

Analysis of Management Options for the Area 2C and 3A Charter Halibut Fisheries for 2016

A Report to the North Pacific Fishery Management Council

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1.0 Introduction

The charter (guided) sport fishery in Southeast and Southcentral Alaska is allocated a portion of the Pacific halibut catch limits approved by the International Pacific Halibut Commission (IPHC) in late January each year. The allocation percentages or amounts are specified in the North Pacific Fishery Management Council's (Council) Halibut Catch Sharing Plan (CSP) for IPHC Areas 2C and 3A. The percentage allocation varies with the magnitude of the combined catch limit for the commercial and charter sectors, referred to as the Fishery Constant Exploitation Yield (FCEY). The CSP further specifies that 'wastage,' or release mortality, of halibut from the charter and commercial sectors will count toward each sector's allocation. The CSP rule with regard to wastage is not specific about sizes of fish, but the FCEY currently includes only halibut over 26 inches in length. Beginning with CSP implementation in 2014, charter harvest accounting is based on numbers of halibut reported harvested in Alaska Department of Fish and Game (ADF&G) charter logbooks, and on average weights from onsite sampling of charter halibut harvest at major ports in Areas 2C and 3A.

The Council's Charter Management Implementation Committee met October 21, 2015 to develop alternative management measures to be analyzed by the Alaska Department of Fish and Game for the 2016 season. Preliminary estimates of charter harvest and release mortality for the 2015 season were provided prior to the meeting, and revised in early November. For Area 2C, an estimated 68,092 halibut were harvested in the charter fishery, with an average weight of 11.75 lb. The number of halibut harvested was 2% lower than the harvest forecast of 69,637 and average weight was about 4% higher than the predicted average weight of 11.28 lb. The Area 2C total charter removal was 0.848 M lb, including an estimated 0.048 M lb of O26 (fish over 26 inches) release mortality. This was a little over 2% higher than the predicted removal of 0.828 M lb, but less than 1% under the allocation of 0.851 M lb. In Area 3A, an estimated 160,353 halibut were harvested with an average weight of 12.69 lb. The number of fish harvested was 435 fish lower than the forecast of 160,788, and average weight was almost 9% higher than the predicted average weight of 11.65 lb. Total charter removal for Area 3A was estimated at 2.063 M lb, including 0.027 M lb of release mortality. The preliminary estimate was 8% greater than the predicted removal of 1.911 M lb and 9% greater than the allocation of 1.89 M lb.

The charter committee identified the following measures for analysis for 2016:

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

1. Reverse slot limit (status quo), potentially combined with an annual limit,
2. Maximum size limit, potentially combined with an annual limit, and
3. Trip limit (limit number of trips per vessel per day).

Area 3A (all options include two-fish bag limit, max one trip per vessel per day)

1. One fish of any size with maximum size limit on the "second" fish (status quo), potentially combined with an annual limit, and
2. Day of the week closure during the period June 1 - September 15, potentially combined with closure of an additional day of the week for part of the season.

This analysis provides information to stakeholders and the Council to assist them in selecting management measures, or combinations of measures, that are likely to constrain total charter removals in each regulatory area to catch limits determined by the IPHC at their annual meeting in January 2016. These catch limits will not be known when the Council is expected to make its recommendations in December 2015. However, the Council may base recommendations on the Blue Line FCEYs¹ and include contingencies to accommodate adoption of higher or lower FCEYs.

At the Interim Meeting on December 1, 2015, the IPHC announced Blue Line FCEYs of 4.63 M lb for Area 2C and 9.37 M lb for Area 3A. The CSP specifies that in Area 2C, when the FCEY is less than 5 M lb the charter allocation is 18.3% of the FCEY. In Area 3A, the charter allocation is 18.9% of the FCEY when the FCEY is less than 10 M lb. Therefore, the corresponding charter allocations under the Blue Line alternative are 0.847 M lb for Area 2C and 1.771 M lb for Area 3A.

This analysis projects total charter fishery removals (harvest plus O26 release mortality) under the status quo regulations in each regulatory area. As shown below, the projected charter removal for Area 2C in 2016 under status quo measures is 0.845 M lb, which is 7,000 lb (< 1%) greater than the 2016 Blue Line allocation of 0.847 M lb. The projected removal for Area 3A under status quo measures is 1.945 M lb, which is about 174,000 lb (10%) greater than the allocation.

Area	Projected Removals under Status Quo Measures (M lb)	2016 Blue Line Charter Allocations (M lb)	Difference lb (%)
2C	0.854	0.847	0.007 (0.8%)
3A	1.945	1.771	0.174 (8.9%)

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.

2.0 General Methods

2.1 Estimation of Removals, Definitions

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

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

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

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

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

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

¹ The “Blue Line” FCEY (fishery constant exploitation yield) for Areas 2C and 3A is the combined commercial and charter harvest limit associated with the harvest rates specified in the current IPHC harvest policy.

2.2 Calculations by Subarea

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

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

2.3 Harvest Forecasts

Harvest forecasts for 2016 were made using time series methods. No other data, such as socioeconomic factors have yet been linked to the halibut fishery in a way that would improve forecasting of effort or harvest. Time series forecasts are uncertain because they rely only on past data, which are not necessarily indicative of future trends. The use of time series methods was reviewed several times by the Council's Scientific and Statistical Committee (SSC), most recently in October 2012. At that time, ADF&G was using exponentially weighted smoothers to forecast harvest. The SSC suggested using autoregressive integrated moving average (ARIMA) models. ARIMA models were used in the analysis of management measures for the 2014 fishery (Meyer and Powers 2013), but the time series of harvest is much shorter than recommended for use with these models. As a result, ARIMA models tend to identify the previous value as the best forecast for next year's value. This can result in large errors in the harvest forecasts because the forecasts are lagging behind the data. Therefore, exponential smoothers were used last year (Meyer and Powers 2014) and are used again this year.

Harvest under status quo regulations was calculated for each subarea as the product of forecasts of effort (angler-trips) and HPUE (harvest per angler-trip). Simple and double exponential smoothing models were used to forecast effort and HPUE using SAS/ETS software (Proc ESM). 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. Exponential smoothing models give more weight to recent years or trends, depending on the value of the smoothing parameters. Smoothing parameters are automatically optimized to minimize one-step-ahead prediction errors. The emphasis on recent years makes forecasts from exponential models fairly robust to changes in regulations. Each subarea forecast was made using both simple and double exponential models, and the best model was selected as the one with the smallest AICc value (Akaike Information Criterion, corrected for small sample size).

Forecasts for 2016 were based on the 2006-2015 logbook data for each subarea (Tables 3 and 4). Logbook data from clients only were used for 2006-2013 to make the time series consistent with later years when crew harvest was prohibited as part of the CSP. Data for 2014-2015 included all reported harvest. The 2015 values for harvest, effort, and HPUE were preliminary estimates for the entire year, expanded from logbook data for trips taken through July 31. These preliminary estimates are expected to be fairly accurate, as the proportion of harvest taken through July is consistent from year to year. Harvest and effort for 2015 were expanded using simple exponential forecasts of the proportion of harvest or effort through July from past years (2006-2014). The preliminary value of HPUE for 2015 was calculated from preliminary estimates of harvest and effort.

2.4 Projecting Harvest under Annual Limits

Annual harvest calculations were derived from 2014 logbook data. First, the number of unique individual licensed anglers that harvested from one fish to the maximum number kept during the year was tallied for each subarea. Logbook data were not compiled for youth anglers because they are not required to be licensed, and therefore logbook data cannot be used to identify individual youth anglers. Youth effort accounted for a steady 4.4% of charter effort in Area 2C and 5.2-5.5% of charter effort in Area 3A during the years 2012-2014. We assumed that the annual harvest distribution of youth anglers was similar to that of licensed anglers, and applied the estimated effects of annual limits to the total harvests by all anglers.

Harvests under each proposed annual limit were estimated by truncating the harvest of each group of anglers that took more fish in 2014 than the annual limit would have allowed. For example, if 500 anglers harvested five fish each in 2014 (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 2014. 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. This method assumes that the 2014 distribution of annual harvest is representative of the 2016 distribution in the absence of an annual limit. Using this approach, the annual harvest by licensed anglers was calculated over a range of annual limits and the percentage reduction in harvest was calculated by comparison to their total harvest without an annual limit. The percentage reductions for each subarea were applied to the projected harvest of all anglers in each subarea without an annual limit, and these were summed to obtain the harvests under each annual limit in Areas 2C and 3A.

By doing the calculations by subarea, the method is inherently conservative. The effect of an annual limit will be underestimated for anglers that fish in multiple subareas within a year. For example, if an individual angler caught four fish in each of two subareas in 2014, the analysis by subarea would indicate that a four-fish annual limit would have no effect on that angler's annual harvest in either subarea. In reality, the limit would cut that angler's annual harvest by 50 percent. The degree of underestimation depends on how many anglers fished multiple subareas in 2014. By underestimating the percent reductions in harvest associated with each annual limit, the harvest under each limit is overestimated. The bias in these estimates was evaluated by comparing the percentage harvest reductions estimated from subarea and areawide data. The subarea method underestimated the percentage reductions in harvest for Area 2C overall by 0.2 to 1.4 percentage points over annual limits of 1 to 5 fish. For an annual limit of 3 halibut in Area 2C, this corresponded to an overestimate of harvest by 0.8%, or a little less than 500 fish. Likewise, the subarea method underestimated the percentage reductions in harvest for Area 3A overall by 0.1 to 4.2 percentage points. For an annual limit of 4 halibut, this represented an overestimate of harvest by 1.7%, or about 2,400 halibut.

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

Under the CSP, the charter halibut allocation includes total removals by the charter sector, including directed harvest and estimated release mortality. Only the release mortality of halibut ≥ 26 inches in length (O26) is included for consistency with treatment of commercial discard mortality. Release mortality has been estimated by size class (O26, U26) for 2013- 2015 using methods described in Meyer (2014) for inclusion in the IPHC annual stock assessment as part of sport fishery removals.²

The magnitude of O26 release mortality relative to the harvest tends to be fairly constant from year to year as long as there are no major changes in size or bag limits. Maximum size limits and reverse slot limits would be expected to have the highest release mortality, as most fish required to be released by these regulations would have higher average weights than retained fish. On the other hand, minimum size

² Letter from ADF&G to IPHC, November 5, 2015.

limits and bag limit reductions would be expected to increase the numbers of small fish released as anglers attempt to harvest a larger fish.

In Area 2C, the ratio of release mortality to charter yield (in pounds) was 0.048 under the U45O68 reverse slot limit in 2013, 0.056 under the U44O76 size limit in 2014, and 0.059 under the U42O80 size limit in 2015. Release mortality poundage increased each of the last two years even though there was a decrease in the number of fish released. It is not possible to say how much of the increase in release mortality was due to the size limit versus other factors. Based on the trend in this ratio, total charter fishery removals in Area 2C under a maximum size limit or reverse slot limit were projected by expanding yield by the factor 1.06 to account for release mortality.

In Area 3A, the ratio of release mortality to charter yield was 0.015 in 2013, 0.017 in 2014, and 0.013 in 2015. The fishery operated under a two-fish bag limit with maximum size limit of 29 inches on one of the fish (if two fish were kept) in 2014 and 2015. Application of the size limit to only one fish probably moderated the effect on release mortality. Given the lack of trend in release mortality, the average ratio was used to expand the yield estimate to account for release mortality. Specifically, charter yield in Area 3A was expanded by the factor 1.015 to project total removals including release mortality.

3.0 Area 2C Management Measures

3.1 Status Quo Harvest Forecast

Status quo measures for Area 2C include a one-fish bag limit and U42O80 reverse slot size limit. The prohibition on retention of halibut by captains and crew is a default measure under the CSP and cannot be changed on an annual basis. There were upward trends in angler effort in nearly all subareas of Area 2C in recent years (Table 3, Figure 1). Recent trends in HPUE were essentially level or declining in all subareas except Sitka. The status quo effort forecast for Area 2C overall is 99,298 angler-trips and the harvest forecast is 70,165 halibut, with a 95% margin of error (2 standard errors) of about $\pm 15,600$ (Table 5). This is up only slightly from the preliminary harvest estimate for 2015 of 68,092 halibut as a result of the opposing trends in effort and HPUE. The weighted average HPUE forecast across all subareas is about 0.71 halibut per angler-trip (Table 5).

3.2 Harvests under Various Annual Limits

Harvests were projected for annual limits of 1-5 halibut in Area 2C. The percentage harvest reduction associated with annual limits ranged from nearly 52% under an annual limit of one fish to less than 2% under an annual limit of five fish (Table 6). Annual limits of two to four fish are estimated to result in harvest reductions ranging from 25% to 3%.

3.3 Reverse Slot Limit With and Without Annual Limit

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

Average weight under reverse slot limits was predicted using the same algorithm used to analyze management measures for 2014 and 2015. 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, weighted by the respective proportion of harvest above and below those limits. This approach assumes that the length-frequency distributions of harvest from 2010 represent the current harvest length distribution in the

absence of a size limit. This assumption grows more tenuous with the passage of time because of changes in the population size structure due to recruitment, mortality, and movement of halibut.

The utility of the 2010 length distribution was evaluated by comparing subarea and areawide predicted average weights to ‘observed’ average weights from the fishery. The comparisons were made for final estimates of average weight for 2012-2014, as well as the preliminary estimate for 2015. All fish sampled each year were included in the estimated average weights, including illegally harvested fish in the protected size range between the lower and upper size limits. Illegal-size fish represented 1.1% to 1.8% of the length sample each year. Errors in predicted average weights ranged from -13.2% to +43.4% for individual subareas, and from +9.9% to +16.4% for Area 2C overall (average = 12.6%). Predicted average weight for individual subareas tended to be either underestimated or overestimated; other than that, there appeared to be no discernible pattern in the errors related to the size limits in place each year. Therefore, correction factors based on the average errors from 2012-2015 were incorporated in the predicted average weights for each subarea. These correction factors ranged from 0.74 to 1.06.

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 2016 harvest forecasts without an annual limit, and for annual limits ranging from one to five halibut (Table 7). A single level of harvest is associated with each sub-table of Table 7 because it was assumed that the size limits by themselves have no effect on the number of fish harvested. Projections of charter removals include the correction factors for bias in estimation of average weight as well as an additional 6% for predicted release mortality. The most liberal measures that meet the fishery targets under the Blue Line alternative are highlighted in the table. The projected charter removal under the status quo size limit of U42O80 is 0.854 M lb. Other regulatory options that would constrain harvest within the 0.847 M lb allocation include lowering the upper and lower length limits or implementing a 5-fish annual limit at the status quo size limit.

3.4 Maximum Size Limit With and Without Annual Limit

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

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

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

There was considerable variation in the predicted average weights among subareas and years. Prediction errors ranged from -22.7% to +17.0% among subareas and years, and from +2.4% to +9.3% for Area 2C

overall among years. Average weight was overestimated for Area 2C by 5.2% on average. Prediction errors were consistently negative (predicted < observed) in the Prince of Wales Island subarea, but positive most years in all other areas. Subarea-specific correction factors ranging from 0.89 to 1.10 were applied to predicted average weights to correct for the net overestimation of average weight.

Total charter removals were projected for maximum size limits ranging from 30 to 55 inches, and under annual limits from one to five fish. Projections included the correction factors for estimation of average weight as well as an additional 6% for predicted release mortality. In the case of no annual limit, projected removals range from 0.464 M lb under a 30-inch maximum size limit to 1.256 M lb under a 55-inch maximum size limit (Table 8). The corresponding average weights range from 6.24 to 16.88 pounds. The most liberal combinations of size limits and annual limits for which projected removals are within the Blue Line FCEY are highlighted in this table.

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

3.5 Trip Limit

This measure was analyzed for Area 2C and Area 3A in 2012 (King et al. 2012) and for Area 3A for the 2014 season (Meyer and Powers 2013). 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 and 2015. The limit only pertains to trips on which halibut are harvested.

Logbook data for Area 2C indicate that about 22-32% of businesses and vessels reported making multiple trips per day for bottomfish at least once during the years 2007-2014 (Table 9). It is unknown how many of these multiple trips per day were made with the same group of clients or different groups of clients. 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. The percentage has varied from 5.7-6.8% in more recent years (2011-2014).

To evaluate the effect of a trip limit on harvest, we used the same approach used in previous evaluations (King et al. 2012, Meyer and Powers 2013). 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, but was generally highest in the Prince of Wales and Juneau subareas, and lowest in the Petersburg and Sitka subareas (Table 10). In the recent years 2012-2014, the Ketchikan, Prince of Wales Island, and Juneau subareas have had the highest percentages of harvest on trips after the first trip of the day. The average harvest percentages for Area 2C overall have been relatively stable, ranging from 2.0% to 3.1% since 2007, and 2.1% to 2.4% during the recent years 2012-2014. There does not appear to be a recent trend in the amount of harvest that occurs on trips after the first trip of the day. The preliminary estimate for 2015 (not shown in Table 10) based on logbook data through July was 2.0%.

A trip limit would be unlikely to achieve the estimated 2.0-2.4% maximum reduction in halibut harvest because of the potential for displaced clients to book alternate vessels or dates. There are a substantial number of available charter vessels in Area 2C. For example, 466 of the 592 charter vessels in Area 2C with bottomfish effort fished 60 days or less in 2014. A trip limit would be most effective for reducing harvest by boats at remote lodges, where clients have fewer options for dates or vessels. In summary, we do not have sufficient information to estimate the effect of a trip limit with precision, but can only say that it would reduce halibut harvest by no more than 2.0-2.4%, and that the reduction would likely be less than that.

4.0 Area 3A Management Measures

4.1 Status Quo Harvest Forecast

The status quo measures for Area 3A included a two-fish bag limit with a maximum size limit of 29 inches on one of the fish, an annual limit per angler of five halibut, a limit of one trip per vessel per day, and no retention of halibut on Thursdays between June 15 and August 31. The status quo forecasts include the vessel trip limit and Thursday closure because it is not possible to discern the effects of these measures. The effects of these two measures were not precisely determined when they were implemented (although a maximum effect was estimated), and the effects are confounded with each other and with extrinsic factors such as changes in angler demand. Status quo also includes the CSP default prohibition on halibut retention by captains and crew.

Recent trends in effort and HPUE were mixed among subareas (Table 4, Figure 2). Effort has been trending down in Central and Lower Cook Inlet, EPWS, and Kodiak, increasing in Glacier Bay, and level in all other areas. Recent trends in HPUE were declining in all subareas except the North Gulf (Seward). The declines were strongest during the last two years in subareas with the largest fish, namely Glacier Bay, Yakutat, and EPWS, presumably due to the 29-inch size limit. These were the areas with the greatest declines in the percentage of harvest made up of fish representing the second fish in angler's bag limits. The status quo effort forecast for Area 3A for 2016 was 102,821 angler-trips, and the harvest forecast for 2016 was 154,001 fish, with a 95% margin of error (2 standard errors) of about 21,300 fish (Table 11). The weighted average HPUE forecast for Area 3A overall was about 1.50 halibut per angler-trip.

4.2 Effects of Annual Limits

As stated earlier, the effect of the annual limit was estimated from logbook data on annual harvests by individual anglers. The 2014 data were most appropriate for this calculation because the maximum size limit in effect in 2014 and 2015 has the effect of decreasing the harvest of second fish in the bag limit, thereby lowering annual harvests of individual anglers.

In past years, the effect of annual limits on harvest (numbers of fish) was evaluated by applying an estimated percent reduction to a status quo harvest forecast in the absence of an annual limit. That was not possible for 2016 because the status quo forecast included a five-fish annual limit in Area 3A. Therefore, the status quo harvests for each subarea (five-fish annual limit) were inflated by the reverse effects of imposing that annual limit to obtain the harvests in the absence of annual limits. However, the resulting harvest estimate still includes other status quo measures, including the 29-inch maximum size limit on the second fish, limit of one trip per vessel per day, and a Thursday closure from June 15 through August 31.

The harvest forecast in the absence of an annual limit was 158,754 halibut. Harvests were also forecast for annual limits from 1 to 10 fish per year (Table 12). As in Area 2C, the effects of annual limits varied by subarea, with the largest percentage reductions in the Kodiak subarea. Areawide, harvest reductions ranged from 56% under a one-fish annual limit to 0.3% under a ten-fish limit. Corresponding harvests were 69,616 fish under a one-fish limit and 158,331 fish under a ten-fish limit. A harvest reduction of greater than 5% would require an annual limit of no more than three fish.

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

Charter removals were projected under size limits ranging from 26 to 35 inches with no annual limit, and combined with annual limits ranging from one to ten fish (Table 13). Projected removals include a 1.5% inflation factor to account for release mortality. The projections were built around the status quo harvest forecast under a 29-inch maximum size limit on the second fish and annual limit of five fish (154,001 halibut). The projections include the vessel trip limit and Thursday closure because, as described earlier, these effects could not be removed from the status quo harvest projection.

Average weight was calculated as a weighted mean of the average weight for each fish in the bag limit. The average weight for the fish of any size was assumed to be the overall mean weight in 2013, the last

year without a size limit in Area 3A. The average weight for size-restricted fish was calculated as the average weight of fish less than that size in 2013. These average weights were then weighted by the proportions of harvest made up of “first” and “second” fish in angler’s bag limits, averaged over 2014-2015 logbook data. The terms ‘first’ and ‘second’ do not refer to the order in which the fish were caught, but rather to whether the fish came from limits of one or two fish. For example, if an angler kept only one halibut on a trip, the fish was designated a “first” fish. If an angler kept two halibut, one was designated “first” and the other “second.”

The predicted average weights for a 29-inch maximum size limit were compared to observed average weights by subarea under these limits in 2014 and 2015. Errors in predicted weights ranged from -2.7% to -33.5% for individual subareas, and averaged -18% areawide over the two years. The errors varied from year to year among subareas without any clear pattern. To account for the underestimation error at 29 inches, correction factors based on the 2014-2015 average errors were applied to the predicted average weights by subarea. The correction factors ranged from 1.10 to 1.48. It is unknown whether these correction factors would be appropriate for other size limits. In fact, it is likely that there would be more high-grading at smaller size limits and less high-grading at higher size limits. Lacking experience with any size limits other than 29 inches, no other correction factors could be incorporated.

Unlike Area 2C, harvest (number of fish) in Area 3A is not independent of the size limit. With a one-fish bag limit and reverse slot size limit, it is more difficult for anglers in Area 2C to select for larger fish. In Area 3A, however, anglers have additional flexibility to harvest a larger fish under a two-fish bag limit with a size limit on only one of the fish. Meyer and Powers (2014) showed that with imposition of the maximum size limit on one fish in 2014, fewer anglers harvested two fish per trip at ports with higher average weights (more large fish available). This is not unexpected: as the maximum size limit on one fish is lowered, those smaller and smaller fish become harder to catch and less desirable to keep. This resulted in a lowering of the HPUE (harvest per angler-trip) and an increase in the average weight of harvested fish. Ideally, this relationship could be incorporated in to the harvest projections, but with only one maximum size limit, the relationship could not be defined. Therefore, this effect is not accounted for in the projections and the recent proportions of first and second fish are used for all size limits.

The implications of not accounting for the effects of size limits on high-grading and the numbers of fish harvested are assumed to be rather small over the range of size limits considered. There should be no effect at a maximum size limit of 29 inches because the predicted values were tuned to 2014-2015 data under this limit. At smaller size limits, the proportion of second fish in the harvest would be expected to decrease, but average weight would be expected to increase as anglers attempt to harvest a larger first fish. At higher size limits, the proportions of second fish would likely increase, but there would be less incentive to harvest larger fish. In both cases, the effects on harvest and average weight would be offsetting to an unknown degree. The relationship cannot be described with the available data.

With no annual limit, projected removals range from 1.879 M lb with a 26-inch maximum size limit to 2.210 M lb under a 35-inch maximum size limit (Table 13). The status quo projection with a 29-inch maximum size limit and 5-fish annual limit is 1.945 M lb, which is 0.174 M lb above the Blue Line allocation of 1.771 M lb. The most liberal combinations of maximum size limits and annual limits that result in projected removals less than or equal to the Blue Line allocation are highlighted in Table 13.

4.4 Potential Expansion of Day of the Week Closure

Last year, a day of the week closure was analyzed for Area 3A for the period June 15 – August 15 as requested by the Charter Halibut Implementation Committee (Meyer and Powers 2014). That analysis estimated the percentage of annual harvest that occurred on each day of the week during that period. The analysis was based on 2014 charter logbook data that only covered trips through July, but the data were prorated to cover the entire year using complete harvest data from 2013. The percentage of harvest that occurred each day of the week represented the maximum reduction in harvest if the fishery were closed

that day. Based on recommendations from the Council and IPHC, the Area 3A fishery was closed on Thursdays from June 15 – August 31 in 2015.

As last year's analysis explained, available data cannot be used to precisely estimate the effect of a daily closure because of the ability of charter clients to book alternate days on the same vessel or a different vessel. Logbook data from 2014 suggest there is ample capacity in the fleet to absorb the diverted effort. About one-half of Area 3A charter vessels that fished for bottomfish fished for fewer than 31 days (Figure 3). On most days from May through September, fewer than 60% of boats that fished bottomfish were active. These data may overstate the true availability, as some boats may be busy doing salmon trips or operating at their desired level and not interested in doing more charters.

As with preseason predictions, we cannot discern postseason how effective the Thursday closure was in 2015. Effort decreased from 2014 to 2015 in some subareas and increased in others, with an areawide net decrease of 3.8% (Table 4, Figure 2). However, we cannot determine how much of the decline was due to Thursday closures versus other factors such as vessel trip limits or annual variation in angler demand for charter trips. It is possible that the Thursday closure had little effect or that it had a larger effect that was offset by an increase in angler demand.

For 2016, the charter committee requested an analysis of the effect of extending the Thursday closure to the period June 1 – September 15. This was estimated by examining the percentage of annual harvest associated with the additional closed days using final logbook data from 2014. In a year with no closed days, closing Thursdays during the period June 15 – August 31 is estimated to reduce harvest by a maximum of 11.2% (Table 14). Extending the Thursday to the period June 1 – September 15 would reduce annual halibut harvest by an additional 1.6%. Extending Thursday closures to the entire year would further reduce halibut harvest by a maximum of 2.6%. Similar reductions would be expected in bottomfish trips and client-days of effort (Table 14).

The charter committee also requested a table showing the percent harvest reductions associated with each day of the week each month. Logbook data from 2014 were again used for this analysis, as 2015 logbook data were only available through July. The period May-September accounted for well over 99% of the charter harvest; therefore harvest was summarized by day of the week only for these months. The amount of harvest attributable to any day of the week for each month ranged from 0.3% to 7.1%, with the largest amounts in July (Table 15). The amount of harvest attributable to each day of the week ranged from 13.7% to 15.2% during the period May-September, from 12.4% to 13.8% during the period June-August, and from 13.7% to 15.3% during the entire year.

Logbook data from 2015 would have been preferred for this analysis, as there was a Thursday closure in 2015 that changed the percentage of harvest falling on other days of the week. Although the 2015 data only went through July, it is potentially useful for calibrating results from above that were based on 2014 data if it is assumed that effects of the Thursday closure were similar before and after July 31. For example, Thursdays accounted for 2.3% of harvest in 2015. This is close to the estimate from 2014 data that indicated extending the Thursday closure to the entire year would reduce harvest an additional 2.6% at most. Given that Thursdays were closed during the peak season in 2015, the percentage of harvest on other days of the week was higher, ranging from 15.7% to 16.7%. Therefore, closure of additional days may provide for larger reductions than suggested by the 2014 estimates in Table 15.

4.5 Additional Combinations of Measures

The combinations of maximum size limits and annual limits listed in Table 13 for Area 3A provide few options that would constrain charter harvest within the Blue Line allocation for 2016. In order to provide more regulatory options, harvest projections were made for selected combinations of maximum size limits, annual limits, and closure of one additional day of the week. As noted earlier, the precise effect of daily closures cannot be estimated. In last year's analysis for the 2015 season, a Thursday closure from June 15-August 15 was estimated to reduce harvest by a maximum of 12.3%. Taking into account factors

that would reduce the effectiveness of the closure, the Council extended the closure through August 31 and assumed that a 10% reduction in harvest would be realized. Closure of an additional day of the week in 2016 may be more effective than the 2015 Thursday closure because a portion of excess vessel capacity has already been removed. The gap between status quo projections and the Blue Line allocation indicates that about a 10% reduction in harvest is needed in Area 3A. Therefore, charter removals for Area 3A were projected under maximum size limits on the second fish of 28-30 inches, annual limits of 4 or 5 fish, a vessel trip limit, closure of Thursdays plus an additional day, and an assumed 10% reduction in the number of fish harvested due to the added daily closure (Table 16). Under a 28-inch maximum size limit, projected removals are less than the Area 3A Blue Line allocation in all scenarios. Under a 29-inch maximum size limit, projected removals are within the allocation for annual limits of 4 or 5 fish. Under a 30-inch maximum size limit, the projected removals are within the allocation under an annual limit of 4 halibut. These projections do not specify which additional day will be closed or for what period in order to reach the assumed 10% reduction in harvest.

5.0 Implementation Issues

5.1 Size Limits

There are no anticipated issues that would prevent implementation of reverse slot limits or maximum size limits on one fish in a two-fish bag limit. These types of size limits, along with a maximum size limit under a one-fish bag limit, have been used in both regulatory areas in recent years. The types of size limits being considered are expected to increase release mortality above the level expected in a fisheries without size limits. Under a maximum size limit on only one fish, many of the fish caught that are above that limit can be retained as the fish of any size. On the other hand, some anglers are put off by the maximum size limit and release all small fish in the search for one larger fish. Under maximum size limits and reverse slot limits, nearly all fish above the lower limit are required to be released. Release mortality is generally higher under these limits but the mortality is accounted for and included in the charter allocation. The relative impact of size limits, in terms of release mortality and angler satisfaction, is expected to vary by subarea due to variation in the availability of large fish in the catch. For example, clients fishing in subareas where large fish are commonly caught would end up releasing more fish above the maximum size limit or in the protected slot.

5.2 Annual Limits

If annual limits are recommended for the charter fishery in either area, it is anticipated that a reporting requirement similar to that used by the State of Alaska be specified in the Council's recommendation to the IPHC. Specifically, all anglers that harvest a halibut would be required to record, in ink, the species, date, and location immediately upon harvest. Recording would be on the back of a State of Alaska fishing license, or, if an angler does not have a paper license or is not required to be licensed, on an ADF&G harvest card available at license vendors and ADF&G offices. Enforcement essentially entails checking anglers with halibut to make sure the harvest is recorded. 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 are required to 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 would not be required to be 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 numbers of halibut harvested 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 need be recorded for youth anglers not required to be licensed. Under the CSP, all anglers (including youth) are required to sign the logbook verifying that the catch recorded for them 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 held. This capability provides a post-season evaluation of compliance by individual charter anglers with annual limits for any species included in the logbook.

This capability was tested in 2013 by examining compliance with the nonresident 4-fish annual limit for king salmon in Southeast Alaska in 2012. Statistical data in the logbooks allowed exclusion of harvests from special use areas or terminal harvest areas where annual limits do not apply. In 2012, 13,187 nonresidents that held 13,293 licenses harvested at least one king salmon. Of these anglers, 76 anglers harvested more than four king salmon over 28 inches (annual limit violations). The illegal harvest (in excess of annual limits) of 102 king salmon represented 0.4% of the total harvest of large kings. The low rate of violations among licensed nonresidents in this popular fishery suggests that enforcement of reporting requirement alone creates an effective incentive for compliance.

An annual limit of five halibut was implemented as a management measure in the Area 3A charter fishery in 2015. Unfortunately, the measure was implemented without a recording requirement due to an oversight in the recommendations made to the IPHC. Even without it, preliminary analysis suggests that compliance with the annual limit was high. Logbook data indicated that 328 of about 48,000 anglers (0.7%) retained more than 5 halibut through July. The true violation rate is likely to be slightly higher, as the 2015 data are incomplete and the number of anglers that held multiple licenses was not yet accounted for. ADF&G has committed to evaluating compliance with the annual limit. We will finalize this estimate once the 2015 logbook data are complete and all license information has been obtained.

Another concern is that compliance may be low among youth anglers. Anglers under the age of 16 are not required to be licensed, but would still be 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 4.4% of angler-trips in Area 2C and 5.3% of angler-trips in Area 3A in recent years (2012-2014). 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. The proportion of youth that would violate annual limits is expected to be small.

As reported above, the post-season evaluations of annual harvests per angler cannot be done until license data are finalized, which is usually by March of the year following harvest. This several-month lag may make post-season enforcement impractical, but the data can be used to inform the Council with respect to compliance issues and allow the Council to determine whether to continue using annual limits as a tool to control harvest.

5.3 Trip Limit

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. There may be a variety of similar or different business models in Area 2C that may be more affected to varying degrees by trip limits.

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 clients. Lodges with clients 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 clients out several times per day, returning to the lodge for meals or rest. Current logbook reporting rules define a trip as ending when charter clients 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.

5.4 Daily Closures

The primary issue with daily closures is that the effect cannot be precisely predicted or evaluated after the fact. 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). It was not possible to make a precise forecast of harvest in the absence of the Thursday daily closure in Area 3A, but it was possible to predict status quo harvest. From the perspective of future analyses, it would be best not to make frequent changes or adjustments to daily closures.

Another consideration for daily closures is the choice of the closed period. Daily closures for a portion of the year alter the temporal distribution of harvest within the year. Depending on real effectiveness and the range of dates closed, this measure could decrease the accuracy of preliminary estimates of halibut harvest for the current year. For example, harvest for the current year is estimated from logbook data for trips through July 31. The harvest through that date is expanded using the proportion of harvest through that date in prior years, typically around 70%. If closure of a day of the week reduces harvest in a manner that is not proportional to harvest over the entire season, the harvest expansion factor will be inaccurate. For example, closure of a day of the week during the month of July would disproportionately lower harvest in the first part of the year, causing underestimation of harvest for the entire year. Therefore, the analysts recommend that daily closures, if selected, be structured such that approximately 70% of the closed days are before August 1. With a closure period of June 1 – August 31, 61-69% of the closed days fall before July 31. Extension of the closure beyond this period is unlikely to have much of an effect because there is relatively little effort.

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 use based on the current International Pacific Halibut Commission length-weight relationships³.

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

(continued at right)

³ IPHC length-weight relationships are $NetWt(lb) = 6.921 \times 10^{-6} ForkLength(cm)^{3.24}$ and $RndWt(lb) = 9.205 \times 10^{-6} ForkLength(cm)^{3.24}$ from Clark (1992).

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

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

Table 3. Charter logbook effort, harvest per unit effort, and harvest of halibut in IPHC Area 2C, 2006-2015. Estimates for 2015 are preliminary, based on logbook data through July 31, 2015.

Year	Subarea						Total 2C
	Ketch	PWI	Pburg	Sitka	Jun	GlacB	
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	78,023
2015	17,349	22,237	3,273	30,459	11,641	11,904	96,863
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	0.834
2015	0.481	0.757	0.685	0.778	0.645	0.795	0.703
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	8,345	16,831	2,242	23,701	7,507	9,466	68,092

^a – Effort is defined as angler-trips with bottomfish effort or harvest of at least one halibut. All effort is client-only except 2014-2015 data which may include some reported crew effort even though prohibited.

^b – Harvest is client-only except 2014-2015 data which may include some reported crew harvest even though prohibited.

Table 4. Charter logbook effort, harvest per unit effort, and harvest of halibut in IPHC Area 3A, 2006-2015. Estimates for 2015 are preliminary, based on logbook data through July 31, 2015.

Year	Subarea								Tot 3A
	GlacBay	Yak	EPWS	WPWS	NGulf	CCI	LCI	Kod	
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	2,077	3,466	3,444	3,675	30,203	19,334	33,403	9,275	104,877
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	0.747	0.997	1.199	1.283	1.464	1.791	1.760	0.956	1.529
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	75,179	12,371	200,478
2014	1,126	3,429	4,379	4,514	42,337	38,507	67,701	12,358	174,351
2015	1,552	3,456	4,129	4,715	44,214	34,620	58,797	8,870	160,353

^a – Effort is defined as angler-trips with bottomfish effort or harvest of at least one halibut. All effort is client-only except 2014-2015 data which may include some reported crew effort even though prohibited.

^b – Harvest is client-only except 2014-2015 data which may include some 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 2016 under status quo regulations, with associated standard errors. Status quo regulations include a one-fish bag limit and U42O80 reverse slot size limit.

Subarea	Effort		HPUE		Harvest	
	(angler-trips)	Std Error		Std Error	(no. halibut)	Std Error
Ketch	18,998	1,520	0.480	0.111	9,113	2,228
PWI	22,234	3,649	0.757	0.219	16,830	5,550
Pburg	3,273	563	0.685	0.189	2,242	720
Sitka	30,457	4,118	0.804	0.080	24,494	4,100
Jun	12,410	900	0.645	0.136	8,004	1,776
GlacBay	11,925	2,326	0.795	0.091	9,483	2,132
Area 2C	99,298	6,254	0.707	NA	70,165	7,797

Table 6. Estimated effects of annual limits of one to five halibut on Area 2C anglers and projected harvest for 2016. Effects were estimated using 2014 logbook data from licensed anglers. The percent of affected anglers is the portion of individual anglers that harvested more than the specified annual limit in 2014.

Annual Limit	Subarea						
	Ketch	PWI	Pburg	Sitka	Jun	GlacB	Area 2C
Estimated percent of anglers affected by the annual limit:							
1	24.2%	73.3%	59.4%	68.6%	43.0%	59.9%	57.9%
2	9.3%	48.5%	33.2%	37.5%	26.4%	41.9%	34.4%
3	2.0%	14.8%	13.0%	8.2%	13.8%	26.2%	11.6%
4	0.5%	3.3%	4.1%	1.2%	5.4%	15.9%	3.9%
5	0.1%	0.9%	0.3%	0.2%	1.1%	9.4%	1.5%
Estimated percent change in harvest:							
1	-26.6%	-58.6%	-52.7%	-53.7%	-47.4%	-62.5%	-51.8%
2	-8.8%	-28.2%	-24.6%	-21.9%	-24.8%	-40.1%	-24.6%
3	-2.0%	-8.1%	-8.9%	-4.5%	-11.0%	-24.4%	-8.6%
4	-0.5%	-2.0%	-2.8%	-0.8%	-3.7%	-14.6%	-3.3%
5	-0.1%	-0.6%	-0.8%	-0.2%	-0.9%	-8.7%	-1.5%
Projected harvest (number of halibut):							
1	6,691	6,972	1,060	11,347	4,206	3,552	33,828
2	8,310	12,082	1,690	19,126	6,016	5,680	52,903
3	8,935	15,466	2,042	23,380	7,126	7,167	64,116
4	9,070	16,498	2,180	24,309	7,706	8,097	67,860
5	9,102	16,727	2,224	24,448	7,933	8,660	69,094
None	9,113	16,830	2,242	24,494	8,004	9,483	70,166

Table 7. Projected charter removals for Area 2C for 2016 under reverse slot limits ranging from U35O50 to U50O80 and annual limits ranging from no limit to five fish. Shaded values represent the most liberal measures for which the projected total charter removals are less than the 0.847 M lb allocation associated with the Blue Line FCEY. All values in the table include corrections for overestimation of average weight and an additional 6.0% release mortality by weight.

No annual limit, harvest = 70,165 halibut

Lower Limit (in)	Upper Length Limit (in)															
	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
35	1.268	1.183	1.119	1.049	0.996	0.948	0.882	0.818	0.783	0.753	0.722	0.703	0.677	0.661	0.659	0.646
36	1.303	1.219	1.156	1.087	1.035	0.987	0.921	0.858	0.823	0.793	0.762	0.744	0.718	0.702	0.700	0.687
37	1.324	1.241	1.179	1.110	1.058	1.011	0.946	0.882	0.848	0.818	0.787	0.769	0.743	0.727	0.725	0.712
38	1.355	1.274	1.213	1.145	1.094	1.047	0.983	0.920	0.885	0.856	0.825	0.807	0.781	0.766	0.763	0.750
39	1.379	1.298	1.238	1.171	1.120	1.073	1.009	0.947	0.913	0.883	0.853	0.834	0.809	0.793	0.791	0.778
40	1.398	1.319	1.260	1.193	1.143	1.096	1.033	0.971	0.937	0.907	0.877	0.859	0.834	0.818	0.816	0.803
41	1.423	1.345	1.286	1.220	1.171	1.125	1.062	1.000	0.966	0.937	0.907	0.889	0.864	0.848	0.846	0.833
42	1.439	1.362	1.304	1.239	1.190	1.144	1.081	1.020	0.986	0.957	0.928	0.910	0.884	0.869	0.866	0.854
43	1.457	1.381	1.324	1.259	1.211	1.165	1.103	1.042	1.009	0.980	0.950	0.932	0.907	0.891	0.889	0.877
44	1.481	1.407	1.351	1.287	1.239	1.194	1.132	1.072	1.038	1.010	0.980	0.962	0.937	0.922	0.919	0.907
45	1.508	1.435	1.380	1.317	1.269	1.225	1.163	1.103	1.070	1.042	1.013	0.995	0.970	0.954	0.952	0.939
46	1.526	1.454	1.399	1.337	1.290	1.246	1.185	1.125	1.092	1.064	1.035	1.017	0.992	0.977	0.974	0.962
47	1.550	1.480	1.426	1.365	1.318	1.275	1.214	1.155	1.123	1.094	1.065	1.048	1.023	1.007	1.005	0.993
48	1.568	1.498	1.445	1.384	1.338	1.294	1.234	1.176	1.143	1.115	1.086	1.068	1.044	1.028	1.026	1.014
49	1.597	1.529	1.476	1.416	1.371	1.328	1.269	1.211	1.178	1.150	1.122	1.104	1.079	1.064	1.062	1.050
50	1.618	1.551	1.500	1.440	1.395	1.353	1.294	1.237	1.205	1.177	1.149	1.131	1.107	1.091	1.089	1.077

5-fish annual limit, harvest = 69,094 halibut

Lower Limit (in)	Upper Length Limit (in)															
	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
35	1.239	1.156	1.094	1.025	0.974	0.927	0.863	0.801	0.766	0.737	0.708	0.689	0.664	0.649	0.647	0.634
36	1.273	1.191	1.130	1.062	1.011	0.965	0.902	0.840	0.806	0.777	0.747	0.729	0.704	0.689	0.687	0.674
37	1.294	1.213	1.152	1.085	1.035	0.989	0.926	0.864	0.830	0.801	0.772	0.754	0.729	0.714	0.712	0.699
38	1.325	1.246	1.186	1.119	1.070	1.024	0.962	0.901	0.867	0.838	0.809	0.791	0.766	0.751	0.749	0.737
39	1.348	1.270	1.211	1.145	1.095	1.050	0.988	0.927	0.894	0.865	0.836	0.818	0.793	0.778	0.776	0.764
40	1.367	1.290	1.232	1.166	1.118	1.073	1.011	0.951	0.917	0.889	0.860	0.842	0.818	0.802	0.800	0.788
41	1.391	1.315	1.258	1.193	1.145	1.101	1.039	0.979	0.946	0.918	0.889	0.872	0.847	0.832	0.830	0.818
42	1.407	1.332	1.275	1.211	1.163	1.119	1.058	0.999	0.966	0.938	0.909	0.891	0.867	0.852	0.850	0.838
43	1.425	1.351	1.295	1.231	1.184	1.140	1.079	1.020	0.988	0.960	0.931	0.914	0.889	0.874	0.872	0.860
44	1.449	1.376	1.321	1.258	1.211	1.168	1.108	1.049	1.016	0.989	0.960	0.943	0.918	0.903	0.901	0.889
45	1.475	1.404	1.349	1.287	1.241	1.198	1.139	1.080	1.048	1.020	0.992	0.975	0.950	0.935	0.933	0.922
46	1.492	1.422	1.368	1.307	1.261	1.219	1.160	1.102	1.069	1.042	1.014	0.997	0.972	0.957	0.955	0.943
47	1.516	1.448	1.395	1.334	1.289	1.247	1.188	1.131	1.099	1.072	1.044	1.026	1.002	0.987	0.985	0.974
48	1.533	1.466	1.413	1.353	1.308	1.267	1.208	1.151	1.119	1.092	1.064	1.047	1.023	1.008	1.006	0.994
49	1.562	1.495	1.444	1.385	1.340	1.299	1.241	1.185	1.153	1.126	1.099	1.081	1.057	1.043	1.041	1.029
50	1.582	1.517	1.467	1.408	1.365	1.324	1.266	1.210	1.179	1.152	1.125	1.108	1.084	1.069	1.067	1.055

(continued)

Table 7. (continued)

4-fish annual limit, harvest = 67,860 halibut

Lower Limit (in)	Upper Length Limit (in)															
	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
35	1.212	1.131	1.069	1.002	0.952	0.907	0.844	0.783	0.750	0.722	0.693	0.675	0.650	0.636	0.634	0.622
36	1.245	1.165	1.105	1.039	0.989	0.944	0.882	0.822	0.789	0.761	0.732	0.714	0.690	0.675	0.673	0.661
37	1.266	1.187	1.127	1.061	1.012	0.967	0.906	0.846	0.813	0.785	0.756	0.739	0.714	0.699	0.697	0.686
38	1.296	1.219	1.160	1.095	1.046	1.002	0.941	0.881	0.848	0.821	0.793	0.775	0.750	0.736	0.734	0.722
39	1.319	1.242	1.184	1.120	1.072	1.028	0.967	0.908	0.875	0.847	0.819	0.802	0.777	0.763	0.761	0.749
40	1.338	1.262	1.205	1.141	1.093	1.050	0.989	0.931	0.898	0.871	0.843	0.825	0.801	0.786	0.784	0.773
41	1.361	1.287	1.230	1.167	1.120	1.077	1.017	0.959	0.926	0.899	0.871	0.854	0.829	0.815	0.813	0.801
42	1.376	1.303	1.247	1.184	1.138	1.095	1.035	0.977	0.945	0.918	0.890	0.873	0.849	0.834	0.832	0.821
43	1.394	1.321	1.266	1.204	1.158	1.115	1.056	0.999	0.966	0.939	0.912	0.895	0.870	0.856	0.854	0.843
44	1.417	1.346	1.292	1.230	1.185	1.143	1.084	1.027	0.995	0.968	0.941	0.923	0.899	0.885	0.883	0.872
45	1.443	1.373	1.320	1.259	1.214	1.172	1.114	1.057	1.026	0.999	0.972	0.955	0.931	0.916	0.914	0.903
46	1.460	1.392	1.339	1.279	1.234	1.193	1.135	1.078	1.047	1.020	0.993	0.976	0.952	0.938	0.936	0.925
47	1.484	1.417	1.365	1.305	1.261	1.220	1.163	1.107	1.075	1.049	1.022	1.005	0.981	0.967	0.965	0.954
48	1.501	1.434	1.383	1.324	1.280	1.240	1.182	1.127	1.095	1.069	1.042	1.025	1.002	0.987	0.986	0.974
49	1.528	1.463	1.413	1.354	1.311	1.271	1.215	1.160	1.128	1.102	1.076	1.059	1.035	1.021	1.019	1.008
50	1.548	1.485	1.435	1.377	1.335	1.295	1.239	1.184	1.153	1.128	1.101	1.084	1.061	1.047	1.045	1.034

3-fish annual limit, harvest = 64,116 halibut

Lower Limit (in)	Upper Length Limit (in)															
	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
35	1.140	1.063	1.005	0.941	0.895	0.852	0.794	0.737	0.705	0.679	0.652	0.636	0.612	0.599	0.597	0.586
36	1.171	1.096	1.039	0.976	0.930	0.888	0.830	0.773	0.742	0.716	0.690	0.673	0.649	0.636	0.634	0.624
37	1.191	1.116	1.060	0.997	0.952	0.910	0.852	0.796	0.764	0.738	0.712	0.696	0.672	0.659	0.657	0.647
38	1.219	1.146	1.091	1.029	0.984	0.943	0.885	0.829	0.798	0.772	0.747	0.730	0.707	0.693	0.692	0.681
39	1.241	1.168	1.114	1.053	1.008	0.967	0.910	0.854	0.823	0.798	0.772	0.755	0.732	0.719	0.717	0.707
40	1.258	1.187	1.133	1.073	1.028	0.988	0.931	0.876	0.845	0.819	0.794	0.777	0.754	0.741	0.739	0.729
41	1.281	1.211	1.157	1.097	1.053	1.013	0.957	0.902	0.871	0.846	0.821	0.804	0.781	0.768	0.766	0.756
42	1.295	1.226	1.173	1.114	1.070	1.030	0.974	0.920	0.889	0.864	0.839	0.822	0.799	0.786	0.784	0.774
43	1.311	1.243	1.191	1.132	1.089	1.049	0.994	0.939	0.909	0.884	0.859	0.842	0.820	0.806	0.805	0.794
44	1.334	1.267	1.215	1.157	1.114	1.075	1.020	0.966	0.936	0.911	0.886	0.870	0.847	0.834	0.832	0.822
45	1.358	1.292	1.242	1.184	1.142	1.103	1.048	0.995	0.965	0.940	0.915	0.899	0.877	0.863	0.862	0.851
46	1.374	1.310	1.260	1.203	1.161	1.123	1.068	1.015	0.985	0.960	0.936	0.919	0.897	0.884	0.882	0.872
47	1.397	1.333	1.284	1.228	1.187	1.149	1.094	1.042	1.012	0.988	0.963	0.947	0.924	0.911	0.910	0.899
48	1.413	1.350	1.301	1.246	1.205	1.167	1.113	1.061	1.031	1.007	0.982	0.966	0.944	0.931	0.929	0.919
49	1.438	1.377	1.329	1.274	1.234	1.197	1.143	1.092	1.062	1.038	1.013	0.997	0.975	0.962	0.961	0.950
50	1.457	1.397	1.350	1.296	1.256	1.219	1.166	1.115	1.085	1.061	1.037	1.021	0.999	0.986	0.984	0.974

(continued)

Table 7. (continued)

2-fish annual limit, harvest = 52,903 halibut

Lower Limit (in)	Upper Length Limit (in)															
	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
35	0.937	0.873	0.826	0.773	0.735	0.701	0.653	0.606	0.580	0.558	0.537	0.524	0.504	0.494	0.492	0.484
36	0.964	0.901	0.854	0.802	0.765	0.731	0.683	0.636	0.610	0.589	0.568	0.555	0.535	0.525	0.523	0.515
37	0.980	0.918	0.871	0.820	0.783	0.749	0.701	0.655	0.629	0.608	0.587	0.574	0.554	0.544	0.542	0.534
38	1.004	0.943	0.897	0.846	0.810	0.776	0.729	0.683	0.658	0.637	0.616	0.602	0.583	0.573	0.571	0.563
39	1.021	0.961	0.916	0.866	0.830	0.797	0.750	0.704	0.678	0.657	0.637	0.623	0.604	0.594	0.592	0.584
40	1.036	0.977	0.932	0.883	0.847	0.814	0.767	0.722	0.696	0.676	0.655	0.642	0.622	0.612	0.611	0.602
41	1.055	0.997	0.953	0.903	0.868	0.835	0.789	0.744	0.718	0.698	0.677	0.664	0.645	0.635	0.633	0.625
42	1.067	1.009	0.966	0.917	0.882	0.849	0.803	0.758	0.733	0.712	0.692	0.679	0.660	0.649	0.648	0.640
43	1.080	1.023	0.980	0.932	0.897	0.865	0.819	0.774	0.749	0.729	0.709	0.695	0.676	0.666	0.665	0.657
44	1.099	1.043	1.001	0.953	0.918	0.887	0.841	0.797	0.772	0.751	0.731	0.718	0.699	0.689	0.688	0.679
45	1.119	1.064	1.023	0.975	0.941	0.910	0.865	0.821	0.796	0.776	0.756	0.743	0.724	0.714	0.712	0.704
46	1.133	1.079	1.038	0.991	0.957	0.926	0.881	0.837	0.813	0.793	0.772	0.759	0.741	0.730	0.729	0.721
47	1.151	1.099	1.058	1.012	0.978	0.948	0.903	0.860	0.835	0.815	0.795	0.782	0.764	0.753	0.752	0.744
48	1.165	1.113	1.072	1.027	0.994	0.963	0.918	0.875	0.851	0.831	0.811	0.798	0.780	0.770	0.768	0.760
49	1.186	1.135	1.095	1.050	1.017	0.987	0.943	0.901	0.876	0.857	0.837	0.824	0.806	0.795	0.794	0.786
50	1.201	1.151	1.112	1.068	1.035	1.005	0.962	0.920	0.896	0.876	0.856	0.844	0.825	0.815	0.814	0.806

1-fish annual limit, harvest = 33,828 halibut

Lower Limit (in)	Upper Length Limit (in)															
	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
35	0.596	0.554	0.524	0.491	0.469	0.447	0.416	0.386	0.370	0.356	0.343	0.335	0.322	0.316	0.315	0.310
36	0.613	0.572	0.543	0.510	0.488	0.467	0.436	0.406	0.390	0.377	0.363	0.355	0.343	0.336	0.336	0.331
37	0.624	0.583	0.554	0.522	0.500	0.478	0.448	0.418	0.402	0.389	0.376	0.368	0.355	0.349	0.348	0.343
38	0.640	0.600	0.571	0.539	0.517	0.496	0.466	0.437	0.421	0.407	0.394	0.386	0.374	0.368	0.367	0.362
39	0.651	0.612	0.583	0.552	0.530	0.509	0.479	0.450	0.434	0.421	0.408	0.400	0.388	0.381	0.381	0.376
40	0.661	0.622	0.594	0.563	0.541	0.521	0.491	0.462	0.446	0.433	0.420	0.412	0.399	0.393	0.392	0.387
41	0.673	0.635	0.607	0.576	0.555	0.535	0.505	0.476	0.461	0.447	0.434	0.427	0.414	0.408	0.407	0.402
42	0.680	0.643	0.615	0.585	0.564	0.543	0.514	0.485	0.470	0.457	0.444	0.436	0.424	0.417	0.417	0.412
43	0.689	0.652	0.625	0.594	0.573	0.553	0.524	0.496	0.480	0.467	0.454	0.446	0.434	0.428	0.427	0.422
44	0.701	0.665	0.638	0.608	0.587	0.567	0.538	0.510	0.495	0.482	0.469	0.461	0.449	0.443	0.442	0.437
45	0.714	0.679	0.652	0.623	0.602	0.582	0.553	0.525	0.510	0.497	0.485	0.477	0.465	0.458	0.458	0.453
46	0.723	0.688	0.662	0.632	0.612	0.593	0.564	0.536	0.521	0.508	0.495	0.488	0.476	0.469	0.469	0.464
47	0.735	0.701	0.675	0.646	0.626	0.607	0.578	0.551	0.536	0.523	0.510	0.502	0.490	0.484	0.484	0.479
48	0.744	0.710	0.684	0.656	0.636	0.617	0.588	0.561	0.546	0.533	0.521	0.513	0.501	0.495	0.494	0.489
49	0.757	0.724	0.699	0.671	0.651	0.632	0.604	0.577	0.562	0.549	0.537	0.529	0.517	0.511	0.510	0.505
50	0.767	0.734	0.710	0.682	0.662	0.644	0.616	0.589	0.574	0.561	0.549	0.541	0.530	0.524	0.523	0.518

Table 8. Projected charter removals for Area 2C for 2016 under maximum size limits ranging from 30 to 55 inches, and with no annual limit as well as annual limits ranging from one to five fish. Table A contains the total projected removals and Table B contains the predicted average weights associated with each size and annual limit. Shaded values represent the most liberal measures for which the projected total charter removals are less than the 0.847 M lb allocation under the Blue Line FCEY. All values in the table include corrections for overestimation of average weight and an additional 6.0% release mortality by weight.

Size limit (inches)	A. Projected total removals including release mortality (M lb).						B. Projected average weight in the harvest (lb).					
	Annual Limit (number of fish per year)						Annual Limit (number of fish per year)					
	1	2	3	4	5	No Limit	1	2	3	4	5	No Limit
30	0.223	0.350	0.424	0.449	0.457	0.464	6.22	6.23	6.24	6.24	6.24	6.24
31	0.240	0.376	0.456	0.482	0.491	0.498	6.70	6.70	6.70	6.70	6.70	6.70
32	0.261	0.408	0.495	0.524	0.533	0.542	7.29	7.27	7.28	7.28	7.28	7.28
33	0.276	0.430	0.521	0.552	0.562	0.571	7.69	7.67	7.67	7.67	7.67	7.67
34	0.293	0.456	0.552	0.585	0.595	0.605	8.16	8.13	8.12	8.13	8.13	8.13
35	0.305	0.476	0.576	0.610	0.622	0.632	8.52	8.49	8.48	8.48	8.49	8.49
36	0.327	0.509	0.615	0.652	0.664	0.674	9.11	9.07	9.06	9.06	9.06	9.07
37	0.340	0.529	0.640	0.678	0.690	0.701	9.48	9.43	9.41	9.42	9.42	9.43
38	0.360	0.559	0.676	0.717	0.730	0.742	10.03	9.97	9.95	9.96	9.97	9.98
39	0.374	0.581	0.703	0.745	0.759	0.772	10.43	10.37	10.35	10.35	10.36	10.38
40	0.387	0.601	0.727	0.770	0.785	0.799	10.79	10.72	10.70	10.71	10.72	10.74
41	0.403	0.625	0.756	0.801	0.817	0.831	11.23	11.15	11.12	11.13	11.15	11.17
42	0.413	0.642	0.776	0.822	0.839	0.854	11.51	11.44	11.41	11.43	11.45	11.48
43	0.424	0.659	0.798	0.846	0.863	0.879	11.83	11.76	11.73	11.76	11.78	11.81
44	0.440	0.684	0.827	0.876	0.894	0.911	12.26	12.19	12.16	12.18	12.21	12.24
45	0.456	0.710	0.858	0.910	0.928	0.946	12.73	12.65	12.63	12.65	12.67	12.71
46	0.468	0.728	0.880	0.933	0.952	0.970	13.05	12.98	12.95	12.97	13.00	13.04
47	0.484	0.752	0.910	0.965	0.984	1.003	13.50	13.42	13.38	13.41	13.44	13.49
48	0.495	0.769	0.930	0.986	1.006	1.026	13.81	13.72	13.68	13.71	13.74	13.79
49	0.513	0.797	0.964	1.023	1.044	1.065	14.30	14.22	14.19	14.22	14.25	14.32
50	0.526	0.819	0.990	1.051	1.073	1.095	14.68	14.60	14.57	14.61	14.65	14.72
51	0.540	0.841	1.017	1.079	1.101	1.124	15.07	14.99	14.96	15.00	15.04	15.11
52	0.560	0.871	1.053	1.118	1.141	1.165	15.62	15.53	15.50	15.54	15.59	15.66
53	0.572	0.890	1.077	1.143	1.167	1.191	15.95	15.88	15.85	15.89	15.93	16.02
54	0.589	0.916	1.108	1.176	1.201	1.226	16.41	16.34	16.31	16.35	16.40	16.48
55	0.602	0.938	1.135	1.204	1.230	1.256	16.80	16.73	16.70	16.74	16.79	16.88

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, 2007-2014.

Year	Businesses			Vessels			Bottomfish Trips		
	Businesses with more than one bottomfish trip per vessel per day	Total number with any bottomfish effort	Percent with more than one bottomfish trip per vessel per day	Vessels with more than one bottomfish trip per day	Total number that reported bottomfish effort	Percent with more than one bottomfish trip per day	Number of bottomfish trips in excess of one trip 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%

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), 2007-2014. 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	Trip	Subarea						Area 2C
		Ketch	PrWalesl	Pburg	Sitka	Jun	GlacBay	
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
	% 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
	% 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
	% 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
	% 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
	% 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
	% 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
	% First	3.1%	4.7%	0.4%	0.4%	3.8%	1.7%	2.4%

Table 11. Forecasts of effort, halibut harvest per unit effort (HPUE), and harvest (numbers of halibut) for Area 3A in 2016 under status quo regulations, with associated standard errors. Status quo includes a two-fish bag limit with a maximum size limit of 29” on one of the fish, one trip per vessel per day, and no retention of halibut on Thursdays.

Subarea	Effort		HPUE	Std Error	Harvest	
	(angler-trips)	Std Error			no. fish)	StdError
CCI	17,349	3,472	1.642	0.046	28,491	5,755
EPWS	3,288	631	1.216	0.116	3,998	854
GlacBay	2,300	316	0.992	0.201	2,280	555
Yak	3,445	377	1.171	0.157	4,033	697
LCI	33,407	4,303	1.727	0.042	57,680	7,561
NGulf	30,200	2,679	1.460	0.059	44,096	4,296
Kod	9,353	1,233	0.957	0.105	8,947	1,529
WPWS	3,480	301	1.286	0.107	4,476	535
Tot 3A	102,821	6,324	1.498	NA	154,001	10,625

Table 12. Estimated effects of annual limits of one to five halibut on Area 3A anglers and projected harvest for 2016. Projected harvests include a 29-inch maximum size limit on one of two fish in the bag limit, limit of one trip per vessel per day, and Thursday closure. Effects were estimated using 2014 logbook data from licensed anglers. The percent of affected anglers is the portion of individual anglers that harvested more than each specified annual limit in 2014.

Annual Limit	Subarea								
	CCI	EPWS	GlacBay	Yak	LCI	NGulf	Kod	WPWS	Area 3A
Estimated percent of anglers affected by an annual limit:									
1	94.4%	57.3%	47.5%	51.8%	94.0%	83.8%	77.6%	62.7%	86.7%
2	18.0%	9.7%	16.3%	21.3%	19.1%	12.3%	40.8%	9.0%	17.6%
3	16.3%	6.3%	5.1%	10.1%	17.2%	9.5%	30.5%	4.6%	14.6%
4	5.0%	1.3%	0.5%	4.0%	4.2%	2.8%	18.9%	0.5%	4.5%
5	4.3%	0.6%	0.0%	1.3%	3.6%	1.9%	12.9%	0.0%	3.5%
6	1.5%	0.2%	0.0%	0.8%	1.1%	0.7%	8.4%	0.0%	1.4%
7	1.3%	0.1%	0.0%	0.6%	0.9%	0.4%	6.1%	0.0%	1.1%
8	0.6%	0.0%	0.0%	0.1%	0.3%	0.2%	2.9%	0.0%	0.4%
9	0.5%	0.0%	0.0%	0.0%	0.2%	0.1%	1.8%	0.0%	0.3%
10	0.3%	0.0%	0.0%	0.0%	0.1%	0.1%	0.5%	0.0%	0.2%
Estimated percent change in harvest:									
1	-58.8%	-43.0%	-40.9%	-47.4%	-58.5%	-52.8%	-66.8%	-43.4%	-56.0%
2	-19.9%	-10.4%	-12.9%	-20.1%	-19.6%	-13.3%	-41.0%	-8.0%	-18.5%
3	-12.6%	-4.9%	-3.3%	-8.9%	-11.7%	-7.5%	-27.5%	-2.9%	-10.9%
4	-5.9%	-1.3%	-0.3%	-3.6%	-4.5%	-3.1%	-17.4%	-0.3%	-4.8%
5	-3.8%	-0.5%	0.0%	-1.4%	-2.8%	-1.7%	-11.1%	0.0%	-2.9%
6	-2.0%	-0.2%	0.0%	-0.7%	-1.3%	-0.9%	-6.8%	0.0%	-1.5%
7	-1.4%	-0.1%	0.0%	-0.3%	-0.8%	-0.5%	-4.0%	0.0%	-1.0%
8	-0.9%	0.0%	0.0%	0.0%	-0.5%	-0.3%	-2.0%	0.0%	-0.6%
9	-0.7%	0.0%	0.0%	0.0%	-0.4%	-0.2%	-1.0%	0.0%	-0.4%
10	-0.5%	0.0%	0.0%	0.0%	-0.2%	-0.2%	-0.5%	0.0%	-0.3%
Projected harvest (number of halibut):									
1	12,196	2,290	1,346	2,154	24,592	21,165	3,341	2,532	69,616
2	23,710	3,601	1,985	3,270	47,698	38,895	5,933	4,119	129,212
3	25,900	3,823	2,205	3,728	52,403	41,498	7,295	4,346	141,200
4	27,886	3,967	2,274	3,946	56,645	43,505	8,314	4,463	151,001
5	28,491	3,998	2,280	4,033	57,680	44,096	8,947	4,476	154,001
6	29,014	4,012	2,280	4,062	58,571	44,493	9,379	4,477	156,287
7	29,193	4,016	2,280	4,079	58,831	44,635	9,661	4,477	157,173
8	29,348	4,018	2,280	4,091	59,042	44,729	9,863	4,477	157,848
9	29,415	4,019	2,280	4,092	59,117	44,766	9,959	4,477	158,125
10	29,473	4,019	2,280	4,092	59,178	44,794	10,018	4,477	158,331
None	29,619	4,019	2,280	4,092	59,325	44,877	10,064	4,477	158,754

Table 13. Area 3A projected charter removals (upper table) and predicted average weights (lower table) for 2016 under a range of maximum size limits on one fish in the bag limit and for annual limits ranging from no limit down to one fish per year. Projected removals assume a limit of one trip per vessel per day and a Thursday closure from June 15 – August 31. Projections also include a correction for bias in estimation of average weight and 1.5% inflation for release mortality. Shaded values represent candidate measures for implementation under the 1.771 M lb charter allocation corresponding with IPHC Blue Line FCEY.

Projected Removals (M lb)

Size Limit (in)	Harvest Forecast Associated with Each Annual Limit (no. fish):										
	69,616	129,212	141,200	151,001	154,001	156,287	157,173	157,848	158,125	158,331	158,754
	Annual Limit										
	1	2	3	4	5	6	7	8	9	10	None
26	0.855	1.539	1.684	1.793	1.827	1.852	1.862	1.870	1.873	1.875	1.879
27	0.870	1.566	1.714	1.826	1.861	1.886	1.896	1.904	1.907	1.909	1.914
28	0.893	1.609	1.761	1.876	1.912	1.938	1.948	1.956	1.959	1.962	1.966
29	0.908	1.637	1.791	1.908	1.945	1.971	1.982	1.990	1.993	1.996	2.001
30	0.930	1.680	1.838	1.958	1.996	2.023	2.034	2.042	2.045	2.048	2.053
31	0.946	1.708	1.869	1.991	2.030	2.057	2.068	2.077	2.080	2.083	2.088
32	0.965	1.745	1.909	2.034	2.073	2.101	2.113	2.121	2.125	2.127	2.133
33	0.977	1.767	1.933	2.060	2.099	2.128	2.140	2.149	2.152	2.155	2.160
34	0.991	1.792	1.960	2.089	2.129	2.158	2.170	2.179	2.182	2.185	2.190
35	0.999	1.808	1.978	2.108	2.148	2.178	2.190	2.199	2.202	2.205	2.210

Predicted Average Weight (lb) in the Harvest

Size limit (in)	Annual Limit										
	1	2	3	4	5	6	7	8	9	10	None
26	12.10	11.73	11.75	11.70	11.69	11.67	11.67	11.67	11.67	11.67	11.66
27	12.31	11.94	11.96	11.91	11.90	11.89	11.88	11.88	11.88	11.88	11.88
28	12.63	12.27	12.29	12.24	12.23	12.22	12.21	12.21	12.21	12.21	12.20
29	12.84	12.48	12.50	12.45	12.44	12.43	12.42	12.42	12.42	12.42	12.42
30	13.17	12.81	12.82	12.78	12.77	12.75	12.75	12.75	12.74	12.74	12.74
31	13.38	13.03	13.04	12.99	12.98	12.97	12.97	12.96	12.96	12.96	12.96
32	13.66	13.30	13.32	13.27	13.26	13.25	13.24	13.24	13.24	13.24	13.23
33	13.83	13.47	13.49	13.44	13.43	13.42	13.41	13.41	13.41	13.41	13.40
34	14.02	13.66	13.67	13.63	13.62	13.60	13.60	13.60	13.60	13.60	13.59
35	14.14	13.79	13.80	13.75	13.74	13.73	13.73	13.72	13.72	13.72	13.72

Table 14. Percent of bottomfish trips, angler-days of effort, and charter halibut harvest associated with Thursday closure periods in Area 3A in 2014. The percent of harvest that occurred each period represents the maximum expected percent reduction in harvest associated with a closure of the fishery on Thursday during that period.

Day of Week	Period	Trips	Percent of Total Trips	Angler-trips	Percent of Total Angler-trips	Hal Kept	Percent of Annual Harvest
Thursday	Jun 15 - Aug 31	2,053	11.0%	13,481	11.3%	19,492	11.2%
Thursday	Jun 1 - Sep 15	2,374	12.8%	15,300	12.9%	22,367	12.8%
Thursday	Entire Year	2,615	14.1%	16,454	13.9%	24,010	13.8%
All Days	Entire Year	18,609		118,777		174,351	

Table 15. Percent of charter halibut harvest associated with closure of each day of the week, by month, in Area 3A in 2014. The percent of harvest in each cell represents the maximum expected percent reduction in harvest associated with a closure of that day and month.

Day of the Week	Percent of Harvest by Month					Percent of Harvest by Period		Entire Year
	May	Jun	Jul	Aug	Sep	May-Sep	Jun-Aug	
Sun	0.8	4.0	5.0	3.9	0.4	14.1	12.9	14.2
Mon	0.5	3.5	5.7	3.3	0.6	13.7	12.5	13.7
Tue	0.6	2.6	7.0	3.3	0.4	13.9	12.9	14.0
Wed	0.8	3.0	7.1	3.7	0.5	15.2	13.8	15.3
Thu	0.8	3.3	6.0	3.2	0.4	13.7	12.4	13.8
Fri	1.0	3.1	5.2	4.4	0.3	14.0	12.8	14.1
Sun	1.4	3.8	5.1	4.2	0.5	15.0	13.1	15.1
Total	6.0	23.5	41.2	25.9	3.2	99.7	90.5	100.0

Table 16. Projected charter removals for Area 3A under a combination of maximum size limits of 28-30 inches on the second fish, annual limits of 4-6 fish, a vessel trip limit, and fishery closure of two days per week (Thursday plus another day). Projected removals assume that a 10% reduction will result from closure of the additional day. Shaded cells indicate combinations of measures for which the projected removals are within the 1.771 M lb Blue Line allocation.

Maximum Size Second Fish (in)	Annual Limit	Projected Removals (M lb)
28	None	1.770
28	6	1.744
28	5	1.721
28	4	1.688
29	None	1.801
29	6	1.774
29	5	1.750
29	4	1.718
30	None	1.848
30	6	1.821
30	5	1.796
30	4	1.762

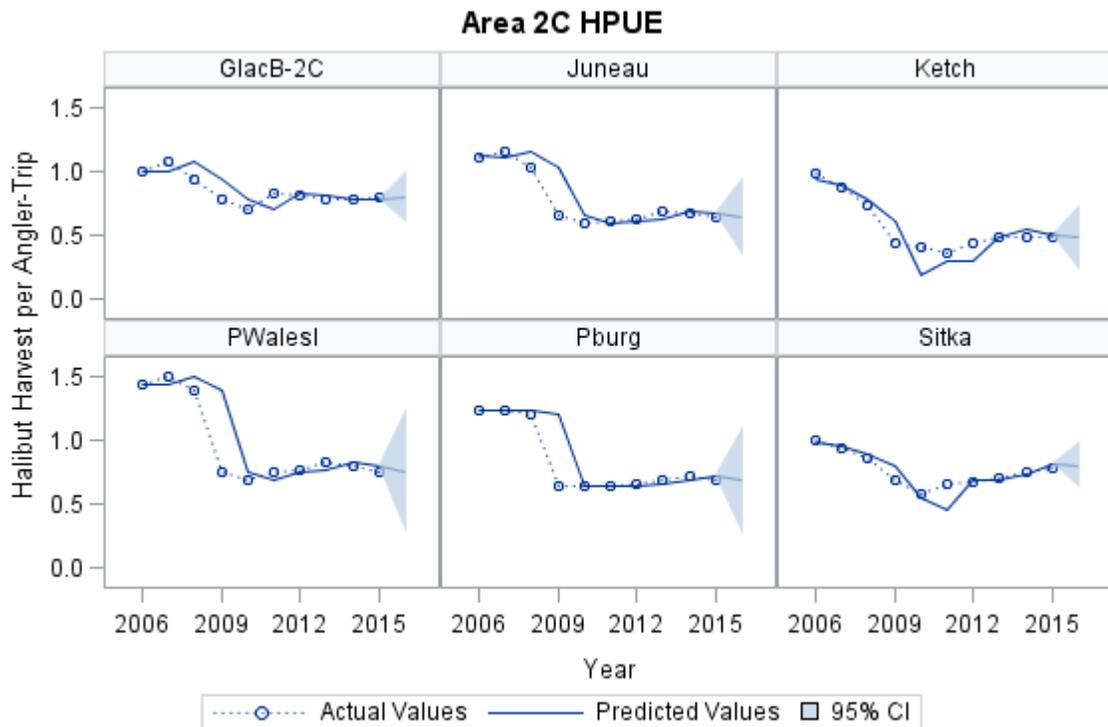
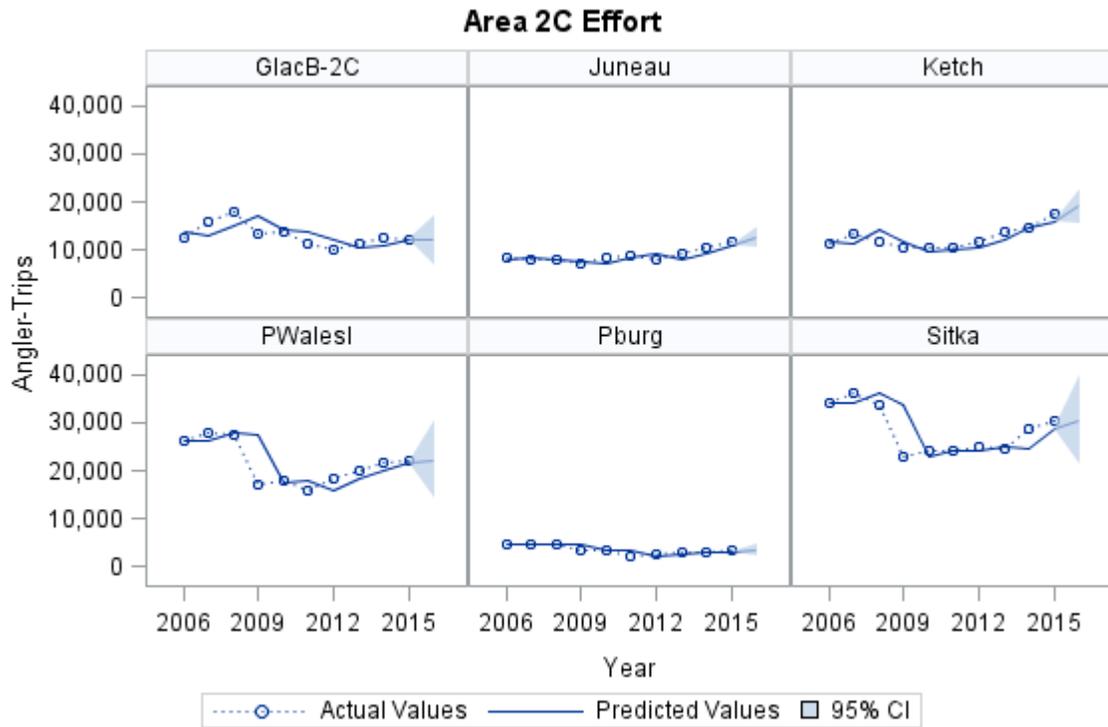


Figure 1. Time series of logbook effort (upper) and HPUE (lower) for subareas of Area 2C with predicted values and forecasts for 2016 from either simple or double exponential smoothers (whichever had the lowest AICc). Blue bands indicate 95% confidence intervals for the 2016 forecasts.

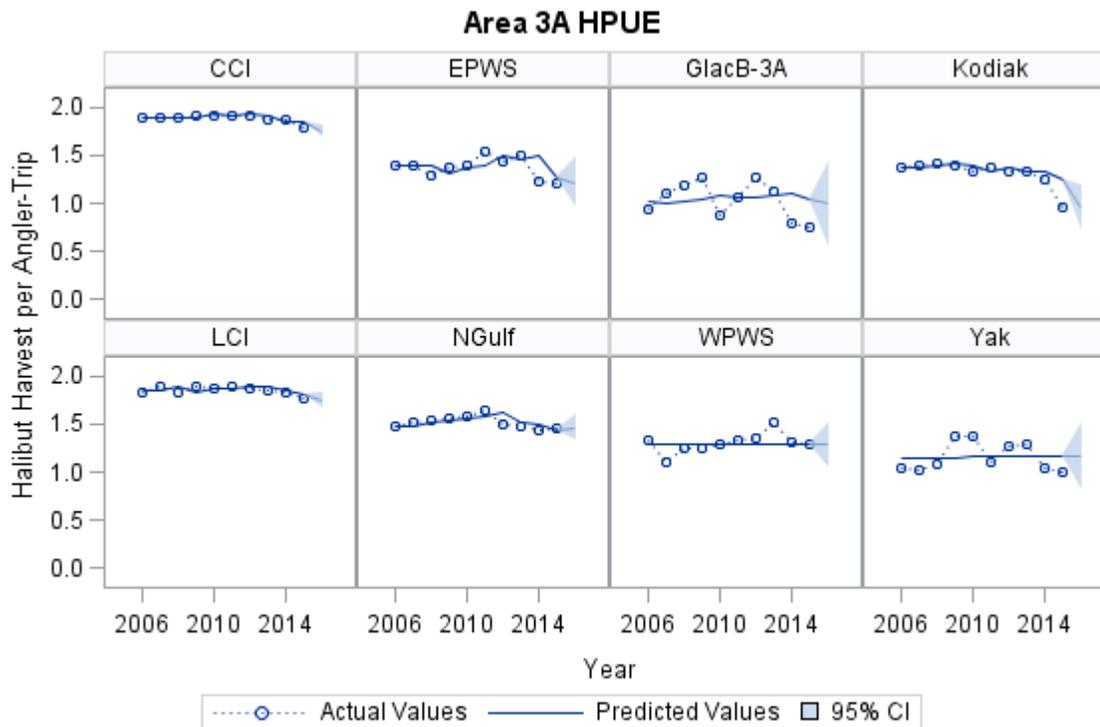
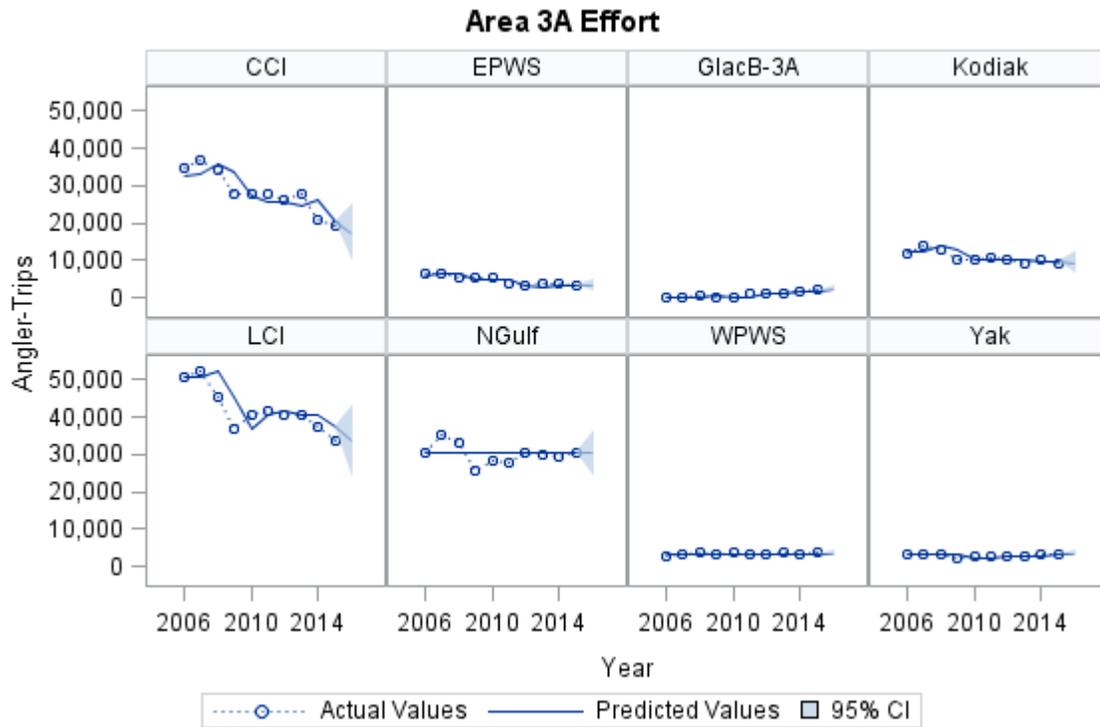


Figure 2. Time series of logbook effort (upper) and HPUE (lower) for subareas of Area 3A with predicted values and forecasts for 2016 from either simple or double exponential smoothers (whichever had the lowest AICc). Blue bands indicate 95% confidence intervals for the 2016 forecasts.

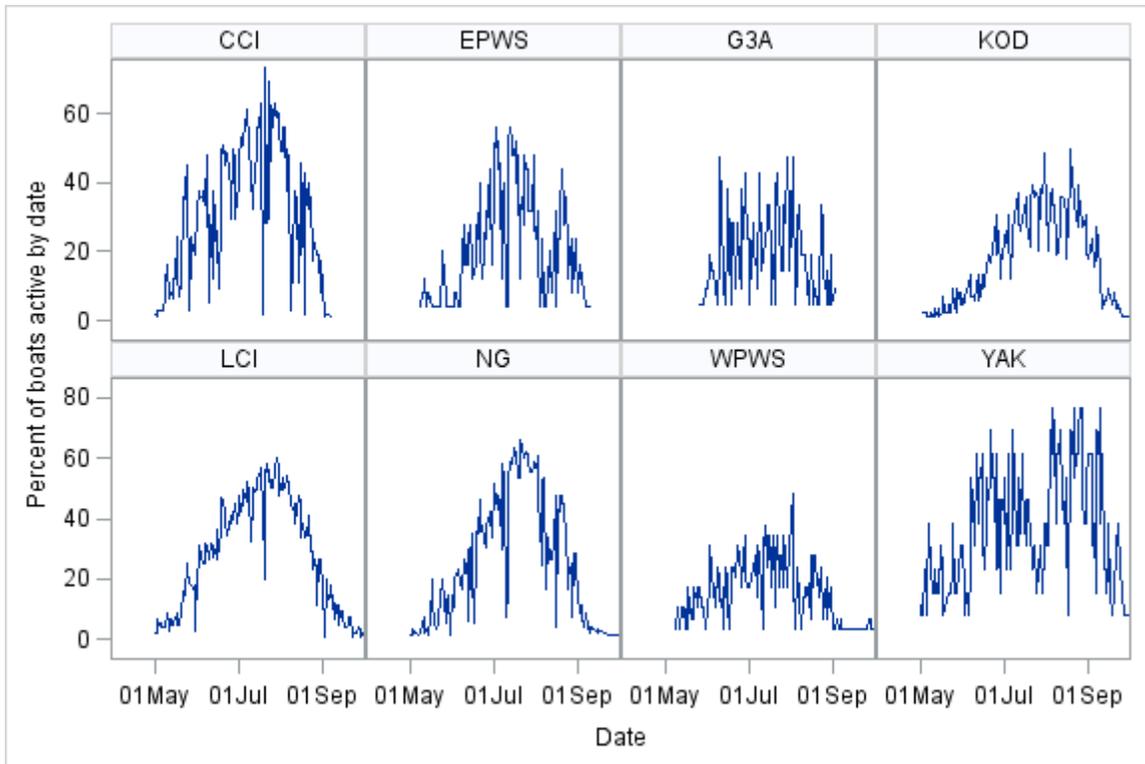
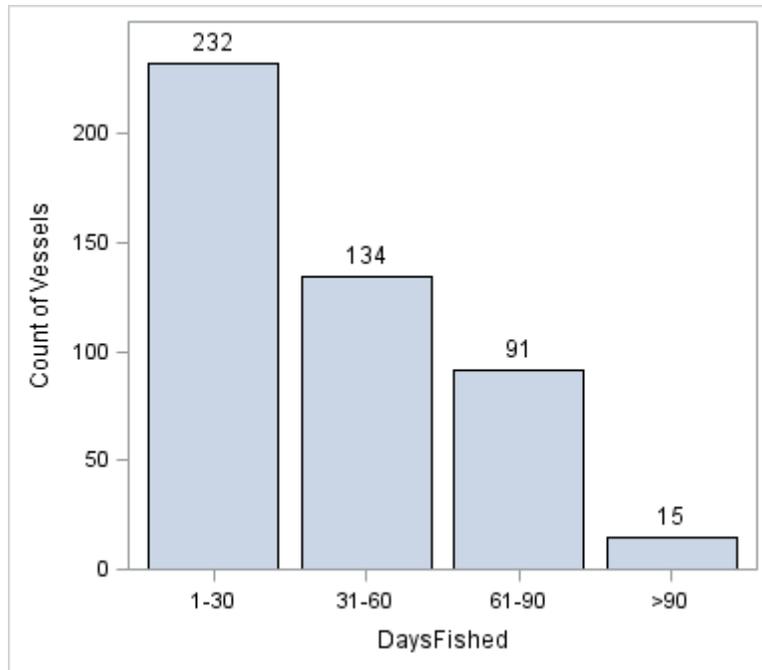


Figure 3. Two descriptions of charter vessel activity in Area 3A. The upper graph shows the total count of vessels by the number of days fished for bottomfish in 2014. The lower panel of graphs shows, for each subarea, the percent of vessels that ever fished for bottomfish that were active (fishing for bottomfish) each day from May-September, 2014.