Analysis of Management Options for the Area 2C and 3A Charter Halibut Fisheries for 2019

A Report to the North Pacific Fishery Management Council

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December 3, 2018

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[1]. 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 30, 2018, to develop alternative management measures to be analyzed by the ADF&G for the 2019 season. ADF&G staff provided preliminary estimates of charter harvest and release mortality for the 2018 season to committee members prior to the meeting.

In Area 2C, the 2018 preliminary harvest estimate for the charter fishery was 71,107 halibut with an average weight of 9.39 lb (Webster et al. 2018). The number of halibut harvested was 5.7% lower than the harvest forecast of 75,430 and average weight was 7.7% lower than the predicted average weight of 10.17 lb. The Area 2C preliminary estimate of charter removals was 0.729 million pounds (Mlb), including an estimated 0.062 Mlb of release mortality. The preliminary estimate of charter removals was 9.8% less than the 0.809 Mlb removal predicted for 2018, and was under the 0.810 Mlb allocation by 10.0%.

In Area 3A, an estimated 135,031 halibut were harvested with an average weight of 13.70 lb (Webster et al. 2018). The number of fish harvested was 3.0% higher than the forecast of 131,068, and average weight was 2.2% higher than the predicted average weight of 13.41 lb. The preliminary estimate of charter removals for Area 3A was 1.867 Mlb, including 0.017 Mlb of release mortality. The preliminary estimate was 5.0% greater than the predicted removal of 1.778 Mlb and 4.3% greater than the allocation of 1.790 Mlb. The preliminary estimates were based on logbook data for trips through July 31, 2018, 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, number of halibut harvested by charter anglers, average weight of halibut, halibut abundance, and economic considerations, identified the following measures for analysis for 2019:

[1] Catch Sharing Plan regulations are at: https://www.federalregister.gov/documents/2013/12/12/2013-29598/pacific-halibut-fisheries-catch-sharing-plan-for-guided-sport-and-commercial-fisheries-in-alaska

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 38 inches or greater than or equal to 80 inches).
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.
3) Additional reverse slot limits (option 2) with annual limits of 1 – 5 fish.
4) Additional reverse slot limits (option 2) with a trip limit of 1 trip per permit per vessel per day.
5) Additional reverse slot limits (option 2) with day of the week closures.
6) Additional reverse slot limits (option 2) with a combination of annual limits of 1 – 5 fish and a trip limit of 1 trip per permit per vessel per day.

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 six Tuesdays in July and August):

1) Status quo.
2) Additional Tuesday closures from June – August.
3) Additional closures on other days of the week from June – August.
4) A 28-inch maximum size limit on one fish and a reverse slot limit on the second fish (analyze lower limits of 35-50 inches and upper limits of 50-80 inches).
5) A change in the size limit for the second fish.

This analysis provides information to stakeholders and the Council to assist them in selecting management 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 2019. The charter allocations will not be known when the Council is expected to make its recommendations in December 2018. However, the Council may base recommendations on the allocations determined from the charter catch limits associated with maintaining the IPHC's reference level of spawning potential ratio (SPR) and reference distributed mortality limits (Stewart 2018 and Wilson). It is recommended that the Council include contingencies to accommodate adoption of higher or lower catch limits.

At the Interim Meeting on November 27, 2018, the IPHC presented the mortality projection tool, which includes charter catch allocations associated with varying levels of TCEY and varying distributed mortality limits. Results presented here use projections from a TCEY at the reference level ($SPR_{46\%}$) of 40.0 Mlb and distributed mortality limits using the Space Time Model. These numbers are consistent with the Interim Management Strategy used in past analyses. In Area 2C, the projected catch allocation is 0.81 Mlb and in Area 3A is 2.29 Mlb. As seen below, using the status quo TCEY (2018 - $SPR_{48\%}$) and/or the status quo distributed mortality limits can substantially change the projected charter allocation and can be used as reference points in the decision-making process.

Area	Distributed Mortality[a]	Harvest (Mlb)	
		Reference TCEY[b]	Status Quo TCEY[b]
2C	Space Time Model	0.81	0.73
	Status Quo	0.91	0.82
3A	Space Time Model	2.29	2.09
	Status Quo	1.89	1.76

[a]The distributed mortality limit in Area 2C is 15.7% in the Space Time Model and 17.0% under status quo (2018 distributed catch). In Area 3A, the distributed mortality limits are 40.9% and 33.8%, respectively.
[b]The Reference TCEY uses $SPR_{46\%}$ and is 40.0 Mlb. The status quo TCEY (2018) uses $SPR_{48\%}$ and is 37.2 Mlb.

This analysis projects total charter fishery removals (harvest plus release mortality) under the status quo (2018) charter fishery regulations in each regulatory area. As shown below, the projected charter removal for Area 2C in 2019 under status quo measures is 0.83 Mlb, slightly above the projected catch limit. The projected removal for Area 3A under status quo measures is 1.83 Mlb, below the projected catch limit.

Area	Projected Status Quo Charter Removals (Mlb)	Charter Allocation (Mlb)	Difference (Mlb) (Allocation – Projection)
2C	0.83	0.81	-0.02
3A	1.83	2.29	+0.46

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 and Space Time Model distributed mortality limits. 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:

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

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

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

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

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

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™[2] 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 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 2019 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 2009-2018 (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 five years that appear to have influenced 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, each halibut permit was limited to one trip per day, the maximum size limit on one fish was decreased to 28 inches and the annual limit was reduced to four fish per angler, and in 2017 and 2018 additional closed days were added to regulations. 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 2018 preliminary estimate of effort in 3A was assumed as the status quo effort level for 2019.

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

[2] SAS/ETS™ software, Version 9.4, SAS System for Windows, Copyright © (2002-2012), SAS Institute, Inc.

harvesting one large fish. The decrease in retention of a second fish by anglers caused HPUE to decline as well (Table 4, Figure 2). However, the proportion of second fish retained continued to decline every year through 2018, even though changes in size limits and annual limits were quite minor (no change to either in 2017 or 2018). 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 2019 to capture the declining trend.

2.4 Accounting for Release Mortality of Halibut

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. In the past, only the release mortality of halibut ≥ 26 inches in length (O26) was included for consistency with treatment of commercial discard mortality by the IPHC. In 2018, the IPHC requested that all release mortality was accounted for in the sport harvest. Release mortality has been estimated for 2013-2018 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[3].

The numbers and average weight of released fish are expected to vary with the types of size limits 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.

In Area 2C, under reverse slot limits, the ratio of release mortality to charter yield (in pounds) is strongly correlated to the lower bound of the reverse slot limit. The ratio for 2018 is 0.092, based on a preliminary estimate of release mortality. Due to the strong correlation between the lower bound of the slot limit and release mortality, a linear regression model was used for the 2019 projections. Under status quo regulations, the predicted 2019 ratio of release mortality to harvested halibut was 0.091.

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 0.018 in 2013, and then decreased steadily from 0.022 in 2014 to 0.009 in 2018. The 6-year average was 0.015. For 2019 projections, the 6-year average of 0.015 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 days or changes in the maximum size of the second fish. 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. There is no history of such a regulation in Area 3A, but we would expect more released fish than under a reverse slot limit, because fish would be discarded for voluntary (too small) as well as regulatory (in the protected slot) reasons.

[3] The ADF&G annual reports to the IPHC are available for download at https://www.npfmc.org/halibut-charter-management. For example, the October 2018 report is available under the "ADF&G Guided Sport Data" section at: https://www.npfmc.org/halibut-charter-management/

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 U38O80 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 variable across subareas with little overall trend. The 2019 status quo effort forecast for Area 2C is 113,346 angler-trips, the weighted average HPUE forecast is 0.67 halibut per angler-trip, and the harvest forecast is 75,988 halibut, with a 95% margin of error (±2 standard errors) of about ± 6,530 (Table 5). This is an increase from the preliminary harvest estimate for 2018 of 71,107 halibut.

3.2 Reverse Slot Limit

3.2.1 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 2014-2018. 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 2012-2018 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 +5% to +16% for Area 2C overall (average = 11%). Predicted average weight errors were highly variable among years and among subareas. 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 from 2012 - 2018 and ranged from 0.77 to 1.02 among subareas. To test the correction factors, the projection algorithm was applied to the final harvest estimates for 2017 and preliminary harvest estimates for 2018. Under the 2019 harvest scenario, the projected charter removal for 2017 was 0.896 Mlb, slightly below the .941 Mlb final estimate, while the projected charter removal for 2018 was .782 Mlb, slightly above the .729Mlb preliminary estimate.

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 2019 harvest forecasts (Table 7a). Projections of charter removals include the correction factors for bias in estimation of average weight as well a correction for predicted release mortality based on the lower slot limit. For reference, the most liberal combinations of size limits for which the projected removals are within the reference SPR allocation are highlighted in Table 7a.

3.2.2 Results

The projected charter removal under the status quo size limit of U38O80 is 0.833 Mlb (Table 6). Under the projected catch levels developed by the IPHC, the Area 2C charter fishery would need to use a slot limit of U37O78 to stay within their allocation.

3.3 Reverse Slot Limit with Various Annual Limits

The effects of various annual limits on harvest in 2C were estimated using charter logbook data that summarized the distribution of annual harvests by individual licensed anglers using 2017 as the base year. This is the most recent year with complete data. Calculations of annual harvests could not be done for youth anglers (under 16 years old for nonresidents and under 18 years old for residents) because they are not required to be licensed, and therefore harvest cannot be assigned to individuals. Youth accounted for a relatively steady average of 4.3% of charter effort in Area 2C during the years 2015-2017. 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.

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 to 1.2 percentage points for annual limits from 1 to 5 fish; therefore, the underestimation caused by anglers fishing multiple areas was considered to be negligible and may provide a slightly conservative estimate.

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

3.3.1 Approach

Total charter removals were projected for a range 1 – 5 fish annual limits under 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 2019 harvest forecast with annual limits (Table 8a-e). 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 a correction for predicted release mortality based on the lower slot limit. 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 8.

3.3.2 Results

The projected charter removal under the status quo size limit of U38O78 and no annual limit is 0.833 Mlb (Table 6). Implementation of an annual limit of five fish would allow for a reverse slot limit of U37O76, while a three-fish limit could be used to liberalize the reverse slot to U38O74 or U39O80. There are more options with a two-fish annual limit, including lower size limits up to 47 inches.

3.4 Reverse Slot Limit with Daily Trip Limits

3.4.1 Approach

This measure was analyzed for Area 2C in 2012 and again for 2016 (King et al. 2012, Meyer and Powers 2015). The Council recommended, and the IPHC adopted, a limit of one trip per vessel per day as an annual management measure in Area 3A in 2014 – 2018. The limit only pertains to trips on which halibut are harvested.

Logbook data for Area 2C indicate that about 22 – 38% of businesses and vessels reported making multiple trips per day for bottomfish at least once during the years 2007-2017 (Table 9). It is unknown how many of these multiple trips per day were made with the same group of anglers or different groups of anglers. Even though one-fifth to one-third of vessels made multiple trips in a day during this period, trips after the first trip of the day only represented 3.1-6.8% of all bottomfish trips each year.

To evaluate the effect of a trip limit on harvest, we used the same approach used in previous evaluations (King et al. 2102, Meyer and Powers 2015). Using logbook data on harvest by individual anglers, we calculated the percentage of harvest that came from trips after the first trip of the day. This represents the maximum percent reduction in halibut harvest that could be realized by restricting vessels to one trip per day with halibut harvest. The percent of harvest on trips after the first trip of the day varied among subareas and among years and was generally lowest in the Petersburg and Sitka subareas (Table 10). The average harvest percentages after the first trip of the day for Area 2C overall have been relatively stable, ranging from 2.0% – 3.1% since 2007, and 2.0% – 2.3% during 2015-2017. There does not appear to be a trend since 2009 in the amount of harvest that occurs after the first trip of the day. The preliminary estimate of harvest after the first trip of the day for 2018 based on logbook data through July was 2.8%.

A trip limit would be unlikely to achieve the estimated 2.0 – 2.3% maximum reduction in halibut harvest because of the potential for displaced clients to book alternate vessels or dates. As described for daily closures, there is a substantial amount of latent capacity on charter vessels in Area 2C (Marrinan and Fey 2017) and would be most effective in areas with remote lodges. In summary, we do not have sufficient information to accurately estimate the effect of a trip limit, and can only say that it would reduce halibut harvest by no more than 2.0 – 2.3%, and that the reduction would likely be less than that.

Harvest with a one trip per vessel per day limit was projected in Area 2C using the average proportion of harvest on the first trip of the day by subarea from 2015 – 2017. The areawide estimated harvest reductions associated with trip limits was 2.1%. Total charter removals were projected for a range of reverse slot limits following the procedures for annual limits (Table 11, procedures outlined in section 3.3.1). For reference, the most liberal combinations of size limits with a trip limit for which the projected removals are within the reference SPR allocation are highlighted in Table 11.

3.4.2 Results

Implementation of a trip limit could be used to bring the projected removals within the allocation. The most liberal regulation under a trip limit would be U37O74.

3.5 Reverse Slot Limit with Day of the Week Closures

3.5.1 Approach

Harvests were projected with day of the week closures in Area 2C using the average proportion of harvest on each day of the week by subarea from 2015 – 2017. The areawide estimated harvest reductions associated with day of the week closures range from about 13.0% to 14.9% with the lowest reductions resulting from closing weekend days (Table 12). A day of the week closure would be unlikely to achieve the estimated 13.0 – 14.9% maximum reduction in halibut harvest because of the potential for displaced clients to book alternate dates either on the same vessel or another vessel with available space. There is a substantial amount of latent capacity on charter vessels in Area 2C (Marrinan and Fey 2017). A day of the week closure would be most effective for reducing harvest by boats at remote lodges, where clients have fewer options for dates and vessels. In summary, we do not have sufficient information to accurately estimate the effect of a day of the week closure, but can only say that it would reduce halibut harvest by no more than 13.0 – 14.9%, and that the reduction would likely be less.

Total charter removals with day of the week closures were projected for a range of reverse slot limits following the procedures for annual limits (Tables 13 a-g, procedures outlined in section 3.3.1). For reference, the most liberal combinations of size limits and day of the week closures for which the projected removals are within the reference SPR allocation are highlighted in Table 13.

3.5.2 Results

Implementation of a daily closure could be used to bring the projected removals within the allocation. The most liberal regulation under a daily closure would be achieved by closing Tuesday or Wednesday and would result in a U43O76 reverse slot.

3.6 Reverse Slot Limit with Annual Limits Combined with Daily Trip Limits

The individual effects of annual harvest limits and daily trip limits are summarized above. The maximum reduction expected from a combination of these two management measures is the harvest under an annual limit (Table 8) less the reduction from a 1 trip per vessel per day limit, 2.1%. As outlined above, trip limits would be unlikely to achieve the estimated maximum reduction in halibut harvest because of the potential for displaced clients to book alternate vessels or dates. Further, it is likely that the effect of trip limits will be reduced at low annual limits as this would decrease demand for trips.

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 six Tuesdays in July and August. As explained earlier, the status quo effort forecast was equal to the 2018 preliminary estimate. All subareas had declining trends in HPUE (Table 4, Figure 2). The status quo effort forecast for Area 3A for 2019 is 107,835 angler-trips, and the harvest forecast is 127,778 halibut with a 95% margin of error (± 2 standard errors) of about 7,160 fish (Table 14). The status quo harvest forecast is 5.4% lower than the 2018 preliminary harvest estimate of 135,031 due to the forecasted decline in HPUE. The weighted average HPUE forecast for Area 3A overall is 1.18 halibut per angler-tripGlacier Bay, Yakutat, North Gulf Coast, and Kodiak 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 Status Quo with Changes in Tuesday Closures

4.2.1 Approach

Status quo regulations in Area 3A included a year-round closure of the charter fishery on Wednesdays, as well as four Tuesdays closed in July and two Tuesdays closed in August. The potential effect of opening or closing Tuesdays was estimated for the months June-August. The analysis for opening Tuesdays relied on complete logbook data for 2016, the last year in which the fishery was open on all Tuesdays and closed on Wednesdays, while the analysis for closing Tuesdays relied on complete logbook data from 2017, a year in which the fishery was closed on Wednesdays and three Tuesdays. Generally speaking, the analysis proceeded by estimating the proportional effect of Tuesdays in 2016 or 2017 and applying those proportional effects to the harvest forecast for 2019.

The first step was to identify the dates of specific Tuesdays that would be closed in 2019 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 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, 2019. Once the specific closed Tuesdays for each scenario were identified, the corresponding Tuesday to each of those dates was identified from the historic data sets for analyses. There was a four-day difference in the date of each Tuesday from 2016 to 2019 and a two-day difference from 2017 to 2019. The potential harvest reduction associated with closing all Tuesdays for the entire year (48 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 or 2017 would be added or eliminated if those days were opened or closed, respectively. In other words, the harvest that occurred on those days represented the potential change in harvest if those days were opened or closed. The total annual harvest under each scenario of opened or closed Tuesdays was compared to the harvest scenario of six closed Tuesdays (2018 status quo) to estimate the proportional change for 2019. As outlined in the 2C analysis of daily closures, the harvest reductions under each scenario represent the maximum expected reduction in the number of fish harvested. A day of the week closure would be unlikely to achieve the maximum reduction in halibut harvest because of the potential for displaced anglers to book alternate dates either on the same vessel or another vessel with available space. There is a substantial amount of latent capacity on charter vessels in Area 3A (Marrinan and Fey 2017).

4.2.2 Results

Under status quo regulations, which include six Tuesday closures, the projected average weight was 14.41 lb and projected removal was 1.834Mlb (Table 15). The potential additional harvest ranged from 2.7% for one less closed Tuesday (5 total closed Tuesdays) to 10.4% for zero closed Tuesdays; reductions in harvest ranged from 1.4% for one additional closed Tuesday (seven closed) to 6.2% for 7 additional closed Tuesdays (13 total). The projected removals associated with these scenarios ranged from 2.023 to 1.681 Mlb. Under the reference catch limits, all Tuesdays could be opened.

4.3 Status Quo with 13 Tuesday Closures and Additional Days Closed

4.3.1 Approach

Status quo regulations in Area 3A included a year-round closure of the charter fishery on Wednesdays, as well as six Tuesdays closed in July and early August. The potential effect of closing all (13) Tuesdays June – August with additional days of the week closed in June – August was estimated. The analysis

followed the same procedures as the analysis for Tuesday closures, outlined above. The analysis estimated the proportional effect of additional daily closures in 2017 and applying those proportional effects to the harvest forecast for 2019.

The first step was to identify the dates of specific days that would be closed in 2019 under each possible number of closed days. Specific days were selected such that, for each scenario, 60-75% of the closed days would fall before August 1.

A total of 13 dates for each day of the week closure during the period June-August, 2019, were identified. Once the specific closed dates for each scenario were identified, the closest date range for the same day of the week was identified from the 2017 data set for analysis. For example, when evaluating closing Sundays from July 14 – August 4, 2019, we used harvest from Sundays between July 16 – August 6, 2017.

The analysis assumed that the proportions of harvest occurring on each date in 2017 would be eliminated if those dates were closed. The total annual harvest under each scenario of closed dates represents the maximum expected harvest, assuming that anglers displaced by the daily closures would not book trips on another day.

4.3.2 Results

The potential reductions in harvest relative to 13 closed Tuesdays ranged from 1.8% for one additional closed day to 18.0% for 13 additional closed days (Table 16). Proportional reductions and projected removals varied slightly and were generally similar regardless of day of the week with Sunday having the least harvest reduction and Saturday the greatest harvest reduction. The projected removals associated with these scenarios ranged from 1.689 Mlb down to 1.410 Mlb (Table 16, Figure 4). Additional closures would not be necessary under the reference catch levels for 2019.

4.4 Reverse Slot Limit Combined with a Maximum Size Limit

4.4.1 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 and 2018 seasons (Meyer and Powers 2016, 2017).

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 scenarios were projected bracketing a plausible range of assumptions. Both scenarios used the 2018 preliminary effort as the projected effort for 2019. The low harvest scenario used the time series forecasts of HPUE and the proportion of second fish for 2019, and was identical to the status quo harvest forecast in Table 14. 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.

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 in Area 3A. The average weight of the second fish was calculated as the average weight of U28 fish in 2013 for the high harvest scenario and the average weight of U28 fish in 2018 for the low harvest scenario. 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.

Projections were made for lower size limits ranging from 35-50 inches (U35-U50), and for upper limits ranging from 50-80 inches (O50-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 U50-O50 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 U50-O50 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).

4.4.2 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 1.364 Mlb to 1.879 Mlb for the range of size limits considered (Table 17a). Under the low scenario, a reverse slot limit would not be necessary to remain within the 2.29 Mlb reference catch allocation. Under the high harvest scenario, projected removals ranged from 1.858 Mlb to 2.418 Mlb (Table 17b). Under the high harvest scenario, the most liberal slot limit that remains within the reference catch allocation is U50O60.

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.

4.5 Maximum Size Limit on One Fish Combined with Tuesday closures

4.5.1 Approach

As described above, status quo for this regulatory mechanism is a maximum size limit on one fish of 28 inches and six Tuesday closures. Other size limits and Tuesday closures were explored to flexibility in recommending management measures. Charter removals were projected under maximum size limits ranging from 26 to 30 inches and Tuesday closures ranging from zero to thirteen days. Projected removals include a 1.5% inflation factor to account for release mortality. These projections incorporate all other status quo measures, including the charter vessel trip limit, permit trip limit, Wednesday closure for the entire year, and an annual limit of four halibut.

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 2019 projected 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 2019 from 2010-2018 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 3-5% in the Glacier Bay and Yakutat subareas, with a weighted average of 36% for Area 3A overall (Figure 3).

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 anglers 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 2016-2018. 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 29% to 16% 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 1.00 to 1.94 among subareas.

4.5.2 Results

Under status quo regulations, which include a 28” maximum size limit on the second fish and six Tuesday closures, the projected removal is approximately 0.46 Mlb less than the allocation corresponding with the reference catch allocation of 2.29 Mlb (Table 18). Under this catch allocation, all Tuesdays could be opened and a maximum size of 30 inches on the second fish could be used. This would still result in the projected yield being approximately 0.20 Mlb less than the allocation.

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) and 2016 – 2018 (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 recent years. 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[4] 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. In 2017, 67,021 licensed anglers harvested 134,308 halibut in 3A. Of those, 165 (0.2%) violated the annual limit and harvested 228 fish in excess of the annual limit which represented 0.2% of the total harvest by licensed anglers.

Another concern with annual limits is that compliance may be low among youth anglers. Youth anglers 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 4-6% 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 Daily Closures

As mentioned earlier, the primary issue with daily closures is that the effect cannot be accurately 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

[4] http://www.adfg.alaska.gov/static/license/sportlicense/pdf/sf_harvest_record_card.pdf

estimate the maximum potential reduction in halibut harvest but cannot predict possible changes in angler behavior, such as anglers booking alternate days. In 3A, with Wednesdays closed all year and six Tuesdays closed during the peak, closure of additional days during the peak season (June through August) may be more effective than closure of a day or two here and there. With each additional day closed, there would be fewer days available to rebook and fewer charters available to take the displaced anglers. The effectiveness of day of the week closures in 2C is expected to be similar to those seen in 3A. However, differences in business models and angler behavior between the areas may impact the effectiveness of this management measure.

Another impact of daily closures is the potential increase in the harvest of state-managed species such as salmon, rockfishes, sablefish, 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 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 daily closures are considered for 3A, that they be structured around the dates listed in Table 15 (Tuesdays) and Figure 4 (additional days).

5.4 Trip Limits (Area 2C)

If trip limits are recommended, it may be important for the Council to carefully specify its intent with regard to various types of business models. For example, when trip limits were implemented in Area 3A in 2014, the regulatory definition was somewhat vague and allowed vessels to make trips spanning midnight so clients could harvest two bag limits (overnight trips). In 2015, the Council recommended that the regulatory definition be written such that each trip ends at 11:59 pm to end the practice of overnight trips. Further, in 2016 the language was amended to include a trip limit on each charter halibut permit. It is recommended that the 2C regulatory language matches the current regulatory language for 3A and that the council carefully consider whether there are other aspects of business models in 2C that need to be incorporated into this regulation.

Because the Council does not have jurisdiction for other recreational fisheries, the vessel trip limit would not apply to vessels or trips targeting or catching only salmon or other state-managed species. The trip limit has been specified in Area 3A to apply only to trips on which halibut were harvested.

In addition, the trip limit in Area 3A in 2014 and 2015 did not apply to trips on which all harvested halibut were GAF. The Council may want to consider explicitly clarifying its intent with regard to trip limits and GAF harvest, which is not counted toward the charter allocation.

Not all businesses that make multiple trips per day are doing so with a different group of anglers. Lodges with anglers that fish several days in a row likely make up a portion of the businesses that regularly make multiple trips per day. Some may be taking the same anglers out several times per day, returning to the lodge for meals or rest. Current logbook reporting rules define a trip as ending when charter anglers or fish are offloaded. If multiple trips per day were prohibited, these businesses would have to make sure that all halibut harvest occurred on only one trip per day.

6.0 References

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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[5].

Length (Inches)	Net Weight (lb)	Round Weight (lb)
20	2.3	3.1
21	2.7	3.6
22	3.2	4.2
23	3.7	4.9
24	4.2	5.6
25	4.8	6.4
26	5.4	7.2
27	6.2	8.2
28	6.9	9.2
29	7.8	10.3
30	8.7	11.5
31	9.6	12.8
32	10.7	14.2
33	11.8	15.7
34	13.0	17.3
35	14.3	19.0
36	15.6	20.8
37	17.1	22.7
38	18.6	24.8
39	20.3	27.0
40	22.0	29.3
41	23.8	31.7
42	25.8	34.3
43	27.8	37.0
44	30.0	39.9
45	32.2	42.9
46	34.6	46.0
47	37.1	49.3
48	39.7	52.8
49	42.5	56.5
50	45.3	60.3

(continued at right)

Length (Inches)	Net Weight (lb)	Round Weight (lb)
51	48.3	64.3
52	51.5	68.5
53	54.8	72.8
54	58.2	77.4
55	61.7	82.1
56	65.5	87.1
57	69.3	92.2
58	73.3	97.5
59	77.5	103.1
60	81.9	108.9
61	86.4	114.9
62	91.0	121.1
63	95.9	127.5
64	100.9	134.2
65	106.1	141.1
66	111.5	148.3
67	117.0	155.7
68	122.8	163.3
69	128.7	171.2
70	134.9	179.4
71	141.2	187.8
72	147.8	196.5
73	154.5	205.5
74	161.5	214.8
75	168.7	224.3
76	176.1	234.2
77	183.7	244.3
78	191.5	254.7
79	199.6	265.5
80	207.9	276.5

[5] 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	PWalesI, PWI
	Petersburg/Wrangell	Petersburg, Wrangell	Pburg
	Sitka	Sitka	Sitka
	Juneau, Haines, Skagway	Juneau	Jun
	Glacier Bay (2C portion)	Gustavus, Elfin Cove	GlacB, GlacB-2C
3A	Glacier Bay (3A portion)	Gustavus, Elfin Cove	GlacB, GlacB-3A
	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, 2006-2018. Estimates for 2018 are preliminary, based on logbook data for charter trips through July 31, 2018, entered as of November 05, 2018.

	Subarea						
Year	Ketch	PWI	Pburg	Sitka	Jun	GlacB-2C	Total 2C
Effort (angler-trips)[a]							
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	18,686	25,466	3,133	33,481	13,729	9,786	104,281
2018	21,267	25,356	3,371	32,399	14,010	11,711	108,116
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	0.507	0.725	0.621	0.789	0.633	0.667	0.687
2017	0.460	0.753	0.630	0.777	0.592	0.692	0.677
2018	0.468	0.717	0.594	0.765	0.612	0.653	0.658
Harvest (number of halibut)[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	8,590	19,172	1,974	26,019	8,123	6,769	70,647
2018	9,943	18,171	2,001	24,774	8,568	7,650	71,107

[a] – Effort is defined as angler-trips with bottomfish effort or harvest of at least one halibut. All effort is client-only except 2014-2018 data includes any reported effort by crew that retained halibut.

[b] – Harvest is client-only except 2014-2018 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, 2006-2018. Estimates for 2018 are preliminary, based on logbook data through July 31, 2018, entered as of November 5, 2018.

	Subarea								
Year	GlacB-3A	Yak	EPWS	WPWS	NGulf	CCI	LCI	Kod	Tot 3A
Effort (angler-trips)[a]									
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	2,216	3,494	3,650	3,791	29,626	17,500	36,206	8,798	105,281
2018	2,851	4,791	4,080	3,730	30,320	17,868	34,849	9,346	107,835
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	0.755	0.929	1.127	1.059	1.239	1.688	1.715	0.934	1.413
2017	0.726	0.915	1.121	0.986	1.100	1.649	1.681	0.882	1.355
2018	0.710	0.890	1.135	1.006	0.952	1.616	1.591	0.769	1.252
Harvest (number of halibut)[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	1,609	3,196	4,090	3,737	32,576	28,850	60,845	7,761	142,664
2018	2,023	4,263	4,631	3,753	28,853	28,880	55,441	7,187	135,031

[a] – Effort is defined as angler-trips with bottomfish effort or harvest of at least one halibut. All effort is client-only except 2014-2018 data includes any reported effort by crew that retained halibut.

[b] – Harvest is client-only except 2014-2018 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 2019 under status quo regulations, with associated standard errors. Status quo regulations include a one-fish bag limit and U38O80 reverse slot size limit.

Subarea	Effort (angler-trips)	Std Error	HPUE	Std Error	Harvest (no. halibut)	Std Error
Ketch	23,067	1,004	0.47	0.04	10,839	1,116
PWI	26,672	1,413	0.75	0.04	19,988	1,571
Pburg	3,102	399	0.59	0.04	1,841	260
Sitka	33,782	1,830	0.77	0.05	25,961	2,197
Jun	15,013	898	0.64	0.04	9,529	825
GlacB-2C	11,710	1,414	0.67	0.06	7,830	1,168
Area 2C	113,346	3,052	0.67	NA	75,988	3,264

Table 6. Projected charter removals (Mlb) for Area 2C in 2019 under reverse slot limits ranging from U35O50 to U50O80 with a 1-fish bag limit. Shaded cells represent projections for the most liberal upper and lower size limits that do not exceed the 0.81 Mlb allocation associated with the reference catch allocation. All values in the table include corrections for 2012-2018 errors in estimation of average weight and correction factors for release mortality by weight.

No annual limit, harvest = 75,998

Lower Limit (in)	Upper Length Limit (in)															
	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
35	1.410	1.316	1.246	1.167	1.111	1.059	0.986	0.916	0.877	0.845	0.813	0.792	0.763	0.746	0.744	0.731
36	1.440	1.349	1.280	1.203	1.147	1.096	1.024	0.956	0.917	0.885	0.853	0.833	0.804	0.787	0.785	0.772
37	1.456	1.366	1.298	1.222	1.167	1.117	1.046	0.977	0.939	0.908	0.876	0.856	0.828	0.811	0.809	0.796
38	1.482	1.394	1.328	1.254	1.200	1.150	1.080	1.013	0.975	0.944	0.913	0.893	0.865	0.848	0.846	0.833
39	1.500	1.413	1.348	1.275	1.222	1.172	1.103	1.037	0.999	0.969	0.938	0.918	0.890	0.874	0.872	0.859
40	1.512	1.427	1.363	1.291	1.238	1.190	1.121	1.056	1.019	0.989	0.958	0.938	0.911	0.894	0.892	0.880
41	1.529	1.446	1.384	1.312	1.261	1.213	1.145	1.081	1.044	1.014	0.984	0.964	0.937	0.921	0.919	0.906
42	1.537	1.455	1.394	1.324	1.273	1.226	1.159	1.095	1.059	1.029	0.999	0.980	0.953	0.936	0.935	0.922
43	1.547	1.467	1.406	1.337	1.287	1.240	1.174	1.111	1.075	1.046	1.016	0.997	0.970	0.954	0.952	0.940
44	1.563	1.485	1.426	1.358	1.309	1.263	1.198	1.135	1.100	1.071	1.041	1.022	0.996	0.980	0.978	0.966
45	1.582	1.506	1.448	1.381	1.333	1.288	1.223	1.162	1.127	1.098	1.069	1.050	1.024	1.008	1.006	0.994
46	1.592	1.517	1.460	1.394	1.346	1.302	1.238	1.178	1.143	1.115	1.086	1.067	1.041	1.026	1.024	1.012
47	1.608	1.535	1.479	1.414	1.367	1.324	1.261	1.201	1.167	1.139	1.110	1.092	1.066	1.051	1.049	1.037
48	1.616	1.544	1.489	1.426	1.380	1.336	1.274	1.215	1.181	1.154	1.125	1.107	1.081	1.066	1.064	1.052
49	1.636	1.566	1.512	1.450	1.405	1.362	1.301	1.243	1.209	1.182	1.154	1.136	1.111	1.096	1.094	1.082
50	1.646	1.578	1.526	1.464	1.420	1.378	1.318	1.260	1.227	1.200	1.173	1.155	1.130	1.115	1.113	1.101

Table 7. Estimated effects of annual limits of one to five halibut on Area 2C charter anglers and projected harvest for 2019. Effects were estimated using 2017 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 2017.

Annual Limit	Subarea						Area 2C
	Ketch	PWI	Pburg	Sitka	Jun	GlacB	
			Estimated percent of anglers affected by the annual limit:				
1	25.1%	73.4%	45.6%	72.7%	39.8%	50.1%	57.3%
2	10.0%	47.8%	21.7%	42.8%	25.0%	29.3%	34.0%
3	2.4%	11.3%	8.2%	9.8%	12.3%	15.1%	9.6%
4	0.7%	2.1%	1.6%	1.7%	4.6%	4.4%	2.3%
5	0.2%	0.7%	0.2%	0.4%	1.2%	0.7%	0.5%
			Estimated percent change in harvest relative to no annual limit:				
1	-27.8%	-57.6%	-43.6%	-56.1%	-45.6%	-50.0%	-50.2%
2	-9.7%	-26.4%	-17.9%	-24.2%	-24.0%	-25.0%	-22.6%
3	-2.4%	-6.1%	-5.6%	-5.4%	-10.4%	-10.3%	-6.3%
4	-0.7%	-1.4%	-1.0%	-1.1%	-3.7%	-2.8%	-1.6%
5	-0.2%	-0.5%	-0.1%	-0.3%	-1.1%	-0.6%	-0.5%
			Projected harvest (number of halibut):				
1	7,827	8,484	1,038	11,393	5,182	3,915	37,840
2	9,790	14,708	1,512	19,674	7,244	5,876	58,804
3	10,575	18,760	1,737	24,552	8,540	7,022	71,187
4	10,766	19,717	1,823	25,672	9,179	7,611	74,769
5	10,822	19,894	1,839	25,871	9,420	7,785	75,631
No Limit	10,839	19,988	1,841	25,961	9,529	7,830	75,988

Table 8. Projected charter removals (Mlb) for Area 2C in 2019 under reverse slot limits ranging from U35O50 to U50O80 with a 1-fish bag limit combined with annual limits ranging from five to one fish. Shaded cells represent projections for the most liberal upper and lower size limits that do not exceed the 0.81 Mlb allocation associated with the reference catch allocation. All values in the table include corrections for 2012-2018 errors in estimation of average weight and correction factors for release mortality by weight.

a. 5-fish annual limit, harvest = 75,631

Lower Limit (in)	Upper Length Limit (in)															
	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
35	1.403	1.310	1.240	1.162	1.106	1.054	0.981	0.912	0.873	0.841	0.809	0.788	0.760	0.743	0.741	0.727
36	1.434	1.343	1.274	1.198	1.142	1.091	1.020	0.951	0.913	0.881	0.849	0.829	0.801	0.784	0.782	0.769
37	1.449	1.359	1.292	1.216	1.162	1.112	1.041	0.973	0.935	0.904	0.872	0.852	0.824	0.807	0.805	0.792
38	1.476	1.388	1.322	1.248	1.194	1.145	1.075	1.008	0.970	0.940	0.908	0.889	0.861	0.844	0.842	0.829
39	1.493	1.407	1.342	1.269	1.216	1.167	1.098	1.032	0.995	0.964	0.933	0.914	0.886	0.870	0.867	0.855
40	1.505	1.421	1.357	1.285	1.233	1.185	1.116	1.051	1.014	0.984	0.953	0.934	0.906	0.890	0.888	0.876
41	1.522	1.440	1.377	1.306	1.255	1.208	1.140	1.076	1.039	1.010	0.979	0.960	0.933	0.917	0.915	0.902
42	1.530	1.449	1.387	1.317	1.267	1.220	1.153	1.090	1.054	1.024	0.994	0.975	0.948	0.932	0.930	0.918
43	1.540	1.460	1.400	1.331	1.281	1.235	1.169	1.106	1.070	1.041	1.011	0.992	0.966	0.950	0.948	0.935
44	1.557	1.479	1.420	1.352	1.303	1.257	1.192	1.130	1.095	1.066	1.036	1.018	0.991	0.976	0.974	0.961
45	1.575	1.500	1.441	1.375	1.327	1.282	1.218	1.157	1.122	1.093	1.064	1.045	1.019	1.004	1.002	0.990
46	1.585	1.510	1.453	1.388	1.340	1.296	1.233	1.172	1.138	1.110	1.081	1.062	1.036	1.021	1.019	1.007
47	1.601	1.528	1.472	1.408	1.361	1.318	1.255	1.196	1.162	1.134	1.105	1.087	1.061	1.046	1.044	1.032
48	1.609	1.538	1.483	1.419	1.373	1.330	1.269	1.210	1.176	1.148	1.120	1.102	1.077	1.061	1.060	1.048
49	1.628	1.559	1.505	1.443	1.398	1.356	1.295	1.237	1.204	1.177	1.149	1.131	1.106	1.091	1.089	1.077
50	1.639	1.571	1.519	1.458	1.413	1.372	1.312	1.255	1.222	1.195	1.167	1.150	1.125	1.110	1.108	1.096

b. 4-fish annual limit, harvest = 74,769

Lower Limit (in)	Upper Length Limit (in)															
	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
35	1.387	1.294	1.225	1.148	1.092	1.041	0.970	0.901	0.862	0.831	0.799	0.779	0.751	0.734	0.732	0.719
36	1.417	1.327	1.259	1.183	1.129	1.078	1.008	0.940	0.902	0.871	0.839	0.819	0.791	0.775	0.773	0.760
37	1.432	1.343	1.277	1.202	1.148	1.098	1.028	0.961	0.924	0.893	0.862	0.842	0.814	0.798	0.796	0.783
38	1.458	1.372	1.306	1.233	1.180	1.131	1.062	0.996	0.959	0.928	0.898	0.878	0.850	0.834	0.832	0.819
39	1.475	1.390	1.326	1.254	1.201	1.153	1.085	1.020	0.983	0.953	0.922	0.903	0.875	0.859	0.857	0.845
40	1.487	1.404	1.341	1.270	1.218	1.171	1.103	1.038	1.002	0.972	0.942	0.923	0.896	0.880	0.878	0.865
41	1.505	1.423	1.361	1.291	1.240	1.193	1.127	1.063	1.027	0.998	0.968	0.949	0.922	0.906	0.904	0.892
42	1.512	1.432	1.371	1.302	1.252	1.206	1.140	1.077	1.041	1.012	0.982	0.964	0.937	0.921	0.919	0.907
43	1.522	1.443	1.383	1.315	1.266	1.220	1.155	1.093	1.057	1.029	0.999	0.981	0.954	0.939	0.937	0.924
44	1.538	1.461	1.403	1.336	1.287	1.242	1.178	1.117	1.082	1.053	1.024	1.006	0.980	0.964	0.962	0.950
45	1.557	1.482	1.424	1.359	1.311	1.267	1.203	1.143	1.108	1.080	1.052	1.033	1.007	0.992	0.990	0.978
46	1.566	1.493	1.436	1.371	1.325	1.281	1.218	1.158	1.124	1.096	1.068	1.050	1.024	1.009	1.007	0.995
47	1.582	1.510	1.455	1.391	1.345	1.302	1.240	1.181	1.148	1.120	1.092	1.074	1.049	1.034	1.032	1.020
48	1.590	1.520	1.465	1.403	1.357	1.315	1.254	1.195	1.162	1.135	1.107	1.089	1.064	1.049	1.047	1.035
49	1.609	1.541	1.488	1.426	1.382	1.340	1.280	1.222	1.189	1.163	1.135	1.118	1.093	1.078	1.076	1.065
50	1.620	1.553	1.501	1.440	1.397	1.356	1.296	1.240	1.207	1.181	1.154	1.136	1.111	1.097	1.095	1.084

(continued)

Table 8. (continued)

c. 3-fish annual limit, harvest = 71,187

Lower Limit (in)	Upper Length Limit (in)															
	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
35	1.318	1.230	1.164	1.091	1.038	0.990	0.921	0.856	0.820	0.790	0.760	0.741	0.714	0.698	0.696	0.684
36	1.347	1.261	1.196	1.124	1.073	1.025	0.958	0.893	0.857	0.828	0.798	0.779	0.752	0.737	0.735	0.723
37	1.361	1.277	1.213	1.142	1.091	1.044	0.977	0.914	0.878	0.849	0.820	0.801	0.774	0.759	0.757	0.745
38	1.386	1.304	1.242	1.172	1.121	1.075	1.010	0.947	0.911	0.883	0.854	0.835	0.809	0.793	0.792	0.780
39	1.403	1.321	1.260	1.191	1.142	1.096	1.031	0.969	0.934	0.906	0.877	0.859	0.833	0.817	0.816	0.804
40	1.414	1.335	1.274	1.207	1.158	1.113	1.049	0.987	0.953	0.924	0.896	0.878	0.852	0.837	0.835	0.823
41	1.430	1.353	1.294	1.227	1.179	1.134	1.071	1.010	0.976	0.948	0.920	0.902	0.877	0.862	0.860	0.848
42	1.437	1.361	1.303	1.237	1.190	1.146	1.083	1.023	0.990	0.962	0.934	0.916	0.891	0.876	0.874	0.863
43	1.446	1.372	1.314	1.249	1.203	1.160	1.098	1.038	1.005	0.978	0.950	0.932	0.907	0.893	0.891	0.879
44	1.462	1.389	1.333	1.269	1.224	1.181	1.120	1.061	1.028	1.001	0.974	0.957	0.932	0.917	0.915	0.904
45	1.480	1.409	1.354	1.291	1.246	1.204	1.144	1.086	1.054	1.027	1.000	0.983	0.958	0.944	0.942	0.931
46	1.489	1.419	1.365	1.303	1.259	1.218	1.158	1.101	1.069	1.042	1.016	0.999	0.974	0.960	0.958	0.947
47	1.504	1.436	1.383	1.322	1.279	1.238	1.179	1.123	1.091	1.065	1.039	1.022	0.998	0.983	0.982	0.971
48	1.512	1.445	1.393	1.333	1.290	1.250	1.192	1.137	1.105	1.079	1.053	1.036	1.012	0.998	0.996	0.985
49	1.530	1.465	1.414	1.356	1.314	1.274	1.217	1.162	1.131	1.105	1.080	1.063	1.039	1.025	1.024	1.013
50	1.540	1.476	1.427	1.369	1.328	1.289	1.232	1.179	1.148	1.123	1.097	1.081	1.057	1.043	1.042	1.031

d. 2-fish annual limit, harvest = 58,804

Lower Limit (in)	Upper Length Limit (in)															
	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
35	1.090	1.016	0.961	0.901	0.858	0.818	0.762	0.708	0.678	0.653	0.628	0.613	0.590	0.578	0.576	0.566
36	1.114	1.042	0.988	0.929	0.887	0.848	0.792	0.739	0.709	0.684	0.660	0.645	0.623	0.610	0.608	0.599
37	1.126	1.055	1.002	0.944	0.903	0.864	0.809	0.756	0.726	0.702	0.678	0.663	0.641	0.628	0.627	0.617
38	1.147	1.078	1.026	0.969	0.928	0.890	0.836	0.783	0.755	0.731	0.707	0.692	0.670	0.658	0.656	0.646
39	1.161	1.093	1.042	0.985	0.945	0.908	0.854	0.802	0.774	0.750	0.726	0.712	0.690	0.678	0.676	0.666
40	1.170	1.104	1.054	0.998	0.959	0.922	0.868	0.817	0.789	0.766	0.742	0.728	0.706	0.694	0.692	0.683
41	1.184	1.119	1.070	1.015	0.976	0.940	0.887	0.837	0.809	0.786	0.763	0.748	0.727	0.715	0.713	0.704
42	1.190	1.126	1.078	1.024	0.986	0.950	0.898	0.848	0.820	0.797	0.774	0.760	0.739	0.727	0.725	0.716
43	1.198	1.135	1.088	1.034	0.997	0.961	0.910	0.860	0.833	0.810	0.788	0.773	0.752	0.741	0.739	0.730
44	1.211	1.150	1.103	1.051	1.014	0.979	0.928	0.880	0.852	0.830	0.808	0.794	0.773	0.761	0.760	0.750
45	1.226	1.166	1.121	1.069	1.033	0.998	0.948	0.900	0.874	0.851	0.829	0.815	0.795	0.783	0.782	0.773
46	1.233	1.175	1.130	1.080	1.044	1.010	0.960	0.913	0.886	0.864	0.843	0.829	0.808	0.797	0.795	0.786
47	1.246	1.189	1.145	1.096	1.060	1.027	0.978	0.932	0.905	0.884	0.862	0.848	0.828	0.817	0.815	0.806
48	1.253	1.197	1.154	1.105	1.070	1.037	0.989	0.943	0.917	0.895	0.874	0.860	0.840	0.829	0.828	0.819
49	1.268	1.213	1.171	1.123	1.089	1.057	1.009	0.964	0.938	0.917	0.896	0.882	0.863	0.851	0.850	0.841
50	1.276	1.223	1.182	1.135	1.101	1.069	1.022	0.978	0.952	0.931	0.910	0.897	0.877	0.866	0.865	0.856

(continued)

Table 8. (continued)

e. 1-fish annual limit, harvest = 37,840

Lower Limit (in)	Upper Length Limit (in)															
	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
35	0.700	0.651	0.616	0.578	0.552	0.527	0.490	0.455	0.437	0.420	0.405	0.395	0.381	0.373	0.372	0.366
36	0.716	0.668	0.634	0.597	0.571	0.546	0.510	0.476	0.457	0.441	0.426	0.416	0.402	0.394	0.393	0.387
37	0.724	0.677	0.643	0.607	0.581	0.557	0.521	0.487	0.469	0.453	0.437	0.428	0.414	0.406	0.405	0.399
38	0.738	0.692	0.660	0.624	0.599	0.574	0.539	0.506	0.488	0.472	0.457	0.448	0.433	0.426	0.425	0.419
39	0.747	0.702	0.670	0.635	0.610	0.586	0.551	0.518	0.500	0.485	0.469	0.461	0.446	0.439	0.438	0.432
40	0.753	0.710	0.678	0.643	0.619	0.595	0.561	0.528	0.510	0.495	0.480	0.471	0.457	0.450	0.449	0.443
41	0.763	0.720	0.689	0.655	0.631	0.608	0.574	0.541	0.524	0.509	0.494	0.485	0.471	0.464	0.463	0.457
42	0.767	0.725	0.694	0.660	0.637	0.614	0.580	0.548	0.531	0.516	0.501	0.493	0.479	0.472	0.471	0.465
43	0.772	0.730	0.700	0.667	0.644	0.621	0.588	0.556	0.539	0.524	0.510	0.501	0.488	0.480	0.479	0.474
44	0.780	0.740	0.711	0.678	0.655	0.633	0.600	0.569	0.552	0.537	0.523	0.514	0.501	0.494	0.493	0.487
45	0.790	0.751	0.722	0.690	0.667	0.645	0.613	0.582	0.566	0.551	0.537	0.529	0.515	0.508	0.507	0.501
46	0.795	0.756	0.728	0.696	0.674	0.653	0.621	0.591	0.574	0.560	0.545	0.537	0.524	0.517	0.516	0.510
47	0.804	0.766	0.738	0.707	0.686	0.664	0.633	0.603	0.587	0.572	0.558	0.550	0.537	0.530	0.529	0.524
48	0.808	0.771	0.744	0.713	0.692	0.671	0.640	0.610	0.594	0.580	0.566	0.558	0.545	0.538	0.537	0.532
49	0.818	0.782	0.755	0.725	0.704	0.684	0.653	0.624	0.608	0.594	0.580	0.572	0.559	0.553	0.552	0.546
50	0.823	0.788	0.762	0.732	0.712	0.692	0.662	0.633	0.617	0.603	0.590	0.582	0.569	0.562	0.561	0.556

Table 9. Number and percent of businesses and vessels that reported at least one day with multiple trips targeting bottomfish or harvesting halibut, and the number and percent of trips in excess of one trip per day in Area 2C, 2007-2017.

	Businesses			Vessels			Bottomfish Trips		
Year	Number of businesses that reported more than one bottomfish trip per vessel per day	Total businesses with reported bottomfish effort	Percent of businesses that reported more than one bottomfish trip per day	Number of vessels that reported more than one bottomfish trip per day	Total number of vessels with reported bottomfish effort	Percent of vessels that reported more than one bottomfish trip per day	Bottomfish trips in excess of one trip per vessel per day (2nd, 3rd, or 4th trip)	Total number of bottomfish trips	Percent of bottomfish trips in excess of one trip per day
2007	126	404	31.2%	232	727	31.9%	903	27,456	3.3%
2008	114	404	28.2%	215	719	29.9%	823	26,221	3.1%
2009	109	366	29.8%	184	636	28.9%	623	19,333	3.2%
2010	75	349	21.5%	133	604	22.0%	613	19,985	3.1%
2011	84	288	29.2%	149	542	27.5%	1,311	19,170	6.8%
2012	82	272	30.1%	157	527	29.8%	1,131	19,853	5.7%
2013	78	259	30.1%	161	517	31.1%	1,318	21,074	6.3%
2014	81	256	31.6%	164	540	30.4%	1,557	23,173	6.7%
2015	80	256	31.3%	179	545	32.8%	1,218	23,892	5.1%
2016	99	264	37.5%	200	557	35.9%	948	24,083	3.9%
2017	97	268	36.2%	203	570	35.6%	1,192	26,093	4.6%

Table 10. Charter harvest (number of halibut) on the first and subsequent trips of the day, and percent of harvest on trips after the first trip of the day by subarea and for Area 2C overall (shaded cells), 2007-2017. The percentages of harvest after the first trip of the day represent the maximum potential reduction in harvest that could be realized by limiting vessels to one trip per day.

Year		Subarea						
		Ketch	PWI	Pburg	Sitka	Jun	GlacB	**Area 2C**
2007	First	11,550	39,994	5,862	33,775	9,124	16,222	116,527
	After First	169	2,050	50	281	201	1,029	3,780
	% After First	1.4%	4.9%	0.8%	0.8%	2.2%	6.0%	3.1%
2008	First	8,486	36,070	5,406	29,267	7,900	16,421	103,550
	After First	109	1,977	46	187	104	595	3,018
	% After First	1.3%	5.2%	0.8%	0.6%	1.3%	3.5%	2.8%
2009	First	4,419	12,622	2,225	15,800	4,659	10,116	49,841
	After First	52	475	21	95	214	317	1,174
	% After First	1.2%	3.6%	0.9%	0.6%	4.4%	3.0%	2.3%
2010	First	4,274	11,974	2,128	13,983	4,807	9,403	46,569
	After First	48	429	10	27	244	209	967
	% After First	1.1%	3.5%	0.5%	0.2%	4.8%	2.2%	2.0%
2011	First	3,668	11,677	1,436	15,917	5,019	9,151	46,868
	After First	78	368	8	83	352	214	1,103
	% After First	2.1%	3.1%	0.6%	0.5%	6.6%	2.3%	2.3%
2012	First	5,124	13,425	1,736	16,642	4,788	7,964	49,679
	After First	110	560	12	69	115	211	1,077
	% After First	2.1%	4.0%	0.7%	0.4%	2.3%	2.6%	2.1%
2013	First	6,521	16,028	2,104	17,178	6,267	8,767	56,865
	After First	190	782	3	87	220	113	1,395
	% After First	2.8%	4.7%	0.1%	0.5%	3.4%	1.3%	2.4%
2014	First	6,914	16,397	2,063	21,705	6,769	9,613	63,461
	After First	224	817	8	93	265	168	1,575
	% After First	3.1%	4.7%	0.4%	0.4%	3.8%	1.7%	2.4%
2015	First	7,451	15,957	2,105	23,514	7,389	7,914	64,330
	After First	311	365	16	97	298	239	1,326
	% After First	4.0%	2.2%	0.8%	0.4%	3.9%	2.9%	2.0%
2016	First	8,147	16,620	2,072	24,405	7,363	6,190	64,797
	After First	270	379	23	123	279	279	1,353
	% After First	3.2%	2.2%	1.1%	0.5%	3.7%	4.3%	2.0%
2017	First	8,220	18,684	1,955	25,880	7,769	6,520	69,028
	After First	378	488	20	138	354	249	1,627
	% After First	4.4%	2.5%	1.0%	0.5%	4.4%	3.7%	2.3%

Table 11. Projected charter removals (Mlb) for Area 2C in 2019 under reverse slot limits ranging from U35O50 to U50O80 with a 1-fish bag limit combined with a trip limit of 1 trip per vessel per day. Shaded cells represent projections for the most liberal upper and lower size limits that do not exceed the 0.81 Mlb allocation associated with the reference catch allocation. All values in the table include corrections for 2012-2018 errors in estimation of average weight and correction factors for release mortality by weight. A reverse slot limit with no trip limit can be found in table 7a.

Lower Limit (in)	Upper Length Limit (in)															
	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
35	1.379	1.287	1.218	1.141	1.085	1.035	0.964	0.895	0.857	0.826	0.794	0.774	0.746	0.729	0.727	0.714
36	1.409	1.319	1.252	1.176	1.121	1.071	1.001	0.934	0.896	0.865	0.834	0.814	0.786	0.769	0.767	0.755
37	1.424	1.336	1.269	1.195	1.141	1.091	1.022	0.955	0.918	0.887	0.856	0.836	0.809	0.792	0.790	0.778
38	1.450	1.364	1.299	1.225	1.172	1.124	1.055	0.990	0.953	0.923	0.892	0.872	0.845	0.829	0.827	0.814
39	1.467	1.382	1.318	1.246	1.194	1.146	1.078	1.013	0.976	0.947	0.916	0.897	0.870	0.854	0.852	0.839
40	1.479	1.396	1.333	1.262	1.210	1.163	1.096	1.032	0.996	0.966	0.936	0.917	0.890	0.874	0.872	0.860
41	1.496	1.415	1.353	1.283	1.232	1.186	1.120	1.056	1.020	0.991	0.961	0.942	0.916	0.900	0.898	0.886
42	1.503	1.424	1.363	1.294	1.244	1.198	1.133	1.070	1.034	1.006	0.976	0.957	0.931	0.915	0.913	0.901
43	1.513	1.435	1.375	1.307	1.258	1.212	1.148	1.086	1.051	1.022	0.993	0.974	0.948	0.933	0.931	0.919
44	1.529	1.453	1.395	1.328	1.279	1.235	1.171	1.110	1.075	1.047	1.018	0.999	0.973	0.958	0.956	0.944
45	1.548	1.473	1.416	1.351	1.303	1.259	1.196	1.136	1.101	1.074	1.045	1.027	1.001	0.986	0.984	0.972
46	1.557	1.484	1.428	1.363	1.316	1.273	1.211	1.151	1.117	1.090	1.061	1.043	1.018	1.003	1.001	0.989
47	1.573	1.501	1.446	1.383	1.337	1.294	1.233	1.174	1.141	1.113	1.085	1.067	1.042	1.027	1.026	1.014
48	1.581	1.511	1.457	1.394	1.349	1.307	1.246	1.188	1.155	1.128	1.100	1.082	1.057	1.042	1.041	1.029
49	1.600	1.532	1.479	1.418	1.373	1.332	1.272	1.215	1.182	1.156	1.128	1.111	1.086	1.071	1.069	1.058
50	1.610	1.544	1.492	1.432	1.388	1.348	1.289	1.232	1.200	1.174	1.147	1.129	1.105	1.090	1.088	1.077

Table 12. Estimated effects of day of the week closures in Area 2C charter and projected harvest for 2019. Effects were estimated using 2015-2017 logbook data.

	Subarea						
Annual Limit	Ketch	PWI	Pburg	Sitka	Jun	GlacB	**Area 2C**
			Estimated percent change in harvest relative to no closed days:				
Sunday	-12.6%	-14.1%	-12.2%	-13.6%	-15.0%	-7.7%	**-13.1%**
Monday	-15.4%	-14.9%	-15.8%	-14.8%	-14.0%	-14.3%	**-14.8%**
Tuesday	-14.5%	-14.3%	-14.0%	-14.5%	-14.5%	-19.2%	**-14.9%**
Wednesday	-13.8%	-14.3%	-15.0%	-14.3%	-14.7%	-19.3%	**-14.8%**
Thursday	-15.1%	-14.8%	-16.7%	-14.9%	-14.3%	-14.5%	**-14.8%**
Friday	-15.6%	-14.4%	-15.9%	-14.6%	-13.5%	-14.0%	**-14.5%**
Saturday	-13.1%	-13.2%	-10.5%	-13.2%	-13.9%	-11.0%	**-13.0%**
			Projected harvest (number of halibut):				
Sunday	9,477	17,162	1,616	22,434	8,096	7,230	**66,016**
Monday	9,173	17,014	1,551	22,128	8,194	6,712	**64,773**
Tuesday	9,267	17,135	1,583	22,188	8,147	6,329	**64,650**
Wednesday	9,348	17,130	1,565	22,236	8,132	6,317	**64,729**
Thursday	9,198	17,032	1,534	22,086	8,164	6,696	**64,710**
Friday	9,147	17,111	1,548	22,163	8,239	6,731	**64,938**
Saturday	9,423	17,344	1,649	22,530	8,202	6,965	**66,113**

Table 13. Projected charter removals (Mlb) for Area 2C in 2019 under reverse slot limits ranging from U35O50 to U50O80 and day of the week closures. Shaded cells represent projections for the most liberal upper and lower size limits that do not exceed the 0.81 Mlb allocation associated with the reference catch allocation. All values in the table include corrections for 2012-2018 errors in estimation of average weight and correction factors for release mortality by weight. A reverse slot limit with no day of the week closures can be found in table 7a.

a. Sunday closure, harvest = 66,016

Lower	Upper Length Limit (in)															
Limit (in)	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
35	1.233	1.151	1.089	1.021	0.971	0.925	0.861	0.800	0.766	0.737	0.709	0.691	0.665	0.650	0.648	0.637
36	1.260	1.179	1.119	1.052	1.003	0.958	0.895	0.834	0.800	0.772	0.744	0.726	0.701	0.686	0.684	0.673
37	1.273	1.194	1.135	1.068	1.020	0.976	0.913	0.853	0.820	0.792	0.764	0.746	0.722	0.707	0.705	0.693
38	1.296	1.219	1.161	1.096	1.049	1.005	0.943	0.884	0.851	0.824	0.796	0.778	0.754	0.739	0.737	0.726
39	1.311	1.235	1.178	1.114	1.067	1.024	0.963	0.905	0.872	0.845	0.818	0.800	0.776	0.761	0.760	0.748
40	1.322	1.248	1.192	1.128	1.082	1.040	0.979	0.922	0.889	0.863	0.835	0.818	0.794	0.780	0.778	0.767
41	1.337	1.264	1.209	1.147	1.102	1.060	1.001	0.943	0.912	0.885	0.858	0.841	0.817	0.803	0.801	0.790
42	1.344	1.273	1.218	1.157	1.113	1.071	1.012	0.956	0.924	0.898	0.872	0.855	0.831	0.817	0.815	0.804
43	1.352	1.282	1.229	1.169	1.125	1.084	1.026	0.970	0.939	0.913	0.887	0.870	0.846	0.832	0.831	0.820
44	1.367	1.299	1.247	1.187	1.144	1.104	1.046	0.991	0.960	0.935	0.909	0.892	0.869	0.855	0.853	0.842
45	1.384	1.317	1.266	1.208	1.165	1.125	1.069	1.015	0.984	0.959	0.933	0.917	0.894	0.880	0.878	0.867
46	1.392	1.326	1.276	1.219	1.177	1.138	1.082	1.029	0.998	0.973	0.948	0.932	0.909	0.895	0.893	0.883
47	1.406	1.342	1.293	1.237	1.196	1.157	1.102	1.049	1.019	0.995	0.969	0.953	0.931	0.917	0.916	0.905
48	1.413	1.350	1.302	1.247	1.206	1.168	1.114	1.061	1.032	1.007	0.982	0.967	0.944	0.931	0.929	0.918
49	1.430	1.369	1.322	1.268	1.228	1.191	1.137	1.086	1.056	1.032	1.008	0.992	0.970	0.957	0.955	0.944
50	1.440	1.380	1.334	1.281	1.242	1.205	1.152	1.101	1.073	1.049	1.024	1.009	0.987	0.974	0.972	0.962

b. Monday closure, harvest = 64,773

Lower	Upper Length Limit (in)															
Limit (in)	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
35	1.202	1.122	1.062	0.995	0.947	0.903	0.841	0.781	0.748	0.721	0.693	0.675	0.651	0.636	0.634	0.623
36	1.228	1.150	1.091	1.026	0.978	0.935	0.873	0.815	0.782	0.755	0.727	0.710	0.686	0.671	0.669	0.658
37	1.241	1.164	1.107	1.042	0.995	0.952	0.891	0.833	0.801	0.774	0.747	0.730	0.706	0.691	0.690	0.678
38	1.264	1.189	1.132	1.069	1.023	0.980	0.921	0.863	0.831	0.805	0.778	0.761	0.737	0.723	0.721	0.710
39	1.278	1.205	1.149	1.087	1.041	1.000	0.940	0.884	0.852	0.826	0.799	0.782	0.759	0.745	0.743	0.732
40	1.289	1.217	1.162	1.100	1.056	1.014	0.956	0.900	0.869	0.843	0.816	0.800	0.776	0.762	0.761	0.750
41	1.304	1.233	1.180	1.119	1.075	1.034	0.977	0.921	0.890	0.865	0.839	0.822	0.799	0.785	0.783	0.773
42	1.310	1.241	1.188	1.128	1.085	1.045	0.988	0.933	0.903	0.877	0.851	0.835	0.812	0.798	0.797	0.786
43	1.319	1.250	1.199	1.140	1.097	1.057	1.001	0.947	0.917	0.892	0.866	0.850	0.827	0.813	0.812	0.801
44	1.333	1.266	1.216	1.158	1.116	1.077	1.021	0.968	0.938	0.913	0.888	0.871	0.849	0.835	0.834	0.823
45	1.349	1.284	1.234	1.178	1.136	1.098	1.043	0.990	0.961	0.936	0.911	0.895	0.873	0.860	0.858	0.847
46	1.357	1.293	1.244	1.188	1.148	1.110	1.056	1.004	0.974	0.950	0.925	0.910	0.887	0.874	0.873	0.862
47	1.370	1.308	1.261	1.206	1.166	1.128	1.075	1.024	0.995	0.971	0.946	0.931	0.909	0.896	0.894	0.884
48	1.377	1.317	1.270	1.215	1.176	1.139	1.086	1.036	1.007	0.983	0.959	0.943	0.922	0.909	0.907	0.897
49	1.394	1.335	1.289	1.236	1.197	1.161	1.109	1.059	1.031	1.008	0.983	0.968	0.947	0.934	0.932	0.922
50	1.403	1.345	1.300	1.248	1.210	1.175	1.123	1.074	1.046	1.023	0.999	0.984	0.963	0.950	0.949	0.939

(*continued*)

Table 13. (continued)

c. Tuesday closure, harvest = 64,650

Lower Limit (in)	Upper Length Limit (in)															
	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
35	1.194	1.114	1.055	0.988	0.941	0.897	0.835	0.777	0.744	0.717	0.689	0.672	0.648	0.633	0.632	0.621
36	1.220	1.142	1.084	1.019	0.972	0.929	0.868	0.810	0.778	0.751	0.724	0.707	0.683	0.668	0.667	0.656
37	1.233	1.157	1.099	1.035	0.989	0.946	0.886	0.829	0.796	0.770	0.743	0.726	0.702	0.688	0.687	0.676
38	1.256	1.181	1.125	1.062	1.016	0.975	0.915	0.859	0.827	0.801	0.774	0.757	0.734	0.720	0.718	0.707
39	1.270	1.197	1.142	1.080	1.035	0.994	0.935	0.879	0.848	0.822	0.796	0.779	0.755	0.742	0.740	0.729
40	1.281	1.209	1.155	1.093	1.049	1.008	0.951	0.895	0.864	0.839	0.813	0.796	0.773	0.759	0.757	0.747
41	1.295	1.225	1.172	1.112	1.068	1.028	0.971	0.916	0.885	0.860	0.835	0.818	0.795	0.782	0.780	0.769
42	1.302	1.233	1.181	1.121	1.078	1.039	0.982	0.928	0.898	0.873	0.847	0.831	0.808	0.795	0.793	0.783
43	1.310	1.242	1.191	1.132	1.090	1.051	0.995	0.942	0.911	0.887	0.862	0.846	0.823	0.810	0.808	0.798
44	1.324	1.258	1.208	1.150	1.109	1.070	1.015	0.962	0.932	0.908	0.883	0.867	0.845	0.831	0.830	0.820
45	1.340	1.276	1.227	1.170	1.129	1.091	1.037	0.985	0.955	0.931	0.907	0.891	0.869	0.855	0.854	0.844
46	1.348	1.285	1.237	1.181	1.141	1.103	1.049	0.998	0.969	0.945	0.921	0.905	0.883	0.870	0.869	0.858
47	1.362	1.300	1.253	1.198	1.158	1.122	1.069	1.018	0.989	0.966	0.941	0.926	0.904	0.891	0.890	0.880
48	1.369	1.308	1.262	1.208	1.169	1.132	1.080	1.030	1.001	0.978	0.954	0.939	0.917	0.904	0.903	0.893
49	1.386	1.327	1.281	1.228	1.190	1.154	1.102	1.053	1.025	1.002	0.978	0.963	0.942	0.929	0.928	0.918
50	1.394	1.337	1.292	1.240	1.203	1.168	1.117	1.068	1.040	1.017	0.994	0.979	0.958	0.945	0.944	0.934

d. Wednesday closure, harvest = 64,729

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	1.056	0.989	0.942	0.898	0.836	0.777	0.744	0.717	0.690	0.673	0.648	0.634	0.632	0.621
36	1.221	1.143	1.085	1.020	0.973	0.930	0.869	0.811	0.778	0.752	0.725	0.708	0.683	0.669	0.668	0.657
37	1.234	1.158	1.100	1.036	0.990	0.947	0.887	0.830	0.797	0.771	0.744	0.727	0.703	0.689	0.687	0.677
38	1.257	1.182	1.126	1.063	1.017	0.976	0.916	0.860	0.828	0.802	0.775	0.758	0.735	0.721	0.719	0.708
39	1.272	1.198	1.143	1.081	1.036	0.995	0.936	0.880	0.848	0.823	0.796	0.780	0.756	0.742	0.741	0.730
40	1.282	1.210	1.156	1.094	1.050	1.010	0.952	0.896	0.865	0.839	0.814	0.797	0.774	0.760	0.758	0.748
41	1.297	1.227	1.173	1.113	1.069	1.029	0.972	0.917	0.886	0.861	0.835	0.819	0.796	0.782	0.781	0.770
42	1.303	1.234	1.182	1.122	1.079	1.040	0.983	0.929	0.898	0.874	0.848	0.832	0.809	0.795	0.794	0.783
43	1.311	1.244	1.192	1.133	1.091	1.052	0.996	0.943	0.912	0.888	0.863	0.846	0.824	0.810	0.809	0.799
44	1.326	1.260	1.209	1.151	1.110	1.071	1.016	0.963	0.933	0.909	0.884	0.868	0.846	0.832	0.831	0.821
45	1.342	1.277	1.228	1.171	1.130	1.092	1.038	0.986	0.956	0.932	0.908	0.892	0.870	0.856	0.855	0.845
46	1.350	1.286	1.238	1.182	1.142	1.104	1.051	0.999	0.970	0.946	0.922	0.906	0.884	0.871	0.869	0.859
47	1.363	1.302	1.254	1.199	1.160	1.123	1.070	1.019	0.990	0.967	0.942	0.927	0.905	0.892	0.891	0.881
48	1.370	1.310	1.263	1.209	1.170	1.134	1.081	1.031	1.002	0.979	0.955	0.940	0.918	0.905	0.904	0.894
49	1.387	1.328	1.282	1.229	1.191	1.155	1.104	1.054	1.026	1.003	0.979	0.964	0.943	0.930	0.929	0.919
50	1.396	1.338	1.294	1.241	1.204	1.169	1.118	1.069	1.041	1.018	0.995	0.980	0.959	0.946	0.945	0.935

(*continued*)

Table 13. (continued)

e. Thursday closure, harvest = 64,710

Lower Limit (in)	Upper Length Limit (in)															
	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
35	1.200	1.120	1.061	0.994	0.946	0.902	0.840	0.780	0.747	0.720	0.692	0.675	0.650	0.635	0.634	0.622
36	1.226	1.148	1.090	1.024	0.977	0.934	0.872	0.814	0.781	0.754	0.727	0.709	0.685	0.671	0.669	0.658
37	1.240	1.163	1.105	1.041	0.994	0.951	0.890	0.832	0.800	0.773	0.746	0.729	0.705	0.691	0.689	0.678
38	1.262	1.187	1.131	1.068	1.022	0.979	0.920	0.862	0.830	0.804	0.777	0.760	0.736	0.722	0.720	0.709
39	1.277	1.203	1.148	1.086	1.040	0.998	0.939	0.883	0.851	0.825	0.798	0.782	0.758	0.744	0.742	0.731
40	1.287	1.215	1.161	1.099	1.055	1.013	0.955	0.899	0.868	0.842	0.815	0.799	0.775	0.762	0.760	0.749
41	1.302	1.232	1.178	1.118	1.074	1.033	0.975	0.920	0.889	0.864	0.838	0.821	0.798	0.784	0.782	0.772
42	1.308	1.239	1.187	1.127	1.084	1.044	0.987	0.932	0.901	0.876	0.850	0.834	0.811	0.797	0.796	0.785
43	1.317	1.249	1.197	1.138	1.096	1.056	1.000	0.946	0.915	0.891	0.865	0.849	0.826	0.812	0.811	0.800
44	1.331	1.265	1.214	1.156	1.114	1.075	1.020	0.967	0.936	0.912	0.886	0.870	0.848	0.834	0.833	0.822
45	1.347	1.282	1.233	1.176	1.135	1.096	1.042	0.989	0.959	0.935	0.910	0.894	0.872	0.858	0.857	0.846
46	1.355	1.292	1.243	1.187	1.146	1.109	1.054	1.003	0.973	0.949	0.924	0.908	0.886	0.873	0.872	0.861
47	1.369	1.307	1.259	1.204	1.164	1.127	1.074	1.023	0.993	0.970	0.945	0.930	0.908	0.895	0.893	0.883
48	1.376	1.315	1.268	1.214	1.175	1.138	1.085	1.034	1.006	0.982	0.958	0.942	0.921	0.908	0.906	0.896
49	1.392	1.333	1.287	1.234	1.196	1.160	1.108	1.058	1.030	1.006	0.982	0.967	0.945	0.933	0.931	0.921
50	1.401	1.344	1.299	1.247	1.209	1.173	1.122	1.073	1.045	1.022	0.998	0.983	0.962	0.949	0.948	0.938

f. Friday closure, harvest = 64,938

Lower Limit (in)	Upper Length Limit (in)															
	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
35	1.205	1.124	1.064	0.998	0.949	0.905	0.843	0.783	0.750	0.722	0.694	0.677	0.652	0.638	0.636	0.625
36	1.231	1.152	1.094	1.028	0.981	0.937	0.875	0.817	0.784	0.757	0.729	0.712	0.687	0.673	0.671	0.660
37	1.244	1.167	1.109	1.044	0.997	0.954	0.894	0.835	0.803	0.776	0.749	0.731	0.707	0.693	0.691	0.680
38	1.267	1.192	1.135	1.071	1.025	0.983	0.923	0.866	0.833	0.807	0.780	0.763	0.739	0.725	0.723	0.712
39	1.281	1.208	1.152	1.089	1.044	1.002	0.943	0.886	0.854	0.828	0.801	0.784	0.761	0.746	0.745	0.734
40	1.292	1.219	1.165	1.103	1.058	1.017	0.958	0.902	0.871	0.845	0.818	0.802	0.778	0.764	0.762	0.751
41	1.307	1.236	1.182	1.121	1.077	1.037	0.979	0.924	0.892	0.867	0.840	0.824	0.801	0.787	0.785	0.774
42	1.313	1.244	1.191	1.131	1.088	1.047	0.990	0.936	0.905	0.879	0.853	0.837	0.814	0.800	0.798	0.788
43	1.321	1.253	1.201	1.142	1.100	1.060	1.003	0.949	0.919	0.894	0.868	0.852	0.829	0.815	0.814	0.803
44	1.336	1.269	1.218	1.160	1.118	1.079	1.023	0.970	0.940	0.915	0.890	0.873	0.851	0.837	0.836	0.825
45	1.352	1.287	1.237	1.180	1.139	1.100	1.045	0.993	0.963	0.938	0.913	0.897	0.875	0.861	0.860	0.849
46	1.360	1.296	1.247	1.191	1.150	1.112	1.058	1.006	0.977	0.952	0.927	0.912	0.889	0.876	0.875	0.864
47	1.373	1.311	1.263	1.208	1.168	1.131	1.077	1.026	0.997	0.973	0.948	0.933	0.911	0.898	0.896	0.886
48	1.380	1.319	1.272	1.218	1.179	1.142	1.089	1.038	1.009	0.985	0.961	0.946	0.924	0.911	0.909	0.899
49	1.397	1.338	1.292	1.239	1.200	1.164	1.111	1.062	1.033	1.010	0.986	0.970	0.949	0.936	0.934	0.924
50	1.406	1.348	1.303	1.251	1.213	1.177	1.126	1.077	1.049	1.025	1.002	0.986	0.965	0.952	0.951	0.941

(*continued*)

Table 13. (continued)

g. Saturday closure, harvest = 66,113

Lower Limit (in)	Upper Length Limit (in)															
	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
35	1.230	1.148	1.086	1.018	0.969	0.923	0.860	0.799	0.764	0.736	0.708	0.690	0.665	0.650	0.648	0.636
36	1.256	1.176	1.116	1.049	1.001	0.956	0.893	0.833	0.799	0.772	0.743	0.726	0.701	0.686	0.684	0.672
37	1.270	1.191	1.132	1.066	1.018	0.974	0.912	0.852	0.819	0.791	0.763	0.746	0.721	0.706	0.705	0.693
38	1.293	1.216	1.158	1.093	1.046	1.003	0.941	0.883	0.850	0.823	0.795	0.778	0.753	0.739	0.737	0.726
39	1.308	1.233	1.176	1.112	1.065	1.022	0.962	0.904	0.871	0.844	0.817	0.800	0.775	0.761	0.759	0.748
40	1.319	1.245	1.189	1.126	1.080	1.038	0.978	0.920	0.888	0.862	0.835	0.818	0.794	0.779	0.777	0.766
41	1.334	1.262	1.207	1.145	1.100	1.058	0.999	0.942	0.910	0.884	0.857	0.840	0.817	0.802	0.801	0.790
42	1.341	1.270	1.216	1.154	1.110	1.069	1.010	0.954	0.923	0.897	0.871	0.854	0.830	0.816	0.814	0.803
43	1.349	1.279	1.226	1.166	1.122	1.082	1.024	0.969	0.937	0.912	0.886	0.869	0.846	0.832	0.830	0.819
44	1.364	1.296	1.244	1.185	1.141	1.101	1.044	0.990	0.959	0.934	0.908	0.891	0.868	0.854	0.853	0.842
45	1.380	1.314	1.263	1.205	1.163	1.123	1.067	1.013	0.983	0.958	0.932	0.916	0.893	0.879	0.877	0.867
46	1.388	1.323	1.273	1.216	1.174	1.136	1.080	1.027	0.997	0.972	0.946	0.930	0.908	0.894	0.892	0.882
47	1.402	1.339	1.290	1.234	1.193	1.155	1.100	1.047	1.018	0.993	0.968	0.952	0.930	0.916	0.914	0.904
48	1.410	1.347	1.299	1.244	1.203	1.166	1.111	1.060	1.030	1.006	0.981	0.965	0.943	0.930	0.928	0.917
49	1.427	1.366	1.319	1.265	1.225	1.188	1.135	1.084	1.055	1.031	1.006	0.990	0.968	0.955	0.954	0.943
50	1.436	1.377	1.331	1.277	1.239	1.202	1.150	1.099	1.071	1.047	1.023	1.007	0.985	0.972	0.971	0.960

Table 14. Projected effort (angler-trips), halibut harvest per unit effort (HPUE), and harvest (numbers of halibut) for Area 3A in 2019 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 six Tuesdays in July and August.

Subarea	Effort	Std Error	HPUE	Std Error	Harvest	Std Error
CCI	17,868	429	1.57	0.03	28,129	877
EPWS	4,080	246	1.13	0.10	4,625	506
GlacB	2,851	389	0.72	0.18	2,048	585
Yak	4,791	372	0.89	0.15	4,280	793
LCI	34,849	906	1.54	0.04	53,767	1,914
NGulf	30,320	1,043	0.82	0.08	24,799	2,471
Kod	9.346	376	0.68	0.09	6,380	875
WPWS	3,730	261	1.01	0.13	3,750	546
Area 3A	107,835	1,552	1.18	NA	127,778	3,582

Table 15. Estimated potential change in harvest and projected removals associated with status quo management measures combined with 0 – 13 Tuesday closures during June through August of 2019. Status quo management measures include one fish any size, 28-inch maximum on the second fish, four fish annual limit, vessel and permit trip limits, Wednesday closure, and Tuesdays closed six days. Projections include corrections for errors in estimation of average weight and an additional 1.5% release mortality by weight. All values are below the reference catch allocation.

Number of Closed Tuesdays	Beginning and Ending Dates	Percentage change in harvest relative to status quo	Projected Harvest (no. Fish)	Projected Removals (Mlb)
0		10.4%	141,083	2.023
1	Jul 30	8.8%	138,966	1.994
2	Jul 30 – Aug 6	7.2%	136,950	1.967
3	Jul 23 – Aug 6	5.8%	135,198	1.940
4	Jul 16 – Aug 6	4.1%	132,976	1.907
5	Jul 16 – Aug 13	2.7%	131,223	1.882
6 (status quo)	Jul 9 - Aug 13	0.0%	127,778	1.834
7	Jul 02 - Aug 13	-1.4%	126,004	1.808
8	Jul 02 - Aug 20	-2.5%	124,615	1.787
9	Jun 25 - Aug 20	-3.4%	123,371	1.770
10	Jun 18 - Aug 20	-4.6%	121,956	1.748
11	Jun 18 - Aug 27	-4.8%	121,673	1.744
12	Jun 11 - Aug 27	-5.7%	120,445	1.726
13	Jun 04 - Aug 27	-6.2%	119,814	1.718
48 (all season)	Feb 01 - Dec 31	-8.2%	117,309	1.681

Table 16. Estimated additional harvest reductions assuming 13 closed Tuesdays in June-August and projected removals associated with status quo management measures with additional closed days for 2019. Projections include corrections for errors in estimation of average weight and an additional 1.5% release mortality by weight. All values are below the reference catch allocation.

	Sunday		Monday		Thursday		Friday		Saturday	
Number of Closed Days	Proportional Reduction in Harvest	Projected Removals (Mlb)	Proportional Reduction in Harvest	Projected Removals (Mlb)	Proportional Reduction in Harvest	Projected Removals (Mlb)	Proportional Reduction in Harvest	Projected Removals (Mlb)	Proportional Reduction in Harvest	Projected Removals (Mlb)
0	0.0%	1.718	0.0%	1.718	0.0%	1.718	0.0%	1.718	0.0%	1.718
1	-1.8%	1.689	-1.9%	1.687	-1.9%	1.687	-1.9%	1.688	-1.9%	1.688
2	-3.2%	1.664	-3.5%	1.659	-3.7%	1.656	-3.6%	1.660	-3.6%	1.659
3	-4.9%	1.637	-4.8%	1.636	-5.0%	1.634	-5.4%	1.627	-5.5%	1.627
4	-6.8%	1.606	-6.9%	1.601	-7.0%	1.600	-7.3%	1.595	-7.4%	1.593
5	-7.1%	1.597	-8.5%	1.574	-8.6%	1.574	-8.7%	1.572	-8.7%	1.572
6	-8.6%	1.571	-10.1%	1.546	-10.3%	1.545	-10.4%	1.543	-10.4%	1.542
7	-10.4%	1.540	-11.8%	1.516	-11.2%	1.530	-11.6%	1.525	-12.0%	1.515
8	-11.2%	1.527	-12.3%	1.509	-12.6%	1.507	-12.8%	1.503	-13.1%	1.497
9	-12.1%	1.509	-13.3%	1.492	-14.0%	1.481	-14.1%	1.481	-14.4%	1.475
10	-13.4%	1.487	-14.5%	1.471	-15.4%	1.458	-15.3%	1.461	-15.3%	1.458
11	-14.2%	1.472	-15.1%	1.460	-16.0%	1.449	-15.9%	1.450	-16.3%	1.441
12	-15.1%	1.456	-16.1%	1.442	-16.9%	1.433	-16.9%	1.434	-17.4%	1.423
13	-15.9%	1.444	-16.7%	1.433	-17.5%	1.423	-17.5%	1.424	-18.0%	1.410

Table 17. Projected charter removals (Mlb) for Area 3A in 2019 under reverse slot limits on one fish ranging from U35O50 to U50O80, 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 proportions of second fish in the harvest and HPUE projected for 2019 under status quo regulations and average weight of second fish in 2018, and a high harvest scenario (b) is based on the proportions and average weight of second fish in the harvest and HPUE from 2013 (before size limits in Area 3A). Projections also include a 4% inflation factor for release mortality and a correction factor to tune mean weight values to current conditions. All values in the low harvest scenario are below the reference catch allocation. Shaded values in the high harvest scenario represent the most liberal sizes that do not exceed the reference catch allocation.

a. Low Harvest Scenario – 127,778 fish

Lower Limit (in)	Upper Length Limit (in)															
	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
35	1.626	1.591	1.559	1.533	1.498	1.464	1.444	1.421	1.401	1.391	1.386	1.381	1.378	1.374	1.371	1.364
36	1.663	1.629	1.596	1.571	1.536	1.502	1.482	1.460	1.440	1.430	1.425	1.420	1.417	1.413	1.410	1.402
37	1.681	1.647	1.615	1.589	1.555	1.521	1.501	1.479	1.459	1.449	1.444	1.439	1.436	1.432	1.429	1.422
38	1.705	1.672	1.640	1.615	1.581	1.547	1.527	1.505	1.485	1.475	1.470	1.465	1.462	1.458	1.455	1.448
39	1.727	1.694	1.662	1.637	1.603	1.569	1.549	1.528	1.508	1.498	1.492	1.488	1.485	1.481	1.478	1.471
40	1.743	1.710	1.679	1.654	1.620	1.586	1.567	1.545	1.525	1.516	1.510	1.505	1.503	1.499	1.496	1.488
41	1.759	1.727	1.696	1.671	1.637	1.603	1.584	1.563	1.543	1.533	1.528	1.523	1.520	1.516	1.513	1.506
42	1.771	1.739	1.708	1.683	1.650	1.616	1.597	1.575	1.556	1.546	1.541	1.536	1.533	1.529	1.526	1.519
43	1.791	1.759	1.728	1.704	1.670	1.637	1.618	1.597	1.577	1.567	1.562	1.557	1.555	1.551	1.548	1.540
44	1.801	1.769	1.739	1.714	1.681	1.648	1.629	1.607	1.588	1.578	1.573	1.568	1.565	1.562	1.558	1.551
45	1.813	1.782	1.752	1.727	1.694	1.661	1.642	1.621	1.602	1.592	1.587	1.582	1.579	1.575	1.572	1.565
46	1.822	1.791	1.761	1.736	1.703	1.670	1.652	1.630	1.611	1.601	1.596	1.591	1.589	1.585	1.581	1.574
47	1.837	1.806	1.776	1.752	1.719	1.687	1.668	1.647	1.628	1.618	1.613	1.608	1.605	1.602	1.598	1.591
48	1.846	1.815	1.786	1.762	1.730	1.697	1.679	1.657	1.638	1.629	1.623	1.619	1.616	1.612	1.609	1.602
49	1.864	1.834	1.805	1.781	1.749	1.716	1.698	1.677	1.658	1.648	1.643	1.638	1.636	1.632	1.629	1.622
50	1.879	1.849	1.820	1.797	1.765	1.733	1.714	1.693	1.674	1.665	1.660	1.655	1.652	1.649	1.645	1.639

(continued)

Table 17. (continued)

b. High Harvest Scenario – 176,891 fish

Lower Limit (in)	Upper Length Limit (in)															
	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
35	2.139	2.102	2.066	2.039	2.001	1.963	1.944	1.920	1.899	1.888	1.881	1.876	1.873	1.869	1.866	1.858
36	2.180	2.143	2.108	2.081	2.044	2.006	1.987	1.962	1.942	1.931	1.924	1.919	1.916	1.912	1.909	1.901
37	2.200	2.164	2.129	2.102	2.065	2.027	2.008	1.984	1.963	1.952	1.946	1.941	1.938	1.934	1.930	1.923
38	2.228	2.191	2.157	2.130	2.093	2.055	2.036	2.012	1.992	1.981	1.974	1.970	1.967	1.962	1.959	1.951
39	2.251	2.216	2.181	2.154	2.117	2.080	2.061	2.037	2.017	2.006	2.000	1.995	1.992	1.988	1.984	1.977
40	2.270	2.234	2.200	2.173	2.137	2.100	2.081	2.057	2.037	2.026	2.019	2.014	2.011	2.007	2.004	1.996
41	2.287	2.252	2.218	2.191	2.155	2.118	2.099	2.076	2.055	2.044	2.038	2.033	2.030	2.026	2.023	2.015
42	2.300	2.265	2.231	2.205	2.169	2.132	2.113	2.090	2.070	2.059	2.052	2.048	2.045	2.041	2.037	2.029
43	2.322	2.287	2.253	2.227	2.191	2.155	2.136	2.113	2.093	2.082	2.076	2.071	2.068	2.064	2.060	2.053
44	2.332	2.298	2.265	2.239	2.203	2.166	2.148	2.124	2.105	2.094	2.087	2.083	2.080	2.076	2.072	2.065
45	2.346	2.312	2.279	2.253	2.217	2.181	2.163	2.139	2.119	2.108	2.102	2.097	2.094	2.090	2.087	2.079
46	2.356	2.322	2.289	2.263	2.227	2.191	2.173	2.149	2.130	2.119	2.113	2.108	2.105	2.101	2.097	2.090
47	2.372	2.339	2.306	2.280	2.245	2.209	2.191	2.168	2.148	2.137	2.131	2.126	2.123	2.119	2.116	2.108
48	2.382	2.349	2.316	2.291	2.256	2.220	2.202	2.179	2.159	2.148	2.142	2.137	2.134	2.130	2.127	2.120
49	2.402	2.369	2.337	2.312	2.277	2.241	2.223	2.200	2.181	2.170	2.164	2.159	2.156	2.152	2.149	2.141
50	2.418	2.386	2.354	2.329	2.294	2.259	2.241	2.218	2.199	2.188	2.182	2.177	2.174	2.170	2.167	2.159

Table 18. Area 3A projected harvest (upper table) and removals (lower table) for 2019 under a range of maximum size limits on one fish in the bag limit and Tuesday closures ranging from zero to thirteen days. Status quo is six Tuesday closures and a 28-inch maximum size limit on one fish. 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, 4-fish annual bag limit. Projections include corrections for errors in estimation of average weight and an additional 1.5% release mortality by weight.

Projected Harvest (number of fish)

	Number of Tuesday Closures													
	0	1	2	3	4	5	6	7	8	9	10	11	12	13
Harvest	141,083	138,966	136,950	135,198	132,976	131,223	127,778	126,004	124,615	123,371	121,956	121,673	120,445	119,814

Projected Charter Removals (Mlb)

	Number of Tuesday Closures													
Size limit	0	1	2	3	4	5	6	7	8	9	10	11	12	13
26	1.956	1.929	1.903	1.877	1.845	1.820	1.773	1.749	1.730	1.712	1.693	1.689	1.672	1.663
27	1.983	1.955	1.928	1.902	1.869	1.845	1.797	1.772	1.753	1.735	1.715	1.712	1.694	1.685
28	2.023	1.994	1.967	1.940	1.907	1.882	1.834	1.808	1.788	1.771	1.750	1.746	1.729	1.719
29	2.049	2.019	1.992	1.965	1.932	1.906	1.857	1.831	1.811	1.793	1.772	1.768	1.750	1.741
30	2.088	2.059	2.031	2.003	1.969	1.943	1.893	1.867	1.846	1.828	1.807	1.803	1.784	1.775

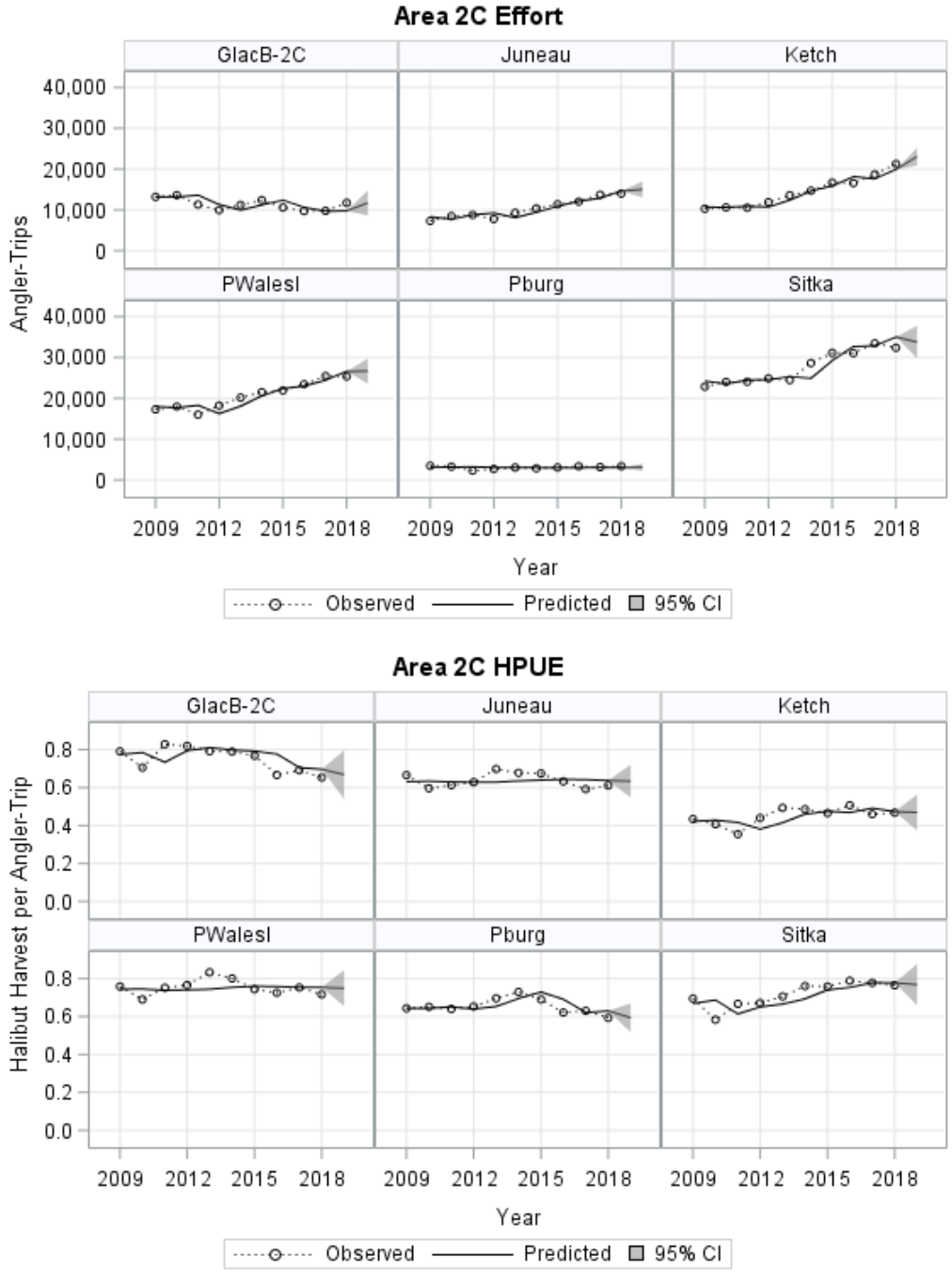

Figure 1. Time series of charter effort (upper) and HPUE (lower) for subareas of Area 2C with predicted values and forecasts for 2019. Shaded bands indicate 95% confidence intervals for the 2019 forecasts. (Source: ADF&G charter logbook)

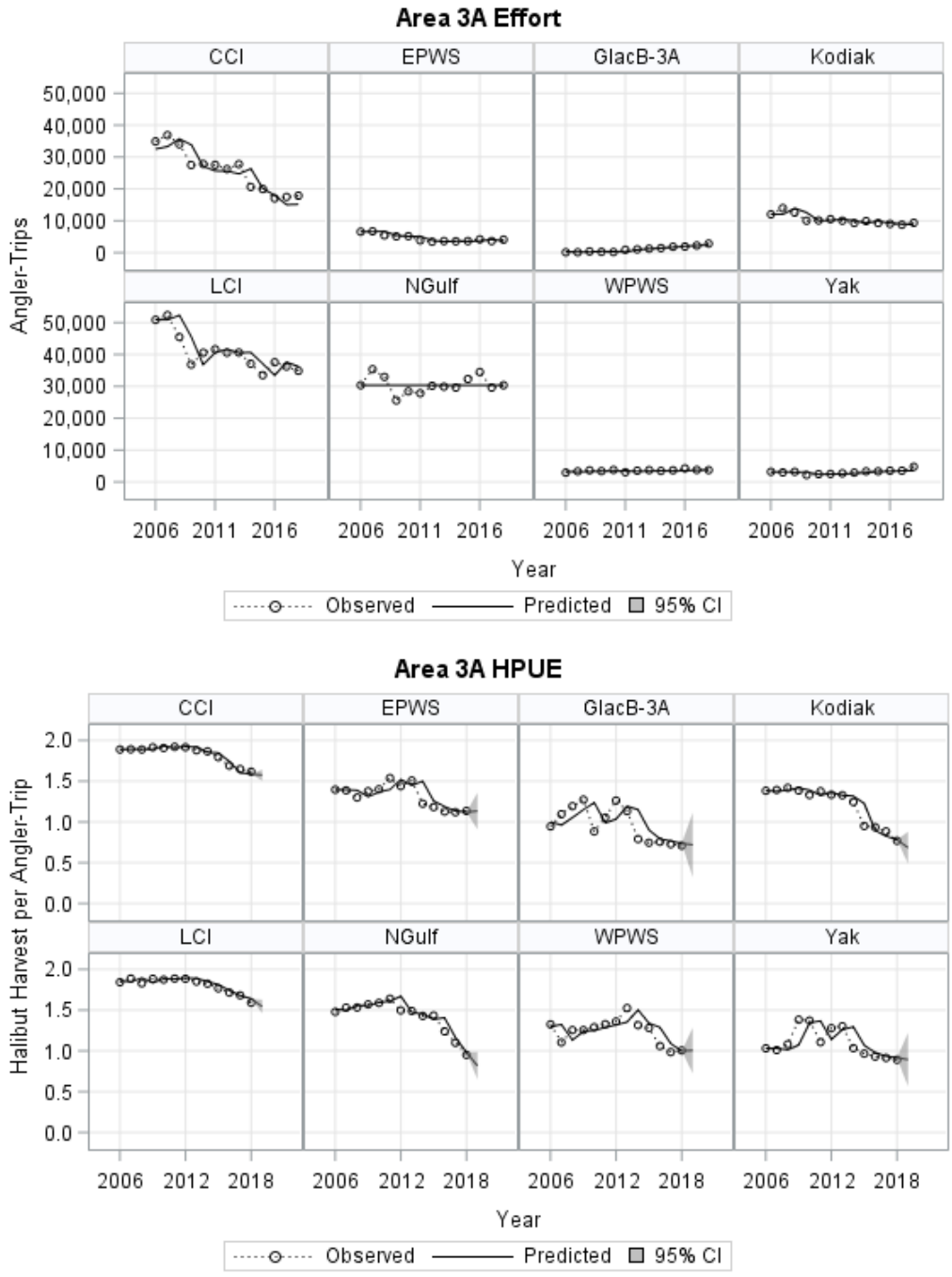

Figure 2. Time series of charter effort (upper) and HPUE (lower) by subarea of Area 3A, with predicted values and forecasts of HPUE only. No time series forecasts were made for effort (see Section 2.3). Shaded bands indicate 95% confidence intervals for the 2019 HPUE forecasts. (Source: ADF&G charter logbook)

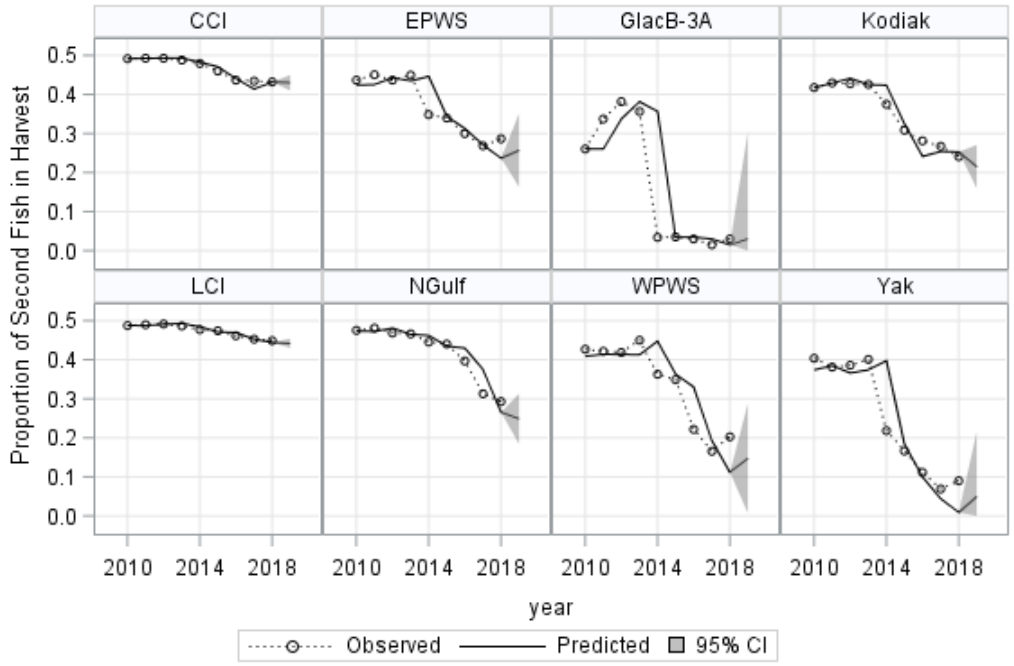

Figure 3. Time series of the proportion of second fish retained by anglers in each subarea of Area 3A, 2010-2018, with predicted values and forecasts for 2019. Shaded bands indicate 95% confidence intervals for the 2019 forecasts. (Source: ADF&G charter logbook)

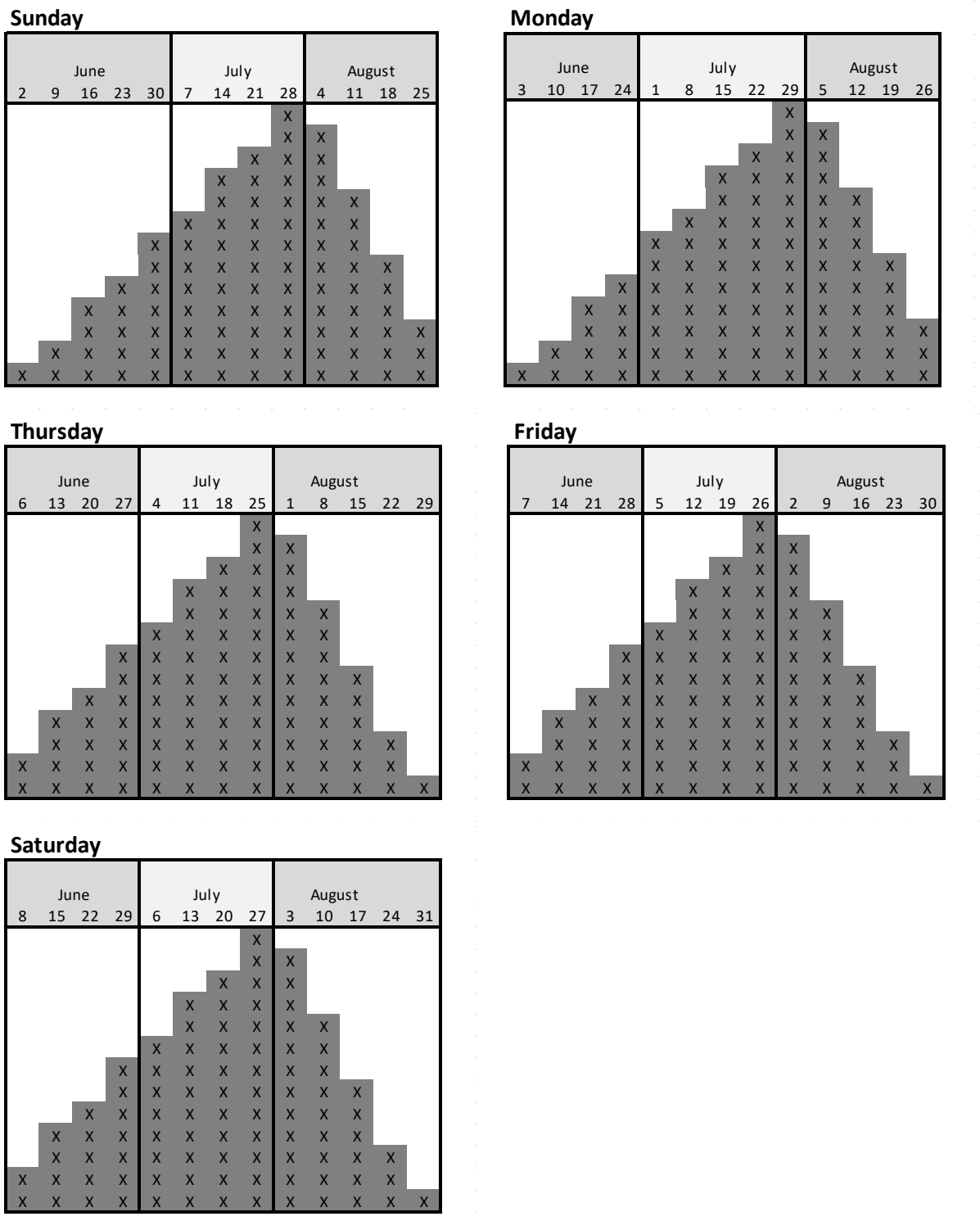

Figure 4. Date ranges for day of the week closures for 2019 in Area 3A. These closures assume status quo with 13 (7 additional) Tuesday closures. Associated harvests can be found in Table 15.