdocuments/halibut/ADFG_sport_fishery_report_IPHC_2017.pdf).

In Area 2C, under reverse slot limits, the ratio of release mortality to charter yield (in pounds) increased steadily from 0.048 in 2014 to 0.063 in 2016. The ratio for 2017 is 0.044, based on a preliminary estimate of release mortality. The 2017 value may be underestimated due to potential problems with recording of size categories of released fish during creel survey interviews in 2017. Therefore, the average ratio for 2013-2017 of 0.054 was used for the 2018 projections. In other words, charter fishery removals in Area 2C under a reverse slot limit were projected by expanding projected yield by the factor 1.054 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, and then decreased steadily from 0.017 in 2014 to 0.007 in 2017. The 5-year average was 0.012. For 2018 projections, the average correction factor of 1.012 was applied to yield to account for release mortality under the status quo management measures of two-fish bag limit with maximum size limit on one fish, and for the same measures with additional closed Tuesdays. A correction factor of 1.02 was assumed for a one-fish bag limit without a size limit. Area 3A has never had a one-fish bag limit, but release mortality would be assumed to be higher given the high-grading expected under a one-fish bag limit. For a 28-inch maximum size limit combined with a reverse slot limit, the correction factor of 1.04 was applied to yield to account for release mortality. Again, there is no history of such a regulation in Area 3A, but we would expect more released fish than under a one fish bag limit, because fish would be discarded for voluntary (too small) as well as regulatory reasons (in the protected slot).

As mentioned above, the amount of release mortality would be expected to vary with the sizes and width of the protected slot under a reverse slot management tool. However, empirical data are not available to model that relationship; a reverse slot limit has only been implemented in Area 2C, and only over a limited range of size limits. Therefore, a single value for release mortality will be used in the reverse slot projections in each area.

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

#### **3.1 Status Quo Forecast of the Number of Fish Harvested**

Status quo measures for Area 2C include a one-fish bag limit and U44O80 reverse slot size limit. 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 in all areas except Juneau, which had a declining trend. The 2018 status quo effort forecast for Area 2C is 110,089 angler-trips, the weighted average HPUE forecast is 0.69 halibut per angler-day, and the harvest forecast is 75,430 halibut, with a 95% margin of error ( $\pm 2$  standard errors) of about  $\pm 6,650$  (Table 5). This is up slightly from the preliminary harvest estimate for 2017 of 71,711 halibut.

#### **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 6%, while a two-fish annual limit would decrease harvest by about 22%.

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

##### **3.3.1 Approach**

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 control 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 size 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 2014-2017. 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 in 2010, where the weighting factors are the respective proportions of harvest above and below those limits.

Average weights estimated from the fishery in 2012-2017 were compared to the algorithm-predicted average weights for the size limits that were in place at the time. The average weights estimated from the fishery included any illegally harvested fish in the protected size slot between the lower and upper size limits (illegal-size fish made up an estimated 0.6% to 1.6% of the Area 2C harvest each year). Errors in predicted average weights ranged from -13% to +43% for individual subareas, and from +9% to +16% for Area 2C overall (average = 12%). Predicted average weight tended to be either underestimated or overestimated in any given subarea, but trends in the errors were highly variable among years. Correction factors were developed for the algorithm-predicted average weights for each subarea. The correction factors were based on the average ratio of the predicted and observed average weights, and ranged from 0.77 to 1.10 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 2018 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 5.4% for predicted release mortality. For reference, the most liberal combinations of size limits and annual limits for which the projected removals are within the reference SPR allocation are highlighted in Table 7.

### **3.3.2 Results**

The projected charter removal under the status quo size limit of U44O80 and no annual limit is 0.971 Mlb (Table 7). This is about 280,000 lb greater than the reference allocation of 0.69 Mlb. Implementation of an annual limit no greater than four fish is required to bring the projected removals within the allocation. The most liberal regulation under a three-fish annual limit would be U35O74. However, there are more options with a two-fish annual limit, including lower size limits up to 40 inches. A one-fish annual limit is required to raise the lower size limit over 40 inches.

To test the correction factors and projections, the projection algorithm was applied to the preliminary harvest estimates for 2017. Under that harvest scenario, the projected charter removal was 0.924 Mlb (not shown in Table 7), which compares favorably with the 2017 preliminary estimate of 0.921 Mlb of removals.

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

### **4.1 Status Quo Harvest Forecast of the Number of Fish Harvested**

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 of four halibut per angler, limits of one trip per vessel and one trip per charter halibut permit per day, no retention of halibut on Wednesdays year-round, and no retention on three Tuesdays in July and August. As explained earlier, the status quo effort forecast was equal to the 2017 preliminary estimate. All subareas had declining trends in HPUE (Table 4, Figure 2). The status quo effort for Area 3A for 2018 is 106,316 angler-trips, and the harvest forecast is 136,734

halibut with a 95% margin of error ( $\pm 2$  standard errors) of about 7,200 (Table 8). The status quo harvest forecast is 4.8% lower than the 2017 preliminary harvest estimate of 143,654 due to the forecasted decline in HPUE. The weighted average HPUE forecast for Area 3A overall is 1.29 halibut per angler-trip, compared with 1.72 in 2010. With the exception of Central Cook Inlet, Lower Cook Inlet, and the North Gulf, all subareas had HPUEs of less than 1 halibut per angler-trip, reflecting the lower retention of second fish in the bag limit in those areas.

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

The status quo annual limit is four halibut per year. Annual limits ranging from 2 to 6 fish per year were evaluated to provide the Council with additional flexibility if needed. Projections were based on data from the base year 2014, the most recent year without an annual limit.

For 2018, the projected harvest in the absence of an annual limit was estimated by starting with the status quo harvest forecast, and then removing the estimated effect of a four-fish annual limit. Projected harvests under all annual limit options were then calculated by applying the estimated percent reductions to the harvest forecast without an annual limit. All harvest projections for 2018 still include other status quo measures, including the charter vessel trip limit, permit trip limit, maximum size limit on the second fish, Wednesday closure for the entire year, and three Tuesday closures in July and August.

The effects of annual limits varied by subarea, with the largest percentage effects in the Kodiak subarea (Table 9). 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 1.6% under a six-fish limit. Lowering the annual limit under other status quo measures from four to three fish is estimated to reduce the harvest from 136,734 to 127,581 halibut, a decrease of 6.7% relative to status quo. Conversely, raising the annual limit to 5 fish would increase the harvest to 139,464, an increase of 2.0% relative to status quo.

#### **4.3 Maximum Size Limit on One Fish Combined with an Annual Limit (Status Quo)**

##### ***4.3.1 Approach***

As described above, this regulatory mechanism is the status quo, with a maximum size limit on one fish of 28 inches and an annual limit of 4 fish. Other size limits and annual limits were explored to provide the Council flexibility in recommending management measures. Charter removals were projected under maximum size limits ranging from 26 to 30 inches and annual limits ranging from two to six fish, as well as no annual limit (Table 10). Projected removals include a 1.2% inflation factor to account for release mortality. These projections incorporate all other status quo measures, including the charter vessel trip limit, permit trip limit, maximum size limit on the second fish, Wednesday closure for the entire year, and three Tuesday closures in July and August.

Average weight under each size limit was calculated as a weighted mean of the fish of any size and the fish subject to a maximum size limit. The average weight for the fish of any size was assumed to be the overall average 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. These terms 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 proportions of “second” fish in the harvest were forecasted for 2018 from 2010-2017 logbook data using the exponentially-weighted time series models described in Section 2.3. These forecasted proportions ranged from 43-44% in Cook Inlet down to 1% in the Yakutat and Glacier Bay subareas, with a weighted average of 36% for Area 3A overall.

The average weights predicted using this method for each size limit differed from average weights observed under those size limits in past years. Factors contributing to those differences include changes

since 2013 in the size distribution of the population, changes in the sizes of fish people are willing to keep given annual limits, and changes in the proportions of first and second fish in the harvest. Therefore, the predicted average weights were corrected, or adjusted to match current average weights. Corrections were based on the difference between predicted and estimated (observed) average weights for 2015-2017. Predicted average weights for past years tended to be underestimated for all subareas, ranging from 51% below to 6% above observed values across all subareas and years, and from 28% to 18% below observed values across years for Area 3A overall. Correction factors, based on the average ratio of the predicted and observed average weights, ranged from 1.03 to 1.65 among subareas.

#### **4.3.2 Results**

Under status quo regulations, which include a 28" maximum size limit on the second fish and 4-fish annual limit, the projected average weight was 13.41 lb and projected removal was 1.855Mlb (Table 10). The status quo projected removal is approximately 160,000 lb greater than the allocation corresponding with the reference SPR of 1.70 Mlb. An annual limit of two fish would be required to retain the 28-inch maximum size limit and still have projected harvest under the allocation.

### **4.4 Status Quo with Additional Tuesday Closures**

#### **4.4.1 Approach**

Status quo regulations in Area 3A included a year-round closure of the charter fishery on Wednesdays, as well as two Tuesdays closed in late July and one Tuesday closed in early August. The potential effect of closing additional Tuesdays was estimated for the months June-August. The analysis relied on complete logbook data for 2016, a year in which the fishery was closed only on Wednesdays. Generally speaking, the analysis proceeded by estimating the proportional effect of additional Tuesday closures in 2016 and applying those proportional effects to the harvest forecast for 2018.

The first step was to identify the dates of specific Tuesdays that would be closed in 2018 under each possible number of closed days. Specific Tuesdays were selected such that, for each scenario, 60-75% of the closed days would fall before August 1. The proportion of harvest occurring before August 1 is an important value that is used to make preliminary estimates of charter harvest each year using incomplete logbook data. The proportion of annual charter harvest occurring through July has averaged 69% since 2014. If daily closures were implemented in a manner that caused that proportion to vary significantly from its recent average, it could bias future preliminary harvest estimates.

There are a total of 13 Tuesdays during the period June-August, 2018. Once the specific closed Tuesdays for each scenario were identified, the closest Tuesday to each of those dates was identified from the 2016 data set for analysis. There was a two-day difference in the date of each Tuesday from 2016 to 2018. The potential harvest reduction associated with closing all Tuesdays for the entire year (47 closed days) was also estimated to provide additional context and perspective. Closing all Tuesdays beyond the June-August period would only reduce harvest another 2%, reflecting the relatively low levels of harvest in the shoulder seasons.

The analysis assumed that the proportions of harvest occurring on each Tuesday in 2016 would be eliminated if those days were closed. In other words, the harvest that occurred on those days represented the potential reduction in harvest if those days were closed. The total annual harvest under each scenario of closed Tuesdays was compared to the harvest scenario of three closed Tuesdays to estimate the proportional reductions. The harvest reductions under each scenario represent the maximum expected reduction in the number of fish harvested, assuming that anglers displaced by the daily closures would not book trips on another day.

#### **4.4.2 Results**

The potential reductions in harvest ranged from 1.3% for one additional closed Tuesday (four closed Tuesdays) to 11.2% for 10 additional closed Tuesdays (13 total). The projected removals associated with

these scenarios ranged from 1.830 Mlb down to 1.645 Mlb (Table 11). Closing all Tuesdays is projected to reduce harvest by up to 13.2%, resulting a predicted charter removal of 1.608 Mlb.

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

##### ***4.5.1 Approach***

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. This regulation is functionally similar to a maximum size limit on both fish, but provides anglers with the potential of harvesting one halibut of exceptional size (above the upper limit). This option was also analyzed for the 2017 season (Meyer and Powers 2016).

The method of projecting removals under this option was a hybrid of the reverse slot and maximum size methods, but still followed the basic equation in Section 2.1. Harvest (numbers of fish) was projected as effort multiplied by HPUE. The average weight of the first fish was projected exactly as was done for the reverse slot limit in Area 2C, but using length data from 2013, the last year without a size limit. The average weight of the second fish was calculated as the average weight of U28 fish in 2013. The overall average weight was calculated as a weighted mean of the first and second fish, where the weighting factors were the projected proportions of first and second fish.

Because a reverse slot limit has never been implemented in Area 3A, there were no empirical data on how the fishery might respond to such a regulation. This regulation limits the size of the fish that, under status quo regulations, can be of any length. It was assumed that restricting the length of both fish would increase the incentive to harvest two fish, thereby increasing the HPUE and the number of fish harvested. However, there are no data to indicate how many more second fish would be retained or how much the harvest could increase.

Because a single prediction could not be made with confidence, two sets of projections were made bracketing a plausible range of assumptions. Both scenarios used the 2017 preliminary effort as the projected effort for 2018. The low harvest scenario used the time series forecasts of HPUE and the proportion of second fish for 2018, and was identical to the status quo harvest forecast in Table 8. Use of the status quo forecast scenario assumes that a size limit on both fish would not increase retention of second fish by anglers. The high harvest scenario used the HPUEs and the corresponding proportions of second fish from 2013, the last year before implementation of any size limit. As indicated previously, implementation of the maximum size limit on one fish in 2014 resulted in immediate and substantial decreases in HPUE and the proportion of second fish in subareas with large fish available.

Projections were made for lower size limits ranging from 35-60 inches (U35-U60), and for upper limits ranging from 60-80 inches (O60-O80). The lack of experience with this measure created another problem, namely that there were no empirical mean weight data that could be used to correct the predictions, or tune them to current conditions, as was done with the status quo measures in Area 2C and Area 3A. However, imposition of a U60-O60 size limit would be the functional equivalent of one fish of any size and a maximum size limit of 28 inches on the second fish. Therefore, the projections for the low harvest scenario were adjusted by a single correction factor to make the projected yield under a U60-O60 reverse slot limit match the projected yield under the status quo (one fish of any size plus one fish under 28 inches). This same correction factor was applied to yield projections under the high harvest scenario. Finally, the yield projections were inflated by a factor of 4% to account for release mortality (see Section 2.5).

##### ***4.5.2 Results***

The differing harvests under each scenario resulted in substantially different projections of removals. Under the low harvest scenario that assumes that the reverse slot limit will not entice more anglers to keep a second fish, projected removals ranged from 1.425 Mlb to 1.906 Mlb for the range of size limits considered (Table 12). This scenario provided for many possible size limit combinations that would be

projected to keep the charter fishery within the 1.70 Milb reference SPR allocation. Under the high harvest scenario, projected removals ranged from 1.749 Milb to 2.238 Milb. None of the size limits under the high harvest scenario would keep the charter sector within the reference SPR allocation.

The results of these two scenarios are not presented as a choice, but rather to show the results of uncertainty in the calculations. The projections are highly sensitive to the proportion of second fish retained, and we lack the history with this management measure to say with reasonable certainty how many more anglers would retain a second fish. Our recommendation is that the Council view these results as two extremes outlining a plausible range of projections.

## **4.6 One-Fish Bag Limit, No Size Limit**

### **4.6.1 Approach**

This measure would combine a one fish bag limit, with no size limit, with all other status quo regulations, including the vessel and permit trip limits, 4-fish annual limit, Wednesday closures all year, and Tuesday closures from July 24-August 7. This option was also analyzed for Area 3A for the 2017 season (Meyer and Powers 2016). As was the case last year, 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 increased 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, it is expected that anglers will high-grade to get the largest fish possible; the resulting increase in average weight will offset the decrease in the number of fish harvested to an unknown degree.

There are no empirical data from a fishery under a one-fish bag limit in Area 3A that can be used to predict the degree to which anglers will high-grade. It is also questionable whether the data from Area 2C is applicable to Area 3A, but the increase in average weight seen in 2009 and 2010 may be indicative of what is possible. There are many plausible approaches to predicting the average weight, with no clear way to decide which is the most accurate. The analysis this year looked at three basic scenarios: (1) the average weight of “first” fish in Area 3A in 2015, (2) the average weight of “first” fish in 2016, and (3) the average weight of O28 fish in 2017. The third option was substituted for average weight of “first” fish in 2017 because logbook data were not available for the entire year. In all three of these years, Area 3A was regulated under a two-fish bag limit that included a fish of any size (“first” fish) and second fish with a maximum size limit. Maximum size limits were 29 inches in 2015 and 28 inches in 2016 and 2017. Three additional average weight scenarios were considered where the average weights under each of the above scenarios were increased 20% due to high-grading. A 20% increase was considered plausible based on the experience from Area 2C. This made a total of six average weight scenarios for consideration.

It is not possible to tell from biological sampling data which fish were “first” fish, much less 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. To identify “first” fish, 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 were considered “first” fish. If the number of fish harvested was less than the number of clients, then all fish were considered “first” fish. This assumption is 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 include a fishing vessel identifier, but not the number of anglers that were onboard. Therefore, the number of anglers was obtained by merging the biological data with logbook or interview data. Once merged, the “first” ( $n$ -largest) fish were identified and the average weights calculated.

For all scenarios, the projected harvest was based on the status quo harvest forecast under a two-fish bag limit (Table 9), reduced by the 2018 forecast of the proportion of second fish in the harvest. The proportions of second fish varied by subarea, with an overall average of 36%. After removing the second fish, the harvest forecast was 88,013 fish. This harvest was multiplied by each average weight option to obtain the projected yield under each scenario, and yields were inflated by 2% to account for release mortality.

#### **4.6.2 Results**

The projections of charter removals under the six scenarios ranged from 1.602 Milb to 2.324 Milb (Table 13). Only the scenarios based on the average weight of first fish in 2015 and 2016 resulted in projections that were within the reference SPR level (Table 13, Figure 4). The procedure used to identify first and second fish in the 2015 and 2016 harvests correlated fairly well with the maximum size limit each year, though it does indicate that after all the largest (first) fish were accounted for, there were still a few second fish over the maximum size limit (Figure 5).

As with the reverse slot/max size measure, it was not possible to identify the most accurate projection for this measure. The projections are highly sensitive to the average weight, and average weight cannot be predicted under this measure because it is not possible to predict angler behavior or the degree of high-grading that will occur. Therefore, these options are presented not as a choice, but to illustrate the range of uncertainty associated with this management measure.

### **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 many regulatory areas for several years. Projections of charter removals associated with combination reverse slot limit/28-inch maximum size limit in Area 3A were too uncertain to identify a likely harvest scenario. In addition, this measure combined with various status quo measures such as trip limits, annual limits, and daily closures, could make for a highly complex and difficult to understand regulatory package. Once implemented in concert with other measures, it could be difficult to separate the relative effects of each measure. This could potentially impair future analyses of regulatory measures in Area 3A.

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, they also increase the average weight of released fish. 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 likely end up releasing relatively more fish above the maximum size limit or in the protected slot, and those fish would likely be larger. 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.

#### **5.2 Annual Limits**

Annual limits were implemented in Area 3A in 2015 (5 fish) as well as 2016 and 2017 (4 fish). If annual limits are recommended for the charter fishery in either area, it is crucial for enforcement purposes to ensure that the regulation be accompanied by a recording requirement similar to that implemented in 2016 and 2017. 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>4</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 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.

The 5-fish annual limit in 2015 was implemented without a recording requirement. That year, 68,775 unique licensed anglers harvested 154,428 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. In that year 71,192 licensed anglers harvested 148,826 halibut in Area 3A. Of those anglers, 352 (0.5%) violated the annual limit, and harvested 516 halibut in excess of the annual limit, which represented 0.3% of the total harvest by licensed anglers.

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 Tuesday Closures (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 Wednesdays closed all year and Three Tuesdays closed during the peak, closure of additional Tuesdays during the peak season (June through August) may

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<sup>4</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)

be more effective than closure of a day or two here and there. 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 harvest 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 65-70%. If daily closures are selected that reduce harvest in a manner that is not proportional to harvest over the season, future preliminary harvest estimates could be biased. We recommend that if additional Tuesday closures are considered, that they be structured around the dates listed in Table 11.

#### **5.4 One-fish Bag Limit (Area 3A)**

As shown in Section 4.6, the projections of charter removals under a one-fish bag limit are sensitive to the average weight, but there is not enough experience or empirical data to indicate what average weight would be under this measure in Area 3A. If implemented, one consideration is that this measure could cause a shift in the distribution of effort and harvest from Cook Inlet and the North Gulf (Seward) to other parts of Area 3A with larger fish, such as Yakutat, Valdez, and Kodiak.

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Table 1. Estimated average net weight (headed and gutted) and round weight of Pacific halibut by length. Estimates are based on the current International Pacific Halibut Commission length-weight relationships<sup>5</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>5</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	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, H-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, Q-Kod

Table 3. Charter logbook effort, harvest per unit effort, and harvest of halibut in IPHC Area 2C, 2006-2017. Estimates for 2017 are preliminary, based on logbook data for charter trips through July 31, 2017, entered as of November 07, 2017.

Year	Subarea						Total 2C
	Ketch	PWI	Pburg	Sitka	Jun	GlacB	
<b>Effort (angler-trips)<sup>a</sup></b>							
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	16,595	23,440	3,373	31,093	12,069	9,694	96,264
2017	18,971	25,369	3,047	33,819	14,631	9,015	104,850
<b>Halibut Harvest per Angler-Trip (HPUE)</b>							
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	0.507	0.725	0.621	0.789	0.633	0.667	0.687
2017	0.479	0.752	0.633	0.789	0.571	0.729	0.684
<b>Harvest (number of halibut)<sup>b</sup></b>							
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	8,414	16,999	2,095	24,528	7,642	6,469	66,147
2017	9,079	19,077	1,929	26,698	8,358	6,570	71,711

<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 2014-2017 data includes any reported effort by crew that retained halibut.

<sup>b</sup> – Harvest is client-only except 2014-2017 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, 2006-2017. Estimates for 2017 are preliminary, based on logbook data through July 31, 2017, entered as of November 7, 2017.

Year	Subarea								Tot 3A
	GlacBay	Yak	EPWS	WPWS	NGulf	CCI	LCI	Kod	
<b>Effort (angler-trips)<sup>a</sup></b>									
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	1,891	3,507	4,207	4,238	34,492	17,027	37,548	9,032	111,942
2017	2,547	3,187	3,704	3,808	28,989	18,205	37,117	8,758	106,316
<b>Halibut Harvest per Angler-Trip (HPUE)</b>									
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	0.755	0.929	1.127	1.059	1.239	1.688	1.715	0.934	1.413
2017	0.746	0.917	1.062	0.982	1.098	1.617	1.679	0.865	1.351
<b>Harvest (number of halibut)<sup>b</sup></b>									
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	38,504	67,701	12,358	174,348
2015	1,381	3,210	4,296	4,635	46,321	35,834	59,110	8,845	163,632
2016	1,428	3,259	4,742	4,487	42,721	28,747	64,392	8,438	158,214
2017	1,899	2,923	3,932	3,741	31,822	29,438	62,319	7,580	143,654

<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 2014-2017 data includes any reported effort by crew that retained halibut.

<sup>b</sup> – Harvest is client-only except 2014-2017 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 2018 under status quo regulations, with associated standard errors. Status quo regulations include a one-fish bag limit and U44O80 reverse slot size limit.

Subarea	Effort		HPUE	Std Error	Harvest	
	(angler-trips)	Std Error			(no. halibut)	Std Error
Ketch	20,212	987	0.48	0.05	9,782	1,032
PWI	26,589	1,418	0.75	0.04	19,997	1,536
Pburg	3,046	382	0.63	0.04	1,929	264
Sitka	35,408	1,725	0.79	0.05	27,853	2,315
Jun	15,819	1,065	0.57	0.05	9,038	937
GlacBay	9,016	1,357	0.76	0.06	6,831	1,147
Area 2C	110,089	3,013	0.69	NA	75,430	3,324

Table 6. Estimated effects of annual limits of one to five halibut on Area 2C charter anglers and projected harvest for 2018. Effects were estimated using 2016 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 2016.

Annual Limit	Subarea						Area 2C
	Ketch	PWI	Pburg	Sitka	Jun	GlacB	
<b>Estimated percent of anglers affected by the annual limit:</b>							
1	26.4%	69.6%	55.3%	71.6%	43.2%	46.1%	56.6%
2	11.1%	41.2%	27.4%	41.0%	27.7%	27.2%	32.3%
3	1.8%	9.6%	10.7%	10.4%	13.4%	14.0%	9.4%
4	0.6%	1.3%	2.9%	1.7%	3.8%	5.6%	2.1%
5	0.2%	0.5%	0.4%	0.4%	1.6%	0.6%	0.5%
<b>Estimated percent change in harvest relative to no annual limit:</b>							
1	-28.6%	-55.0%	-49.2%	-55.6%	-47.6%	-48.5%	-50.2%
2	-9.7%	-23.7%	-21.0%	-23.8%	-25.0%	-24.7%	-22.1%
3	-1.8%	-5.2%	-7.1%	-5.6%	-10.4%	-10.7%	-6.1%
4	-0.6%	-0.9%	-1.7%	-1.0%	-3.4%	-3.5%	-1.4%
5	-0.2%	-0.3%	-0.2%	-0.2%	-1.4%	-0.6%	-0.4%
<b>Projected harvest (number of halibut):</b>							
1	6,985	8,989	981	12,366	4,738	3,520	37,578
2	8,831	15,248	1,523	21,222	6,783	5,143	58,750
3	9,603	18,952	1,792	26,294	8,097	6,101	70,839
4	9,727	19,815	1,897	27,582	8,733	6,592	74,345
5	9,766	19,934	1,925	27,790	8,913	6,789	75,117
No Limit	9,782	19,997	1,929	27,853	9,038	6,831	75,430

Table 7. Projected charter removals (Mlb) for Area 2C in 2018 under reverse slot limits ranging from U35O50 to U50O80 and annual limits ranging from no limit to five fish. Shaded cells represent projections for the most liberal upper and lower size limits that do not exceed the 0.69 Mlb allocation associated with the reference SPR. All values in the table include corrections for 2012-2017 errors in estimation of average weight and an additional 5.4% release mortality by weight.

**No annual limit, harvest = 75,430 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	1.348	1.259	1.191	1.114	1.059	1.010	0.941	0.874	0.836	0.806	0.777	0.756	0.728	0.712	0.711	0.698
36	1.385	1.298	1.231	1.155	1.100	1.052	0.983	0.917	0.879	0.850	0.820	0.800	0.772	0.756	0.754	0.742
37	1.407	1.321	1.255	1.180	1.126	1.077	1.009	0.943	0.905	0.876	0.847	0.826	0.799	0.783	0.781	0.769
38	1.441	1.356	1.291	1.217	1.163	1.115	1.047	0.982	0.945	0.916	0.886	0.866	0.839	0.823	0.821	0.809
39	1.466	1.383	1.318	1.244	1.191	1.144	1.076	1.012	0.974	0.945	0.916	0.896	0.868	0.853	0.851	0.839
40	1.487	1.404	1.340	1.267	1.215	1.167	1.100	1.036	0.999	0.970	0.941	0.921	0.894	0.878	0.876	0.864
41	1.512	1.431	1.368	1.295	1.243	1.196	1.130	1.066	1.029	1.000	0.971	0.951	0.924	0.908	0.907	0.895
42	1.528	1.448	1.386	1.314	1.262	1.216	1.150	1.086	1.049	1.021	0.992	0.972	0.945	0.929	0.928	0.916
43	1.547	1.468	1.406	1.335	1.284	1.238	1.172	1.109	1.072	1.044	1.015	0.995	0.968	0.952	0.951	0.939
44	1.574	1.496	1.435	1.365	1.314	1.268	1.203	1.140	1.103	1.075	1.047	1.027	1.000	0.984	0.983	0.971
45	1.602	1.526	1.466	1.397	1.346	1.301	1.236	1.174	1.138	1.110	1.081	1.061	1.035	1.019	1.017	1.005
46	1.621	1.546	1.487	1.418	1.368	1.323	1.259	1.197	1.161	1.133	1.105	1.085	1.058	1.043	1.041	1.029
47	1.647	1.573	1.515	1.447	1.398	1.353	1.289	1.228	1.192	1.164	1.136	1.116	1.090	1.074	1.073	1.061
48	1.666	1.593	1.535	1.468	1.419	1.375	1.311	1.250	1.214	1.187	1.158	1.139	1.112	1.097	1.095	1.083
49	1.697	1.625	1.568	1.502	1.453	1.410	1.346	1.286	1.250	1.223	1.195	1.176	1.149	1.134	1.132	1.120
50	1.718	1.647	1.592	1.526	1.478	1.435	1.372	1.312	1.277	1.250	1.222	1.202	1.176	1.161	1.159	1.147

**5-fish annual limit, harvest = 75,117**

Lower Limit (in)	Upper Length Limit (in)															
	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
35	1.343	1.254	1.186	1.110	1.055	1.006	0.937	0.871	0.832	0.803	0.773	0.753	0.725	0.709	0.708	0.696
36	1.380	1.293	1.226	1.151	1.096	1.048	0.979	0.914	0.876	0.846	0.817	0.797	0.769	0.753	0.751	0.739
37	1.402	1.316	1.250	1.175	1.121	1.073	1.005	0.940	0.902	0.873	0.843	0.823	0.796	0.780	0.778	0.766
38	1.435	1.351	1.286	1.212	1.158	1.111	1.043	0.978	0.941	0.912	0.883	0.862	0.835	0.819	0.818	0.806
39	1.460	1.377	1.313	1.239	1.186	1.139	1.072	1.007	0.970	0.941	0.912	0.892	0.865	0.849	0.847	0.835
40	1.481	1.399	1.335	1.262	1.210	1.163	1.096	1.032	0.995	0.966	0.937	0.917	0.890	0.874	0.873	0.861
41	1.506	1.425	1.362	1.290	1.238	1.192	1.125	1.062	1.025	0.996	0.967	0.947	0.920	0.905	0.903	0.891
42	1.522	1.443	1.380	1.309	1.257	1.211	1.145	1.082	1.045	1.017	0.988	0.968	0.941	0.925	0.924	0.912
43	1.541	1.462	1.401	1.330	1.279	1.233	1.167	1.104	1.068	1.040	1.011	0.991	0.964	0.948	0.947	0.935
44	1.568	1.490	1.429	1.359	1.309	1.263	1.198	1.135	1.099	1.071	1.042	1.023	0.996	0.980	0.979	0.967
45	1.596	1.520	1.460	1.391	1.341	1.296	1.231	1.169	1.133	1.105	1.077	1.057	1.030	1.015	1.013	1.001
46	1.615	1.540	1.481	1.413	1.363	1.318	1.254	1.192	1.156	1.129	1.100	1.081	1.054	1.039	1.037	1.025
47	1.641	1.567	1.509	1.441	1.392	1.348	1.284	1.223	1.187	1.160	1.131	1.112	1.086	1.070	1.068	1.057
48	1.660	1.587	1.529	1.462	1.414	1.369	1.306	1.245	1.209	1.182	1.154	1.134	1.108	1.093	1.091	1.079
49	1.690	1.619	1.562	1.496	1.448	1.404	1.341	1.281	1.245	1.218	1.190	1.171	1.145	1.129	1.128	1.116
50	1.711	1.641	1.585	1.520	1.472	1.429	1.367	1.307	1.272	1.245	1.217	1.198	1.171	1.156	1.154	1.143

(continued)

Table 7. (continued)

**4-fish annual limit, harvest = 74,345**

Lower Limit (in)	Upper Length Limit (in)															
	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
35	1.327	1.240	1.173	1.097	1.043	0.995	0.926	0.861	0.823	0.794	0.765	0.745	0.718	0.702	0.700	0.688
36	1.364	1.278	1.212	1.137	1.084	1.036	0.968	0.903	0.866	0.837	0.808	0.788	0.761	0.745	0.743	0.731
37	1.386	1.301	1.236	1.162	1.109	1.061	0.994	0.929	0.892	0.863	0.834	0.814	0.787	0.771	0.770	0.758
38	1.419	1.336	1.271	1.198	1.145	1.098	1.031	0.967	0.930	0.902	0.873	0.853	0.826	0.810	0.809	0.797
39	1.444	1.362	1.298	1.225	1.173	1.126	1.060	0.996	0.959	0.931	0.902	0.882	0.855	0.840	0.838	0.826
40	1.464	1.383	1.320	1.248	1.196	1.150	1.084	1.020	0.984	0.955	0.927	0.907	0.880	0.865	0.863	0.851
41	1.489	1.409	1.347	1.275	1.224	1.178	1.113	1.050	1.013	0.985	0.957	0.937	0.910	0.895	0.893	0.881
42	1.505	1.426	1.365	1.294	1.243	1.197	1.132	1.070	1.033	1.005	0.977	0.957	0.931	0.915	0.914	0.902
43	1.524	1.446	1.385	1.315	1.264	1.219	1.154	1.092	1.055	1.028	1.000	0.980	0.953	0.938	0.936	0.925
44	1.550	1.473	1.413	1.344	1.294	1.249	1.184	1.123	1.086	1.059	1.031	1.011	0.985	0.969	0.968	0.956
45	1.578	1.503	1.444	1.375	1.326	1.281	1.217	1.156	1.120	1.093	1.065	1.045	1.019	1.004	1.002	0.990
46	1.597	1.523	1.464	1.396	1.348	1.303	1.240	1.179	1.143	1.116	1.088	1.069	1.042	1.027	1.025	1.014
47	1.622	1.549	1.492	1.425	1.377	1.333	1.270	1.209	1.174	1.147	1.119	1.100	1.073	1.058	1.056	1.045
48	1.641	1.569	1.512	1.445	1.397	1.354	1.291	1.231	1.196	1.169	1.141	1.122	1.096	1.080	1.079	1.067
49	1.671	1.600	1.544	1.479	1.431	1.388	1.326	1.266	1.231	1.204	1.177	1.158	1.132	1.117	1.115	1.104
50	1.692	1.623	1.567	1.502	1.456	1.413	1.351	1.292	1.257	1.230	1.203	1.184	1.158	1.143	1.141	1.130

**3-fish annual limit, harvest = 70,839**

Lower Limit (in)	Upper Length Limit (in)															
	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
35	1.263	1.180	1.116	1.044	0.992	0.946	0.881	0.819	0.783	0.756	0.728	0.709	0.683	0.668	0.667	0.655
36	1.298	1.216	1.153	1.082	1.031	0.986	0.921	0.860	0.824	0.797	0.769	0.750	0.724	0.709	0.708	0.697
37	1.319	1.238	1.176	1.105	1.055	1.010	0.945	0.884	0.848	0.821	0.794	0.775	0.749	0.734	0.733	0.722
38	1.350	1.271	1.210	1.140	1.090	1.045	0.981	0.921	0.885	0.858	0.831	0.812	0.786	0.772	0.770	0.759
39	1.374	1.296	1.235	1.166	1.116	1.072	1.008	0.948	0.913	0.886	0.859	0.840	0.814	0.800	0.798	0.787
40	1.393	1.316	1.256	1.187	1.138	1.094	1.031	0.971	0.936	0.909	0.883	0.864	0.838	0.823	0.822	0.811
41	1.417	1.341	1.281	1.213	1.165	1.121	1.059	0.999	0.964	0.937	0.911	0.892	0.867	0.852	0.850	0.839
42	1.432	1.357	1.298	1.231	1.183	1.139	1.077	1.018	0.983	0.957	0.930	0.911	0.886	0.871	0.870	0.859
43	1.450	1.375	1.318	1.251	1.203	1.160	1.098	1.039	1.004	0.978	0.951	0.933	0.907	0.893	0.891	0.880
44	1.475	1.401	1.344	1.278	1.231	1.188	1.127	1.068	1.034	1.008	0.981	0.963	0.937	0.923	0.921	0.910
45	1.502	1.430	1.374	1.308	1.262	1.219	1.158	1.100	1.066	1.040	1.013	0.995	0.970	0.955	0.954	0.943
46	1.520	1.449	1.393	1.329	1.282	1.240	1.180	1.122	1.088	1.062	1.036	1.017	0.992	0.978	0.976	0.965
47	1.544	1.474	1.420	1.356	1.310	1.268	1.208	1.151	1.117	1.091	1.065	1.047	1.022	1.007	1.006	0.995
48	1.562	1.493	1.439	1.375	1.330	1.289	1.229	1.172	1.138	1.112	1.086	1.068	1.043	1.029	1.027	1.016
49	1.590	1.523	1.470	1.407	1.362	1.321	1.262	1.205	1.172	1.146	1.120	1.102	1.077	1.063	1.062	1.051
50	1.610	1.544	1.491	1.429	1.385	1.344	1.285	1.229	1.196	1.171	1.145	1.127	1.102	1.088	1.086	1.076

(continued)

Table 7. (continued)

**2-fish annual limit, harvest = 58,750**

Lower Limit (in)	Upper Length Limit (in)															
	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
35	1.047	0.977	0.924	0.865	0.823	0.785	0.731	0.679	0.649	0.627	0.604	0.588	0.567	0.554	0.553	0.544
36	1.076	1.008	0.956	0.897	0.855	0.818	0.764	0.713	0.683	0.661	0.638	0.623	0.601	0.589	0.587	0.578
37	1.094	1.026	0.974	0.916	0.875	0.838	0.784	0.733	0.704	0.681	0.659	0.643	0.622	0.610	0.608	0.599
38	1.120	1.053	1.003	0.945	0.904	0.867	0.814	0.764	0.735	0.712	0.690	0.674	0.653	0.641	0.639	0.630
39	1.140	1.074	1.024	0.967	0.926	0.889	0.837	0.787	0.758	0.735	0.713	0.698	0.676	0.664	0.663	0.654
40	1.156	1.091	1.041	0.985	0.945	0.908	0.856	0.806	0.777	0.755	0.733	0.717	0.696	0.684	0.683	0.673
41	1.175	1.112	1.063	1.007	0.967	0.931	0.879	0.829	0.801	0.778	0.756	0.741	0.720	0.708	0.707	0.697
42	1.188	1.125	1.077	1.021	0.982	0.946	0.894	0.845	0.816	0.794	0.772	0.757	0.736	0.724	0.723	0.714
43	1.203	1.141	1.093	1.038	0.999	0.963	0.911	0.862	0.834	0.812	0.790	0.775	0.754	0.742	0.740	0.731
44	1.224	1.162	1.115	1.061	1.022	0.987	0.936	0.887	0.859	0.837	0.815	0.800	0.779	0.767	0.766	0.757
45	1.246	1.186	1.139	1.086	1.047	1.012	0.962	0.913	0.885	0.863	0.842	0.827	0.806	0.794	0.793	0.784
46	1.261	1.202	1.156	1.103	1.065	1.030	0.980	0.931	0.903	0.882	0.860	0.845	0.824	0.813	0.811	0.802
47	1.281	1.223	1.178	1.125	1.088	1.053	1.003	0.956	0.928	0.906	0.885	0.870	0.849	0.837	0.836	0.827
48	1.296	1.239	1.194	1.142	1.105	1.070	1.021	0.973	0.946	0.924	0.903	0.888	0.867	0.855	0.854	0.845
49	1.320	1.264	1.219	1.168	1.131	1.097	1.048	1.001	0.973	0.952	0.931	0.916	0.895	0.884	0.882	0.874
50	1.336	1.281	1.238	1.187	1.150	1.117	1.068	1.021	0.994	0.973	0.951	0.937	0.916	0.904	0.903	0.894

**1-fish annual limit, harvest = 37,578**

Lower Limit (in)	Upper Length Limit (in)															
	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
35	0.667	0.622	0.589	0.552	0.526	0.502	0.467	0.434	0.415	0.400	0.386	0.376	0.362	0.355	0.354	0.348
36	0.686	0.642	0.609	0.572	0.547	0.523	0.488	0.456	0.437	0.422	0.408	0.399	0.385	0.377	0.376	0.370
37	0.698	0.654	0.621	0.585	0.559	0.536	0.501	0.469	0.451	0.436	0.421	0.412	0.398	0.390	0.390	0.384
38	0.715	0.672	0.640	0.604	0.579	0.555	0.521	0.489	0.471	0.456	0.442	0.432	0.419	0.411	0.410	0.404
39	0.728	0.685	0.653	0.618	0.593	0.569	0.536	0.503	0.486	0.471	0.457	0.447	0.433	0.426	0.425	0.419
40	0.738	0.696	0.665	0.629	0.605	0.582	0.548	0.516	0.498	0.483	0.469	0.460	0.446	0.439	0.438	0.432
41	0.751	0.710	0.679	0.644	0.620	0.597	0.563	0.531	0.514	0.499	0.485	0.476	0.462	0.455	0.454	0.448
42	0.759	0.718	0.688	0.653	0.629	0.606	0.573	0.541	0.524	0.509	0.495	0.486	0.472	0.465	0.464	0.458
43	0.769	0.728	0.698	0.663	0.640	0.617	0.584	0.552	0.535	0.520	0.506	0.497	0.484	0.476	0.475	0.470
44	0.782	0.742	0.712	0.678	0.655	0.632	0.600	0.568	0.551	0.536	0.522	0.513	0.500	0.492	0.492	0.486
45	0.796	0.757	0.728	0.694	0.671	0.649	0.616	0.585	0.568	0.554	0.540	0.531	0.517	0.510	0.509	0.503
46	0.806	0.767	0.738	0.705	0.682	0.660	0.628	0.597	0.580	0.565	0.551	0.542	0.529	0.522	0.521	0.515
47	0.819	0.782	0.753	0.720	0.697	0.675	0.643	0.613	0.596	0.581	0.568	0.559	0.545	0.538	0.537	0.531
48	0.829	0.792	0.763	0.731	0.708	0.686	0.654	0.624	0.607	0.593	0.579	0.570	0.557	0.549	0.549	0.543
49	0.844	0.807	0.779	0.747	0.725	0.703	0.672	0.642	0.625	0.611	0.597	0.588	0.575	0.568	0.567	0.561
50	0.854	0.819	0.791	0.759	0.737	0.716	0.685	0.655	0.638	0.624	0.610	0.601	0.588	0.581	0.580	0.575

Table 8. Projected effort, halibut harvest per unit effort (HPUE), and harvest (numbers of halibut) for Area 3A in 2018 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, no retention of halibut on Wednesdays, and no retention on three Tuesdays in July and August.

Subarea	Effort (angler-trips)	Std Error	HPUE	Std Error	Harvest no. fish)	StdError
CCI	18,205	420	1.54	0.03	28,009	831
EPWS	3,704	236	1.07	0.11	3,956	479
GlacBay	2,547	350	0.76	0.19	1,924	546
Yak	3,187	223	0.92	0.16	2,932	540
LCI	37,117	900	1.64	0.04	60,829	1,998
NGulf	28,989	1,048	0.99	0.08	28,580	2,522
Kod	8,758	370	0.77	0.09	6,714	859
WPWS	3,808	274	1.00	0.14	3,790	580
Tot 3A	106,316	1,514	1.29	NA	136,734	3,597

Table 9. Estimated effects of annual limits of two to six halibut on Area 3A anglers and projected harvest for 2018 under a 28-inch maximum size limit on one of two fish in the bag limit, vessel trip limit, Wednesday closure, and Thursday closure on three days in July and August. Effects were estimated using logbook data from licensed anglers in 2014, the last year without a size limit. The percent of affected anglers is the portion of individual anglers that harvested more than each specified annual limit in 2014. For reference, the highlighted cells represent the status quo harvest projections also shown in Table 9.

Annual Limit	Subarea								Area 3A
	CCI	EPWS	GlacBay	Yak	LCI	NGulf	Kod	WPWS	
<b>Estimated percent of anglers affected by an annual limit:</b>									
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%
<b>Estimated percent change in harvest relative to no annual limit:</b>									
2	-19.9%	-10.4%	-12.9%	-20.1%	-19.6%	-13.3%	-41.0%	-8.0%	-19.0%
3	-12.6%	-4.9%	-3.3%	-8.9%	-11.7%	-7.5%	-27.5%	-2.9%	-11.3%
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%
<b>Projected harvest (number of halibut):</b>									
2	23,815	3,591	1,680	2,429	51,221	25,552	4,791	3,498	116,577
3	26,014	3,813	1,866	2,770	56,274	27,261	5,891	3,691	127,581
4	28,009	3,956	1,924	2,932	60,829	28,580	6,714	3,790	136,734
5	28,617	3,987	1,929	2,996	61,941	28,968	7,225	3,801	139,464
6	29,142	4,000	1,929	3,018	62,897	29,229	7,574	3,802	141,591
None	29,750	4,008	1,929	3,040	63,707	29,481	8,127	3,802	143,845

Table 10. 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 following status quo measures: limit of one trip per vessel and one trip per permit per day, Wednesday closure all year, three closed Tuesdays. Shaded values represent projections that do not exceed the 1.70 Mlb allocation associated with the reference SPR. Projections include corrections for errors in estimation of average weight and an additional 1.2% release mortality by weight.

**Projected Harvest (number of fish)**

Year	Annual Limit (number of halibut)					No limit
	2	3	4 (status quo)	5	6	
2018	116,577	127,581	136,734	139,464	141,591	143,845

**Projected Average Net Weight (lb)**

Size Limit (in)	Annual Limit (number of halibut)					No Limit
	2	3	4 (status quo)	5	6	
26	13.04	13.02	12.95	12.93	12.91	12.89
27	13.22	13.20	13.13	13.11	13.09	13.07
28	13.49	13.48	13.41	13.39	13.37	13.35
29	13.67	13.65	13.58	13.56	13.54	13.52
30	13.94	13.92	13.85	13.83	13.81	13.79

**Projected Charter Removals (Mlb)**

Size Limit (in)	Annual Limit (number of halibut)					No Limit
	2	3	4 (status quo)	5	6	
26	1.538	1.682	1.792	1.825	1.850	1.876
27	1.559	1.705	1.817	1.851	1.876	1.903
28	1.592	1.740	1.855	1.890	1.915	1.943
29	1.612	1.763	1.879	1.914	1.940	1.968
30	1.644	1.797	1.916	1.952	1.979	2.008

Table 11. Estimated potential harvest reductions and projected removals associated with status quo management measures combined with additional Tuesday closures during June through August of 2018. Status quo management measures include one fish any size, 28-inch maximum on second fish, four fish annual limit, vessel and permit trip limits, Wednesday closure, and Tuesdays closed three days. Projections include corrections for errors in estimation of average weight and an additional 1.2% release mortality by weight. Shaded values represent projections that do not exceed the 1.70 Mlb allocation associated with the reference SPR.

Number of Closed Tuesdays	Beginning and Ending Dates	Percentage reduction in harvest relative to status quo	Projected Harvest (no. Fish)	Projected Removals (Mlb)
3 (Status quo)	Jul 24 - Aug 07	0.0%	136,734	1.855
4	Jul 17 - Aug 07	-1.3%	134,986	1.830
5	Jul 17 - Aug 14	-2.5%	133,298	1.808
6	Jul 10 - Aug 14	-4.1%	131,068	1.777
7	Jul 03 - Aug 14	-5.5%	129,257	1.752
8	Jul 03 - Aug 21	-6.4%	127,977	1.736
9	Jun 26 - Aug 21	-7.6%	126,313	1.712
10	Jun 19 - Aug 21	-8.8%	124,686	1.689
11	Jun 19 - Aug 28	-9.5%	123,794	1.677
12	Jun 12 - Aug 28	-10.4%	122,449	1.659
13	Jun 05 - Aug 28	-11.2%	121,391	1.645
47 (all season)	Feb 01 - Dec 31	-13.2%	118,749	1.608

Table 12. Projected charter removals (Mlb) for Area 3A in 2018 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 provided for two scenarios: a low harvest scenario (A) is based on the HPUE and proportions of second fish in the harvest projected for 2018 under status quo regulations, and a high harvest scenario (B) is based on the HPUE and proportions of second fish in the harvest from 2013 (before size limits in Area 3A). Projections also include a 4% inflation factor for release mortality. Shaded values represent projections that do not exceed the 1.70 Mlb allocation associated with the reference SPR.

<b>A – Low Harvest Scenario (136,734 fish)</b>											
Lower Limit (in)	Upper Length Limit (in)										
	60	62	64	66	68	70	72	74	76	78	80
35	1.514	1.498	1.478	1.460	1.451	1.445	1.441	1.438	1.435	1.432	1.425
36	1.552	1.536	1.516	1.498	1.489	1.484	1.479	1.477	1.473	1.470	1.463
37	1.571	1.555	1.535	1.517	1.508	1.502	1.498	1.496	1.492	1.489	1.482
38	1.596	1.580	1.560	1.542	1.533	1.528	1.524	1.521	1.517	1.514	1.508
39	1.617	1.602	1.582	1.564	1.555	1.550	1.545	1.543	1.539	1.536	1.529
40	1.634	1.618	1.598	1.581	1.572	1.566	1.562	1.560	1.556	1.553	1.546
41	1.650	1.634	1.614	1.597	1.588	1.582	1.578	1.576	1.572	1.569	1.562
42	1.662	1.646	1.626	1.609	1.600	1.595	1.591	1.588	1.585	1.581	1.575
43	1.682	1.666	1.647	1.630	1.620	1.615	1.611	1.608	1.605	1.602	1.595
44	1.692	1.677	1.657	1.640	1.630	1.625	1.621	1.618	1.615	1.612	1.605
45	1.704	1.689	1.669	1.653	1.643	1.638	1.634	1.631	1.628	1.625	1.618
46	1.713	1.698	1.678	1.661	1.652	1.647	1.643	1.640	1.637	1.633	1.627
47	1.728	1.713	1.693	1.677	1.667	1.662	1.658	1.655	1.652	1.649	1.642
48	1.737	1.722	1.703	1.686	1.677	1.672	1.668	1.665	1.662	1.658	1.652
49	1.756	1.741	1.722	1.705	1.696	1.691	1.686	1.684	1.681	1.677	1.671
50	1.770	1.756	1.736	1.720	1.711	1.706	1.702	1.699	1.696	1.692	1.686
51	1.785	1.770	1.751	1.735	1.726	1.721	1.716	1.714	1.711	1.707	1.701
52	1.800	1.785	1.766	1.750	1.741	1.735	1.731	1.729	1.726	1.722	1.716
53	1.810	1.795	1.776	1.760	1.751	1.746	1.742	1.739	1.736	1.733	1.727
54	1.827	1.813	1.794	1.778	1.768	1.763	1.759	1.757	1.754	1.750	1.744
55	1.835	1.820	1.802	1.785	1.776	1.771	1.767	1.765	1.761	1.758	1.752
56	1.848	1.834	1.815	1.799	1.790	1.785	1.781	1.778	1.775	1.772	1.766
57	1.865	1.851	1.832	1.816	1.807	1.802	1.798	1.795	1.792	1.789	1.783
58	1.878	1.864	1.845	1.829	1.820	1.815	1.811	1.809	1.806	1.802	1.796
59	1.891	1.878	1.859	1.843	1.834	1.829	1.825	1.823	1.819	1.816	1.810
60	1.906	1.893	1.874	1.858	1.849	1.845	1.841	1.838	1.835	1.832	1.826

(continued)

Table 12. Page 2 of 2.

<b>B – High Harvest Scenario (176,083 fish)</b>											
Lower Limit (in)	Upper Length Limit (in)										
	60	62	64	66	68	70	72	74	76	78	80
35	1.838	1.823	1.802	1.785	1.775	1.770	1.765	1.763	1.759	1.756	1.749
36	1.877	1.862	1.842	1.825	1.815	1.810	1.805	1.803	1.799	1.796	1.789
37	1.897	1.882	1.862	1.844	1.835	1.829	1.825	1.822	1.819	1.815	1.809
38	1.923	1.908	1.888	1.871	1.861	1.856	1.852	1.849	1.845	1.842	1.835
39	1.945	1.931	1.911	1.893	1.884	1.878	1.874	1.872	1.868	1.865	1.858
40	1.963	1.948	1.928	1.911	1.901	1.896	1.892	1.889	1.886	1.882	1.876
41	1.979	1.964	1.944	1.927	1.918	1.912	1.908	1.905	1.902	1.899	1.892
42	1.991	1.977	1.957	1.940	1.930	1.925	1.921	1.918	1.915	1.912	1.905
43	2.012	1.997	1.978	1.961	1.951	1.946	1.942	1.939	1.936	1.932	1.926
44	2.022	2.007	1.988	1.971	1.961	1.956	1.952	1.949	1.946	1.943	1.936
45	2.034	2.020	2.001	1.984	1.974	1.969	1.965	1.962	1.959	1.955	1.949
46	2.043	2.029	2.010	1.993	1.983	1.978	1.974	1.971	1.968	1.964	1.958
47	2.058	2.044	2.025	2.008	1.999	1.993	1.989	1.987	1.983	1.980	1.974
48	2.068	2.054	2.034	2.017	2.008	2.003	1.999	1.996	1.993	1.989	1.983
49	2.086	2.072	2.053	2.036	2.027	2.022	2.018	2.015	2.012	2.008	2.002
50	2.101	2.087	2.068	2.052	2.042	2.037	2.033	2.030	2.027	2.024	2.018
51	2.116	2.103	2.084	2.067	2.058	2.053	2.049	2.046	2.043	2.039	2.033
52	2.131	2.117	2.098	2.082	2.072	2.067	2.063	2.060	2.057	2.054	2.048
53	2.141	2.127	2.108	2.092	2.083	2.078	2.074	2.071	2.068	2.064	2.058
54	2.158	2.145	2.126	2.110	2.100	2.095	2.091	2.089	2.085	2.082	2.076
55	2.166	2.152	2.134	2.117	2.108	2.103	2.099	2.096	2.093	2.090	2.084
56	2.179	2.166	2.147	2.131	2.122	2.116	2.112	2.110	2.107	2.103	2.097
57	2.196	2.183	2.164	2.148	2.139	2.134	2.130	2.127	2.124	2.121	2.115
58	2.209	2.196	2.177	2.161	2.152	2.147	2.143	2.141	2.137	2.134	2.128
59	2.223	2.210	2.191	2.175	2.166	2.161	2.157	2.154	2.151	2.148	2.142
60	2.238	2.225	2.207	2.191	2.182	2.177	2.173	2.170	2.167	2.164	2.158

Table 13. Projected average weights and charter removals under six possible scenarios for average weight in Area 3A under a one-fish bag limit with no size limit. Shaded values represent projections that do not exceed the 1.70 Mlb allocation associated with the reference SPR.

Base Year	Mean wt Scenario	Average wt(lb)	Removals (Mlb)	SE (Mlb)
2015	Average weight of first fish	17.84	1.602	0.092
	Average weight of first fish + 20%	21.41	1.922	0.111
2016	Average weight of first fish	17.09	1.534	0.082
	Average weight of first fish + 20%	20.51	1.841	0.098
2017	Average weight of O28 fish	21.58	1.937	0.103
	Average weight of O28 fish + 20%	25.89	2.324	0.124

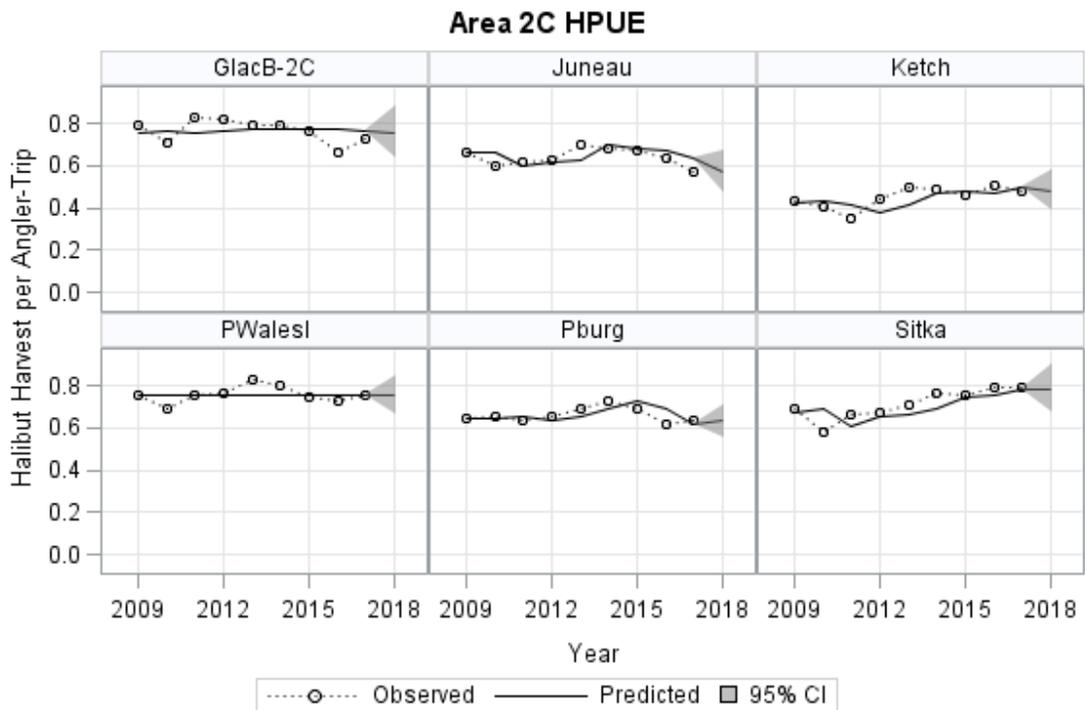
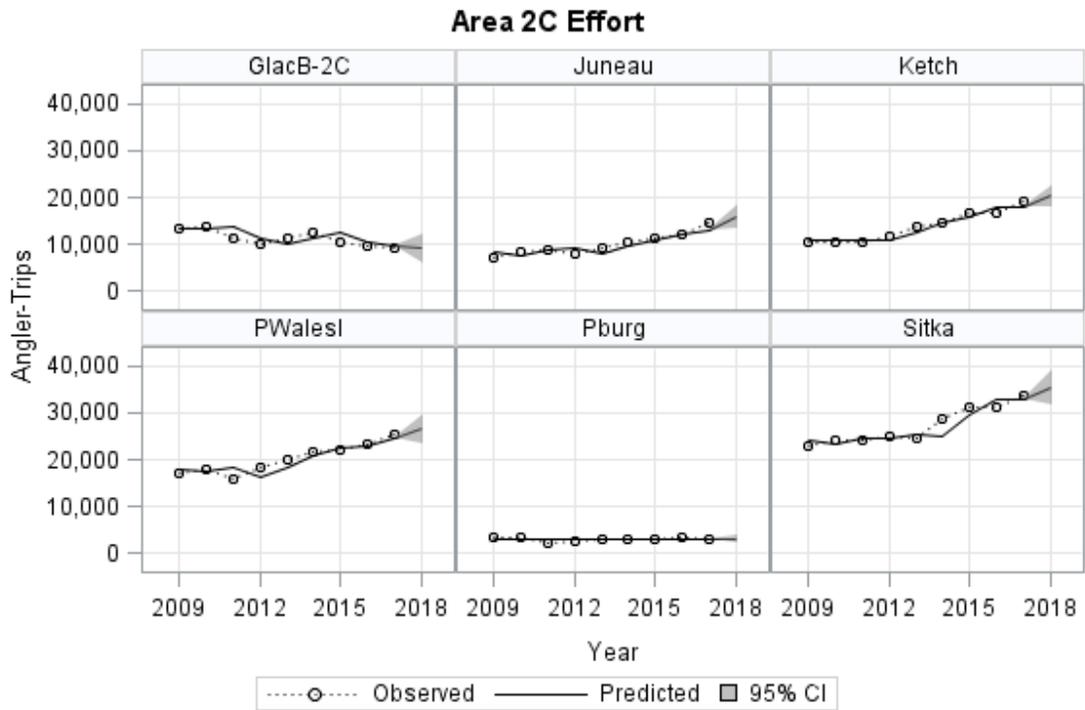


Figure 1. Time series of charter effort (upper) and HPUE (lower) for subareas of Area 2C with predicted values and forecasts for 2018. Shaded bands indicate 95% confidence intervals for the 2018 forecasts. (Source: ADF&G charter logbook)

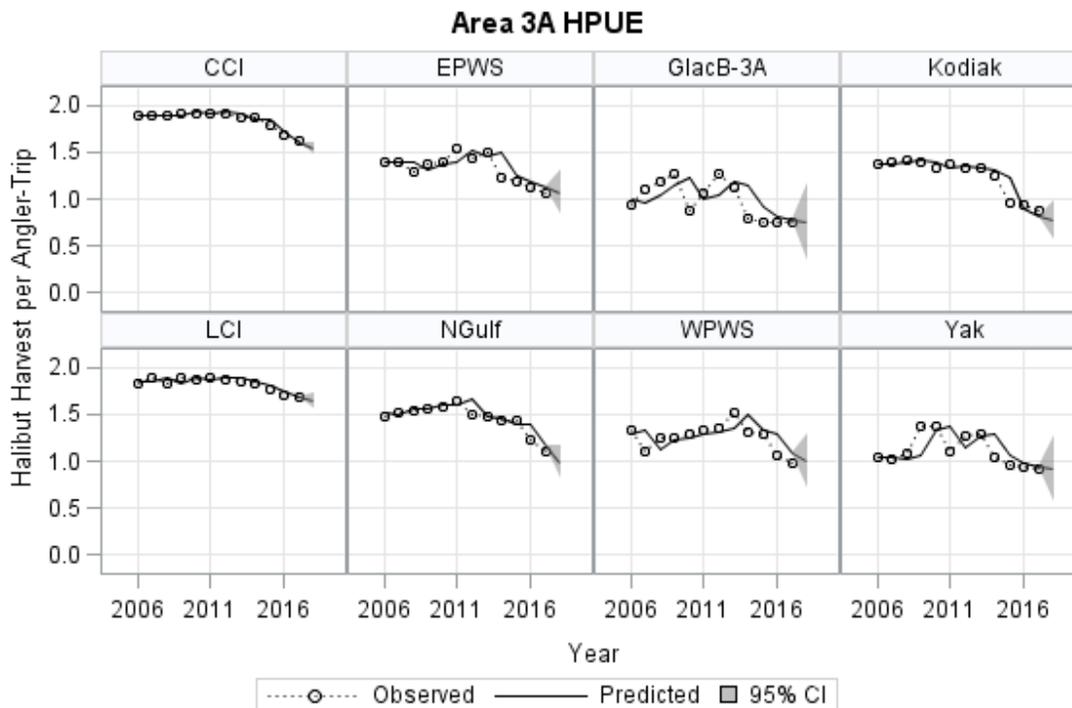
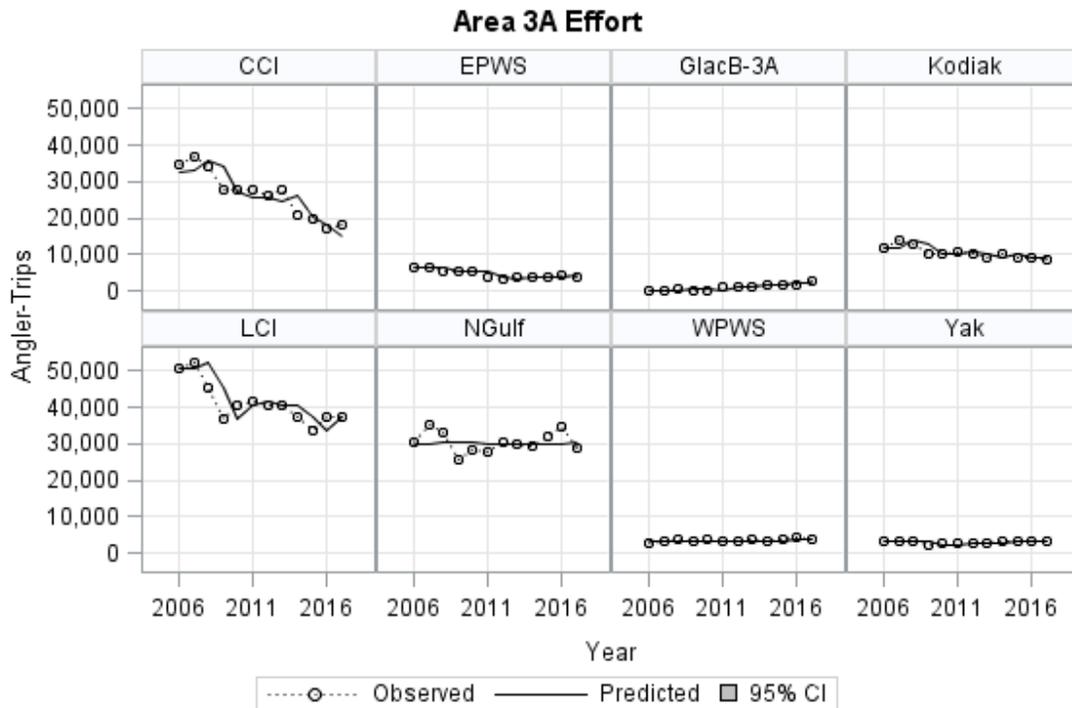


Figure 2. Time series of charter effort (upper) and HPUE (lower) by subarea of Area 3A, with predicted values and forecasts of HPUE only. No time series forecasts were made for effort (see Section 2.3). Shaded bands indicate 95% confidence intervals for the 2018 HPUE forecasts. (Source: ADF&G charter logbook)

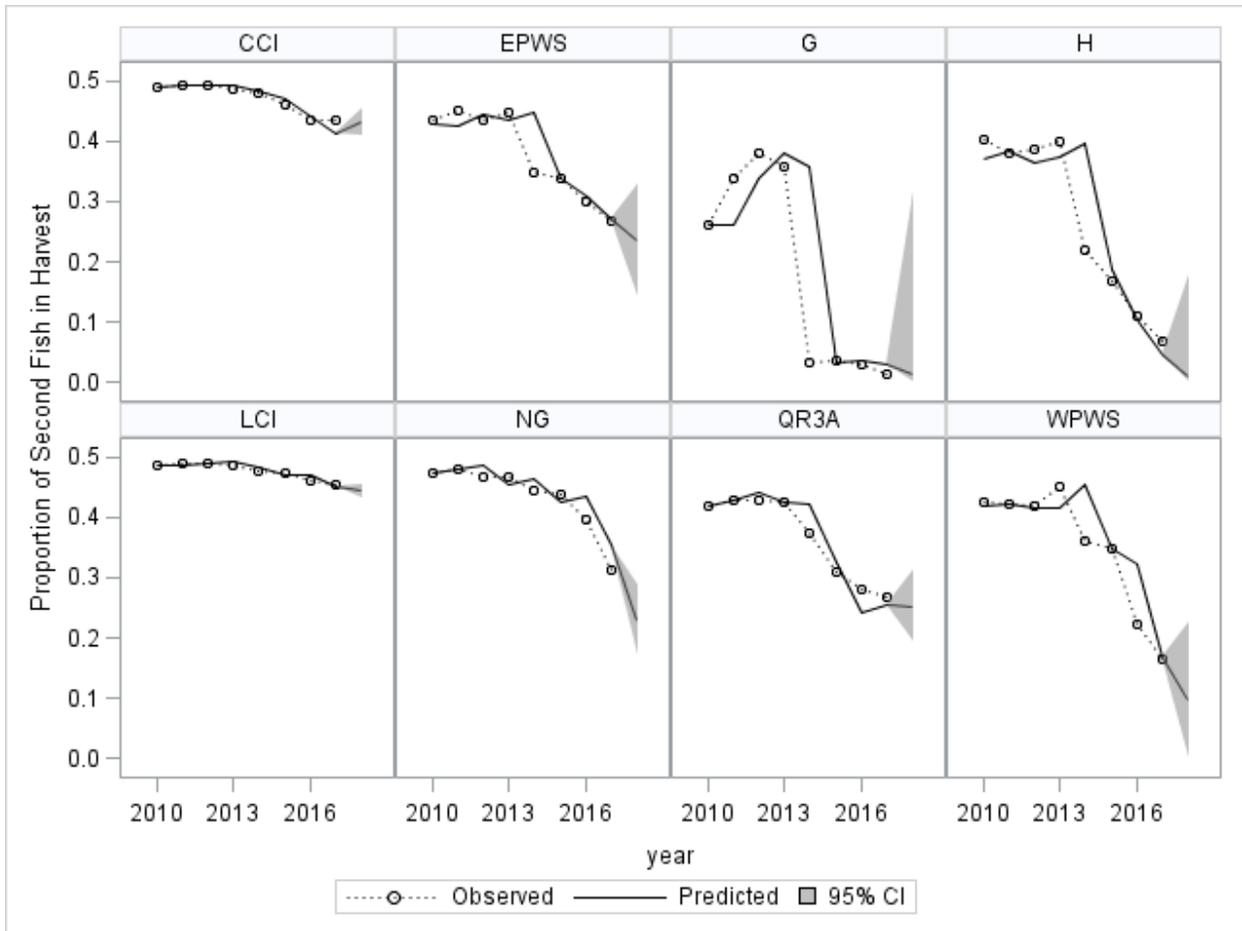


Figure 3. Time series of the proportion of second fish retained by anglers in each subarea of Area 3A, 2010-2017, with predicted values and forecasts for 2018. Shaded bands indicate 95% confidence intervals for the 2018 forecasts. (Source: ADF&G charter logbook)

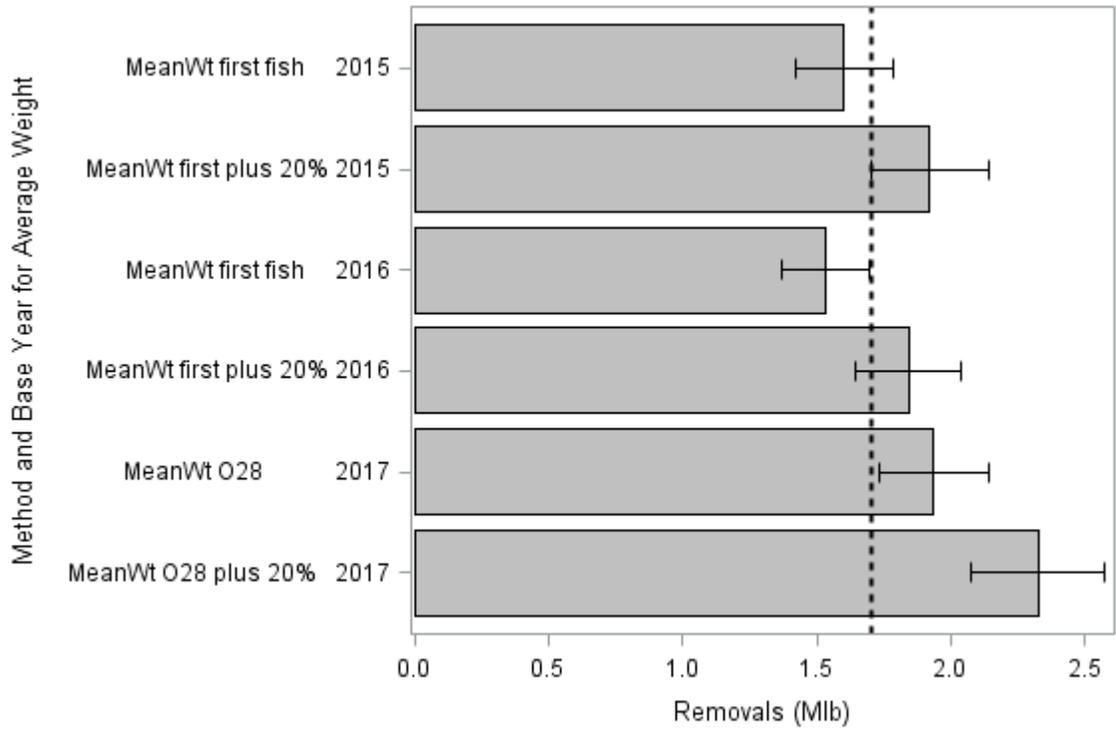


Figure 4. Plot of projected charter removals for Area 3A under a one-fish bag limit (no size limit) for six plausible methods of estimating the average weight. The vertical dotted line represents the charter allocation associated with the reference SPR. Note that four of the six methods of estimating average weight result in removals that exceed the reference SPR allocation.

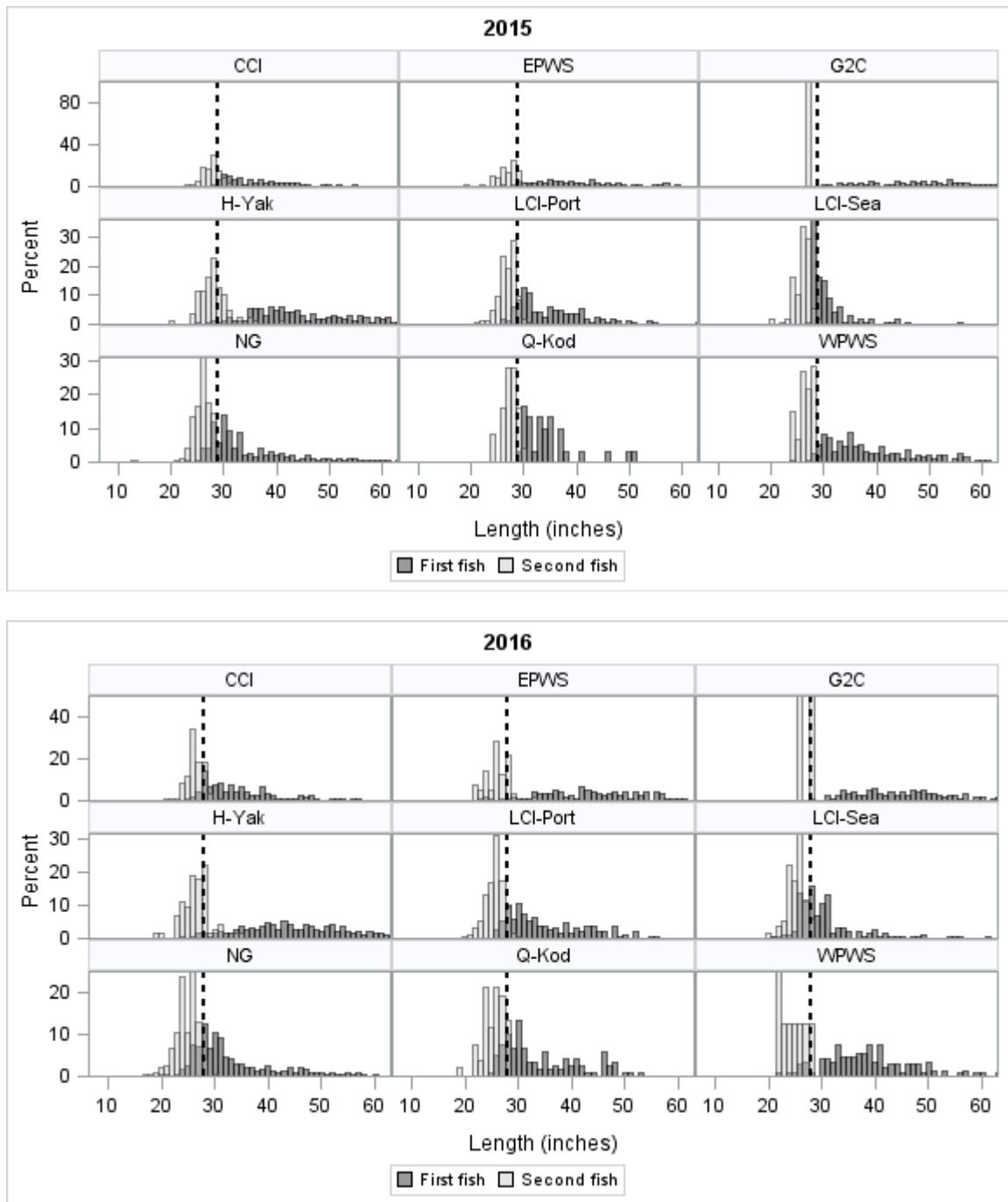


Figure 5. Length distributions of “first” and “second” fish in the charter halibut harvest in subareas of Area 3A in 2015 and 2015. Vertical reference lines depict the maximum size limit for second fish in 2015 (29 inches) and 2016 (28 inches). Lengths of first and second fish were determined using a combination of logbook, creel survey interview, and creel survey length sampling data as described in Section 4.6.1.