Analysis of Management Options for the Area 2C and 3A Charter Halibut Fisheries for 2013

A Report to the North Pacific Fishery Management Council, December 2012

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December 1, 2012

1.0 Introduction

The North Pacific Fishery Management Council's Charter Halibut Implementation Committee met October 19, 2012. At the time, the preliminary estimate for Area 2C was 0.627 M lb for Area 2C (subsequently revised to 0.645 M lb). The Area 2C revised charter harvest was about 31% below the 0.931 M lb guideline harvest level (GHL), and was regulated under a U45O68 reverse slot size limit. This limit allowed harvest of fish less than or equal to 45 inches in length and fish greater than or equal to 68 inches in length. The committee felt these restrictions could be relaxed should the 2013 GHL be set equal to or higher than the current GHL. The committee requested analyses of two potential management measures for Area 2C:

1. Reverse slot size limits, with the range of lower limits expanded to allow increased harvest if appropriate, and
2. A maximum size limit combined with an annual limit of one halibut larger than that size limit.

Both of these measures would be applied over the existing one-fish daily bag limit for charter anglers in Area 2C. Other current federal measures that would remain in place for Area 2C include the prohibition on retention of halibut by skipper and crew and line limit.

The Charter Halibut Implementation Committee also discussed Area 3A. At the time of the meeting, the preliminary estimate of Area 3A charter harvest was about 2.35 M lb for Area 3A (subsequently revised to 2.375 M lb). The committee noted that the harvest of 2.35 M lb was below the 2012 GHL of 3.103 M lb, and would still be below the GHL in 2013 even if it were to drop two steps to 2.373 M lb. Therefore, the committee did not request analysis of any particular management measure for Area 3A for 2013. A committee member representing Area 3A specified that, if a minor harvest restriction was needed, first priority should be given to a prohibition on skipper and crew harvest.

The GHL is linked in 50 CFR §300.65 to the total Constant Exploitation Yield (tCEY), which is determined by the International Pacific Halibut Commission (IPHC) each year. The tCEY represents the total allowable fishery removals, including directed commercial setline catch and waste, recreational harvest, subsistence harvest, and bycatch mortality. The IPHC does not formally adopt a tCEY value. In past years, IPHC staff typically calculated the commercial fishery CEY (fCEY) for each regulatory area that was associated with a preferred stock assessment model and the agency's current harvest rate policy. These calculations included a deduction of the charter GHL from the tCEY in Areas 2C and 3A, where the GHL was based on the tCEY as specified in federal regulation. Adoption of alternate catch limits by the IPHC commissioners did not result in a change to the tCEY or GHL.

The IPHC will meet in January 2013 to adopt seasons, commercial fishery catch limits, and other annual management measures. This year, IPHC staff will not be providing a single set of fCEY recommendations to the IPHC commissioners. Instead, the staff is providing a decision table that includes several alternate levels of fCEY and measurements of risk associated with each alternative. The tCEYs associated with each alternative are not provided. The decision table is centered on the "blue line" alternative. This choice

represents the fCEY calculated using the IPHC's estimates of exploitable biomass and harvest rates from the current harvest policy. The tCEYs and GHLs associated with the blue line alternative are:

Area	tCEY (M lb)	GHL (M lb)
2C	5.00	0.788
3A	15.13	2.373

The IPHC commissioners could potentially adopt fCEYs and commercial fishery catch limits associated with another alternative, even one not yet identified in the decision table. Therefore, unlike last year, the GHLs for Area 2C and 3A will be uncertain as of the December 2012 Council meeting. To address this change and accommodate possible directions the Council could go, an effort was made to present a wide range of projections to encompass the range of likely GHLs.

The purpose of this report is to provide the Council with the available information to recommend adoption of management measures for the 2013 charter fisheries in Areas 2C and 3A. For clarity, the report is organized in two main sections, one dealing with each regulatory area.

2.0 Analysis of Options for Area 2C

2.1 Methods

2.1.1 Harvest Forecasts

Before evaluating the particular alternatives recommended for analysis, it was necessary to forecast halibut harvest (numbers of fish) for 2013. The Area 2C harvest forecasts were combined with predictions of average weights described later for each management alternative. Forecasting of Area 2C harvest was done three ways:

1. *Best Time Series*: Forecasts were made for each subarea using the Box and Jenkins (1976) procedure for identifying and estimating with autoregressive integrated moving average (ARIMA) models. The best model was selected for each subarea using Akaike's Information Criteria, corrected for small sample size (AICc; Burnham and Anderson 2002). The total forecast for Area 2C was calculated by summing the best subarea forecasts.

2. *Recent Rate of Change*: Given that estimates of harvest increased in all subareas of Area 2C from 2011 to 2012, forecasts were made for each subarea under the assumption that charter harvest *H* would change from 2012 to 2013 at the same relative rate of change from 2011 to 2012, or

   $$\widehat{H}_{2013} = \widehat{H}_{2012}\frac{\widehat{H}_{2012}}{\widehat{H}_{2011}}$$

   As with the first method, the Area 2C forecast was calculated by summing the subarea forecasts.

3. *Annual Harvest Distribution*: This forecast method was required to evaluate the annual limit alternative, but provided a useful alternative to the first two forecast methods. In general, the method applies a forecast of the number of successful individual halibut anglers (based on a recent average) to a distribution of annual harvest. First, the numbers of individual licensed anglers (excluding crew) that harvested at least one halibut in each subarea were obtained from ADF&G charter logbooks. This number did not include youth anglers because they are unlicensed and therefore cannot be identified as individuals. The number of licensed anglers for 2012 was derived using logbook data through July, expanded by the 2009-2011 average ratio of anglers through July to total number of anglers for the year. The total number of successful anglers, including youth, was estimated by expanding the numbers of licensed anglers by the proportion of total angler effort (angler-days) attributable to licensed anglers. The 2013 forecast of the number of successful anglers was then set at the 2010-2012 average number of anglers in

each subarea. The 2010-2012 average was used because angler time series in each subarea was essentially flat or declining. Next, this number of successful anglers was apportioned using the 2009-2011 average annual harvest distribution, or the number of anglers that harvested 1, 2, 3, etc. halibut in each subarea. The 2009-2011 annual harvest distributions were used because annual harvest distributions prior to 2009 were quite different under the 2-fish daily bag limit. This resulted in a distribution of the number of anglers that harvested 1, 2, 3, etc. halibut, from which the total harvest was calculated.

The six subareas of Area 2C used for the analysis are Ketchikan, Prince of Wales Island, Petersburg/Wrangell, Sitka, Juneau/Haines/Skagway, and the 2C portion of Glacier Bay. These subareas correspond with ADF&G Statewide Harvest Survey (SWHS) reporting areas (Jennings et al. 2011).

2.1.2 Reverse Slot Size Limits

A reverse slot size limit allows harvest of relatively small and large fish and provides protection for a range of fish in between (also called "protected slot limit"). Reverse slot limits are typically implemented to achieve objectives relating to spawning biomass or reproduction. In the case of halibut, reverse slot limits are envisioned as a way of reducing the average weight of the charter harvest in order to ensure that the GHL is not exceeded. A U45O68 reverse slot limit was implemented in 2011 to limit the size of most of the fish harvested to less than or equal to 45 inches (U45) but still allow anglers the opportunity to retain fish of exceptional size, of fish greater than or equal to 68 inches (O68).

Yield was projected using the method described in Meyer (2012). In short, the method provides estimates of average weight resulting from combinations of lower and upper size limits. These estimates are essentially weighted means of fish above and below the size limits, where the weights are the respective proportions of harvest. The proportions of harvest and average weight below the lower limit and above the upper limit were calculated from the 2010 harvest length frequency distribution, the most recent year for which there was no size limit. Weights of individual fish were estimated from length using the IPHC length-weight relationship for net weight (Clark 1992). Estimates of average weight were calculated for each subarea and multiplied by harvest forecasts to calculate yield for each subarea, and these were summed to obtain the Area 2C yield projections.

The method used to predict average weights for 2013 was simplified from the one used to make projections for 2012 (Meyer 2011). Last year's calculations included an option for a highgrading multiplier that increased the proportion of harvest above the upper limit. The highgrading multiplier was removed because there was no way to know which multiplier was appropriate, and because data from the 2012 fishery indicated that average weight was lower than predicted even without the multiplier.

Key assumptions in this method include the following:

1. The length frequency distribution from 2010 is assumed to be representative of harvest in 2013 in the absence of a size limit.
2. The forecasts of the number of fish harvested in each subarea are accurate.
3. The size limit is assumed to have no effect on angler demand or harvest. In particular, it assumes that all fish caught that are in the protected slot will be released and replaced in the harvest with legal size fish.
4. The legal harvest will be distributed below the lower limit and above the upper limit in a manner similar to their relative distribution in 2010.

Violation of the assumptions could lead to projections that are too high or too low. The latter two assumptions are likely to be incorrect in a manner that would tend to produce estimates of yield that are conservative (higher than the resulting harvest). One reason is that angler demand may be reduced by the limited opportunity posed by any type of size limit. Another is that not all released fish may be replaced in the harvest. Furthermore, if protected-size fish are replaced in the harvest, they may not be replaced in proportion to the size distribution without a size limit. Specifically, the predicted harvest of exceptionally

large fish (above the upper limit) may not be realized because they are so rare in the population, or because of avoidance due to the difficulty of measuring to ensure they are of legal size. This would be expected to result in a lower average weight than predicted.

2.1.3 Maximum Size Limit Combined with Annual Limit

Because annual limits have never been implemented in the recreational halibut fishery, there were no data from which to draw inferences regarding hypothetical versus realized annual harvest or sizes of harvested fish. Given the lack of information, projections were made in an attempt to bracket a full range of reasonable assumptions. Yield (Y_m) for each candidate maximum size limit (L_{max}) was estimated as the sum of yield of fish above and below the maximum size limit:

$$\hat{Y}_m = \hat{H}_a\hat{\bar{w}}_a + \hat{H}_b\hat{\bar{w}}_b$$

where

$\hat{H}_a$ = the estimated number of halibut harvested that are > L_{max} (fish harvested under one-fish annual limit),

$\hat{\bar{w}}_a$ = the estimated average weight of halibut harvested that are > L_{max},

$\hat{H}_b$ = the estimated number of halibut harvested that are ≤ L_{max} (fish harvested under daily bag limits), and

$\hat{\bar{w}}_b$ = the estimated average weight of halibut harvested that are ≤ L_{max}.

Yield was calculated for an annual limit of one halibut above L_{max} under two scenarios regarding annual harvest and two scenarios regarding average weight, for a total of four scenarios. All four scenarios use the average of the 2009-2011 annual harvest distributions among charter anglers (ADF&G charter logbook data) and forecasts of the number of anglers from the "Annual Harvest Distribution" method described above.

The assumptions related specifically to the four scenarios are as follows:

<table>
<tr><th>Scenario</th><th>Number of halibut larger than L_{max} harvested</th><th>Average weight of harvested halibut that are larger than L_{max} (fish harvested under annual limit)</th><th>Average weight of harvested halibut that are equal to or smaller than L_{max}</th></tr>
<tr><td>A</td><td rowspan="2">Every angler harvests one fish.</td><td rowspan="4">Equal to average weight of halibut > L_{max} in 2010.</td><td>Equal to predicted weight of a halibut of length L_{max}</td></tr>
<tr><td>B</td><td>Equal to average weight of halibut ≤ L_{max} in 2010.</td></tr>
<tr><td>C</td><td rowspan="2">Proportion of anglers that keep one equals the proportion of harvest in 2010 that was > L_{max}</td><td>Equal to predicted weight of a halibut of length L_{max}</td></tr>
<tr><td>D</td><td>Equal to average weight of halibut ≤ L_{max} in 2010.</td></tr>
</table>

2.2 Results

2.2.1 Forecasts of Harvest and Effort

Under the first forecast method, the "naïve" forecast (forecast = previous year's harvest) was selected as the best procedure for every subarea except Juneau/Haines/Skagway. The naïve forecast is equivalent to an ARIMA(0,1,0) model with no constant term (mean). The best model for the Juneau/Haines/Skagway was a single exponential model, or ARIMA(0,1,1) with no constant parameter. The total Area 2C time series forecast was 44,352 fish with a standard error of 8,696 (Table 1, Figure 1).

Given that the naïve forecast tends to lag behind estimated harvest, it was prudent to provide an alternative forecast that assumed continuation of the recent (2011-2012) rate of change in harvest. During that period, harvests increased in each subarea from 8% in the Juneau area to 81% in the Ketchikan area. Overall, harvest increased in Area 2C by 21%. The rate of change method produced an Area 2C total forecast of 54,908 fish. Similar forecasts were done back to 1997 to evaluate performance of this method. These calculations indicate that this method was less precise than the time series forecasts, with a standard error of 12,596 (Table 1, Figure 1).

The number of successful halibut anglers in each subarea decreased in 2009 with implementation of the 1-fish daily bag limit, and then stabilized (Table 2). The Area 2C total forecast for 2013 was 23,173 anglers. The forecasts for each subarea were apportioned using the 2009-2011 average distributions of annual harvest to obtain annual harvest distributions and total harvest projections for each subarea (Table 3). The Area 2C harvest forecast based on annual harvest distributions was 47,148 halibut, which is in between the forecasts from the other two methods (Table 1). The time series of annual harvest information under a 1-fish bag limit was too short to estimate the standard error of this forecast.

2.2.2 Reverse Slot Size Limits

The Area 2C charter average weight was projected for lower size limits ranging from 35 to 50 inches and upper limits ranging from 50 to 80 inches, resulting in a range of size limits from U35O50 toU50O80. Yield was projected under each size limit for harvest forecasts of 44,352 fish (Table 4), 54,908 fish (Table 5), and 47,148 fish (Table 6).

Projected yields over the length limits examined ranged from 0.595 to 1.280 Mlb for an assumed harvest of 44,352 fish, and from 0.735 to 1.585 M lb for an assumed harvest of 54,908 fish (Tables 4-6). The GHL associated with the IPHC's "blue line" alternative is 0.788 M lb. As expected, the number of size limit options for which the projected yield is less than 0.788 M lb decreases at higher levels of assumed harvest (see shaded cells in Tables 4-6).

2.2.3 Maximum Size Limit Combined with Annual Limit

The average weight of halibut smaller than L_{max} in 2010 varied by subarea, with more pronounced differences at higher values of L_{max} (Table 7). These average weights were lowest in the Prince of Wales area, where the size composition of harvest is historically made up of relatively small fish. The difference between these average weights and the predicted weight for a halibut equal to L_{max} was also more pronounced at higher levels of L_{max} (Table 7). As will be shown later, this accounts for large differences in yield projections under varying assumptions regarding the average weight of fish smaller than L_{max}. The average weights of halibut greater than L_{max} are presented in Table 8. These average weights were applied to all harvested halibut larger than L_{max} (harvested under annual limit rule) under all scenarios.

Yield was projected using the annual limit harvest projection of 47,148 halibut. Yield varied substantially among the four scenarios (Table 9 and Figure 2). For example, at a maximum size limit of 40 inches, the maximum difference between the four scenarios was 924,000 lb. Assuming that all anglers harvested a fish larger than L_{max} resulted in higher yield projections than when annual harvest was related to the size limit. This was true under both assumptions regarding average weight. For example, yield under Scenario A was higher than under Scenario C. Likewise, yield under Scenario B was higher than under D. Annual harvest assumptions aside, yield was also higher when assuming that all fish harvested under L_{max} were high-graded to L_{max}. For example, yield is higher under Scenario A than B, and higher under C than D.

When combined with an annual limit of one fish larger than L_{max}, the largest maximum size limits that result in projected yield less than the 0.788 M lb GHL are 27 inches for Scenario A, 28 inches for B, 29 inches for C, and 34 inches for D (shaded cells in Table 9).

2.3 Discussion

2.3.1 Harvest Projections

There was over a 10,000 fish difference between the smallest and largest harvest forecasts (Table 1). The forecast based on the continued rate of change was about 24% larger than the time series forecast. Although the time series method was more precise, based on the fit to past data, that is no guarantee that it would be more accurate in any particular year. It is not possible to predict which of the forecasts is most accurate.

In addition, these three forecasts are merely alternatives and do not represent the entire plausible range of harvest in 2013. The forecasts do not take into account possible effects on angler demand arising from the management measures because there is not enough information to quantify these effects. One reason is that changes in management measures have only been applied to the charter halibut fishery in recent years. Another is that it is not yet possible to sort out changes in halibut effort or harvest due to management actions from changes due to economic factors, variability in the abundance and composition of the halibut stock, variations in management and stocks of related fisheries, and other extrinsic factors.

2.3.2 Reverse Slot Size Limits

There is considerable uncertainty in the projections of yield under reverse slot limits, but this uncertainty cannot be quantified because of the number and nature of assumptions involved. We have little experience with projecting average weight under size limits. A maximum size limit was in place under a 1-fish bag limit in 2011, and a reverse slot size limit was in place in 2012. This short history does not provide enough information to revise the projection methods, but some lessons can be learned from comparing predictions from this method with preliminary estimates from the 2012 season.

2.3.2.1 Evaluation of 2012 Results

The U45O68 reverse slot limit recommended by the Council last year was based on an assumed harvest of 45,338 fish and 20% additional highgrading. The preliminary estimate of harvest for 2012, however, was 44,311 halibut. In order to evaluate the projection methodology, various measures from the 2012 "observed" harvest were compared to predictions using the methods in this paper (without highgrading) under an assumed harvest of 44,311 halibut. These predictions are based on the 2010 length-frequency distribution, which is what determines the projected length-frequency and average weight.

The average weights for the U45 portion of the charter harvest in 2012 were less than predicted in all subareas except Prince of Wales Island. Fish in the U45 category made up 91.0 to 99.1% of the charter harvest. The average weights of O68 fish were higher than predicted in four of the five areas with harvest of this size. This may have been due to avoidance of retaining fish close to 68 inches because of the risk of violations from measurement errors. These large fish, however, made up smaller proportions of the harvest than predicted. The net effect was that the observed average weights of charter harvest were less than predicted in every subarea (Figure 3). The observed yield was also lower than predicted for all subareas except Juneau (Figure 3). In total, the Area 2C observed yield was 0.645 M lb, or 19% less than the predicted yield of 0.794 M lb for the same level of harvest (44,311 halibut).

There could be several reasons for the discrepancies between predicted and observed average weight. As stated earlier, the prediction method relies on simplifying assumptions. Anglers did not harvest the same proportions of U45 and O68 fish as was assumed. The 2010 length-frequency distribution may have been inappropriate due to year-to year changes in the size composition and spatial distribution of the halibut stock. Likewise, predictions for 2013 could be inaccurate for similar reasons.

Based on observations from last year, it may be reasonable to conclude that the projection method for estimating average weight under reverse slot limits is conservative. Since the reverse slot limit projections provided for 2012 and 2013 are based on the 2010 length-frequency data, we could also assume that average weights by subarea in 2013 under a U45O68 reverse slot limit will be the same as they were in

2012. With this assumption, projected yields for a U45O68 slot limit under the three harvest forecasts range from 0.645 to 0.802 M lb (Table 10). These projections could be fairly accurate if there has been no appreciable change in the composition of the halibut stock or angler behavior in response to a continuation of the reverse slot limit.

2.3.2.2 Release Mortality

Last year's analysis of reverse slot limits (Meyer 2011) noted potential problems with implementation of reverse slot limits, especially related to measuring and handling fish of lengths close to the lower or upper size limits, as well as handling and release mortality of fish in the protected size slot. Anecdotally, several charter operators reported avoiding harvest of fish over 68 inches altogether. The expected result of this is lower than predicted proportions of harvest of large fish, but also an increase in the average weight of fish that are larger than the upper size limit.

Release mortality, and how to calculate it and compare among different size limits, remains an important issue. Release mortality in the charter fishery is composed of both voluntary and regulatory discards. Voluntary discards include fish released because they are smaller or larger than desired. They can also include fish released by anglers not interested in keeping a halibut. The sizes of halibut released voluntarily are largely unknown. Meyer (2007) developed a procedure to generate the size composition of voluntary discards. Although the SSC concluded that the method produces reasonable estimates of average weight, the accuracy of the estimates cannot be evaluated without data.

Regulatory discards include only those fish required to be released by a size limit regulation. Last year, a method was developed to estimate regulatory discards from the reverse slot limit. This approach used the 2010 length composition of harvest (absent a size limit) and assumed that all fish in the protected slot would be released. Given release of fish in the protected slot, the total catch (harvested + released) that would be required to result in the predicted harvest was calculated. The average weight and an assumed mortality rate of 6% were applied to the released fish to calculate release mortality in pounds.

Two types of information are available to evaluate release mortality in 2012 under the reverse slot limit. First, numbers of released halibut have been reported in logbooks since 2006. Logbook data for 2012 are incomplete at the time of this report, but using regressions of partial and full year data from past years, a preliminary estimate of the numbers of halibut released was calculated for 2012. Second, ADF&G collected size class information on released halibut through dockside interviews in 2012. Charter operators were asked to report the number of halibut kept and released, and classify released halibut as under 45 inches (U45), between 45 and 68 inches (45-68), and over 68 inches (O68). The total number of released halibut was estimated by applying the ratios of kept to released fish to the preliminary harvest estimates for 2012 for each subarea. Next, the two estimates of release numbers were multiplied by the proportion of released fish in the 45-68 category, and these were multiplied by the average weight and mortality rate as above to estimate the poundage of regulatory discards. Regulatory discard mortality was estimated at about 37,000 lb using release data from logbooks, about 27,000 lb using interview data, and about 47,000 lb using the method employed last year. The first two approaches rely on data from the 2012 fishery and suggest that the number of released fish in the protected slot was lower than predicted using last year's method. This may be due to changes in location or gear by the charter fleet to avoid capture of fish in the protected slot.

2.3.3 Maximum Size Limit Combined with Annual Limit

Annual limits have been considered in the past to constrain charter harvest to the GHLs in Areas 2C and 3A (NPFMC 2006, 2008). No annual limits have ever been implemented for halibut, however. The wide variations in yield projections are due to the simplifying assumptions on which the projections were based. The assumptions were required because there are no data from which to model the numbers or size of fish making up the harvest under an annual limit. The results were highly sensitive to the assumptions, and the uncertainty of the assumptions could not be quantified. Although this management measure

conceptually provides potential benefits for the charter industry, a specific combination of size limit and annual limit cannot be recommended. For future consideration, some of the uncertainty could be eliminated by considering an annual limit only, without any type of size limit.

The NPFMC (2008) analysis listed a number of reporting and recordkeeping requirements that might need to be put in place in order to implement and enforce annual limits. The Council has not seriously pursued annual limits since 2008 and it is unclear which, if any, of the recordkeeping, data sharing, and enforcement requirements identified earlier would be needed or possible to implement.

One suggestion for implementation would be to establish enforcement requirements modeled after State of Alaska requirements for annual limits on Chinook salmon, rainbow trout, lingcod, sablefish, yelloweye rockfish, and sharks (except dogfish). State regulations require immediate reporting, in ink, of the species, location, and date of harvest on the back of the angler's license, or if unlicensed, on a harvest report card. Any angler in possession of fish not immediately recoded on their license or harvest card would be in violation of the reporting requirement and subject to citation by federal or state enforcement staff.

Angler licenses and harvest cards are not collected at the end of the year, so these reporting mechanisms could not be used to determine the annual harvest of fish larger than L_{max}. Total annual harvest could be obtained from ADF&G logbook data, and size composition data would still be estimated through ADF&G dockside sampling programs that currently provide estimates of average weight.

Enforcement staff and others have noted that anglers may be able to violate annual limits by simply obtaining a duplicate fishing license once their annual limit is filled. Although this is possible, it is not likely to jeopardize the effectiveness of the management measure at controlling harvest. Over 95% of Area 2C charter anglers are nonresidents. ADF&G license from 2007-2011 indicate that duplicate licenses made up less than 0.01% of the total licenses sold to nonresidents.

A related potential enforcement concern is that nonresidents are able to purchase a variety of types of licenses, including 1-day, 3-day, 7-day, 14-day, and annual licenses. Since licenses are not collected post-season, this opens up the possibility that nonresident charter anglers could record a fish taken under the annual limit provision on a short-term license, and then purchase additional licenses and harvest fish larger than L_{max} in excess of their annual limit.

3.0 Analysis of Options for Area 3A

3.1 Methods

3.1.1 Area 3A Yield Forecast

The preliminary 2012 Area 3A harvest estimate of 2.375 M lb is close to the GHL of 2.373 M lb associated with IPHC "blue line" alternative. Therefore, a yield forecast was provided for Area 3A for 2013 should the Council choose to implement additional restrictions.

A forecast of the number of fish harvested was made for each subarea using the ARIMA time series process described for Area 2C. Average weight in each subarea was assumed to be the same as in 2012, which was considered to be conservative (slightly high) because the long-term trend in each subarea is either declining or flat.

The subareas of Area 3A used for the analysis are Kodiak, Central Cook Inlet, Lower Cook Inlet, North Gulf, western Prince William Sound, eastern Prince William Sound, Yakutat, and the 3A portion of the Glacier Bay subarea (G3A). In subareas are structured around on ADF&G Statewide Harvest Survey (SWHS) areas or logical divisions thereof, based on harvest data availability.

3.1.2 Prohibition on Crew Harvest

Charter skippers and crew (collectively "crew" hereafter) in Area 3A are currently allowed to retain halibut, and these fish count toward the charter GHL. The State of Alaska issued Emergency Orders

(EOs) to restrict harvest of all species by crew while guiding clients for portions of the 2007, 2008, and 2009 seasons. The state EO necessarily applied to all species because the state lacks authority specifically for the halibut fishery. Under federal regulations, however, the prohibition on crew retention could be applied specifically to halibut. The advantage of a prohibition on crew harvest is that it preserves harvest opportunity for clients.

The effect of prohibiting crew harvest was estimated using subarea-specific logbook data on client and crew harvest. There are no size data specific to crew-caught fish. Therefore, the reductions are applied to the yield forecasts, which is equivalent to assuming that crew and clients harvest fish of equal size. Specifically, the initial yield forecasts were reduced by the 2010-2011 average proportion of harvest that was taken by crew in each subarea (multiplied by 1 minus the crew harvest proportion). The underlying assumption is that crew would have about the same propensity to harvest halibut in the coming year as in recent years.

3.2 Results

3.2.1 Area 3A Yield Forecast

The naïve forecasts (forecast = previous year's harvest) were selected in five of the eight subareas in Area 3A. The single exponential forecasts (with no constant) were selected for western Prince William Sound, Yakutat, and Glacier Bay. The total harvest forecast for 2013 was 176,506 fish, down slightly from the 2012 preliminary estimate of 178,268 (Figure 4). Multiplying by the subarea average weights from 2012 resulted in a yield forecast of 2.338 M lb (Table 11).

3.2.2 Prohibition on Crew Harvest

Logbook data indicate that for 2010-2011 the average proportion of crew harvest in each subarea ranged from about 0.7% at Yakutat to nearly 8% in the Central Cook Inlet fishery (Table 12). In addition, the percentage of crew harvest increased from 2010 to 2011 in all but two areas. Applying the average percentage reduction to the yield forecasts resulted in an area-wide reduction in yield of 5.5%, and a projected yield of 2.208 M lb (Table 13).

3.3 Discussion

The recent trends in harvest and average weight in Area 3A have been flat or declining. Therefore, utilizing a projection approach based largely on the most recent year's values could be perceived to be conservative. As was true for Area 2C, there is no guarantee as to the accuracy of the harvest projection.

Likewise, the projected reduction in charter harvest from a prohibition on crew retention could be considered conservative because the 2010-2011 average values were used, rather than the higher 2011 values. There is some question as to how much of a real reduction in crew harvest can be detected in harvest estimates from the ADF&G Statewide Harvest Survey (SWHS). The question stems from the fact that the SWHS does not specifically account for harvest by crew. It is suspected that some portion of the crew harvest is not captured either because operators are reluctant to respond to the survey or report large annual harvests. ADF&G does receive SWHS responses, however, from licensed charter operators that occasionally report large annual harvests of halibut. Most charter operators that retain halibut are believed to give fish to clients, and some portion of halibut caught by crew and given to clients is likely also reported by the clients in the survey and included in the estimates.

4.0 Acknowledgements

Bob Powers (ADF&G) provided charter logbook data on client and crew harvest, numbers of released fish, numbers of licensed and youth anglers, and distributions of annual harvest. This report would not have been possible without his expert assistance, attention to detail, and rapid turnaround. Diana Tersteeg (ADF&G) and Barbi Failor (ADF&G) provided Area 2C and Area 3A size and creel survey data used to

forecast and analyze average weight and release mortality. The work of dozens of ADF&G technicians that collected these data is also appreciated. Nicole Kimball (ADF&G) and members of the Charter Halibut Implementation Committee for reviewing an earlier draft of this report. Finally, I would like to thank my wife and family for their support and patience throughout preparation of this and earlier reports.

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Table 1. Alternative 2013 Area 2C charter halibut harvest forecasts by method and subarea.

	Best Time Series		2011-2012 Rate of Change		Annual Harvest Distribution	
Subarea	Forecast	Std. Err	Forecast	Std. Err	Forecast	Std. Err
Ketchikan	4,673	1,907	8,480	3,201	4,310	NA
Prince of Wales	10,311	5,536	12,628	8,516	12,329	NA
Petersburg/Wrangell	2,139	1,542	2,887	2,461	1,748	NA
Sitka	16,076	5,311	17,841	6,484	15,316	NA
Juneau/Haines/Skagway	4,045	1,906	4,341	3,701	4,655	NA
Glacier Bay (2C)	7,108	2,669	8,731	3,755	8,790	NA
Total	44,352	8,696	54,908	12,596	47,148	NA

Table 2. Estimated number of individual charter anglers (licensed and unlicensed, excluding crew) that harvested at least one halibut in each subarea of Area 2C, 2006-2012, and forecasts for 2013. The 2012 estimates are based on logbook data through July 31, and the 2013 forecasts (bold) are simply the 2010-2012 average.

Year	Ketchikan	Prince of Wales	Petersburg/ Wrangell	Sitka	Juneau	Glacier Bay (2C only)	Total 2C
2006	4,304	9,394	1,557	11,621	2,834	4,540	34,250
2007	4,324	9,294	1,669	12,106	3,098	5,483	35,974
2008	3,408	8,815	1,658	10,999	2,734	5,407	33,021
2009	2,943	5,738	1,079	7,533	2,896	4,365	24,554
2010	2,842	5,742	1,041	7,744	3,003	3,866	24,238
2011	2,533	5,334	760	8,021	3,004	3,440	23,092
2012	2,992	5,549	805	7,585	2,136	3,122	22,189
2013	**2,789**	**5,542**	**869**	**7,783**	**2,714**	**3,476**	**23,173**

Table 3. Forecasts of 2013 charter halibut harvest by subarea for Area 2C using the annual harvest distribution method. Forecasts of numbers of successful charter anglers (excluding crew) are multiplied by the 2009-2011 average angler proportions ("p") to obtain the number of anglers that harvested 1, 2, 3, etc. halibut (columns labeled "Anglers"). Harvest is calculated as the product of the number of anglers and their annual harvest ("HalKept").

	Ketchikan			Pr. Wales I.			Pburg/Wrangell			Sitka			Juneau/Haines/Skag			Glacier Bay			Total Area 2C	
HalKept	p	Anglers	Harvest	p	Anglers	Harvest	p	Anglers	Harvest	p	Anglers	Harvest	p	Anglers	Harvest	p	Anglers	Harvest	Anglers	Harvest
1	0.651	1,816	1,816	0.322	1,786	1,786	0.446	388	388	0.399	3,109	3,109	0.634	1,720	1,720	0.396	1,377	1,377	10,196	10,196
2	0.201	562	1,124	0.286	1,584	3,168	0.254	221	442	0.315	2,452	4,904	0.167	453	906	0.199	693	1,386	5,965	11,930
3	0.112	312	936	0.273	1,511	4,533	0.175	152	456	0.222	1,726	5,178	0.100	272	816	0.161	561	1,683	4,534	13,602
4	0.025	71	284	0.094	523	2,092	0.092	80	320	0.051	396	1,584	0.059	161	644	0.117	405	1,620	1,636	6,544
5	0.008	21	105	0.017	95	475	0.030	26	130	0.009	66	330	0.033	89	445	0.065	224	1,120	521	2,605
6	0.001	4	24	0.005	25	150	0.003	2	12	0.003	26	156	0.005	12	72	0.022	77	462	146	876
7	0.001	3	21	0.002	9	63	0.000	0	0	0.000	2	14	0.002	5	35	0.013	44	308	63	441
8	0.000	0	0	0.000	3	24	0.000	0	0	0.000	4	32	0.000	1	8	0.012	43	344	51	408
9	0.000	0	0	0.000	3	27	0.000	0	0	0.000	1	9	0.000	1	9	0.007	24	216	29	261
10	0.000	0	0	0.000	0	0	0.000	0	0	0.000	0	0	0.000	0	0	0.007	24	240	24	240
11	0.000	0	0	0.000	1	11	0.000	0	0	0.000	0	0	0.000	0	0	0.000	2	22	3	33
12	0.000	0	0	0.000	0	0	0.000	0	0	0.000	0	0	0.000	0	0	0.000	1	12	1	12
13	0.000	0	0	0.000	0	0	0.000	0	0	0.000	0	0	0.000	0	0	0.000	0	0	0	0
14	0.000	0	0	0.000	0	0	0.000	0	0	0.000	0	0	0.000	0	0	0.000	0	0	0	0
15	0.000	0	0	0.000	0	0	0.000	0	0	0.000	0	0	0.000	0	0	0.000	0	0	0	0
16	0.000	0	0	0.000	0	0	0.000	0	0	0.000	0	0	0.000	0	0	0.000	0	0	0	0
17	0.000	0	0	0.000	0	0	0.000	0	0	0.000	0	0	0.000	0	0	0.000	0	0	0	0
		2,789	4,310		5,542	12,329		869	1,748		7,783	15,316		2,714	4,655		3,476	8,790	23,169	47,148

Table 4. Projected yield associated with a projected harvest of 44,352 halibut under reverse slot limits ranging from U35O50 to U50O80. Shaded cells represent the largest yield that is less than the 0.788 M lb GHL associated with the IPHC "blue line" alternative for 2013.

		Upper Length Limit (in)															
		50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
Lower Length Limit (in)	35	1.280	1.260	1.229	1.180	1.140	1.099	1.033	0.944	0.891	0.831	0.771	0.731	0.676	0.642	0.633	0.595
	36	1.235	1.212	1.181	1.133	1.094	1.054	0.991	0.909	0.861	0.808	0.754	0.720	0.672	0.642	0.633	0.599
	37	1.207	1.183	1.151	1.104	1.064	1.024	0.963	0.884	0.839	0.789	0.739	0.707	0.664	0.635	0.628	0.597
	38	1.179	1.154	1.120	1.074	1.034	0.995	0.936	0.861	0.819	0.774	0.728	0.700	0.661	0.635	0.628	0.601
	39	1.166	1.140	1.108	1.063	1.024	0.985	0.929	0.857	0.817	0.775	0.732	0.705	0.668	0.644	0.638	0.612
	40	1.148	1.122	1.090	1.045	1.008	0.970	0.915	0.847	0.809	0.770	0.730	0.705	0.671	0.649	0.643	0.619
	41	1.135	1.108	1.076	1.032	0.995	0.959	0.906	0.841	0.805	0.769	0.732	0.708	0.677	0.656	0.651	0.630
	42	1.124	1.097	1.065	1.023	0.986	0.950	0.899	0.837	0.802	0.768	0.733	0.711	0.682	0.662	0.657	0.638
	43	1.118	1.091	1.060	1.018	0.983	0.948	0.897	0.838	0.805	0.773	0.739	0.719	0.691	0.672	0.668	0.649
	44	1.117	1.090	1.060	1.019	0.985	0.952	0.903	0.846	0.814	0.783	0.752	0.732	0.706	0.688	0.684	0.666
	45	1.118	1.092	1.062	1.023	0.990	0.958	0.911	0.856	0.826	0.797	0.766	0.748	0.723	0.706	0.702	0.685
	46	1.119	1.093	1.064	1.026	0.994	0.962	0.916	0.863	0.834	0.806	0.777	0.759	0.734	0.718	0.714	0.698
	47	1.122	1.097	1.068	1.031	1.000	0.969	0.925	0.874	0.845	0.819	0.791	0.774	0.750	0.735	0.731	0.716
	48	1.126	1.102	1.074	1.038	1.007	0.977	0.933	0.884	0.856	0.830	0.803	0.786	0.763	0.748	0.745	0.730
	49	1.134	1.110	1.083	1.047	1.017	0.988	0.946	0.898	0.872	0.847	0.821	0.805	0.783	0.769	0.766	0.752
	50	1.140	1.117	1.090	1.056	1.027	0.999	0.957	0.911	0.885	0.862	0.837	0.821	0.800	0.786	0.783	0.770

Table 5. Projected yield associated with a projected harvest of 54,908 halibut under reverse slot limits ranging from U35O50 to U50O80. Shaded cells represent the largest yield that is less than the 0.788 M lb GHL associated with the IPHC "blue line" alternative for 2013.

		Upper Length Limit (in)															
		50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
Lower Length Limit (in)	35	1.585	1.558	1.520	1.460	1.414	1.362	1.279	1.167	1.103	1.025	0.953	0.905	0.834	0.793	0.782	0.735
	36	1.528	1.498	1.459	1.402	1.355	1.305	1.227	1.123	1.066	0.998	0.933	0.891	0.831	0.793	0.783	0.741
	37	1.494	1.463	1.422	1.365	1.319	1.268	1.192	1.092	1.038	0.974	0.914	0.875	0.820	0.786	0.776	0.738
	38	1.458	1.425	1.384	1.328	1.282	1.232	1.159	1.065	1.014	0.956	0.902	0.867	0.818	0.786	0.778	0.745
	39	1.442	1.409	1.368	1.314	1.268	1.220	1.149	1.060	1.012	0.958	0.906	0.873	0.828	0.798	0.790	0.759
	40	1.420	1.386	1.346	1.292	1.248	1.201	1.132	1.047	1.002	0.952	0.904	0.874	0.832	0.804	0.797	0.768
	41	1.403	1.369	1.329	1.276	1.233	1.187	1.121	1.040	0.997	0.951	0.907	0.879	0.840	0.814	0.808	0.781
	42	1.390	1.355	1.316	1.264	1.221	1.177	1.112	1.035	0.994	0.950	0.908	0.882	0.845	0.821	0.816	0.791
	43	1.382	1.348	1.309	1.258	1.217	1.173	1.110	1.036	0.996	0.956	0.916	0.891	0.856	0.833	0.828	0.805
	44	1.381	1.347	1.309	1.260	1.220	1.178	1.117	1.047	1.008	0.970	0.932	0.909	0.875	0.853	0.848	0.827
	45	1.382	1.349	1.313	1.265	1.227	1.186	1.127	1.059	1.023	0.986	0.950	0.928	0.896	0.875	0.871	0.850
	46	1.384	1.351	1.315	1.269	1.231	1.191	1.134	1.069	1.033	0.998	0.963	0.941	0.911	0.891	0.886	0.866
	47	1.388	1.356	1.321	1.276	1.239	1.201	1.145	1.083	1.048	1.015	0.982	0.961	0.932	0.913	0.909	0.890
	48	1.394	1.363	1.329	1.285	1.249	1.211	1.157	1.095	1.062	1.029	0.997	0.977	0.948	0.930	0.925	0.907
	49	1.403	1.372	1.339	1.296	1.261	1.225	1.172	1.113	1.081	1.050	1.019	1.000	0.973	0.955	0.951	0.934
	50	1.411	1.381	1.349	1.307	1.273	1.238	1.186	1.129	1.098	1.068	1.039	1.020	0.994	0.977	0.973	0.957

Table 6. Projected yield associated with a projected harvest of 47,148 halibut under reverse slot limits ranging from U35O50 to U50O80. Shaded cells represent the largest yield that is less than the 0.788 M lb GHL associated with the IPHC "blue line" alternative for 2013.

		Upper Length Limit (in)															
		50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80
Lower Length Limit (in)	35	1.379	1.361	1.334	1.287	1.248	1.207	1.139	1.047	0.993	0.929	0.861	0.820	0.763	0.722	0.710	0.663
	36	1.332	1.313	1.284	1.238	1.200	1.158	1.093	1.007	0.957	0.900	0.838	0.802	0.753	0.715	0.704	0.662
	37	1.302	1.281	1.251	1.205	1.166	1.124	1.059	0.976	0.929	0.875	0.818	0.784	0.739	0.704	0.694	0.656
	38	1.271	1.247	1.216	1.171	1.131	1.089	1.026	0.947	0.903	0.854	0.802	0.771	0.730	0.699	0.691	0.657
	39	1.257	1.233	1.202	1.158	1.119	1.078	1.017	0.941	0.899	0.853	0.803	0.775	0.736	0.706	0.698	0.667
	40	1.238	1.213	1.181	1.138	1.099	1.059	1.000	0.927	0.888	0.844	0.798	0.771	0.736	0.708	0.701	0.672
	41	1.222	1.196	1.165	1.122	1.084	1.044	0.987	0.918	0.880	0.840	0.797	0.772	0.739	0.714	0.707	0.681
	42	1.209	1.183	1.152	1.109	1.072	1.033	0.977	0.911	0.875	0.837	0.796	0.773	0.742	0.718	0.712	0.688
	43	1.202	1.176	1.145	1.103	1.067	1.029	0.974	0.911	0.876	0.840	0.801	0.779	0.750	0.727	0.721	0.699
	44	1.200	1.174	1.144	1.103	1.067	1.031	0.978	0.917	0.884	0.850	0.813	0.792	0.764	0.742	0.737	0.715
	45	1.200	1.174	1.145	1.106	1.071	1.036	0.985	0.926	0.894	0.862	0.826	0.807	0.780	0.759	0.754	0.733
	46	1.200	1.174	1.146	1.107	1.073	1.038	0.989	0.932	0.901	0.870	0.836	0.817	0.791	0.771	0.766	0.746
	47	1.202	1.177	1.149	1.111	1.078	1.044	0.996	0.942	0.912	0.882	0.850	0.831	0.807	0.788	0.783	0.765
	48	1.206	1.181	1.154	1.117	1.085	1.052	1.004	0.951	0.922	0.893	0.861	0.843	0.819	0.800	0.796	0.778
	49	1.213	1.189	1.162	1.126	1.095	1.063	1.017	0.966	0.938	0.910	0.880	0.863	0.840	0.822	0.819	0.802
	50	1.219	1.195	1.169	1.134	1.104	1.073	1.028	0.979	0.952	0.925	0.896	0.880	0.857	0.841	0.837	0.821

Table 7. Average weights used to project yield of halibut that are less than or equal to the candidate maximum size limit (L_{max}) under Scenarios A, B, C, and D (see page 3). The column labeled "Average weight of fish = L_{max}" contains the predicted weight of halibut that are equal in length to L_{max}, as calculated using the IPHC length-weight relationship. These weights are used in Scenarios A and C. The remaining columns are the observed average weights of all fish that were less than or equal in length to L_{max} in 2010, and are used in Scenario B and D calculations.

		Average weight of halibut ≤ L_{max} (lb)					
L_{max} (in)	Average weight of fish = L_{max}	Ketchikan	Pr. Wales I.	Petersburg	Sitka	Juneau	Glacier Bay
25	4.799	3.805	4.219	2.846	3.708	4.038	3.024
26	5.449	3.929	4.860	3.364	4.311	4.564	3.830
27	6.158	4.615	5.126	3.755	4.781	5.225	3.958
28	6.928	5.338	5.785	3.755	5.281	5.679	5.378
29	7.762	6.007	6.107	4.962	5.754	6.029	5.771
30	8.664	6.616	6.573	5.492	6.454	6.781	6.415
31	9.635	7.199	6.814	6.520	6.998	7.337	6.937
32	10.679	7.977	7.157	6.734	7.587	7.920	8.156
33	11.798	8.557	7.425	7.799	7.957	8.391	8.557
34	12.996	9.229	7.695	8.195	8.482	8.917	9.141
35	14.276	9.606	7.894	8.990	8.869	9.186	9.877
36	15.640	10.347	8.129	10.769	9.585	9.792	10.518
37	17.092	10.701	8.235	11.505	10.011	10.326	11.187
38	18.635	11.448	8.488	12.561	10.516	10.950	12.302
39	20.271	11.882	8.658	13.663	11.003	11.385	12.820
40	22.004	12.259	8.718	15.197	11.429	11.468	13.731
41	23.837	12.810	8.805	16.434	11.829	12.011	14.762
42	25.773	12.981	8.830	17.410	12.229	12.061	15.739
43	27.814	13.104	8.886	18.843	12.597	12.463	16.563
44	29.965	13.688	9.038	20.294	13.150	12.527	17.358
45	32.228	14.159	9.138	21.395	13.813	12.882	18.233

Table 8. Average weights of harvested halibut that were greater in length than the candidate maximum size limits (L_{max}) in 2010. These average weights were used to estimate yield of halibut retained as angler's 1-fish annual limit of fish over L_{max} in all scenarios A-D.

	Average weight of halibut > Lmax (lb)					
Lmax (in)	Ketchikan	Pr. Wales I.	Petersburg	Sitka	Juneau	Glacier Bay
25	22.644	15.431	35.105	26.096	16.563	47.909
26	22.709	16.481	35.212	26.605	16.816	48.145
27	23.026	17.154	35.318	27.200	17.371	48.184
28	23.536	19.661	35.318	28.008	17.847	48.883
29	24.257	21.592	35.624	28.891	18.296	49.196
30	25.072	25.331	35.828	30.487	19.380	49.743
31	26.000	27.869	36.224	32.065	20.503	50.296
32	27.659	31.899	36.322	33.979	21.999	51.824
33	29.288	35.873	36.801	35.334	23.489	52.579
34	31.485	40.515	36.989	37.262	25.364	53.552
35	32.784	44.451	37.355	38.745	26.404	54.953
36	35.673	49.840	38.466	41.805	28.837	56.219
37	37.312	52.323	39.025	43.859	31.590	57.680
38	40.994	58.797	39.858	46.223	36.082	59.857
39	43.340	63.663	40.782	48.500	40.322	60.915
40	45.478	65.281	42.315	50.494	41.170	62.789
41	48.961	67.576	43.854	52.386	47.874	65.255
42	50.009	68.156	45.288	54.277	48.605	67.635
43	50.724	69.309	47.517	55.973	54.703	69.800
44	53.635	72.377	50.386	58.438	55.779	71.870
45	56.140	74.345	53.182	61.587	62.236	74.295

Table 9. Projected halibut yield (M lb) under a maximum size limit (L_{max}) combined with a 1-fish annual exemption, or annual limit, of a halibut larger than L_{max}. Projected yields assume a harvest of 47,148 halibut. Projections are provided for four scenarios. Scenarios A and B assume that every angler that harvests at least one halibut will retain a fish larger than L_{max}. Scenarios C and D assume that the number of fish harvested that are larger than L_{max} decreases as L_{max} increases. Scenarios A and C assume that the average weight of fish < L_{max} is equal to the predicted weight for a fish of length equal to L_{max}, or that all fish harvested under daily bag and size limits are high-graded to L_{max}. Scenarios B and D calculate the average weight of halibut under L_{max} as the observed average weight of fish less than L_{max} in 2010. Shaded cells indicate the highest projected yields that are still less than the 0.788 M lb GHL associated with the IPHC "blue line" alternative.

L_{max} (in)	Scenario A	Scenario B	Scenario C	Scenario D
25	0.709	0.682	0.696	0.669
26	0.736	0.709	0.712	0.683
27	0.764	0.728	0.730	0.692
28	0.808	0.772	0.751	0.710
29	0.850	0.804	0.774	0.720
30	0.912	0.859	0.800	0.735
31	0.969	0.905	0.830	0.747
32	1.046	0.972	0.864	0.762
33	1.117	1.026	0.901	0.772
34	1.201	1.093	0.942	0.783
35	1.277	1.148	0.987	0.793
36	1.383	1.235	1.036	0.807
37	1.465	1.292	1.090	0.817
38	1.587	1.392	1.149	0.832
39	1.694	1.469	1.212	0.842
40	1.776	1.521	1.280	0.852
41	1.885	1.598	1.353	0.864
42	1.964	1.640	1.431	0.874
43	2.060	1.697	1.514	0.884
44	2.169	1.766	1.603	0.895
45	2.294	1.849	1.697	0.908

Table 10. Projected Area 2C charter yield for 2013 under three harvest forecast options, assuming average weights by subarea is equal to the 2012 preliminary estimates.

Forecast Method	Harvest Forecast	Area 2C Average Weight (lb)[a]	Yield (M lb)
Time Series	44,352	14.55301	0.645
Recent Rate of Change	54,908	14.60540	0.802
Annual Harvest Distribution	47,148	14.61182	0.689

[a] The Area 2C-wide average weight is calculated as a weighted average across subareas.

Table 11. Projected charter yield for Area 3A for 2013, based on time series forecasts of harvest and preliminary estimates of average weight from 2012.

Subarea	Time Series Harvest Forecast	Average Net Wt (lb)	Projected Yield (M lb)
Kodiak	13,067	13.19376	0.172
Central Cook Inlet	43,892	11.81105	0.518
Lower Cook Inlet	68,304	11.94245	0.816
North Gulf	34,561	12.65619	0.437
Western PWS	7,149	19.86957	0.142
Eastern PWS	5,100	21.21399	0.108
Yakutat	3,799	32.04121	0.122
Glac Bay (3A portion)	634	34.07735	0.022
Total	176,506	13.24325	2.338

Table 12. Area 3A charter crew harvest and total charter harvest, 2010 and 2011. Data are from ADF&G charter logbooks.

	2010			2011			
Subarea	Crew Harvest	Total Harvest	% Crew	Crew Harvest	Total Harvest	% Crew	2010-2011 Average Crew Percentage
Kodiak	793	14,248	5.57%	898	15,424	5.82%	5.69%
CCI	4,485	57,917	7.74%	4,754	58,101	8.18%	7.96%
LCI	4,037	80,271	5.03%	4,815	83,576	5.76%	5.40%
N Gulf	2,586	47,937	5.39%	2,689	48,518	5.54%	5.47%
WPWS	144	5,008	2.88%	115	4,128	2.79%	2.83%
EPWS	289	7,533	3.84%	326	6,272	5.20%	4.52%
Yakutat	2	3,359	0.06%	40	2,801	1.43%	0.74%
G3A	3	147	2.04%	1	973	0.10%	1.07%
	12,339	216,420	5.70%	13,638	219,793	6.20%	5.95%

Table 13. Calculation of projected charter halibut yield for Area 2C in 2013 under a prohibition on crew harvest.

Subarea	Initial Yield Forecast (lb)	2010-2011 Average Crew Proportion	Projected Yield With Crew Harvest Prohibition (lb)
Kodiak	172,40	0.05694	162,586
CCI	518,411	0.07963	477,129
LCI	815,717	0.05395	771,707
N Gulf	437,411	0.05468	413,491
WPWS	142,048	0.02831	138,027
EPWS	108,191	0.04517	103,304
Yakutat	121,725	0.00744	120,819
G3A	21,605	0.01072	21,373
Total	2,337,510	0.055218	2,208,438

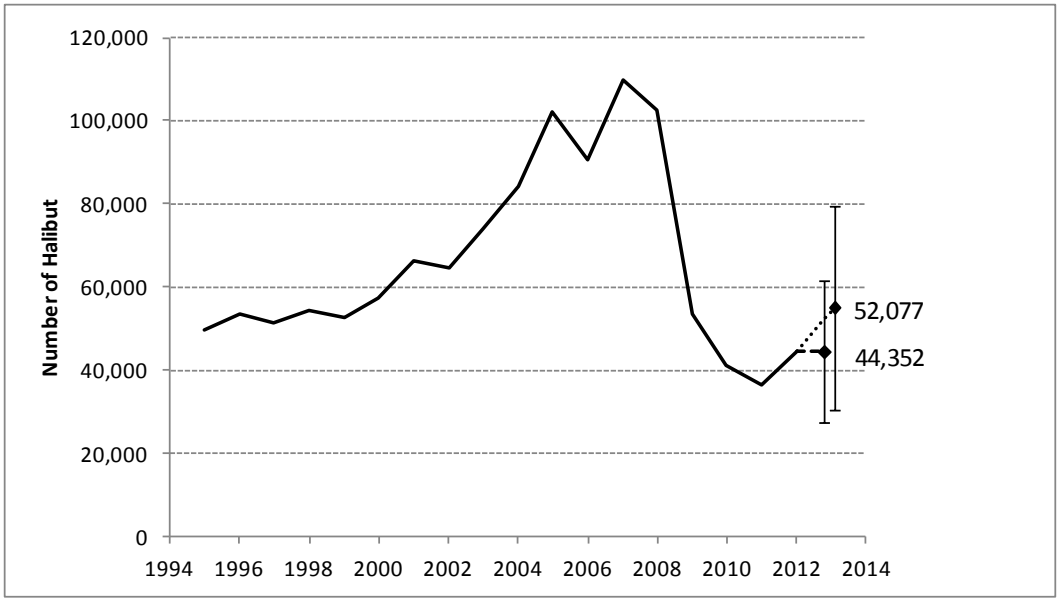


Figure 1. Area 2C charter halibut harvest (number of fish) and forecasts for 2012 using the best time series method (44,352) and recent time series method (52,077). Error bars represent 95% confidence intervals. The intermediate forecast based on annual harvest distributions (47,148) is not shown.

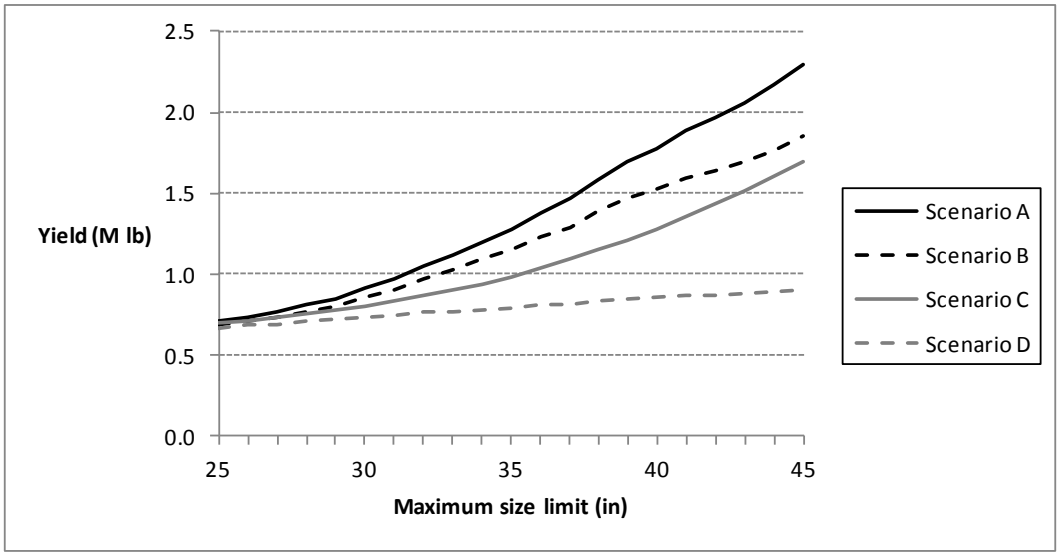
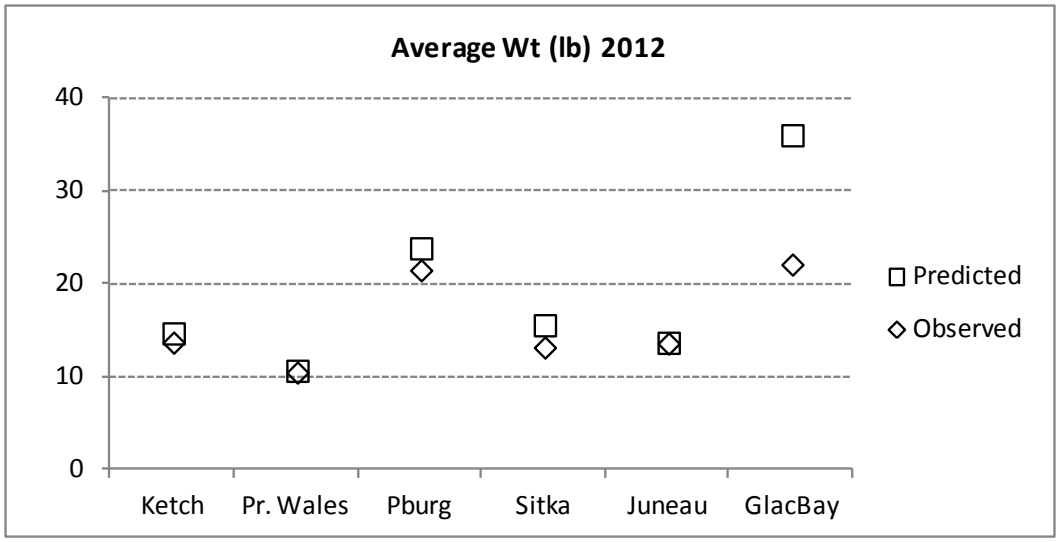


Figure 2. Projected yield under a maximum size limit combined with an annual limit of one fish over that size limit. Yield curves and scenarios are as shown in Table 7.



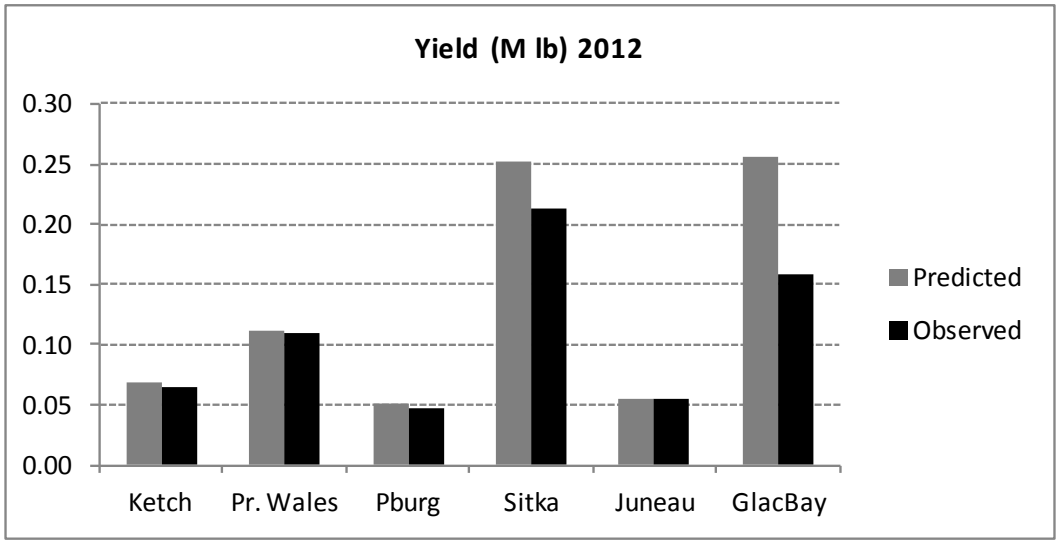


Figure 3. Comparison of observed and predicted charter halibut average weight and yield by subarea in Area 2C in 2012. The observed values are preliminary estimates, and the predicted values are based on the reverse slot limit methods in this paper assuming a charter harvest of 44,311 halibut (the preliminary estimate for 2012).

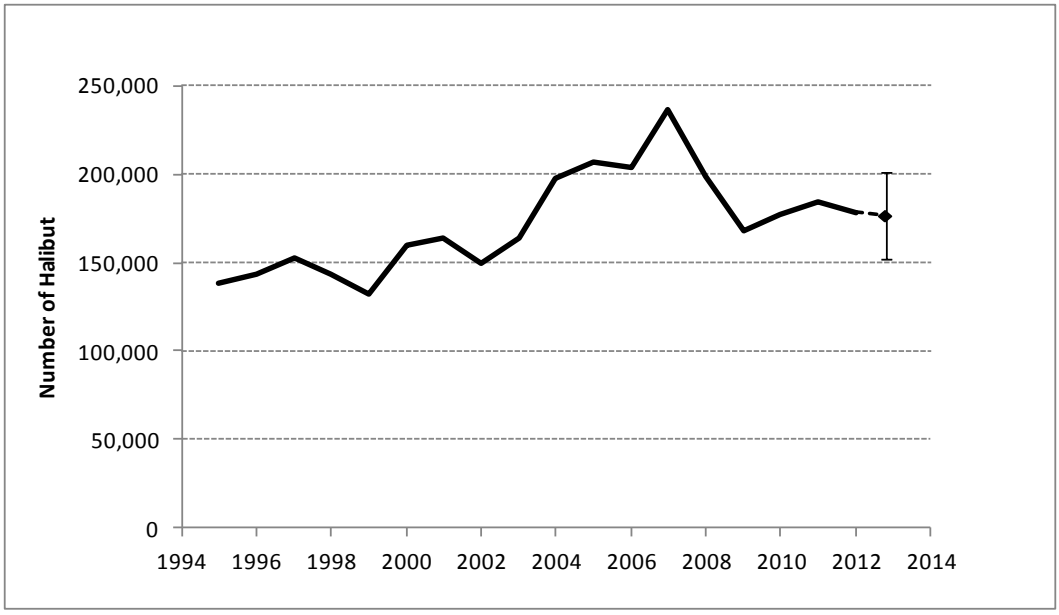


Figure 4. Area 3A charter halibut harvest (number of fish) and forecast for 2012 using the best time series method (176,506). Error bars represent the 95% confidence interval.