Methods for Establishing Maximum Size Limits for the Charter Fishery Under the Halibut Catch Sharing Plan

A Report to the North Pacific Fishery Management Council, June 2011

Scott Meyer, Alaska Department of Fish and Game (ADF&G)
May 23, 2011

Introduction

The North Pacific Fishery Management Council approved a motion in October 2008 to establish a Catch Sharing Plan (CSP) for the commercial longline and guided sport (charter) sectors of the Pacific halibut fishery. Under this plan, the International Pacific Halibut Commission (IPHC) would approve an annual combined catch limit (CCL) for both sectors. The CSP would allocate this combined catch limit to each sector. The commercial allocation would become the catch limit for the commercial IFQ fishery. The charter fishery would be managed under regulations intended to keep the charter harvest within an acceptable allocation range. The allocations and regulations would vary with the magnitude of the CCL established by the IPHC. Regulations would be established at the start of the season and not changed inseason.

At lower levels of combined catch limits, the plan calls for a maximum size limit in the charter fishery when projected harvests under a one fish bag limit exceed the acceptable charter allocation range. The Council did not specify what the maximum length limits would be, only that a maximum size limit would be established to keep the charter harvest at or below the level specified by the target allocation percentage (midpoint of the allocation range).

The Council contracted an analyst to prepare a supplemental analysis on the process for selecting a maximum length limit to manage guided sport halibut harvest in times of low abundance. The analyst presented a paper to the Council's SSC in February 2009 outlining two methods for calculating the maximum length limit (King 2009)[1]. The two approaches (methods A and B) differed in their assumptions about the possible amount and effect of high-grading, the practice of releasing small halibut and continuing to fish in an attempt to keep a larger fish. The SSC viewed these two approaches as bracketing the range of expected outcomes. Since that analysis, ADF&G has explored an alternate, hybrid approach that combines aspects of the two approaches presented in King (2009). This method results in intermediate values of projected average weight and recommended maximum size limits.

The purpose of this paper is to describe this hybrid method and compare results to the previous approaches suggested in King (2009). The hybrid approach will be described as Method C in the CSP proposed rule as another alternative for establishing maximum size limits. The Council, after review from the SSC, may wish to recommend the use of a particular method or suggest an alternate approach.

Description of Three Approaches

ADF&G estimates the number of charter halibut harvested in each of several subareas of IPHC areas 2C and 3A. Size data are also collected from harvested fish through ADF&G creel surveys conducted at sites within most of the subareas (see Appendix A for details). Length of each fish is recorded and the weight of each individual fish is predicted using the IPHC length weight relationship. Average weight is calculated as the average of the predicted weights for each individual fish. The size distribution of the charter halibut harvest varies by subarea, more so in Area 2C than in Area 3A (Figure 1). Therefore, guided sport removals R_p (in pounds net weight) for each IPHC regulatory area are estimated or projected using a stratified estimator as follows:

[1] King (2009) is available online at:
http://www.alaskafisheries.noaa.gov/npfmc/current_issues/halibut_issues/HalibutCSPdisc709.pdf

$$R_p = \sum_S H_{Sp} w_{Sp} \tag{1}$$

where

$H_{Sp} =$ the estimated or projected number of fish harvested in each subarea S, and

$w_{Sp} =$ the estimated or projected average net weight (in pounds) in each subarea S.

Method A described by King (2009) assumes that upon imposition of a size limit, there would be no high-grading and that the projected average weight of halibut harvested by charter anglers will equal the average weight of those fish that were below the size limit in a recent year in which anglers were allowed to harvest fish of at least that length. For example, when estimating charter removals resulting from a size limit of 40 inches, the average weight would be calculated from only those harvested halibut that were equal to or less than 40 inches in length in the sample from the most recent year. These average weights would be calculated by subarea and projected harvests would be calculated using equation 1. After repeating the calculations for a range of maximum length limits, the size limit L_{in} that results in a projected charter removal (R_p) that is no larger than the annual catch limit for the charter sector would be selected.

Method B assumes that every halibut harvested and retained by charter vessel anglers would be precisely equal in length to the maximum length limit. Because all fish are assumed to be the same length, there would be no differences in the projected size distributions between subareas and an unstratified estimator could be used. The first step in selecting a length limit could be to calculate the average weight w_p that, when multiplied by the projected number of fish harvested in the entire regulatory area, would result in the annual charter sector catch limit for that area:

$$charter\ catch\ limit = H_p w_p \tag{2}$$

where

$H_p =$ the projected total number of fish harvested in an IPHC area,

$w_p =$ the average net weight in pounds of all fish in an IPHC area.

The second step would be to solve the IPHC length-weight relationship[2] for the length that would produce the projected average weight w_p. The maximum size limit would be set to this length.

The SSC reviewed the King (2009) paper and presentation and provided comments to the Council in their February 2009 minutes. The SSC concluded,

> "The decision about which maximum size limit (Lmax) to use (between the limits of Methods A or B) is essentially a policy call." The SSC also noted that "Method A (with an estimated Lmax of about 38 to 40 inches) would be expected to produce the largest overage in harvest, the least impact on the charter industry, but the most impact on the resource. (Because the overage is not subtracted from the CEY in this new plan, the overage is essentially deducted from the resource itself.) In contrast, method B (with an estimated Lmax of about 30 inches) would be expected to restrict harvest to less than desired catch levels, creating an undesirable economic loss to the charter industry and a loss of opportunity to interested anglers. The Council may wish to choose an intermediate value, between these two methods, as a first step in an iterative process. The Council may also wish to install a buffer between the default charter harvest limit and the one actually recommended, to account for uncertainty."

[2] The IPHC relationship between net weight W (lb) and fork length L (cm) is $W = 6.921(10^{-6})FL^{3.24}$ (Clark 1992).

The Council, however, did not make an explicit decision with regard to the method that would be used to establish a maximum length limit.

In January 2011, the IPHC used Method B when it recommended a maximum size limit for the 2011 fishery for charter vessel anglers harvesting halibut in Area 2C. The Secretary of State and Secretary of Commerce approved the IPHC's recommendation (76 FR 14300, March 16, 2011) and charter vessel anglers in Area 2C are limited to catching and retaining one halibut per calendar day that is no longer than 37 inches in 2011. Following the IPHC's recommendation, charter sector representatives commented to the National Marine Fisheries Service (NMFS) that the 37-inch size limit was too conservative because it was based on a method that assumed that all charter vessel anglers would be able to harvest halibut that were precisely the maximum size limit. They felt this was unlikely to occur and that some anglers will harvest halibut smaller than the maximum size limit. The charter sector representatives suggested that it might be possible to use a less conservative methodology than Method B that would result in a relatively larger maximum length limit while also limiting guided sport harvest to target levels.

In response to requests from charter sector stakeholders, ADF&G used an alternative method to calculate a maximum size limit. This hybrid approach combines extreme assumptions used in methods A and B to produce an intermediate result. Like Method A, the hybrid would be used to calculate a maximum size limit using data from a previous year in which the fishery was not constrained by a size limit, or a year in which a less constraining (higher) maximum size limit was in place to manage the charter fishery under its allocation.

The hybrid method assumes that under a size limit in the coming year, (a) the proportion of the halibut harvest that will be smaller than the size limit will equal the proportion that were under that length in the previous year, (b) the average weight of fish smaller than the size limit will remain unchanged from the previous year, and (c) the portion of the previous year's harvest that was larger than the prospective maximum size limit will be exactly equal to the size limit in the coming year.

The hybrid method would calculate charter removals over a range of prospective size limits using equation 1, with the average weight for each subarea w_S calculated as follows:

$$w_S = (p_{UL}w_{UL}) + (p_{OL}w_{OL}) \tag{5}$$

where

$p_{UL} =$ the proportion of halibut in the previous year's creel survey sample from subarea S that were less than or equal in length to the prospective length limit L_{in},

$w_{UL} =$ the average weight of halibut in the previous year's sample from subarea S that were less than or equal in length to the prospective length limit L_{in},

$p_{OL} =$ the proportion of halibut in the previous year's creel survey sample from subarea S that were greater in length to the prospective length limit L_{in} (p_{UL}+p_{OL} = 1), and

$w_{OL} =$ the average weight of a halibut of length L_{in}, predicted from the IPHC length-weight relationship (equation 4).

The maximum length limit would then be selected as the largest size limit in whole inches that results in a projected charter removal (R_p) that is less than or equal to the annual catch limit for the charter sector. This is equivalent to selecting the largest size limit for which the predicted average weight is less than the target average weight derived from the allocation and projected harvest using equation 2.

Comparisons

Because the three approaches described above vary in their underlying assumptions, they also vary in their output. The differences in these methods are illustrated here through (a) comparison of the length frequency distributions associated with each method, (b) a comparison of average weights predicted from each method over a range of maximum size limits, and (c) a comparison of maximum size limits resulting from each method under likely size limit scenarios for Area 2C and Area 3A. In each comparison, estimates based on Method A and the hybrid method used 2010 length-frequency data. These comparisons assume that the proportion of harvest in each subarea (subarea weightings) will not be affected by imposition of the size limit. In other words, they involve only a redistribution of the sizes of harvested fish. The validity of this assumption will be examined in the discussion section.

Changes in Length Frequency Distributions

One way to understand the effects of the various assumptions is by looking at the length frequency distributions that result from application of each method. For each area, a target average weight was chosen to meet an example allocation, and then all three methods were applied to calculate the maximum size limit in whole inches that would constrain the harvest to that allocation. For Area 2C, the target average weight of 13.84 pounds was chosen, which derives from a charter allocation of 692,000 pounds and projected harvest of 50,000 fish. For Area 3A, the target average weight was 12.6 lb, derived from a charter catch limit of 1.26 M lb and projected harvest of 100,000 fish.

Figure 2 shows, for each IPHC area, the original 2010 length distributions and the assumed length frequency distributions that correspond with the size limit determined using each method. The predicted average weight is also provided for each method. The assumed composition of the harvest under each method varies, with the broadest distribution resulting from Method A and the narrowest from Method B. It is readily apparent that the size distributions from the hybrid method are a mix of the other two – there are fish below the size limit as well as an accumulation of fish in the length category that includes the size limit.

Prediction of Average Weights

For each method, the average net weights associated with a range of maximum size limits from 30 to 50 inches were calculated for each subarea. These were then weighted by the proportion of charter harvest in each subarea (using 2010 projections) to obtain the overall average weight estimates for each IPHC area.

As expected, the average net weights for each prospective size limit were highest using Method B (which assumes all fish equal to the size limit) and lowest for Method A, with an intermediate value for the hybrid method (Table 1, Figure 3). At relatively small size limits, the difference between the average weights from each method are small. As the size limit is increased, however, the discrepancy between average weights from methods A and B increases exponentially because the average weights predicted under Method B are essentially tracking the IPHC length weight relationship. The hybrid method results in average weights that are intermediate in value. The discrepancy between average weights from Method A and the hybrid method also increases as the size limit increases, but the discrepancy is much smaller than that from Method B. This occurs because as the size limit is increased, a smaller and smaller portion of the harvest is assumed to be the same size as the size limit.

The discrepancy between average weights predicted using Method B and other methods is greater in Area 3A than in Area 2C. This is because there were relatively fewer large fish in the harvest in Area 3A than in Area 2C. The average weights from Method A and the hybrid method are dependent entirely or in part on an observed size distribution, but Method B is unconstrained by data and therefore the predicted weights from Method B are the same in Area 3A and Area 2C.

Recommended Size Limits

This comparison looks at size limits that would be derived using each method for Area 2C and 3A at realistic levels of the combined catch limit and projected charter harvest under a one-fish bag limit (Table 2). The charter allocation percentages are as specified in the catch sharing plan. The projected charter harvests are plausible approximations for each area – projected charter harvest was about 47,000 fish under a one fish bag limit in Area 2C, and about 196,000 fish under a two-fish bag limit in Area 3A. The Area 3A harvest would therefore be roughly 100,000 fish under a one-fish bag limit.

Under all scenarios, Method A provides the largest maximum size limits and Method B provides the smallest. Maximum size limits from Method A are also more variable for a given range of allocations than limits set using Method B. For example, as the charter allocation in Area 2C is raised from 0.52 M lb to 0.83 M lb, size limits based on Method A increase from 37 to 49 inches. Size limits from Method B, however, only range from 31 to 36 inches. Size limits determined by the hybrid method are intermediate in value.

Discussion

Uncertainty and Assumptions

Uncertainty is the pervasive issue in the choice or recommendation of a method to establish maximum size limits. With Method A and the hybrid method, there is uncertainty associated with using the size frequency distribution from a prior year. This uncertainty comes from sampling error associated with collection of the size data, potential for bias in the design of the study to collect the data, and uncertainty as to whether the size distribution from a previous year is applicable to the year in question. With Method B, there is no associated sampling error because the size limit is based on the assumption that all fish are the same length as the length limit. Variability in the average weights predicted under each method was not presented because NMFS desires to implement an objective rule to set size limits. The Council intended that the CSP be implemented by IPHC annual management measures prior to the beginning of each fishing season, and the CSP regulations will identify the process used to determine the effective charter restrictions. In other words, the proposed rule will specify a method that will be followed to set a maximum length limit, and the limits so determined will not be open to discretionary modification. Revision of the maximum size limit calculation method would require NMFS to amend the CSP regulations.

Regardless of the sampling variability inherent in data used for Method A and the hybrid method, most of the uncertainty rests on the assumptions about high-grading. There are not yet sufficient data to determine quantitatively how the charter fishery might respond under a maximum size limit, or to be able to discern changes caused by the maximum size limit versus year-to-year variability in the sizes of available fish. Without these data, a qualitative approach can still be used to evaluate assumptions.

Method A assumes that no additional high-grading will occur upon imposition of a size limit. If the fishery were subject to a one-fish bag limit without a size limit in the previous year, then there would probably already be a substantial amount of high-grading occurring. Imposition of a size limit may cause some anglers to want to try to achieve it, but the amount of additional high-grading that would occur is unknown. In 2007, the National Marine Fisheries Service changed the charter daily bag limit in Area 2C from two fish of any size to two fish with a 32-inch maximum size limit on the second fish retained. This change was implemented specifically to lower the average weight in the harvest. Average weight during the 2007 season was lower than in 2006, but not by as much as was projected. The projections did not account for high-grading. It is not possible to say how much of the change in average weight from 2006 to 2007 was due to high-grading and how much was due to annual variation in the availability or catchability of fish. Nevertheless, anglers have the ability to high-grade, and a precautionary approach would assume that additional high-grading would occur.

Method B assumes, for purposes of setting a limit, that all harvested halibut will be of a size equal to the limit. This is highly unlikely for several reasons. Fish that are exactly equal to the size limit are not equally available to all anglers. The probability of catching a halibut larger than 35 inches is relatively low in the Prince of Wales Island subarea, and several other subareas of Area 2C and Area 3A (Figure 1). Charter anglers currently release almost as many halibut as they keep; Area 2C charter anglers released 43 percent of the halibut they caught and Area 3A anglers released 44 percent of the halibut they caught in

2009. Anglers would have to catch and release many more fish than they already do, but are limited in their ability to stay out all day in search of larger fish. The ability to fish longer would be particularly limited for anglers on half-day charters. Anglers that catch and release halibut in search of a larger fish may end up settling for a fish that is smaller than some of the fish they released. Therefore, Method B will likely overestimate the average weight associated with a given size limit, and results in the smallest size limits for any given allocation (Table 2, Figure 4).

Beyond the current mode of about 30 inches, as the maximum size limit increases, the probability that all anglers will be able to catch a fish of that size decreases. In other words, the higher the size limit established by Method B, the more untenable the assumption that all fish will equal the maximum size, and the more potential harvest will be forgone by the charter sector.

The hybrid method contains elements and assumptions of method A and B, but the net effect is offsetting. Average weights and size limits associated with the hybrid method are not just a simple average of results from methods A and B, however. As shown in Figure 3, the average weight estimated by the hybrid approach tends toward the estimate based on Method A. This is because the hybrid approach is a stratified estimate (see equation 5) – as the maximum size limit increases, the proportion of harvest under that size limit, and therefore the weighting given to the average size from the size distribution increases. Likewise, the weighting given to the assumption that fish larger than the size limit will equal the size limit decreases. This is consistent with the argument above that the probability of catching a fish equal in size to the maximum size limit decreases as the maximum size limit is raised.

Although the hybrid approach results in size limits that are closer to those from Method A than those from Method B, those limits may still be conservative. The hybrid approach will likely be based on a size distribution from a year in which the fishery was already operating under a one fish bag limit. Therefore, some high-grading would be incorporated in the size distribution data. Anglers will not likely be able to replace fish that were larger than the size limit in the previous year with fish that are exactly equal to the size limit. All things being equal, the average weight projected using the hybrid method may be higher than the realized average weight under that size limit, and the size limit may be set a little lower than necessary.

All things will likely not be equal, however. There is substantial variability from year to year in average weights within each subarea, although some of the variability in Area 2C since 2007 was caused by changes in regulations (Figure 5). Because Method B overestimates the average weight associated with a maximum size limit, it provides a buffer for some of the annual variability in estimated average weight. The hybrid method is also assumed to be conservative, but does not provide as much buffer as Method B. Whether the buffer is adequate to absorb the variation cannot be determined without size data from years in which a maximum size limit was in place.

Limitation of This Analysis

The comparisons of methods all assume that the projected number of fish will be harvested regardless of how the size distribution affects the composition of the catch. This may not in fact be true. It is likely that angler demand, or effort, will be affected by imposition or changes in size limits, which will in turn affect harvest. Because the size composition already varies by subarea, the effects of size limits on effort and harvest will be area-specific, which will effectively change the weightings and final estimates of removals calculated with equation 1. However, at this time there are no data from the charter fishery to indicate how effort might be affected by imposition of a size limit.

Method A and the hybrid method rely on size frequency data from the fishery. If these data are collected in a manner that biases estimation of average weight, or if the sampled points of landing are not representative of the actual sport harvest, the maximum size limits established using these approaches might be too high or too low. On the other hand, if the data are biased and the degree of bias is relatively consistent from year to year, there should be little net effect because the estimates of charter harvest and the allocations toward which they are measured are also based on these same size data. Appendix A provides an overview of the sampling programs to collect size data in Area 2C and Area 3A.

A Gap in Size Limit Methodology

Method A, Method B, and the hybrid method can all potentially be used to set maximum size limits when the fishery is being constrained. This would include scenarios in which a one-fish bag limit is already in place and a size limit is enacted for the first time, or a size limit is in place but needs to be reduced because of a decline in the amount of harvest allocated to the charter fleet. However, in situations where a size limit has been in place but needs to be increased to harvest a larger charter allocation, it is not clear how size frequency data from a previous year would be used under Method A or the hybrid method. Presumably, there would be a gap between the largest fish in the previous year's sample and the larger maximum size limit to be imposed. The approach the department suggests is along the line of the hybrid method, and is to calculate the average weight associated with a prospective size limit assuming that the proportion of fish smaller than the size limit (p_{UL} from equation 5) would be based on either the previous year's size limit, or based on the average of the previous year's size limit and the prospective size limit for the coming year. The choice of a method in this situation should be consistent with other situations, or confusing results could be obtained. For example, if Method A or the hybrid method were used to calculate a size limit in one year, and Method B was used to calculate a size limit in a subsequent year when the charter allocation was increased, the size limit dictated by Method B could be smaller than the limit from the previous year.

References

King, J. 2009. Issues in selecting a maximum length limit to manage charter halibut harvest in times of low abundance. Northern Economics, Inc., Anchorage. (July 6, 2009 version)

Clark, W. G. 1992. Validation of the IPHC length-weight relationship for halibut. International Pacific Halibut Commission, Report of Assessment and Research Activities 1991. Pages 113-116.

Table 1. Average net weights of halibut predicted for various maximum size limits L_{max} in IPHC areas 2C and 3A using Method A, Method B, and the Hybrid approach. Calculations for Method A and the hybrid method are based on 2010 length-frequency data from ADF&G creel surveys.

IPHC Area	L_{max} (inches)	Method A	Method B	Hybrid
2C	30	6.648	8.664	8.173
	31	7.156	9.635	8.897
	32	7.809	10.679	9.625
	33	8.256	11.798	10.342
	34	8.755	12.996	11.061
	35	9.200	14.276	11.778
	36	9.848	15.640	12.484
	37	10.277	17.092	13.177
	38	10.951	18.635	13.867
	39	11.406	20.271	14.546
	40	11.892	22.004	15.222
	41	12.466	23.837	15.880
	42	12.885	25.773	16.532
	43	13.348	27.814	17.176
	44	13.867	29.965	17.811
	45	14.406	32.228	18.420
	46	14.788	34.607	19.010
	47	15.373	37.105	19.579
	48	15.721	39.724	20.133
	49	16.400	42.468	20.662
	50	16.991	45.341	21.175
3A	30	7.022	8.664	8.192
	31	7.512	9.635	8.872
	32	8.245	10.679	9.510
	33	8.651	11.798	10.085
	34	9.208	12.996	10.598
	35	9.625	14.276	11.051
	36	10.125	15.640	11.438
	37	10.403	17.092	11.774
	38	10.753	18.635	12.071
	39	11.052	20.271	12.339
	40	11.246	22.004	12.583
	41	11.498	23.837	12.806
	42	11.637	25.773	13.013
	43	11.857	27.814	13.205
	44	11.968	29.965	13.388
	45	12.159	32.228	13.563
	46	12.308	34.607	13.727
	47	12.525	37.105	13.879
	48	12.601	39.724	14.024
	49	12.741	42.468	14.166
	50	12.987	45.341	14.296

Table 2. Maximum size limits specified for areas 2C and 3A using Method A, Method B, and the Hybrid method for hypothetical scenarios under which a size limit is required by the Catch Sharing Plan for IPHC areas 2C and 3A. Calculations for Method A and the hybrid method are based on 2010 length-frequency data from ADF&G creel surveys.

IPHC Area	Combined Catch Limit (M lb)	Charter Allocation	Charter Catch Limit (M lb)	Projected Harvest (no. fish)	Maximum Allowable Average Weight (lb)	Maximum Size Limit (inches)		
						Method A	Method B	Hybrid
2C	3.0	17.3%	0.519	50000	10.38	37	31	33
	4.0	17.3%	0.692	50000	13.84	43	34	37
	5.5	15.1%	0.831	50000	16.61	49	36	42
3A	6.0	15.4%	0.924	100000	9.24	34	30	31
	7.0	15.4%	1.078	100000	10.78	38	32	34
	8.5	15.4%	1.309	100000	13.09	50	34	42

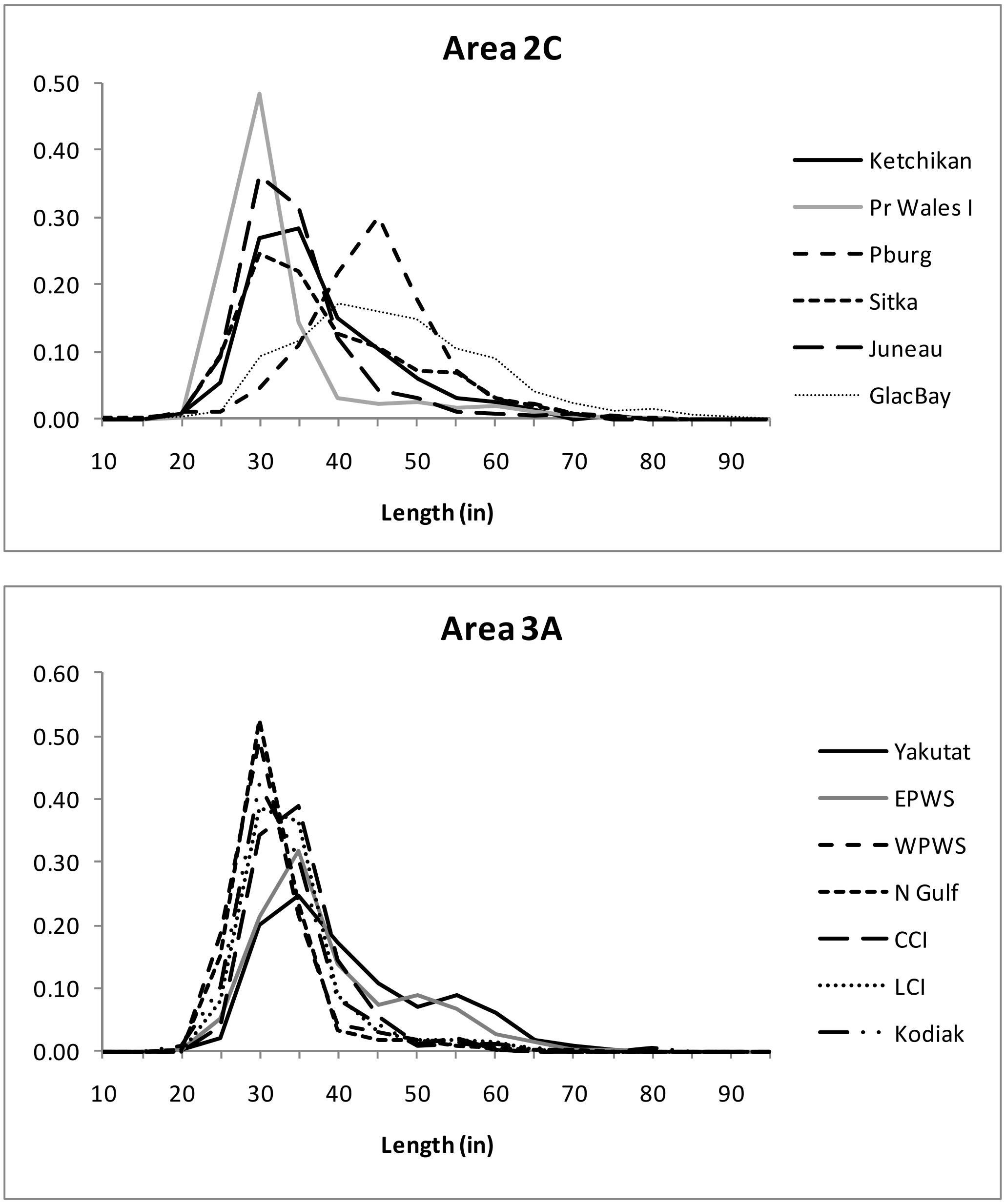

Figure 1. Relative size frequency distributions (proportion by size class) of charter harvest by subarea in Areas 2C and 3A, 2010 (subarea definitions are in Table A1 of Appendix A).

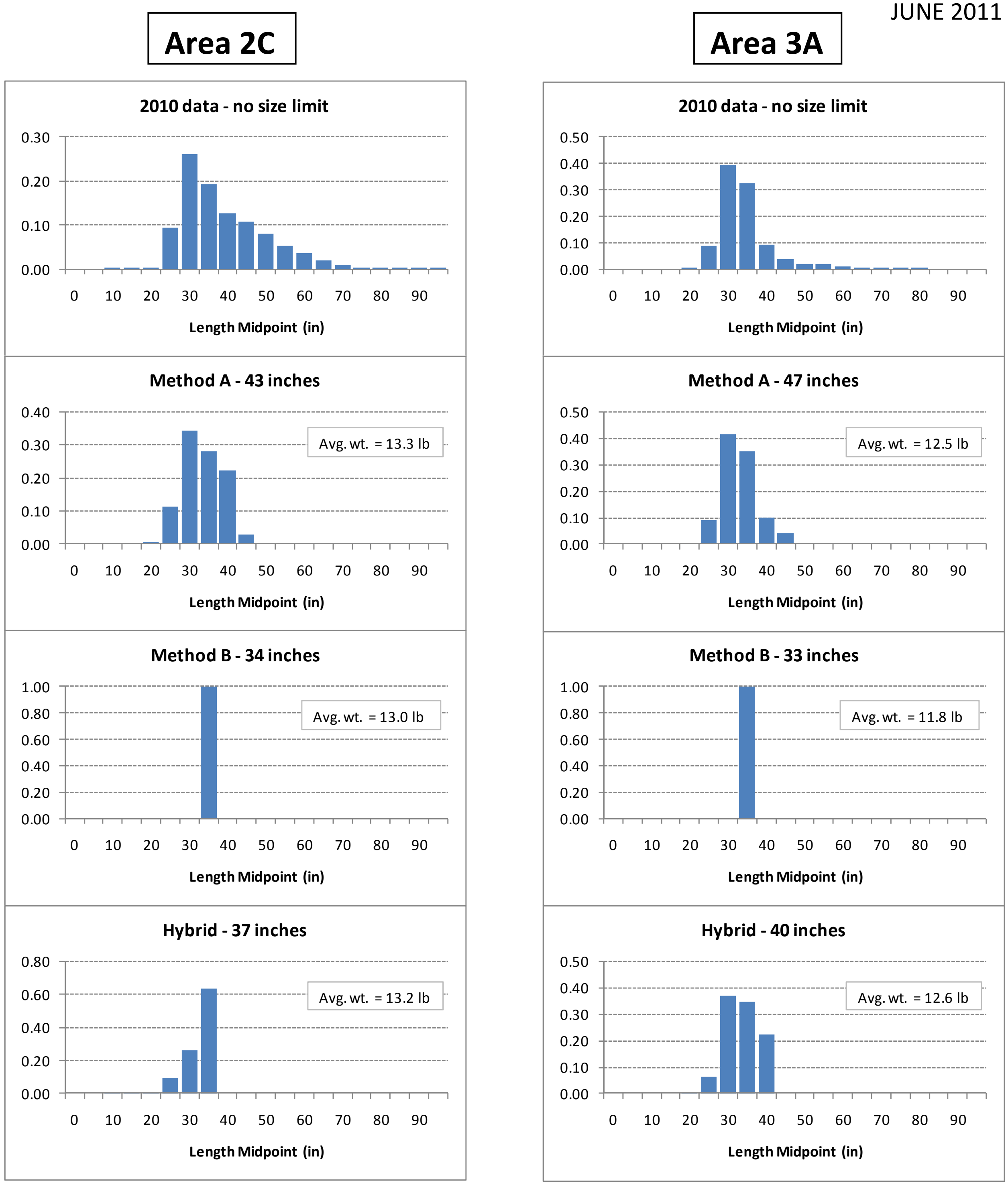

Figure 2. Examples of the assumed redistribution of charter halibut harvest using Method A, Method B, and the Hybrid method to achieve a target average weight of 13.84 lb in Area 2C and 12.6 lb in Area 3A. The graphs show the relative size frequency (proportion of harvest) distribution associated with the maximum size limit chosen by each method to be at or below the target average weight.

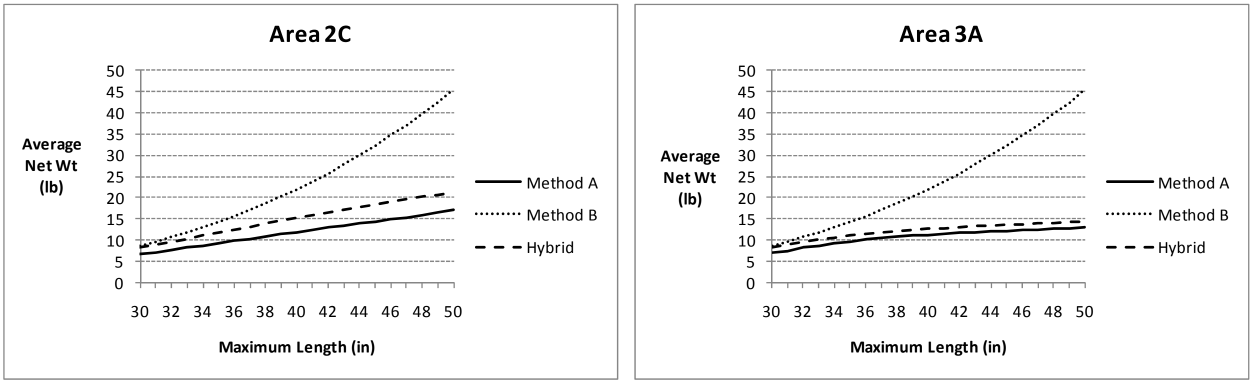

Figure 3. Average net weights of halibut predicted over a range of size limits for areas 2C and 3A using Method A, Method B, and the Hybrid method. These are the same data presented in Table 2 of this report.

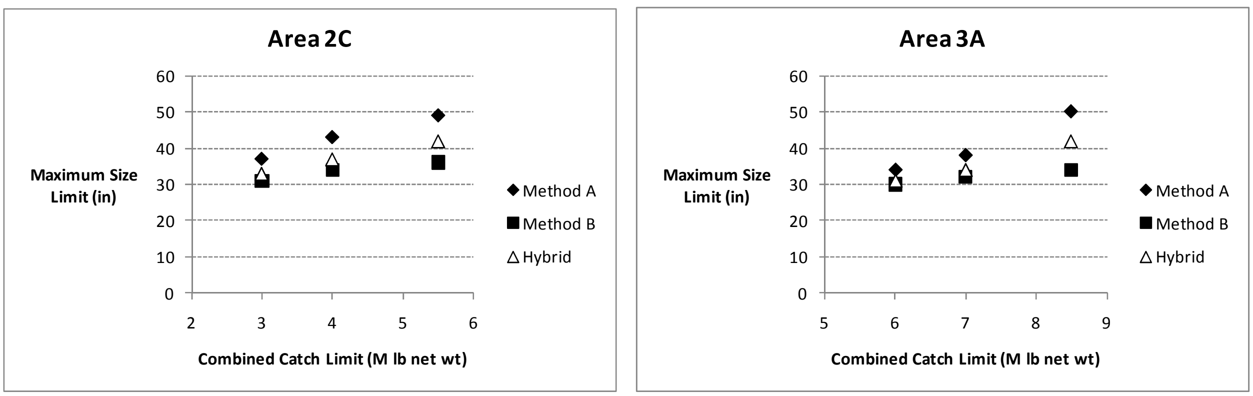

Figure 4. A comparison of maximum size limits specified using three different methods for hypothetical scenarios under which a size limit is required by the Catch Sharing Plan for IPHC areas 2C and 3A. These are the same data presented in Table 3 of this report.

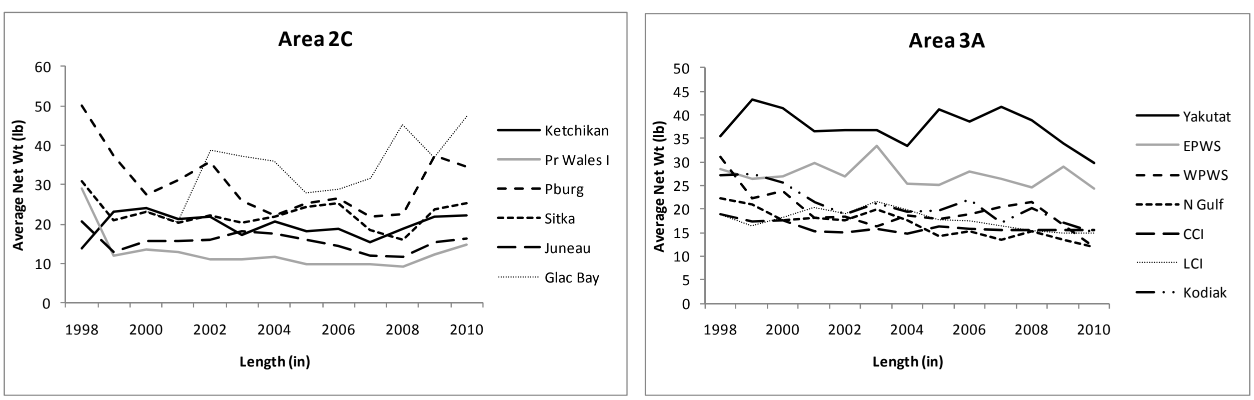

Figure 5. Plots showing the variability in estimated average net weight of charter harvest by subarea in IPHC areas 2C and 3A, 1998-2010 (subarea listings are in Appendix A).

Appendix A. Summary of Alaska Department of Fish and Game Creel Sampling Methods for Pacific Halibut

The halibut size frequency data used in the examples in this paper is obtained through ADF&G marine creel sampling programs located in Southeast and Southcentral Alaska. These programs have multiple objectives and acquire a variety of data on other species, including Chinook salmon, coho salmon, rockfishes, lingcod, and sharks. The objective of halibut sampling in each program is to estimate the average weight of the recreational harvest by sector (charter and non-charter) and by port. These estimated average weights are then used to calculate estimates of sport halibut harvest in pounds using equation 1 in this report.

Sampling is conducted at the major points of landing in each IPHC area. At least one port is sampled in each subarea of the IPHC areas (Table A1). These subareas correspond with ADF&G management areas or Statewide Harvest Survey reporting areas. This approach inherently assumes that the data collected at the sampled sites is representative of harvest within the corresponding subareas.

Sampling is conducted in Southeast Alaska from late April through late August or early September, depending on the port. The sampling season in Southcentral Alaska also varies by port, from mid-May or early June through August or early September. The choice of sampling dates for each port depends on the species sampled and objectives for each port, but the major period of halibut harvest is generally covered. In 2009, about 64 percent of the Area 2C charter halibut harvest was landed at ports sampled by ADF&G during the inclusive dates of sampling. Similarly, the Area 3A sampling coverage was 87 percent that year (Table A2).

The sampling design is generally a multistage approach, where the stages are days, locations, vessel-trips, and individual fish. To avoid subsampling bias, all fish of a given species or category are sampled from each boat party. If all of the harvest is not available, then none of the fish of that species or category from that boat party are included in the sample. The choice of sampling unit (boat-party) is not strictly probabilistic because of logistic constraints, but sampling is designed with the goal of selecting vessels in proportion to their effort.

Technicians measure fork length, from which the net weight of each fish is estimated using the IPHC length-weight relationship. Technicians also conduct skipper or angler interviews, recording effort and harvest and release of halibut. The reported number of halibut harvested from charter boats is validated when possible by directly counting fish, and the validation is used for subsequent evaluation of logbook accuracy. Sample sizes (number of measurements) for the charter sector over the last two years averaged 3,656 in Area 2C and 3,566 in Area 3A. Sample sizes for the non-charter sector averaged 3,250 in Area 2C and 2,434 in Area 3A over the same period.

Creel sampling of halibut for size data has been funded entirely by the State of Alaska since 2009.

Table A1. Subareas and corresponding ports sampled by the ADF&G for halibut size data from the recreational harvest, 2011.

IPHC Area	Subarea	Sampled Ports
2C	Ketchikan	Ketchikan
	Prince of Wales Island	Craig and Klawock
	Petersburg/Wrangell	Petersburg and Wrangell
	Sitka	Sitka
	Juneau	Juneau
	Haines/Skagway	Juneau
	Glacier Bay	Gustavus and Elfin Cove
3A	Yakutat	Yakutat
	E. William Sound	Valdez
	W. Prince William Sound	Whittier
	North Gulf Coast	Seward
	Central Cook Inlet	Deep Creek and Anchor Point beaches
	Lower Cook Inlet	Homer
	Kodiak	Kodiak city

Table A2. Sampling coverage, or the percentage of the charter harvest in each subarea that was landed at sites sampled by ADF&G during inclusive dates of creel surveys in 2009. Charter harvest is based on logbook data.

IPHC Area	Subarea	Sampling Coverage
2C	Ketchikan	82.8%
	Prince of Wales Island	36.6%
	Petersburg/Wrangell	70.2%
	Sitka	92.5%
	Juneau/Haines/Skagway	48.3%
	Glacier Bay	54.4%
	Total	64.2%
3A	Yakutat	84.5%
	E. PWS	94.0%
	W. PWS	86.9%
	North Gulf Coast	92.9%
	Central Cook Inlet	88.0%
	Lower Cook Inlet	93.4%
	Kodiak	33.1%
	Total	87.1%