

4.4 Regulatory area harvest policy calculations and catch tables

Ian J. Stewart

Abstract

This document reports the results of the application of the current International Pacific Halibut Commission (IPHC) harvest policy as well as additional information on fishing intensity and management alternatives for 2017. The IPHC fishery-independent setline survey legal-size (O32) Weight-Per-Unit-Effort (WPUE) is used to estimate the distribution of the stock available to the directed fisheries each year (Webster and Stewart 2017). The apportionment percentages and the target harvest rates for each regulatory area (21.5% for Areas 2A-3A, and 16.125% for Areas 3B-4CDE) together result in a target distribution for the annual TCEY. The scale of this distribution is based on the estimate of the coastwide exploitable biomass at the beginning of 2017 from the stock assessment. The Blue Line catch table is then calculated by solving for the area-specific Fishery Constant Exploitation Yield (FCEY) values that satisfy both the target scale and distribution of the coastwide Total Constant Exploitation Yield (TCEY) based on projections of all sources of O26 (over 26" (66 cm) in length) removals. Differing components of the O26 removals are included in the FCEY, along with commercial fishery landings, in Areas 2A-3A, depending on the Catch Sharing Plan (CSP) in place for each area. Catch tables including all sizes and sources of removals, (including U26) are presented for the 2017 Blue Line, and several other management alternatives corresponding to higher and lower levels of fishery and total removals. This analysis indicates that the 2017 Blue Line results in a slightly lower total TCEY (35.41 million lbs, ~16,060 t) than the Blue Line calculated in 2016 (36.31 million lbs, ~16,470 t) due to a small decrease in the exploitable biomass estimate from the stock assessment (181 million lbs, ~82,100 t). After accounting for changes in bycatch, wastage, and other sources of projected removals, the 2017 Blue Line results in increases in target FCEY values for four regulatory areas (3A, 3B, 4B, and 4CDE) relative to the 2015 results. An alternative based on the average fishing intensity over 20014-2016, the *status quo* SPR, results in an increase over the 2016 Blue Line in all Areas except 2A, and an increase over the 2016 adopted FCEYs for all Areas except 2A, 2B, and 2C. Additional management alternatives are also presented for comparison.

Introduction

This document reports the results of the application of the current IPHC harvest policy as well as information on fishing intensity and additional management alternatives for 2017. The analysis uses the results of both the most recent apportionment calculations (Webster and Stewart 2017) and stock assessment (Stewart and Hicks 2017).

In 2012, the IPHC began to more transparently delineate between the results of scientific analyses (apportionment and the stock assessment) and the application of harvest policy and management decisions resulting in annual catch limits. To that end, the stock assessment reports estimates of current stock size, recent trends, and projections based on a range of alternative harvest levels and distributions. Those results are summarized in a risk assessment, the Harvest Decision

Table, based on the response of several stock and fishery metrics to these management alternatives. To provide consistency with previous year's catch advice, the Blue Line alternative represents the application of the IPHC's current harvest policy to the results of the survey-based apportionment and stock assessment analyses. For 2017, an additional alternative is reported representing the average level of fishing intensity over the period 2014-16: the *status quo* Spawning Potential Ratio (SPR). Several other alternative harvest levels representing lower and higher levels of removals are also presented.

Apportionment results

Based on the most recent setline survey observations available (Webster and Stewart 2017), the current O32 halibut biomass is estimated to be roughly divided into thirds: one-third in Area 2 (2A, 2B, and 2C), one-third in Area 3A, and one-third in Areas 3B-4CDE (Table 1). These percentages for 2017 provide the basis for the application of the harvest policy and other alternatives described below.

Harvest policy

The current harvest policy for Pacific halibut is based on two non-independent harvest targets: the scale of that harvest at the coastwide level (which is inferred from the individual Regulatory Area targets), and the distribution of harvest among regulatory areas. Only O26 removals are explicitly included in these calculations; however, the target harvest rates implicitly include a constant level of U26 mortality consistent with the period over which the rates were developed (Hare 2011). The current target harvest rates are area-specific: 21.5% in Areas 2A, 2B, 2C and 3A, and 16.125% to Areas 3B, 4A, 4B, and 4CDE. The combination of the apportionment results and the relative target harvest rates yields a target distribution for the coastwide TCEY (Table 1).

Because the harvest policy is defined at the area-specific level, the results of apportionment calculations are needed to evaluate the harvest intensity, even though the assessment is conducted at a coastwide scale. Specifically, the coastwide assessment of exploitable biomass is first apportioned to area, and then area-specific catch limits are aggregated back to the coastwide level (Fig. 1). The harvest policy also includes a Harvest Control Rule (HCR), which does not change the distribution of harvest among regulatory areas, but reduces the target harvest rates (for all areas) at low stock sizes. Specifically, if the stock (measured as the female spawning biomass) is estimated to have fallen below 30% of the equilibrium stock size in the absence of fishing ($SB_{30\%}$; defined relative to historically good size-at-age and recruitment in a relatively unproductive environmental regime, Clark and Hare 2006), the target harvest rates are decreased linearly such that there would be no fishing mortality below 20% relative female spawning biomass (Fig. 2). This policy was designed to provide a constant harvest rate that would avoid decreasing the stock below $SB_{30\%}$ with a relatively high frequency, and still provide a large fraction of the maximum sustainable yield available.

Results for 2016

The 2016 stock assessment (Stewart and Hicks 2017) estimated a slightly smaller exploitable biomass at the beginning of 2017 (181 million lbs, ~82,100 t) than was estimated for the terminal year of the previous assessment. This value is very uncertain, due to uncertainty both within and among individual models included in the assessment. There is no specific accounting for this

uncertainty built in to the current harvest policy; however, the cumulative probability distribution indicates plausible values of the 2017 exploitable biomass ranging from less than 150 million lbs (~68,040 t) to almost 250 million lbs (~113,400 t; [Fig. 3](#)). The time-series of assessment results indicate that relative harvest rates have exceeded the harvest policy target at the coastwide level since the early 2000s, although these rates have been decreasing for the last five years ([Fig. 4](#)). When considered with the current apportionment estimates for each year, very high historical relative exploitation rates are hind-cast for Areas 2A, 2B, and 2C ([Fig. 5](#)). Rates are also estimated to have been above the target levels in recent years, with Areas 3B, 4A, 4B, and 4CDE very close to targets in 2016.

In 2016, adopted FCEYs ([Table 2](#)) were projected to result in harvest rates lower than the preceding years, but still above the coastwide target ([Fig. 4](#)). The adopted limits for 2015 were projected to have a greater proportion of the TCEY distributed to Areas 2B and 4B than would be consistent with the current harvest policy ([Fig. 6](#)). Based on the final estimates of removals available for 2016 ([Table 3](#)), the realized harvest rate was only slightly higher than projected, and lower than previous year's estimates ([Fig. 4](#)). This was due to a small decrease in the actual vs. projected 2016 O26 removals, resulting in a decrease in the coastwide harvest rate for the fifth year in a row.

Application of the current harvest policy to the apportionment and assessment results produces the Blue Line area-specific TCEY values. FCEYs are then calculated such that all O26 removals sum to the TCEY target within each regulatory area and at the coastwide level. Based on the distribution of biomass at the beginning of 2016, the effective coastwide harvest rate is estimated to be 19.6% ([Table 1](#)). The coastwide TCEY is therefore 35.41 million lbs (~16,060 t, [Table 4](#)). In order to calculate the FCEY, 2016 levels of bycatch, subsistence and personal use, and unguided recreational removals in Alaska are projected to remain constant through 2017. Commercial wastage was scaled proportional to the change in fishery landings, based on the rates estimated for 2016. The Catch Sharing Plans (CSPs) adopted in Areas 2C and 3A in 2014 included the charter recreational removals and wastage along with the directed fishery landings and O26 wastage in the FCEY (and not just the directed fishery landings, as was the case prior to 2014).

The projected total removals for the 2017 Blue Line ([Table 4](#)) are slightly smaller than those from the 2016 Blue Line ([Table 5](#)). After accounting for changes in bycatch, wastage, and other sources of removals that are deducted from the TCEY before the calculation of the FCEY, the 2017 Blue Line results in increases in target FCEY values for four regulatory areas (3A, 3B, 4B, and 4CDE) relative to the 2016 Blue Line results. When compared to the 2016 adopted FCEYs, the total 2017 Blue Line is lower; however larger FCEY values are projected for two regulatory areas (3B, and 4CDE). The relatively small increase in the FCEY for Area 4CDE reflects the offsetting reduction in the TCEY (a function of the smaller stock size estimate) and a reduction in O26 bycatch ([Table 7](#)). In Area 3A, the TCEY estimate was larger for the 2017 Blue Line than the 2016 Blue Line ([Table 7](#)).

Additional management alternatives

Results for alternate rows from the decision table with 30 million lbs (~13,610 t) and 50 million lbs (~22,680 t) of total mortality are presented in [Tables 8](#) and [9](#). Based on the analysis of all sources of removals, it is possible to use the estimated Spawning Potential Ratio (*SPR*), to measure the total fishing intensity exerted on the stock. *SPR* represents the ratio of equilibrium spawning biomass per recruit for any level of fishing relative to the equilibrium spawning biomass per recruit

in the absence of any fishing mortality. *SPR* is often reported in terms of $F_{xx\%}$, where the percentage refers to the percent of unexploited equilibrium; e.g., no fishing mortality would correspond to $F_{100\%}$. See Hicks and Stewart 2017 for a more thorough description of this concept and its potential use in an improved IPHC harvest policy.

Based on the stock assessment results, the 2017 Blue Line has a fishing intensity of $F_{48\%}$; a value equal to the average estimated for the period 2014-16. This value would be the analog of the 19.6% exploitation fraction indicated by the current harvest policy, but includes all sources of removals regardless of size. Using the 2017 Blue Line as a relative target, a summary of recent fishing intensity suggests a very similar pattern to that inferred from the current harvest policy: harvest rates in excess of target levels, but decreasing in recent years as management actions have reduced the removals from the population (Fig. 7). *SPR* can also be used to find the FCEYs for 2016 that would result in the same level of overall fishing intensity that was estimated to have occurred during the period 2014-2016, the *status quo* *SPR* ($F_{46\%}$). This alternative could be considered the *de facto* harvest policy, as it represents the fishing intensity resulting from recent Commission decisions. Using this rate to determine the scale of coastwide removals, and then distributing those removals consistently with both apportionment and the target harvest rates results in higher removals than the 2017 Blue Line (Table 10, Fig. 7), only slightly lower in aggregate than the 2016 adopted catch limits (Tables 6-7).

Given uncertainty in the inputs to and performance of the current harvest policy (Hicks and Stewart 2017), an additional option for evaluating relative harvest rates is presented here. Consider that we are interested in a measure of exploitation (U) in each year (y) and area (a) that is independent of the concept of exploitable biomass, and is based only on data, rather than assessment output. In this case we want the metric to be proportional to the O26 catch (C) and some measure of the biomass (B):

$$U_{y,a} \sim \frac{C_{y,a}}{B_{y,a}}$$

The biomass can be a function of the observed survey index (I) and an unknown catchability parameter (q):

$$B_{y,a} = q_{y,a} \cdot I_{y,a}$$

And finally, the survey index is a function of the observed O32 WPUE and the geographic extent (A) of each Area:

$$I_{y,a} = WPUE_{y,a} \cdot A_a$$

For this simple example, the first equation holds as long as the value for the catchability parameter is constant (or at least non-trending) across years and constant among areas. This assumes that survey timing and hook competition (accounted for in the space-time modelling of WPUE; Webster 2017) are the most important factors influencing potential differences among Areas. Alternative formulations of this calculation could be made using O26 survey WPUE, commercial fishery WPUE, or allowing catchability to vary over time and/or areas.

Given this approximation, and an unknown constant value for catchability, the absolute scale of the exploitation intensity is unknown. Therefore, to compare across years all U s were scaled relative to the average over the period 2014-2016, providing a metric of relative exploitation rates. Higher U s are estimated (especially historically) for Areas 2A-2C (consistent with the higher target

rates in that area), and the U s in all Areas have decreased in the last few years (Fig. 8). If the ratio of harvest rates in Areas 2A-3A (21.5%) to 3B-4CDE (16.125%) is used to scale the annual U s for all Areas to an average value of 1.0 in each year, then departures from the distribution consistent with the current harvest policy can be seen more clearly. In this case it is clear that the distribution of historical U s in Areas 2B and 2C were greater than the current targets in some years, while Areas 3A, 4A, and 4B were generally lower than current targets (Fig. 9).

References

- Clark, W. G., and Hare, S. R. 2006. Assessment and management of Pacific halibut: data, methods, and policy. Int. Pac. Halibut Comm. Sci. Rep. No. 83. 104 p.
- Hare, S. R. 2011. Potential modifications to the IPHC harvest policy. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 2010: 177-200.
- Hicks, A. C., and Stewart, I. J. 2017. An investigation of the current IPHC harvest policy and potential improvements. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 2016. IPHC-2016-RARA-26-R: 421-438.
- Stewart, I. J., and Hicks, A. C. 2017. Assessment of the Pacific halibut stock at the end of 2016. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 2016. IPHC-2016-RARA-26-R: 365-394.
- Webster, R. A. 2017. Results of space-time modelling of IPHC fishery-independent setline survey WPUE and NPUE data. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 2016. IPHC-2016-RARA-26-R: 241-257.
- Webster, R. A. and Stewart, I. J. 2017. Setline survey-based apportionment estimates. Int. Pac. Halibut Comm. Report of Assessment and Research Activities 2016. IPHC-2016-RARA-26-R: 395-402.

Table 1. Results of survey-based apportionment calculations for 2017 (see Webster and Stewart, 2017 for details), target harvest rates and target TCEY distribution from the current harvest policy.

	2A	2B	2C	3A	3B	4A	4B	4CDE	Total
Apportionment	2.2%	14.1%	15.0%	32.2%	13.6%	5.7%	4.5%	12.6%	100.0%
Target harvest rate	21.5%	21.5%	21.5%	21.5%	16.1%	16.1%	16.1%	16.1%	19.6%
Target TCEY Distribution	2.5%	15.6%	16.6%	35.4%	11.2%	4.7%	3.7%	10.4%	100.0%

Table 2. Catch table projected for 2016 (from the 2015 assessment) based on the adopted FCEYs. All values reported in millions of net pounds.

	2A	2B	2C	3A	3B	4A	4B	4CDE	Total
<u>O26 Non-FCEY</u>									
Comm. wastage	0.03	0.24	NA	NA	0.19	0.07	0.04	0.06	0.61
Bycatch	0.09	0.30	0.02	1.44	0.48	0.47	0.19	2.27	5.26
Sport (+ wastage)	NA	NA	1.14	1.48	0.01	0.02	0.00	0.00	2.65
Pers./Subs.	NA	0.41	0.43	0.23	0.02	0.01	0.00	0.08	1.17
Total Non-FCEY	0.12	0.94	1.59	3.15	0.70	0.56	0.23	2.41	9.70
<u>O26 FCEY</u>									
Comm. wastage	NA	NA	0.12	0.45	NA	NA	NA	NA	0.57
CSP Sport (+wastage)	0.46	1.13	0.91	1.81	NA	NA	NA	NA	4.31
Pers./Subs.	0.03	NA	NA	NA	NA	NA	NA	NA	0.03
Comm. Landings	0.65	6.17	3.92	7.33	2.71	1.39	1.14	1.66	24.98
Total FCEY	1.14	7.30	4.95	9.60	2.71	1.39	1.14	1.66	29.89
TCEY	1.26	8.24	6.54	12.75	3.41	1.95	1.37	4.07	39.59
<u>U26</u>									
Comm. wastage	0.00	0.01	0.01	0.02	0.03	0.01	0.00	0.01	0.07
Bycatch	0.00	0.03	0.00	0.64	0.18	0.19	0.04	1.15	2.24
Total U26	0.00	0.04	0.01	0.67	0.21	0.20	0.04	1.15	2.31
Total Mortality	1.26	8.28	6.55	13.42	3.62	2.15	1.41	5.22	41.91

Table 3. Estimated removals for 2016 based on data through 11 November, 2016. All values reported in millions of net pounds.

	2A	2B	2C	3A	3B	4A	4B	4CDE	Total
<u>O26 Non-FCEY</u>									
Comm. wastage	0.04	0.23	NA	NA	0.21	0.05	0.06	0.07	0.64
Bycatch	0.10	0.24	0.03	1.34	0.65	0.32	0.14	1.84	4.64
Sport (+ wastage)	NA	NA	1.33	1.56	0.01	0.01	0.00	0.00	2.91
Pers./Subs.	NA	0.41	0.43	0.23	0.02	0.01	0.00	0.08	1.17
Total Non-FCEY	0.14	0.87	1.79	3.13	0.88	0.38	0.20	1.98	9.36
<u>O26 FCEY</u>									
Comm. wastage	NA	NA	0.12	0.36	NA	NA	NA	NA	0.48
CSP Sport (+wastage) ¹	0.51	1.09	0.88	2.00	NA	NA	NA	NA	4.48
Pers./Subs.	0.03	NA	NA	NA	NA	NA	NA	NA	0.03
Comm. Landings ²	0.64	6.14	4.01	7.52	2.75	1.38	1.12	1.48	25.03
Total FCEY	1.17	7.23	5.01	9.88	2.75	1.38	1.12	1.48	30.01
TCEY	1.31	8.09	6.80	13.01	3.62	1.76	1.32	3.47	39.37
<u>U26</u>									
Comm. wastage	0.00	0.00	0.00	0.01	0.03	0.01	0.00	0.00	0.06
Bycatch	0.00	0.02	0.00	0.71	0.33	0.22	0.01	1.17	2.45
Total U26	0.00	0.02	0.00	0.72	0.36	0.22	0.01	1.18	2.51
Total Mortality	1.31	8.12	6.80	13.73	3.98	1.98	1.33	4.64	41.89

¹ Includes commercial fish leased to the recreational sector: XRQ in Area 2B and Guided Angler Fish (GAF) in Areas 2C and 3A.

² Includes overage/underage and research catches.

Table 4. Catch table projected for the 2017 Blue Line. All values reported in millions of net pounds.

	2A	2B	2C	3A	3B	4A	4B	4CDE	Total
<u>O26 Non-FCEY</u>									
Comm. Wastage	0.02	0.15	NA	NA	0.23	0.04	0.06	0.08	0.58
Bycatch	0.10	0.24	0.03	1.34	0.65	0.32	0.14	1.84	4.64
Sport (+ wastage)	NA	NA	1.33	1.56	0.01	0.01	0.00	0.00	2.91
Pers./Subs.	NA	0.41	0.43	0.23	0.02	0.01	0.00	0.08	1.17
Total Non-FCEY	0.12	0.79	1.79	3.13	0.90	0.38	0.20	1.99	9.29
<u>O26 FCEY</u>									
Comm. Wastage	NA	NA	0.09	0.35	NA	NA	NA	NA	0.44
CSP Sport (+wastage)	0.34	0.73	0.75	1.78	NA	NA	NA	NA	3.59
Pers./Subs.	0.03	NA	NA	NA	NA	NA	NA	NA	0.03
Comm. Landings	0.38	3.99	3.24	7.28	3.08	1.28	1.12	1.69	22.05
Total FCEY	0.75	4.72	4.08	9.41	3.08	1.28	1.12	1.69	26.12
TCEY	0.87	5.51	5.86	12.53	3.98	1.66	1.32	3.68	35.41
<u>U26</u>									
Comm. wastage	0.00	0.00	0.00	0.01	0.03	0.01	0.00	0.00	0.06
Bycatch	0.00	0.02	0.00	0.71	0.33	0.22	0.01	1.17	2.45
Total U26	0.00	0.02	0.00	0.72	0.36	0.22	0.01	1.18	2.52
Total Mortality	0.87	5.53	5.86	13.25	4.34	1.89	1.33	4.86	37.93

Table 5. Catch table projected for the 2016 Blue Line (from the 2015 assessment). All values reported in millions of net pounds.

	2A	2B	2C	3A	3B	4A	4B	4CDE	Total
<u>O26 Non-FCEY</u>									
Comm. wastage	0.02	0.17	NA	NA	0.19	0.06	0.03	0.06	0.53
Bycatch	0.09	0.30	0.02	1.44	0.48	0.47	0.19	2.27	5.26
Sport (+ wastage)	NA	NA	1.14	1.48	0.01	0.02	0.00	0.00	2.65
Pers./Subs.	NA	0.41	0.43	0.23	0.02	0.01	0.00	0.08	1.17
Total Non-FCEY	0.12	0.88	1.59	3.15	0.70	0.56	0.22	2.41	9.62
<u>O26 FCEY</u>									
Comm. wastage	NA	NA	0.11	0.44	NA	NA	NA	NA	0.55
CSP Sport (+wastage)	0.44	0.81	0.85	1.75	NA	NA	NA	NA	3.84
Pers./Subs.	0.03	NA	NA	NA	NA	NA	NA	NA	0.03
Comm. Landings	0.55	4.41	3.66	7.09	2.71	1.30	0.92	1.64	22.28
Total FCEY	1.02	5.22	4.62	9.27	2.71	1.30	0.92	1.64	26.70
TCEY	1.13	6.10	6.21	12.43	3.41	1.85	1.14	4.05	36.31
<u>U26</u>									
Comm. wastage	0.00	0.00	0.00	0.02	0.03	0.01	0.00	0.01	0.07
Bycatch	0.00	0.03	0.00	0.64	0.18	0.19	0.04	1.15	2.24
Total U26	0.00	0.04	0.00	0.67	0.21	0.20	0.04	1.15	2.31
Total Mortality	1.14	6.13	6.22	13.09	3.62	2.05	1.17	5.20	38.63

Table 6. Comparison of FCEY values (M lb).

	2A	2B	2C	3A	3B	4A	4B	4CDE	Total
2014 Blue Line	0.72	4.98	4.16	9.43	2.84	0.85	0.82	0.64	24.45
2015 Blue Line	0.75	4.96	4.30	10.10	2.46	1.39	0.73	0.52	25.22
2016 Blue Line	1.02	5.22	4.62	9.27	2.71	1.30	0.92	1.64	26.70
2016 Adopted	1.14	7.30	4.95	9.60	2.71	1.39	1.14	1.66	29.89
2017 Blue Line	0.75	4.72	4.08	9.41	3.08	1.28	1.12	1.69	26.12
2017 <i>status quo</i> SPR	0.84	5.28	4.69	10.72	3.46	1.45	1.25	2.05	29.73

Table 7. Comparison of TCEY values (M lb).

	2A	2B	2C	3A	3B	4A	4B	4CDE	Total
2014 Blue Line	0.86	5.72	5.47	12.06	3.74	1.56	1.16	2.91	33.48
2015 Blue Line	0.84	5.75	5.85	13.00	3.51	1.95	1.10	3.48	35.48
2016 Blue Line	1.13	6.10	6.21	12.43	3.41	1.85	1.14	4.05	36.31
2017 Blue Line	0.87	5.51	5.86	12.53	3.98	1.66	1.32	3.68	35.41
2017 <i>status quo</i> SPR	0.96	6.08	6.47	13.84	4.39	1.84	1.46	4.06	39.10

Table 8. Catch table projected based on achieving a 30 million lbs (~13,610 t) total mortality in 2017. All values reported in millions of net pounds.

	2A	2B	2C	3A	3B	4A	4B	4CDE	Total
<u>O26 Non-FCEY</u>									
Comm. wastage	0.02	0.11	NA	NA	0.17	0.03	0.04	0.04	0.41
Bycatch	0.10	0.24	0.03	1.34	0.65	0.32	0.14	1.84	4.64
Sport (+ wastage)	NA	NA	1.33	1.56	0.01	0.01	0.00	0.00	2.91
Pers./Subs.	NA	0.41	0.43	0.23	0.02	0.01	0.00	0.08	1.17
Total Non-FCEY	0.11	0.75	1.79	3.13	0.84	0.37	0.19	1.96	9.13
<u>O26 FCEY</u>									
Comm. wastage	NA	NA	0.06	0.25	NA	NA	NA	NA	0.31
CSP Sport (+wastage)	0.25	0.55	0.51	1.25	NA	NA	NA	NA	2.55
Pers./Subs.	0.03	NA	NA	NA	NA	NA	NA	NA	0.03
Comm. Landings	0.28	2.98	2.20	5.11	2.25	0.93	0.84	0.90	15.49
Total FCEY	0.56	3.53	2.77	6.61	2.25	0.93	0.84	0.90	18.38
TCEY	0.67	4.28	4.55	9.73	3.09	1.29	1.02	2.86	27.50
<u>U26</u>									
Comm. wastage	0.00	0.00	0.00	0.01	0.02	0.00	0.00	0.00	0.04
Bycatch	0.00	0.02	0.00	0.71	0.33	0.22	0.01	1.17	2.45
Total U26	0.00	0.02	0.00	0.71	0.35	0.22	0.01	1.18	2.50
Total Mortality	0.68	4.30	4.55	10.45	3.44	1.51	1.03	4.03	30.00

Table 9. Catch table projected based on achieving a 50 million lbs (~22,680 t) total mortality in 2017. All values reported in millions of net pounds.

	2A	2B	2C	3A	3B	4A	4B	4CDE	Total
<u>O26 Non-FCEY</u>									
Comm. wastage	0.03	0.20	NA	NA	0.32	0.06	0.08	0.13	0.83
Bycatch	0.10	0.24	0.03	1.34	0.65	0.32	0.14	1.84	4.64
Sport (+ wastage)	NA	NA	1.33	1.56	0.01	0.01	0.00	0.00	2.91
Pers./Subs.	NA	0.41	0.43	0.23	0.02	0.01	0.00	0.08	1.17
Total Non-FCEY	0.13	0.84	1.79	3.13	1.00	0.40	0.22	2.05	9.55
<u>O26 FCEY</u>									
Comm. wastage	NA	NA	0.14	0.52	NA	NA	NA	NA	0.66
CSP Sport (+wastage)	0.44	1.01	0.96	2.39	NA	NA	NA	NA	4.81
Pers./Subs.	0.03	NA	NA	NA	NA	NA	NA	NA	0.03
Comm. Landings	0.56	5.53	4.96	10.76	4.33	1.83	1.54	2.88	32.40
Total FCEY	1.03	6.54	6.07	13.67	4.33	1.83	1.54	2.88	37.90
TCEY	1.16	7.38	7.86	16.79	5.33	2.23	1.77	4.93	47.45
<u>U26</u>									
Comm. wastage	0.00	0.00	0.00	0.02	0.05	0.01	0.00	0.01	0.09
Bycatch	0.00	0.02	0.00	0.71	0.33	0.22	0.01	1.17	2.45
Total U26	0.00	0.02	0.00	0.73	0.37	0.22	0.01	1.18	2.54
Total Mortality	1.17	7.40	7.86	17.52	5.71	2.45	1.78	6.11	50.00

Table 10. Catch table projected for 2017 based on the *status quo* SPR ($F_{46\%}$; the average over 2014-2016); maintaining the same level fishing intensity. All values reported in millions of net pounds.

	2A	2B	2C	3A	3B	4A	4B	4CDE	Total
<u>O26 Non-FCEY</u>									
Comm. wastage	0.03	0.16	NA	NA	0.26	0.05	0.06	0.09	0.65
Bycatch	0.10	0.24	0.03	1.34	0.65	0.32	0.14	1.84	4.64
Sport (+ wastage)	NA	NA	1.33	1.56	0.01	0.01	0.00	0.00	2.91
Pers./Subs.	NA	0.41	0.43	0.23	0.02	0.01	0.00	0.08	1.17
Total Non-FCEY	0.12	0.81	1.79	3.13	0.93	0.38	0.21	2.01	9.37
<u>O26 FCEY</u>									
Comm. wastage	NA	NA	0.11	0.40	NA	NA	NA	NA	0.51
CSP Sport (+wastage)	0.38	0.82	0.86	1.89	NA	NA	NA	NA	3.94
Pers./Subs.	0.03	NA	NA	NA	NA	NA	NA	NA	0.03
Comm. Landings	0.43	4.46	3.72	8.42	3.46	1.45	1.25	2.05	25.25
Total FCEY	0.84	5.28	4.69	10.72	3.46	1.45	1.25	2.05	29.73
TCEY	0.96	6.08	6.47	13.84	4.39	1.84	1.46	4.06	39.10
<u>U26</u>									
Comm. wastage	0.00	0.00	0.00	0.02	0.04	0.01	0.00	0.00	0.07
Bycatch	0.00	0.02	0.00	0.71	0.33	0.22	0.01	1.17	2.45
Total U26	0.00	0.02	0.00	0.72	0.37	0.22	0.01	1.18	2.52
Total Mortality	0.96	6.11	6.48	14.56	4.76	2.06	1.47	5.24	41.63

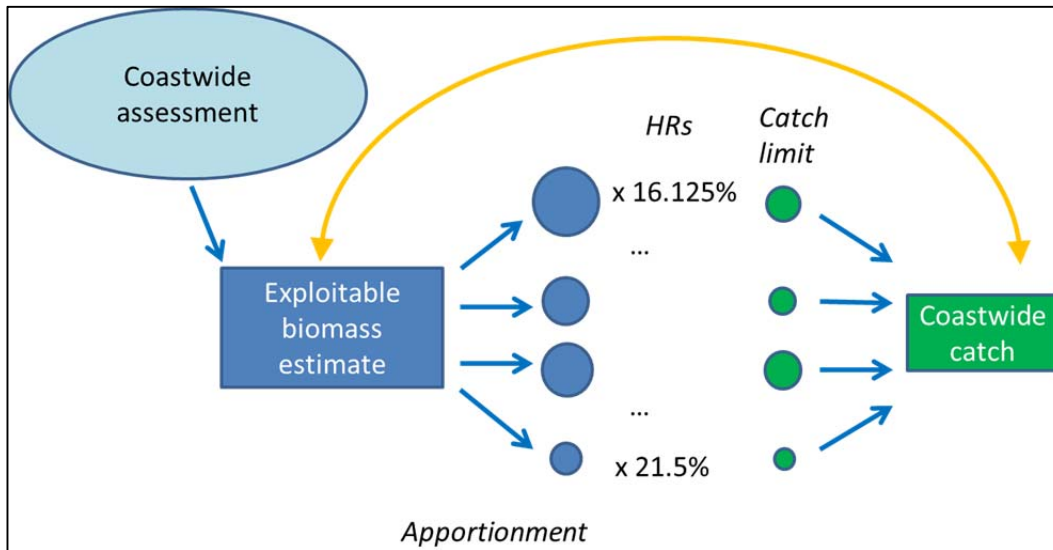


Figure 1. Illustration of the method for calculating the coastwide harvest rate target based on the IPHC’s current harvest policy.

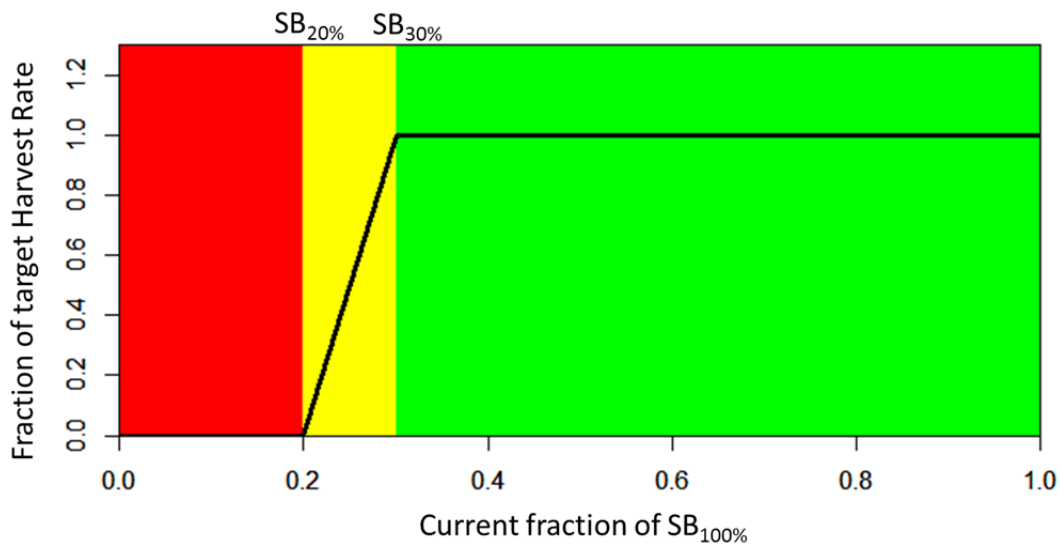


Figure 2. Current IPHC harvest control rule for determining the relative target harvest rate to apply in each regulatory area, as a function of the coastwide relative spawning biomass.

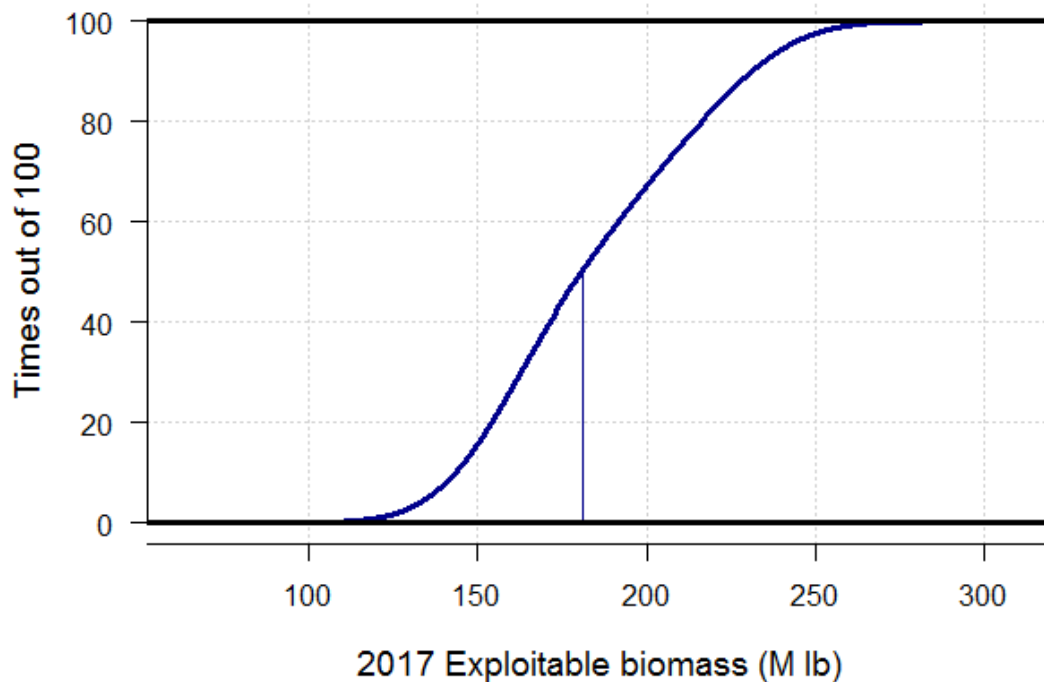


Figure 3. Cumulative distribution of 2017 exploitable biomass estimates including model and estimation uncertainty, but not uncertainty in the selectivity curve generating the calculation. Curve represents the estimated probability that the biomass is less than or equal to the value on the x-axis. Vertical line indicates the median value (181 million lbs, ~82,100 t).

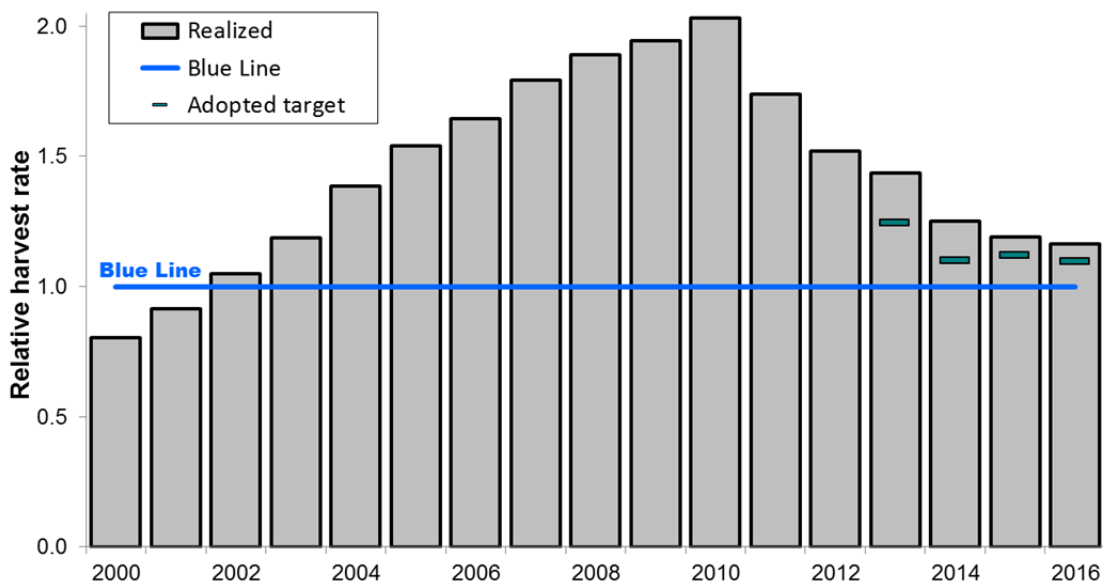


Figure 4. Time-series of estimated coastwide harvest rates (bars) relative to the annual harvest rate targets (line) from the current harvest policy. Values are hind-cast based on the current ensemble estimates of exploitable biomass, not the estimates available each year. Dashes indicate the projected harvest rate (at the time) from the 2013-2016 adopted catch limits.

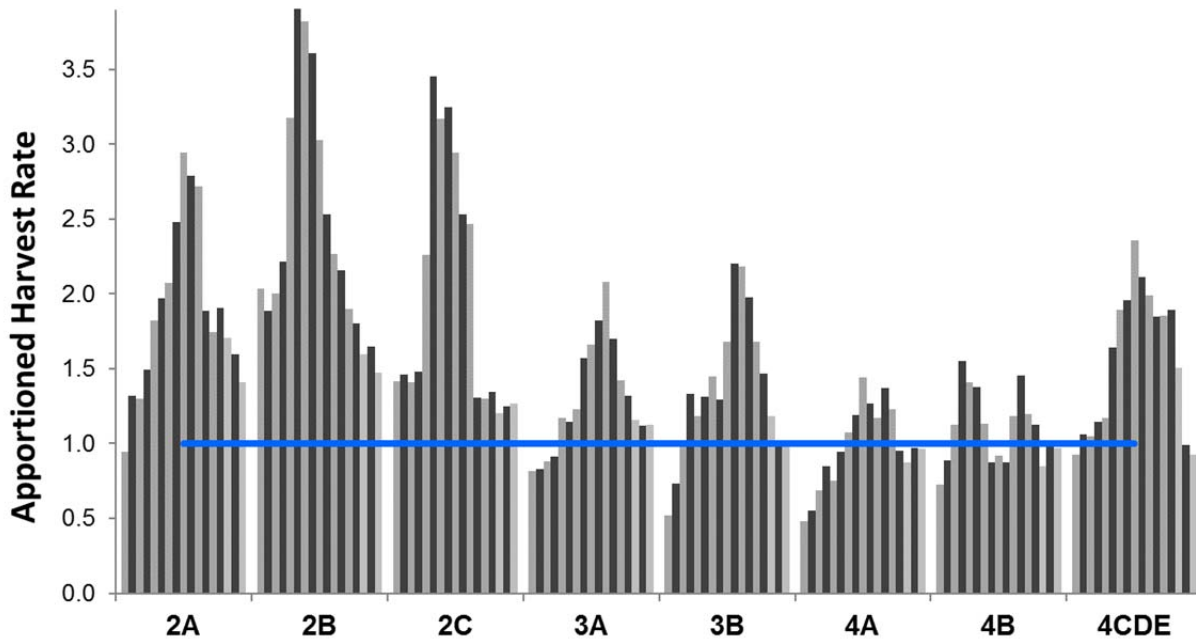


Figure 5. Estimated area-specific harvest rates from 2000 to 2016 (bars) relative to the annual harvest rate targets (line) from the current harvest policy. Values are hind-cast based on the current ensemble estimates of coastwide exploitable biomass and apportionment results.

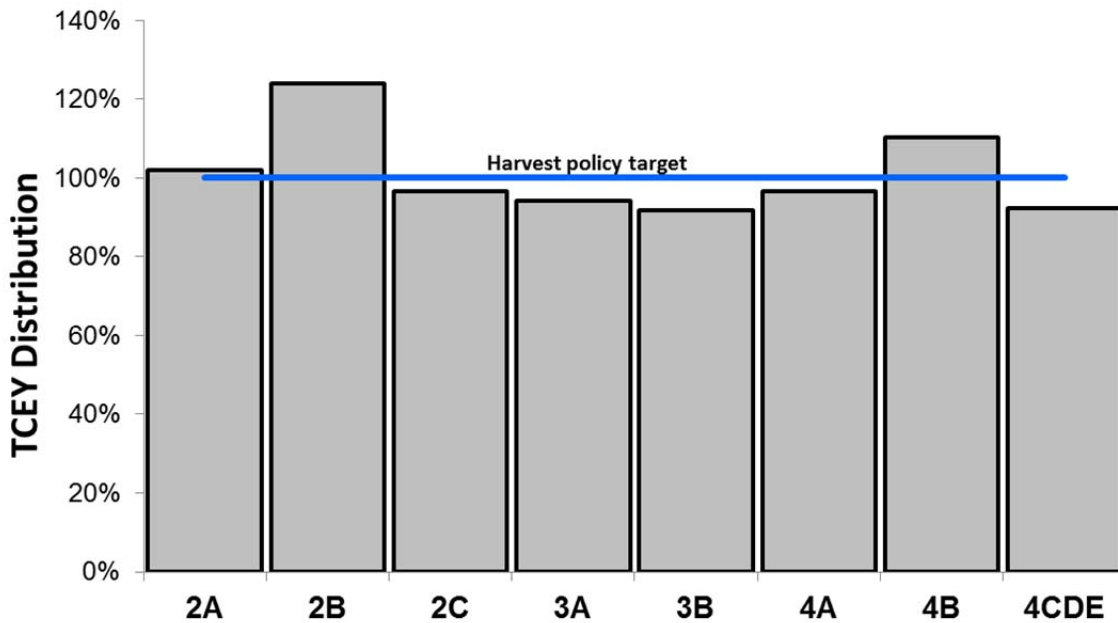


Figure 6. Distribution of the 2016 TCEY projected at the time the catch limits were adopted.

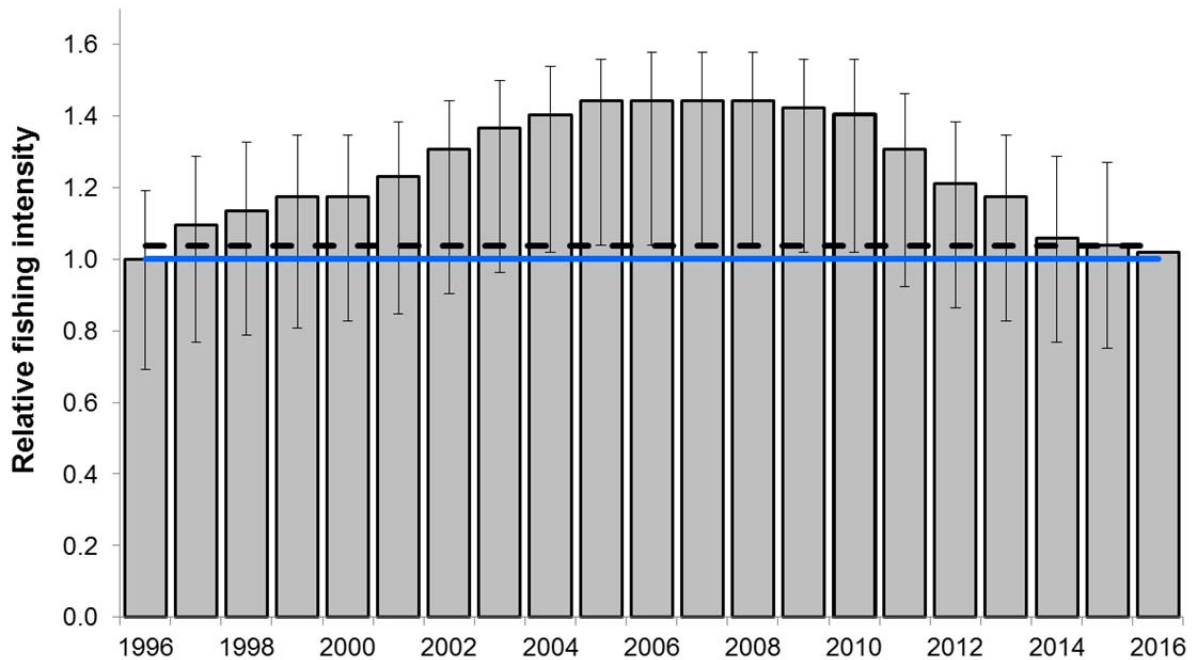


Figure 7. Time-series of estimated coastwide harvest rates (bars) relative to the target harvest rate for all sizes and sources of removals projected for the 2017 Blue Line (horizontal line; $F_{48\%}$) and the status quo SPR (dashed horizontal line; $F_{46\%}$). Values are hind-cast based on the current ensemble estimates of Spawning Potential Ratio.

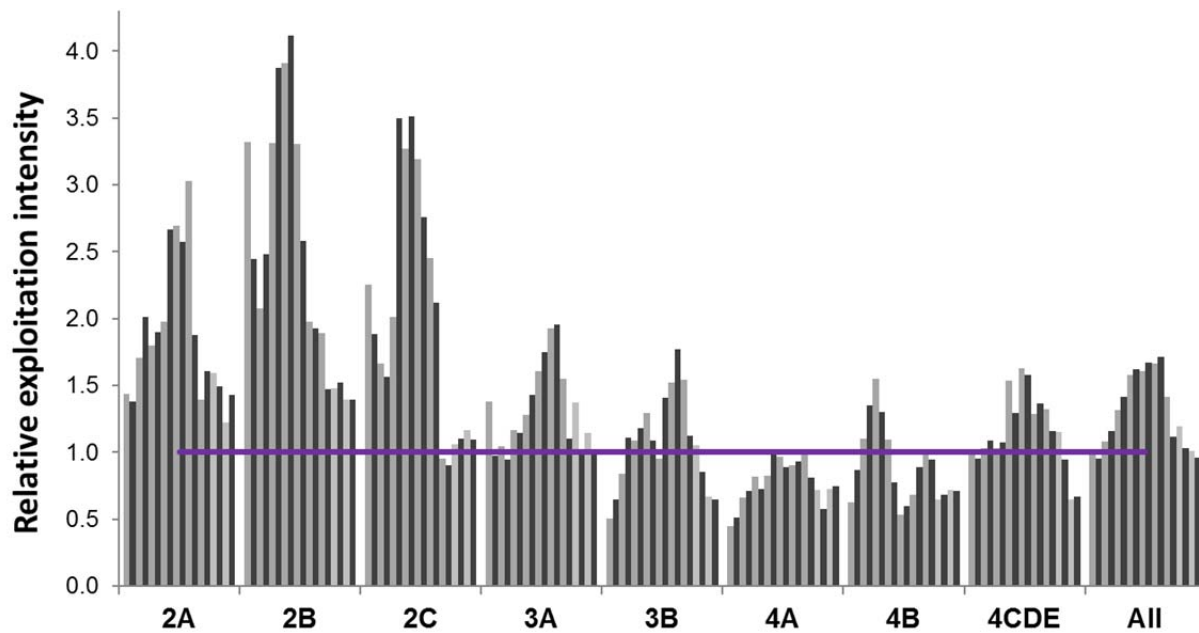


Figure 8. Empirical exploitation intensity based on O26 catch and the index of survey WPUE. All values are scaled relative to a value of 1.0 for the coastwide estimate from 2014-16.

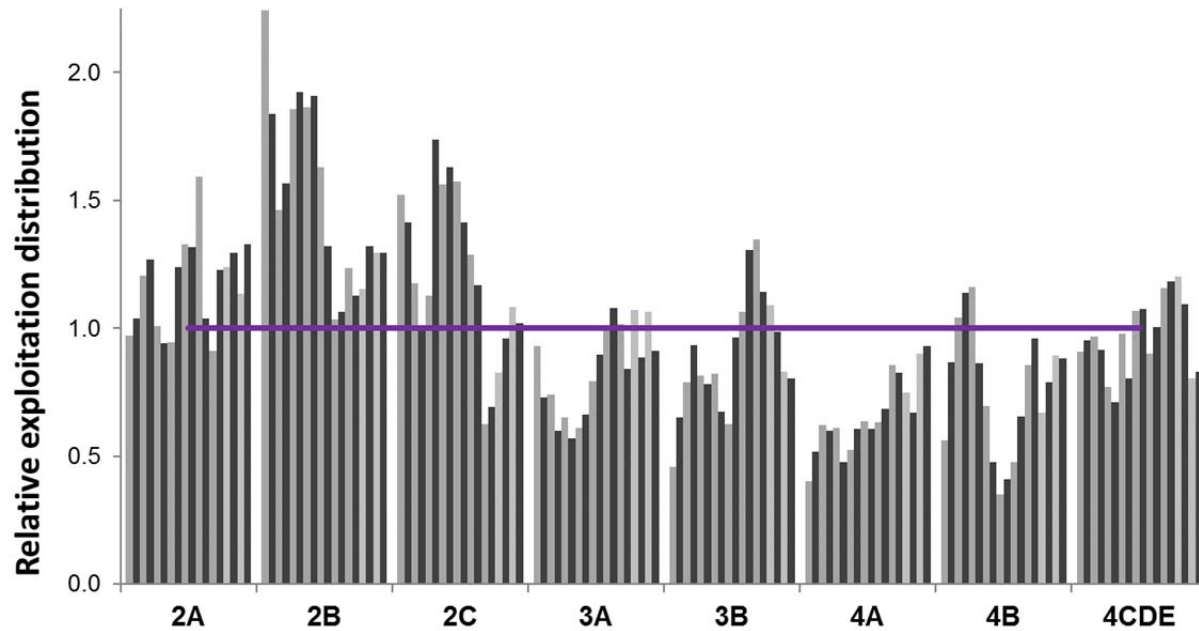


Figure 9. Empirical exploitation distribution relative to the 21.5% harvest rate target for Areas 2A-3A and the and 16.125% harvest rate target for Areas 3B-4CDE. Each year is scaled to an average of 1.0 across all areas.