Approaches to Abundance-Based Halibut PSC Limits for the Amendment 80 Sector

Discussion Paper

September 2020[1]

1 Introduction 1
1.1 Council objectives for ABM 2
2 Discrete PSC limit control rule based on survey breakpoints (look-up table) 3
2.1 Description of Look-up table concept and breakpoints 3
2.2 Survey updates and implications of spatiotemporal modeling 4
2.3 Proposed breakpoints compared with historical usage 5
2.4 Evaluate breakpoints 10
2.5 A80 sector halibut catch, mortality, and survey correlations 11
2.6 PSC limit volatility 16
2.7 Implementation considerations 19
3 Performance Standard 20
3.1 A80 historical PSC use relative to considered standards 22
3.2 Examples of PSC performance standards (Chinook salmon) 27
3.3 Implementation considerations 29
4 CDQ compensation concept 31
4.1 Explanation of concept 31
4.2 Potential legal issues with concept 35
5 Potential effects of lower PSC use, limits on Area 4 halibut fishery 36
6 References 37

1 Introduction

Since 2015, the Council has been developing alternatives to manage halibut prohibited species catch (PSC) limits in BSAI groundfish fisheries based on surveyed halibut abundance estimates. The most recent and most comprehensive analysis of those alternatives, to date, is the preliminary draft EIS (DEIS) that is published concurrent with this discussion paper for the Council's October 2020 meeting (NPFMC 2020).[2] Section 1.3 of that document (*History of Action*) provides an extensive overview of the Council's development process, including links to roughly a dozen staff documents that were published between April 2016 and October 2019. In February 2020 the Council restricted the scope of the abundance-based management (ABM) approach to the Amendment 80 (A80) sector (February 2020 motion on scope). The A80 sector is comprised of all the trawl catcher/processor (CP) vessels that directed fish for non-pollock groundfish in the BSAI FMP area. Previously, the ABM initiative had included BSAI limited access trawl catcher vessels (CV) as well as hook-and-line CPs and CVs that are also subject to annual halibut PSC limits.

In addition to continued analysis of existing ABM alternatives for the A80 sector, the Council tasked this discussion paper to examine three new (or modified) ways that an abundance-based PSC limit could be structured for the A80 sector (February 2020 motion initiating this paper). Upon reviewing this discussion paper, the Council will determine whether to incorporate any of these approaches into the primary set of

---

[1] Prepared by Diana Stram, Sam Cunningham, and Anna Henry (NPFMC). Contributions from Mike Fey (AKFIN), Allan Hicks (IPHC), and Sarah Marrinan (NPFMC). Authorship or contribution does not imply endorsement by an individual's associated agency.
[2] The October 2020 draft EIS can be accessed under Item C6 on the Council Agenda.

alternatives that will be further analyzed in the next iteration of the DEIS. Any of the approaches described in this paper could be selected individually or, in some cases, selected elements could be combined. Staff are directed to examine how these three approaches would function and how they could be implemented in Federal regulations and as part of the annual harvest specifications process. Specific analyses requested by the Council can be seen in the February 2020 motion linked above. Sections 2, 3, and 4 in this document treat each of the three approaches individually.

1.1 Council objectives for ABM

This discussion paper describes how three proposed alternative approaches to ABM would function and identifies practical or legal barriers to implementation. When considering these approaches, the Council should bear in mind its five overarching ABM objectives and the purpose and need statement (see below). The objectives are not ranked by priority. The Council is aware that these objectives could be in tension with one another, thus requiring policy choices to be made. Section 1.2 (*Purpose and Need*) of the October 2020 draft EIS discusses how an ABM program for the A80 sector might achieve the stated objectives and is incorporated here by reference. That section outlines the limitations on the Council's ability to directly affect catch limits for the commercial halibut fishery, but acknowledges the ways that Federal bycatch management intersects with the International Pacific Halibut Commission's (IPHC) accounting for halibut mortality and resulting management of the halibut resource. Understanding the relationship between the respective management authority of the policy-making bodies involved in halibut bycatch management is especially crucial for this discussion paper since the proposed approaches are designed around IPHC survey estimates (Section 2) or halibut catch limit thresholds (Sections 3 and 4) that would inform Federal bycatch limits for the A80 sector.

Consistent with the Council's purpose and need statement, some of the abundance-based halibut PSC limit alternatives may provide additional harvest opportunities for the Area 4 commercial halibut fishery, particularly at low levels of halibut abundance. This would be consistent with the Council's objective to provide for directed halibut fishing operations and IPHC's objective to maintain the Pacific halibut stock at a level that will permit optimum yield from the directed fishery. The impacts of the ABM alternatives that are presently under consideration are described in Section 6 of the DEIS (NPFMC 2020). If total halibut PSC is reduced relative to the status quo, BSAI directed halibut fisheries could benefit as a result of lower bycatch mortality on halibut that are over 26 inches in length (O26). These O26 halibut could be available to the commercial halibut fishery in the area where the PSC reductions occurred, during the year subsequent to the year in which PSC mortality was reduced. The directed halibut fishery could also benefit from O26 halibut that were not taken as PSC once the fish reach the commercial legal-size limit (greater than or equal to 32 inches in total length). Longer term benefits to the directed halibut fishery could accrue throughout the distribution of the halibut stock. Benefits from reduced mortality of these smaller halibut could occur both in the Bering Sea and elsewhere as these halibut migrate and recruit into the directed halibut fisheries. At higher levels of halibut abundance, abundance-based halibut PSC limits may provide the groundfish fisheries with higher PSC limits and thus fewer constraints on groundfish harvesting. This would be consistent with the Council's objective to avoid constraining groundfish harvests, particularly at higher levels of abundance. Finally, the ABM alternatives consider inter-annual variability in abundance-based halibut PSC limits by including an option to constrain year-on-year variation in relative percentage terms. That option is consistent with the Council's objective to provide for some stability in PSC limits on an inter-annual basis.

<u>ABM Purpose and Need</u>:

> *The current fixed yield-based halibut PSC caps are inconsistent with management of the directed halibut fisheries and Council management of groundfish fisheries, which are managed based on abundance. When halibut abundance declines, PSC becomes a larger proportion of total halibut removals and thereby further reduces the proportion and amount*

of halibut available for harvest in directed halibut fisheries. Conversely, if halibut abundance increases, halibut PSC limits could be unnecessarily constraining. The Council is considering linking PSC limits to halibut abundance to provide a responsive management approach at varying levels of halibut abundance. The Council is considering abundance-based PSC limits to control total halibut mortality, particularly at low levels of abundance. Abundance based PSC limits also could provide an opportunity for the directed-halibut fishery and protect the halibut spawning stock biomass. The Council recognizes that abundance-based halibut PSC limits may increase and decrease with changes in halibut abundance.

<u>Council Objectives for ABM</u>:

- Halibut PSC limits should be indexed to halibut abundance
- Halibut spawning stock biomass should be protected especially at lower levels of abundance
- There should be flexibility provided to avoid unnecessarily constraining the groundfish fishery particularly when halibut abundance is high
- Provide for directed halibut fishing operations in the Bering Sea
- Provide for some stability in PSC limits on an inter-annual basis

2 Discrete PSC limit control rule based on survey breakpoints (look-up table)

2.1 Description of Look-up table concept and breakpoints

The first novel approach to structuring abundance-based halibut PSC limits for the A80 sector is a control rule in the form of a “look-up” table. A look-up table, as shown in Table 2-1 below, sets the level of the PSC limit (metric tons of halibut mortality) based on the independent values of two survey abundance indices: the EBS shelf trawl survey index (metric tons) and the IPHC setline survey index in Area 4ABCDE (weight per unit of effort, or WPUE).[3] If the Council elects to use a look-up table control rule then it will need to replace the ranges in the “High,” “Low,” and “Very Low” cells with discrete values (e.g., “Medium” = 1,745 mt). Sections 2.3 through 2.6 provide the requested evaluation of whether the values suggested in Table 2-1 are appropriate, and include highlighting additional issues that the Council might consider when specifying look-up table values.

[3] The table shown in this document has the dimensions 3x2 rather than the 3x3 dimensions of the table provided by the Council for evaluation in its February 2020 motion. Staff noted that there was no difference between the PSC limit ranges that were yielded by EBS trawl survey index values labeled “Medium” (130,000 – 159,999) and “High” (≥ 160,000). As a result, staff decided to collapse those into one column labeled “High” that corresponds to any EBS trawl survey index value ≥ 130,000.

Table 2-1 Council's proposed look-up table for the A80 halibut PSC limit. IPHC Setline survey values in weight-per-unit-effort (WPUE) while EBS trawl survey is in metric tons (t)

		EBS shelf trawl survey index (t)	
		Low < 130,000	**High ≥ 130,000**
IPHC setline survey index in Area 4ABCDE (WPUE)	**High ≥ 11,000**	Medium 1,745 mt (current limit)	High 2,207 – 2,325 mt (15% above current limit or 2015 limit)
	Medium 8,000 – 10,999	Low 1,309 – 1,483 mt (15-25% below current)	Medium 1,745 mt (current limit)
	Low < 8,000	Very Low 1,047 – 1,222 mt (30-40% below current)	Low 1,309 – 1,483 mt (15-25% below current)

Look-up tables are included as an element (Element 7) in the preliminary DEIS suite of alternatives that could be applied to any of the control rule formulations for any sector. The current action alternatives in that analysis do not include a look-up table but one could be applied to any alternative should the Council wish to select this element. In the previous (October 2019) preliminary DEIS one look-up table was evaluated in that analysis, specifically for the fixed gear sector. The look-up table was proposed as an alternative (substitute) to elements that would have established inflection points ("breakpoints") that amplify or dampen the responsiveness of a continuous linear control rule depending on the value(s) of the abundance index/indices being used.[4] Because a look-up table is not a continuous control rule, the responsiveness of the PSC limit to the abundance indices is determined by two factors: how much the PSC limit values in each cell differ from their nearest neighbors, and how likely the index values are to cross the selected thresholds from one year to the next (e.g., p(EBS < 130,000) or p(setline > 8,000)). Both the values in each cell and the thresholds delineating one index state from another (e.g., High vs. Low) would be decided by the Council. The Council's choices will influence the volatility of the control rule. If, for example, the values in the cells are selected to provide a relatively narrow range then changes in surveyed abundance would have less of an impact on the A80 PSC limit. Conversely, large differences in values for adjacent index states (e.g. Very Low/Low or Low/Medium) could, in some cases, amplify the impact of a small change in surveyed abundance. Year-on-year changes in abundance that occur *around a threshold value* would make the PSC limit behave with volatility.

2.2 Survey updates and implications of spatiotemporal modeling

The IPHC Setline survey index in Area 4ABCDE uses a space-time model to calculate weight-per-unit-effort (WPUE) and numbers-per-unit-effort (NPUE) for each IPHC Regulatory Area, with 4CDE combined into a single area. The space-time model uses all years of available data to inform the estimated WPUE in each year by estimating spatial and temporal correlations. The application of a spatiotemporal model has two outcomes that are important to consider here. First, an additional year of observations results in an update to the entire time-series with the greatest changes occurring to recent years and years with few observations. For example, the addition of 2019 data in 2020 slightly changed the survey index value for 2018 compared to what was estimated when 2019 data were not yet sampled (this resulted in a

[4] ABM Elements 4 and 5 (NPFMC 2019).

1.21% change relative to the previous value). Second, using spatial and temporal correlations allows for the estimation of survey stations that were not sampled in a specific year (i.e., uses information from nearby stations that have observations in nearby years). This approach means that WPUE can be estimated in areas that were not sampled, so long as the estimation is given the appropriate uncertainty. This optimized use of the sampled data reduces uncertainty overall and allows for the estimation of a consistent time-series across all years. This is particularly important for 2020 since the scope of the IPHC survey was reduced to core areas in response to the COVID-19 pandemic. The BSAI region was not surveyed by the IPHC or NMFS in 2020, but the space-time approach will still produce an estimate for the area using the observations from previous years and from stations outside of the BSAI that are sampled in 2020; this approach appropriately estimates increased uncertainty around the survey estimates due to the smaller number of observations.

The breakpoints in Table 2-1 are set as absolute survey values. Absolute values – e.g., EBS = 130,000; IPHC setline = 11,000 – are used by design to increase transparency and simplicity for the public when interpreting published survey results and the resulting PSC limits. As noted above, the absolute values of the IPHC setline survey are modified from one year to the next based on the spatiotemporal model but changes to the design of the survey, assumptions about the survey analysis, and changes to the modeling approach may result in changes to the absolute estimates without a considerable change in the trend. Some consideration of space-time modeling is being used in the estimated values of the EBS trawl survey for assessing groundfish stocks in the Bering Sea (considered currently in some assessments, e.g., EBS Pacific cod and EBS pollock) and may be applied more to more groundfish stocks in the future.

While recognizing that the Council did not request standardized breakpoints in the look-up table, the analysts thought it appropriate to lay out some potential benefits of standardized indices given the manner in which survey index values are derived. The analysts acknowledge that basing a look-up table on standardized values makes it more difficult for stakeholders to read reported survey indices in a given year and map those onto a table to anticipate the resulting A80 PSC limit. Nevertheless, the estimates from the EBS trawl survey and the IPHC setline survey are relative indices and are not considered absolute estimates. The modeling analysis of the ABM alternatives in the DEIS (NPFMC 2020) uses standardized indices because the change in the indices drives the change in PSC limits. The relative difference between estimates in each year (i.e., the trend) is the important outcome of the survey estimates. As with the IPHC space-time model, a spatiotemporal approach to estimate trawl survey trends or improved survey methods would likely result in changes to estimates for the entire survey time-series. Choosing a year to which the breakpoints can be standardized would be less variable than absolute values because of the correlation between years, and would be less susceptible to large changes that may be the result of modified assumptions (e.g., a change in the bottom area of the survey may result in large changes to the absolute estimates but little change to the relative indices). In summary, the absolute values for the index are dependent on the assumptions of the design and analysis, whereas a standardized index could show less year-on-year variability. Nonetheless, other PSC limits in the BSAI are set as values indexed to either a survey or modeled estimate of survey biomass, not a standardized value (See Section 2.6.1).

2.3 Proposed breakpoints compared with historical usage

Figure 2-1 illustrates the possible PSC limits from the look-up table in a way that can be compared to historical halibut usage by the A80 sector from 2010 through 2019.[5] PSC limit states that are given as a

[5] This document uses 2010 through 2019 data to be consistent with the DEIS (NPFMC 2020). The range was selected as the most recent available 10-year period that captures the entire period during which the A80 sector has operated under cooperative management (there was a limited access fishery within the A80 sector from 2008 through 2010). Years prior to 2010 were also not included in the DEIS due to data quality issues related to

range in the Council's look-up table are represented as blue bands. Figure 2-2 and Figure 2-3 report the relevant abundance index values dating back to 1998. Those values are the inputs that would have been applied to the look-up table each year to determine the PSC limit, had this ABM approach been in place. The EBS trawl survey was in the High state from 2003 through 2016 but fell into the Low state from 2017 to the present. The IPHC setline survey was in the Medium state from 2003 through 2016 but has been in the Low since 2017. (Absolute index values are shown in Table 2-2.) Table 2-2 and Figure 2-4 show what A80 PSC limits would have been in past years if the limit had been determined by this look-up table, based on the indices as estimated in late 2019. For the plotted years, the limit would have been set at the Medium level from 2010 through 2016 and fallen to Very Low from 2017 through 2019. The Medium level is equal to the existing PSC limit (1,745 t). The Very Low level would set the limit somewhere in the range of 1,047 t to 1,222 t, pending further specification by the Council.

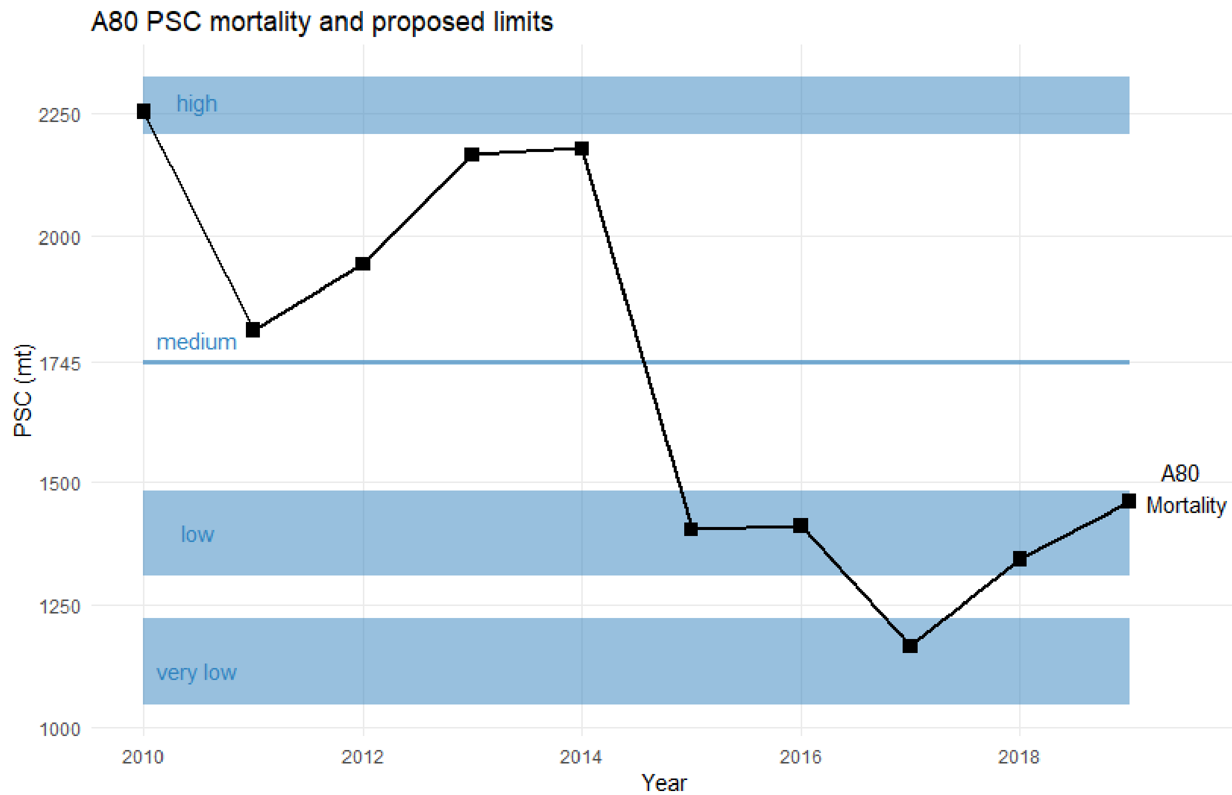

Figure 2-1 Amendment 80 halibut PSC mortality (metric tons) 2010 through 2019 in black line. Blue bands display proposed PSC limits in the proposed look-up table.

separating some TLAS CV fishing from AFA pollock fishing in the NMFS Catch Accounting System, though this is of lesser concern now that the Council has narrowed the scope of ABM to the A80 sector.

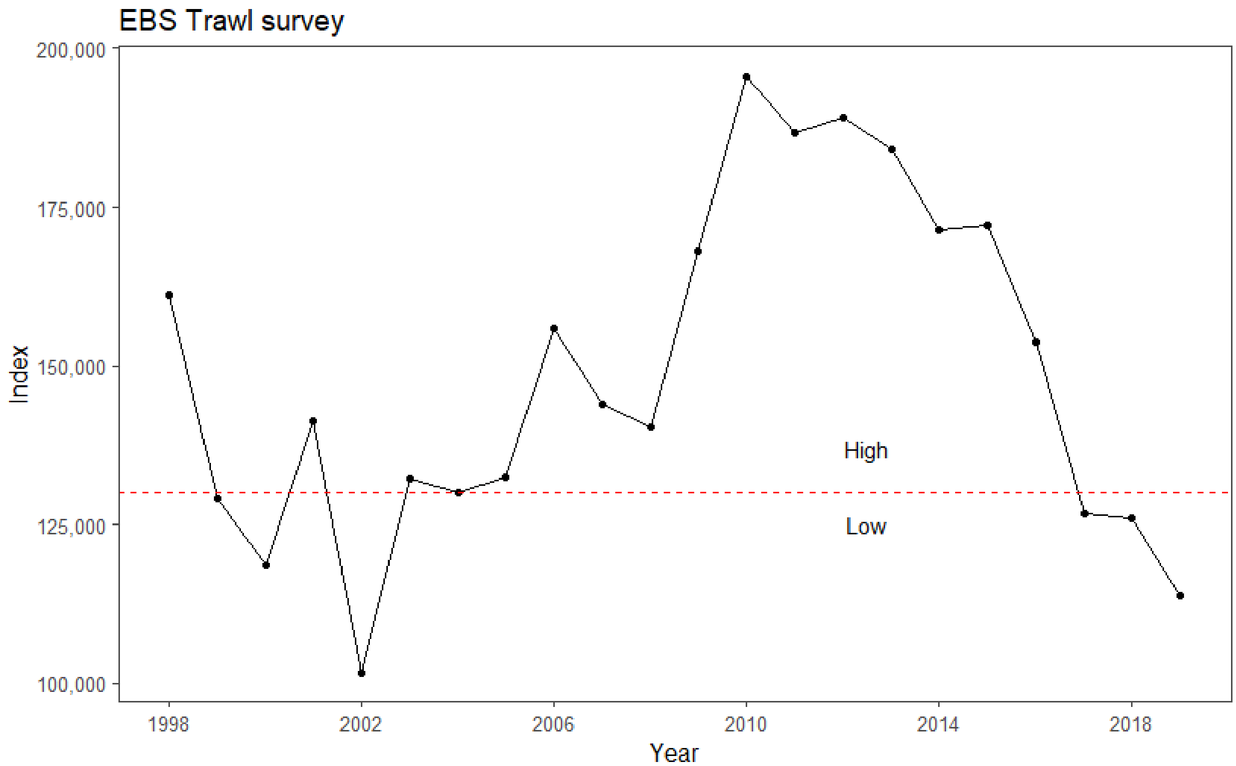

Figure 2-2 EBS trawl survey index 1998-2019 (as reported in February 2020). Red line indicates breakpoint between Low and High states as proposed in look-up table.

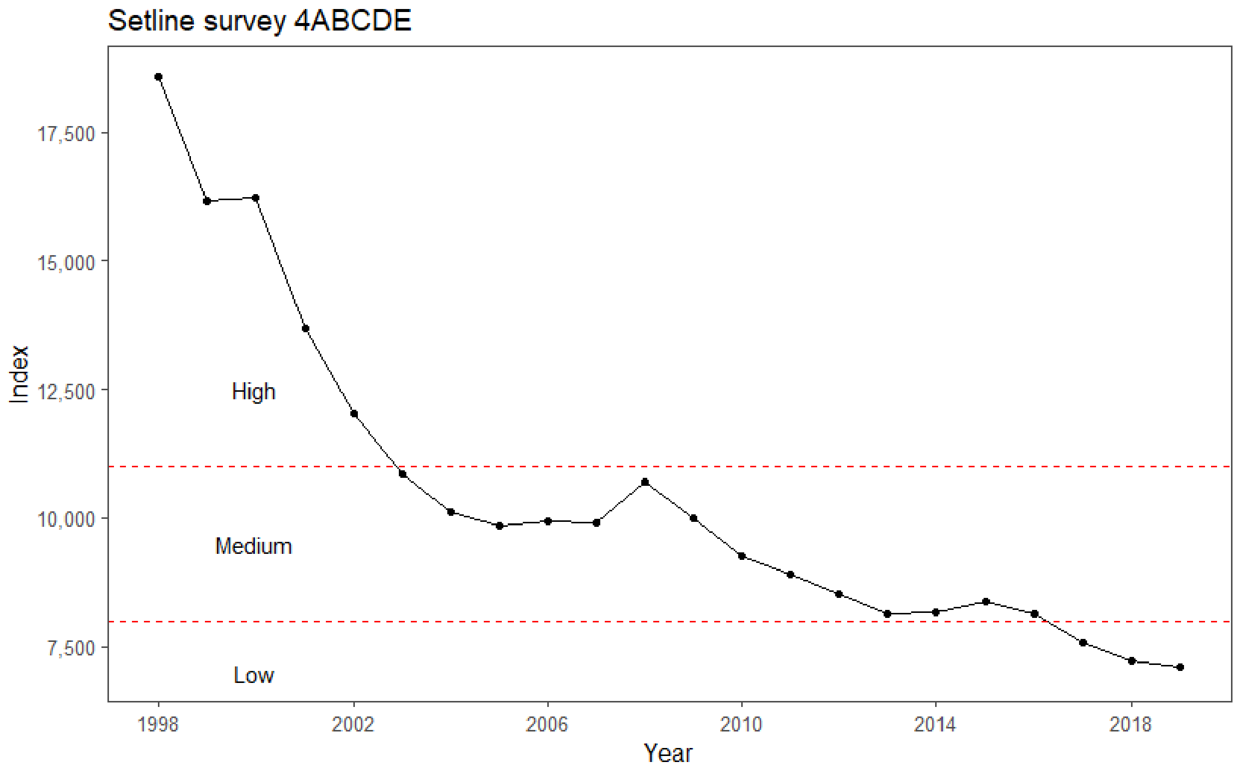

Figure 2-3 Setline survey 4ABCDE Index 1998-2019 (as reported in February 2020). Red line indicates breakpoints of Low, Medium, and High states as proposed in look-up table.

Table 2-2 and Figure 2-4 also report the A80 sector's PSC use (mortality) from 2010 through 2019, highlighting the years during which use would have exceeded the limit. That would have been the case in seven or eight out of 10 years, depending on where in the range the Council sets the value for the Very Low limit. *The analysts are not implying that the A80 sector would necessarily have been shut down during parts of those years* because fishery participants have the opportunity to make operational choices that might allow the sector as a whole to function under a lower limit. Nevertheless, lower limits may cause operational modifications or act as a constraint on the A80 sector – either of which could have adverse economic impacts in years when the limit is reached and in years when it is approached. Lower limits might also affect certain participants within the A80 sector differently depending on their relative exposure to higher-PSC groundfish targets (see mortality by groundfish target in Table 2-4 and further discussion in Section 2.6, including Figure 3-4).

When looking at Table 2-2 or the plots of historical survey abundance levels, note the number of instances in which an index value was within a small margin of one of the breakpoints defined in the look-up table (Table 2-1). Table 2-2 highlights the possibility that, in an edge-case, a relatively small difference in survey estimates could translate to a substantial PSC limit change for the A80 fleet. These edge-cases occur around EBS=130,000, Setline=11,000, and Setline=8,000.

Table 2-2 Historical survey indices and corresponding PSC limit states (High/Medium/Low/VeryLow) based on "Look-up Table," PSC limits, and A80 PSC use (highlighted cells = A80 sector would/could have reached the limit)

Year	Setline Survey 4ABCDE		EBS Trawl Survey		Look-up Table State	"New" PSC Limit	Amendment 80 PSC (mt)		
	Index (WPUE)	State	Index (mt)	State			Limit	Encounter	Mortality
1998	18,577	High	161,256	High	High	2,207 – 2,325			
1999	16,155	High	129,116	Low	Medium	1,745			
2000	16,207	High	118,677	Low	Medium	1,745			
2001	13,681	High	141,219	High	High	2,207 – 2,325			
2002	12,037	High	101,706	Low	Medium	1,745			
2003	10,862	Medium	132,151	High	Medium	1,745			
2004	10,128	Medium	130,075	High	Medium	1,745			
2005	9,856	Medium	132,518	High	Medium	1,745			
2006	9,932	Medium	155,964	High	Medium	1,745			
2007	9,922	Medium	143,903	High	Medium	1,745			
2008	10,714	Medium	140,247	High	Medium	1,745			
2009	9,989	Medium	168,102	High	Medium	1,745			
2010	9,271	Medium	195,535	High	Medium	1,745	2,425	2,823	2,254
2011	8,896	Medium	186,666	High	Medium	1,745	2,375	2,277	1,810
2012	8,539	Medium	189,000	High	Medium	1,745	2,325	2,469	1,944
2013	8,133	Medium	183,989	High	Medium	1,745	2,325	2,677	2,166
2014	8,173	Medium	171,427	High	Medium	1,745	2,325	2,667	2,178
2015	8,385	Medium	172,237	High	Medium	1,745	2,325	1,719	1,404
2016	8,134	Medium	153,704	High	Medium	1,745	1,745	1,965	1,412
2017	7,583	Low	126,684	Low	Very Low	1,047 – 1,222	1,745	1,976	1,167
2018	7,228	Low	125,957	Low	Very Low	1,047 – 1,222	1,745	2,555	1,343
2019	7,104	Low	113,855	Low	Very Low	1,047 – 1,222	1,745	3,067	1,461

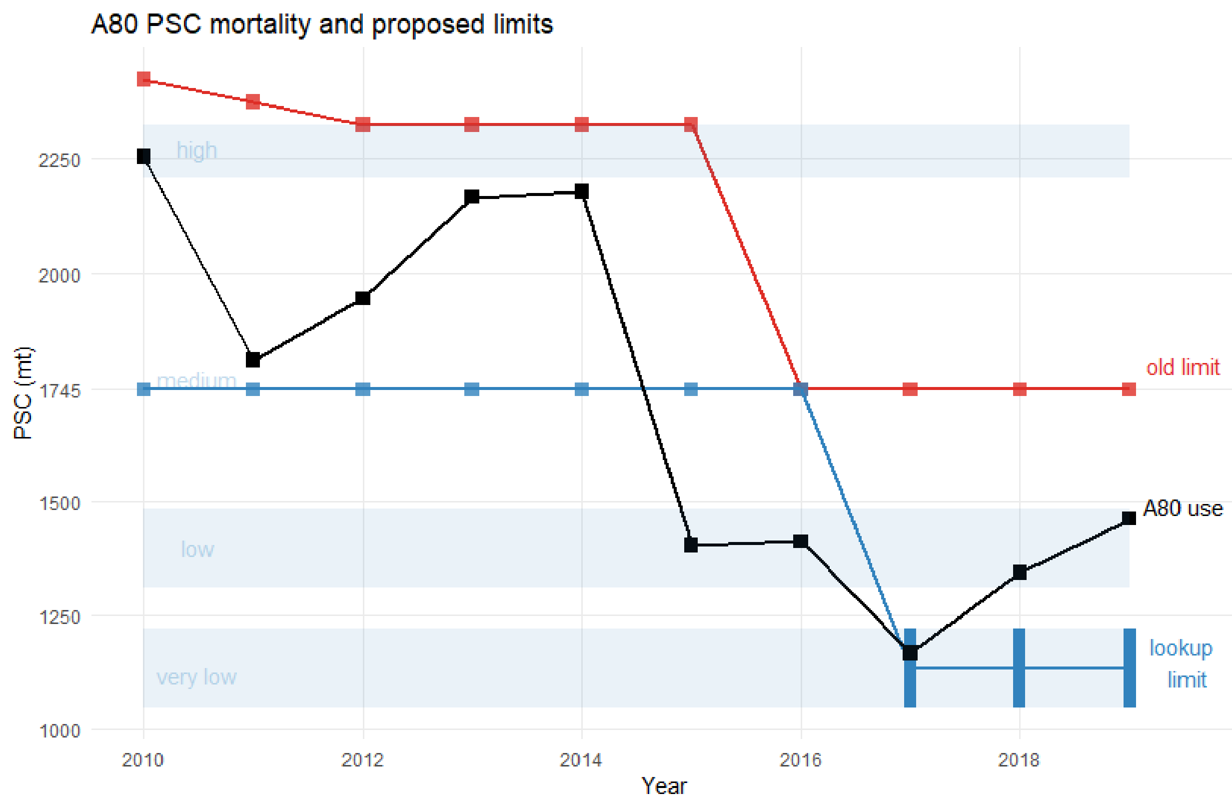

Figure 2-4 A80 PSC mortality ('A80 use'), existing PSC limits ('old limit'), and new limits that would have been applied based on survey indices as proposed in look-up table. Light blue bands show look-up table states for reference.

2.4 Evaluate breakpoints

Table 2-3 Comparison of survey index statistics with proposed breakpoints

	Survey Index Statistics						Proposed Breakpoints		
Survey	**Years**	**Average**	**25th percentile**	**Median**	**75th percentile**	**Low**	**Medium**	**High**
Setline	1998-2019	10,432	8,226	9,889	10,825	< 8,000	8,000 – 10,999	≥ 11,000
	2010-2019	8,145	7,721	8,154	8,501			
EBS Trawl	1998-2019	148,818	129,356	142,561	170,596	< 130,000	NA	≥ 130,000
	2010-2019	161,905	133,439	171,832	185,997			

Table 2-3 compares survey index statistics for each of the candidate surveys and the proposed breakpoints. For the setline survey over the longer time frame (1998-2019) all of the reported statistics fall within the Medium state values in the look-up table. For the more recent time frame (2010-2019), the 25th percentile would result in a Low state. This can be seen in Table 2-2 where from 2017-2019 the setline survey falls below the 'Low' threshold. By comparison, for the EBS trawl survey statistics in Table 2-3 would place the look-up table in the High state for all years during the 2010-2019 period. The EBS trawl survey statistics that go back to 1998 include some years below the 25th percentile that would fall into the Low state category. This is in contrast to Table 2-2 where the most recent three years (2017-2019) all fall within the Low category for the EBS trawl survey.

2.5 A80 sector halibut catch, mortality, and survey correlations

The DEIS reports halibut bycatch in the A80 sector and, for the most part, is included by reference and not repeated here (see Section 3.4 of NPFMC 2020). However, for completeness, some additional information is provided here on correlations between the surveys and bycatch. This information includes key figures from the DEIS illustrating spatial and temporal overlap between the EBS trawl survey and the A80 fishery. Additionally, this section reports survey trends as they relate to A80 halibut mortality at the sector-level and by A80 groundfish target species.

Figure 2-5 shows A80 halibut catch and mortality in the top panels and shows the survey index values in the bottom panels (Table 2-2 shows these metrics numerically). The vertical axis represents metric tons for all panels (note that the vertical scale is different in each panel). Both surveys display downward abundance trends. Halibut catch and mortality (PSC) follow similar trajectories from 2010 through 2015, but since then halibut catch has increased at a greater rate than mortality due to changes in catch accounting and fish handling procedures described in the DEIS (i.e. deck sorting and A80 Halibut Avoidance Plan; see Section 3.4.4 of NPFMC 2020).

Figure 2-6 plots A80 halibut PSC encounter (catch) and mortality as well as the two survey indices. Survey indices have consistently declined while catch reached a high in 2019; mortality has increased since 2017 but at a slower rate than catch. The relationship between halibut catch and the survey value is neither statistically significant nor well correlated. Factors other than halibut population size that may lead to increased encounter rates include mixing with target species, variable groundfish aggregation behavior across years, and targeting of different species by the various fleets/companies within the sector. Halibut mortality shows a slightly better correlation with both abundance indices. Halibut population size and distribution certainly plays some role in the abundance:mortality relationship but total PSC mortality is likely also driven by fleet behavior in response to management. For example, deck sorting, test tows, shorter tows, and excluder use have become more widely adopted since 2015, resulting in lower effective mortality (ratio of halibut mortality to catch) even though halibut catch has increased.[6] Looking at the bottom panel of Figure 2-6, there would likely be no trend without the inclusion of 2015 through 2019 – the period during which active mortality mitigation measures became widely adopted throughout the A80 fleet. Based on the data available, one might conclude that halibut catch rates are somewhat stochastic but may have increased in recent years as the A80 fleet has found ways to mitigate the negative consequences of halibut encounter, thus allowing the fleet to prioritize finding the right mix of groundfish slightly ahead of minimizing the number of halibut in a haul. That said, the analysts do not solely attribute the recent upward trend in halibut encounter to fleet choices; it is possible that higher encounter rates are at least partially attributable to environmental conditions (e.g., comingling of species in an ocean environment with less temperature variation that could help separate species and guide time/area targeting). One could also conclude that halibut mortality rates are correlated to abundance through the mechanism of management pressure to reduce mortality levels in times of low abundance by any available means. Going forward, the Council will have to consider what PSC mortality level (tons) the A80 fleet can maintain while staying within a tolerable range of historical groundfish TAC utilization, recognizing that there may be diminishing returns to actions that actively suppress effective mortality rates (e.g., deck sorting).

[6] Section 3.4 of the DEIS (NPFMC 2020) more thoroughly addresses A80 halibut bycatch encounter and mortality data. Figure 3-26 (Section 3.4.1) plots the relationship between deck sorting and effective mortality. Figures 3-38 and 3-39 (Section 3.4.4) quantify the expanded adoption of deck sorting throughout the A80 fleet and across all target species in recent years.

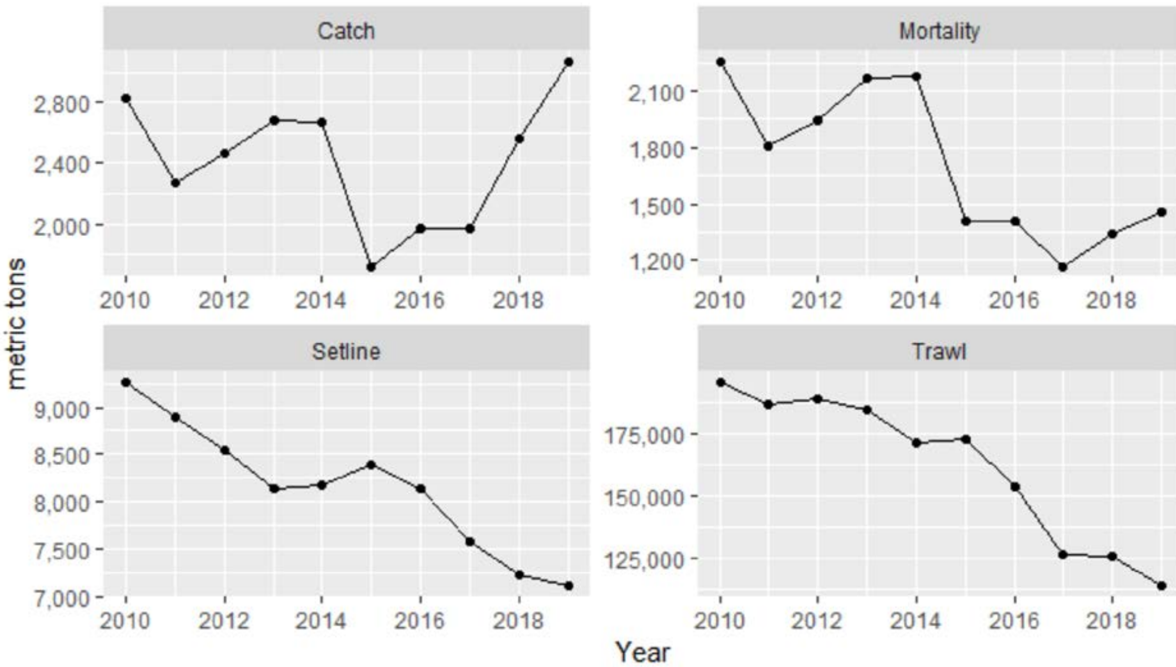

Figure 2-5 A80 halibut catch and mortality (top panels) and setline and trawl survey indices (bottom panels), 2010 through 2019

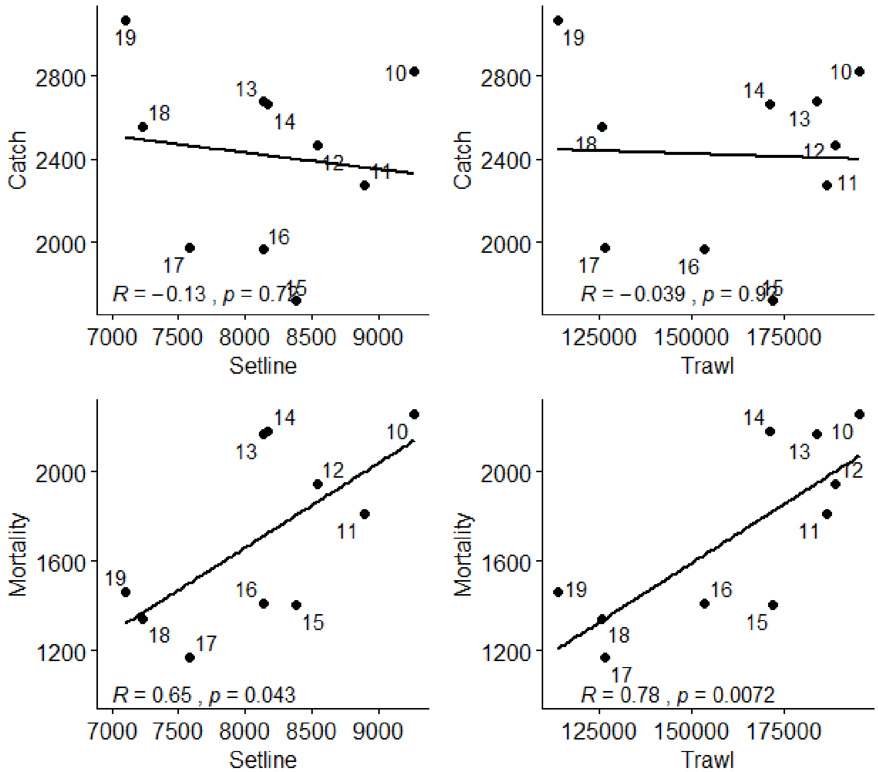

Figure 2-6 Correlation of halibut catch and mortality with survey indices (*R* is correlation coefficient and *p* is a measure of statistical significance, significant at $p < 0.05$)

Figure 2-7 plots the cumulative A80 halibut encounter rate by target species for 2010 through 2019. Yellowfin sole target fishing clearly accounts for the highest groundfish catch volume and the highest halibut encounter rate, followed by northern rock sole. After those two, halibut encounter drops off due to either lower effort (other flatfish) or lower PSC rates (Atka mackerel and POP). Table 2-4 provides the survey values and look-up table “states” as well as total A80 mortality by year and the mortality by target for the species shown in Figure 2-7.[7] There may be some utility in examining the general association between trends in mortality by year (overall and by target) and trends in survey indices (Table 2-4). For most targets and for overall A80 PSC mortality, higher values of both surveys (2010-2014) trended with higher overall A80 PSC mortality as well as higher halibut PSC for most targets. Both surveys have been at lower abundance levels in the more recent years. Total PSC has been lower relative to the 2010-2014 period, though the analysts attribute at least some of that trend to active mitigation measures implemented by the A80 sector. PSC mortality by target has varied considerably, trending upward in 2018 and 2019 for both yellowfin sole and flathead sole targets. The two clear target-level conclusions that can be made are: yellowfin sole and northern rock sole account for the greatest proportion of halibut PSC mortality because they are the highest volume flatfish targets; and Atka mackerel/POP generally account for less PSC per ton of groundfish catch when compared to flatfish targets (see Table 3-20 in Section 3.4.1 of the DEIS).

[7] YFS = yellowfin sole; NRS = northern rock sole; FHS = flathead sole; ATF = arrowtooth flounder; POP = Pacific ocean perch; Atka = Atka mackerel; Pcod = Pacific cod. Note that Pacific cod is not shown in Table 2-4 because, in most cases, cod is not the explicit target of an A80 “trip”. Rather, Pacific cod is taken as a valuable and necessary secondary species when fishing for other A80 species but might be targeted in circumstances where a vessel is already processing cod delivered at-sea by CVs. In many cases, NMFS Catch Accounting System identifies Pacific cod as a trip target when catch by volume exceeds a certain proportion as a matter of circumstance.

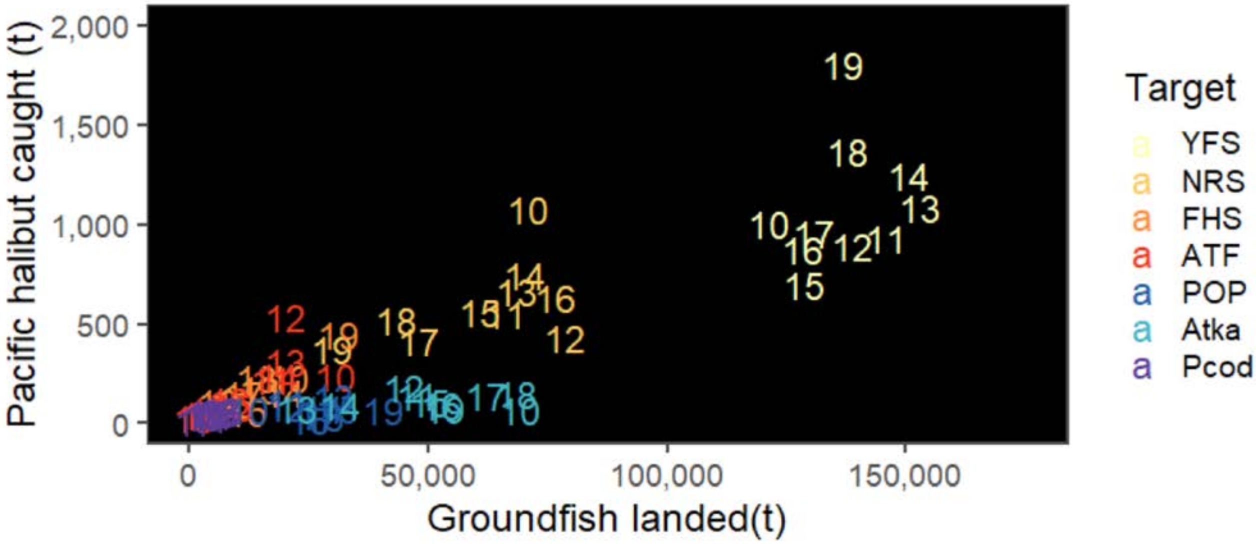

Figure 2-7 **A80 sector bycatch of Pacific halibut (t) versus groundfish catch by target species, 2010 through 2019**

Table 2-4 **Survey index values (WPUE and metric tons (t)) and "State" from Table 2-2 with associated tons of A80 sector halibut mortality in total and by selected targets, 2010 through 2019. Shading corresponds to higher (darker) and lower (lighter) values within individual columns.**

Year	Setline Survey 4ABCDE		EBS Trawl Survey		Mortality (t)	Target					
	Index (WPUE)	State	Index (t)	State	Total A80	YFS	NRS	FHS	ATF	POP	Atka
2010	9,271	Medium	195,535	High	**2,254**	833	913	302	190	57	55
2011	8,896	Medium	186,666	High	**1,810**	790	467	119	172	92	111
2012	8,539	Medium	189,000	High	**1,944**	761	378	104	415	75	144
2013	8,133	Medium	183,989	High	**2,166**	955	583	159	238	107	62
2014	8,173	Medium	171,427	High	**2,178**	1,102	645	112	188	63	77
2015	8,385	Medium	172,237	High	**1,404**	598	480	46	62	60	86
2016	8,134	Medium	153,704	High	**1,412**	631	521	63	71	18	80
2017	7,583	Low	126,684	Low	**1,167**	608	256	63	35	34	105
2018	7,228	Low	125,957	Low	**1,343**	752	278	105	12	24	110
2019	7,104	Low	113,855	Low	**1,461**	890	207	183	17	44	51

Figure 2-8 compares the ADF&G statistical areas where A80 fishing occurred during the typical EBS survey season (June/July) with areas where the survey encountered halibut. Figure 2-9 overlays ADF&G statistical areas where halibut occurred in the fishery throughout the year and during the typical survey season on the surveyed areas where halibut were encountered. Data are shown for 2017 through 2019, which is presumed to be the best available representation of how the A80 sector is behaving under current environmental, market, and management conditions. The figures indicate that the survey stations capture the area where the A80 sector is fishing during the survey season in the Bering Sea and along the shelf. The EBS survey, by its nature, does not provide data on catch and halibut encounter in the Aleutian Islands. The analysts note that the predominant A80 species caught in the Aleutian Islands are Atka mackerel and Pacific ocean perch, which are typically associated with lower halibut bycatch (see Figure 3-34 in the DEIS and Table 2-4, above). The lower panel of Figure 2-9 illustrates the year-to-year variability in where the A80 sector operates at a given point in the season. That variation can be ascribed to any of several reasons: groundfish CPUE, halibut encounter rates, or mix of species including constraining Pacific cod, to name a few. This information is more fully reported in Section 3.4.3 of the DEIS (NPFMC 2020).

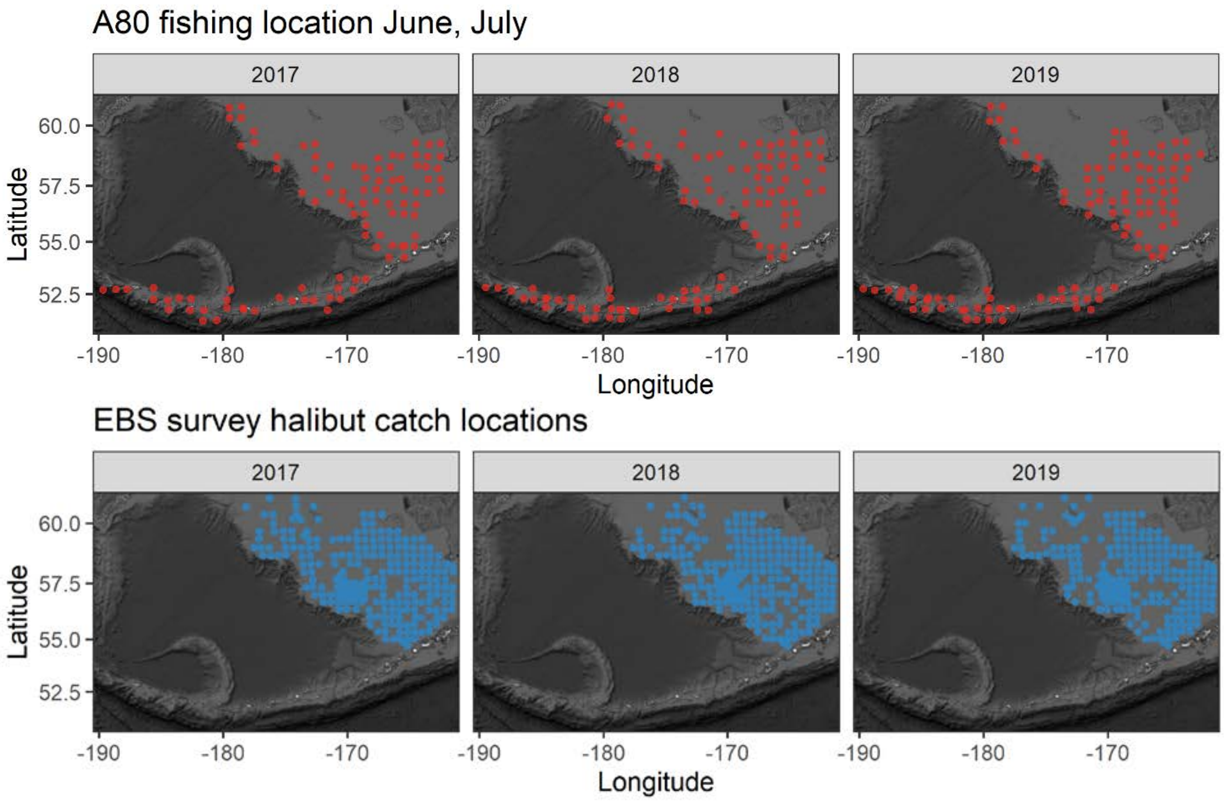

Figure 2-8 ADF&G statistical areas where the A80 sector fished during the months when the EBS trawl survey (EBS) typically occurs and ADF&G statistical areas where the EBS survey encountered halibut, 2017 through 2019

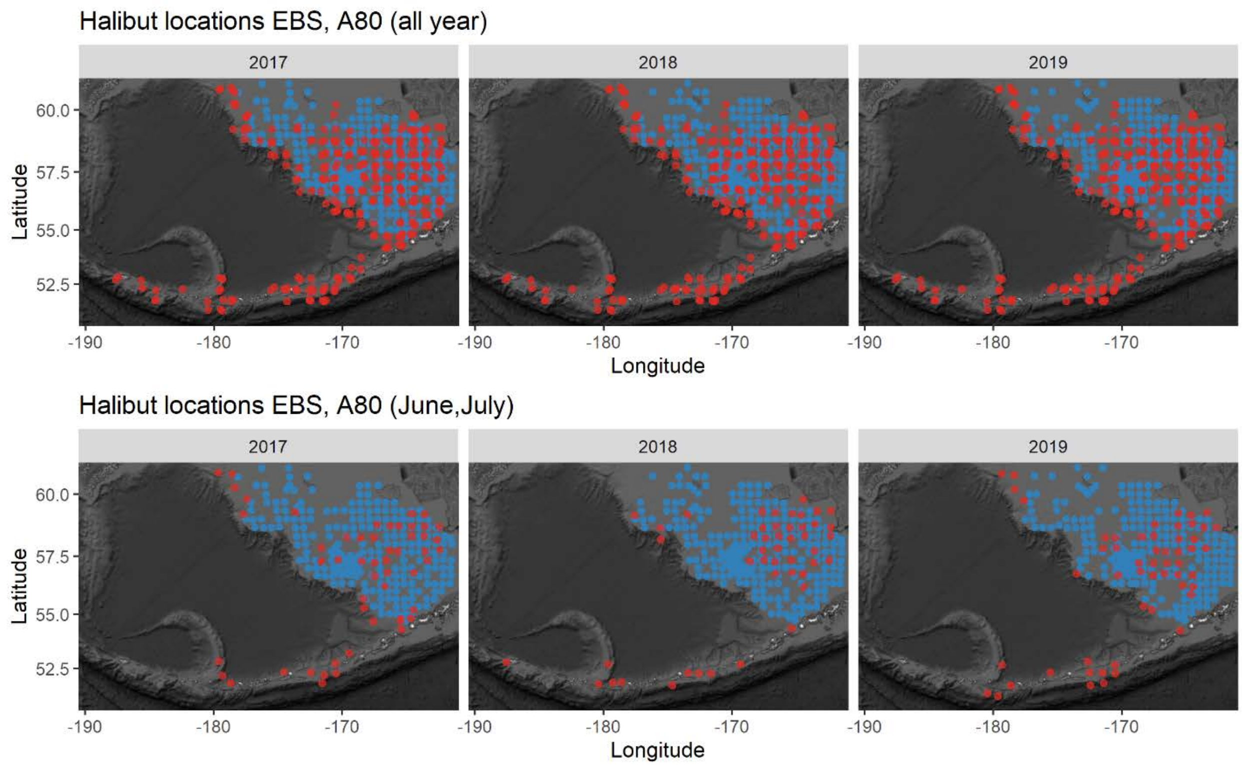

Figure 2-9 **ADF&G statistical areas where halibut PSC occurred in the A80 fishery overlaid on areas where the EBS trawl survey (EBS) encountered halibut, 2017 through 2019. Top panel shows areas with A80 halibut catch throughout the year; bottom panel show areas with A80 halibut catch for the months during which the EBS trawl survey typically occurs.**

2.6 PSC limit volatility

A continuous control rule that establishes new PSC limits every year as a function of an index or indices would clearly create inter-annual variability as the indices they are based on vary over time. A look-up table can provide inter-annual stability by bracketing a range of index values so that the PSC limit could potentially remain stable from year to year. However, there are some circumstances in which a look-up table may generate more inter-annual volatility as the difference between threshold values is likely more abrupt than shifts along a continuous control rule.

As noted in Section 2.1, the PSC limits established by the look-up table are highly sensitive to inter-annual volatility when the relative abundances in each survey approach the breakpoints where small changes in one or both surveys move the limit across a threshold (Table 2-2). Using 2017 as an example (Table 2-2), the setline survey value dropped 551 tons; had it only dropped 134 tons the breakpoint would still have been reached and the state change from Medium to Low would have still occurred. When combined with an EBS trawl survey drop of over 27,000 tons the resulting PSC limit would have moved past the Low state and into the Very Low state, resulting in year-on-year PSC limit change from 1,745 tons to potentially as low as 1,047 tons.

Survey data updates or methodological changes can result in jumps from one state to the next, as shown in Table 2-5. This is particularly important in relation to subtle retroactive recalculations of the setline survey that could result in a different “look-up table PSC state” for a given historical year based on revised estimates using updated data. The 2016 estimate for the setline survey using 2019 data was considered to be at the Medium state in the look-up table, but when the same estimate was provided using the data available in 2018 the PSC limit fell into the look-up table’s Low state. The reverse is also possible. For example, an estimate in 2021 could show that either survey is at a Low state which may cause a resulting drop in the PSC limit implemented in that year (depending upon the state of the other survey). In the subsequent year, new data estimation could result in the index landing in a higher 'Medium' state, in hindsight. This is no different than updating stock assessments with the most recent data (or a new model) and finding that a previous year's point estimate of biomass was higher or lower than estimated at that time. Data revisions in the context of the PSC limit look-up table could have more drastic implications for the regulated sectors than a stock assessment would because of the more abrupt potential adjustments to the PSC limit. The abruptness of the change is essentially a policy choice, determined by the relative values selected for each cell in the look-up table.

Table 2-5 Relative changes in the IPHC setline survey 'state' when using 2019 data versus 2018 data for use in the proposed look-up table (Table 2-1)

	Setline Survey 4ABCDE (2019)		EBS Trawl Survey		Using 2019 setline index		Setline Survey 4ABCDE (2018)		Using 2018 setline index	
Year	Index (mt)	Category	Index (mt)	Category	Combined Category	New Limit	Index (mt)	Category	Combined Category	New Limit
1998	18,577	High	161,256	High	High	2,207-2,325	18,502	High	High	2,207-2,325
1999	16,155	High	129,116	Low	Medium	1,745	16,201	High	Medium	1,745
2000	16,207	High	118,677	Low	Medium	1,745	16,203	High	Medium	1,745
2001	13,681	High	141,219	High	High	2,207-2,325	13,780	High	High	2,207-2,325
2002	12,037	High	101,706	Low	Medium	1,745	12,104	High	Medium	1,745
2003	10,862	Medium	132,151	High	Medium	1,745	10,866	Medium	Medium	1,745
2004	10,128	Medium	130,075	High	Medium	1,745	9,987	Medium	Medium	1,745
2005	9,856	Medium	132,518	High	Medium	1,745	9,550	Medium	Medium	1,745
2006	9,932	Medium	155,964	High	Medium	1,745	9,802	Medium	Medium	1,745
2007	9,922	Medium	143,903	High	Medium	1,745	9,673	Medium	Medium	1,745
2008	10,714	Medium	140,247	High	Medium	1,745	10,264	Medium	Medium	1,745
2009	9,989	Medium	168,102	High	Medium	1,745	9,834	Medium	Medium	1,745
2010	9,271	Medium	195,535	High	Medium	1,745	9,146	Medium	Medium	1,745
2011	8,896	Medium	186,666	High	Medium	1,745	8,669	Medium	Medium	1,745
2012	8,539	Medium	189,000	High	Medium	1,745	8,403	Medium	Medium	1,745
2013	8,133	Medium	183,989	High	Medium	1,745	7,989	Low	Low	1309-1483
2014	8,173	Medium	171,427	High	Medium	1,745	7,995	Low	Low	1309-1484
2015	8,385	Medium	172,237	High	Medium	1,745	8,130	Medium	Medium	1,745
2016	8,134	Medium	153,704	High	Medium	1,745	7,826	Low	Low	1309-1483
2017	7,583	Low	126,684	Low	Very Low	1,047-1,222	7,250	Low	Very_Low	1,047
2018	7,228	Low	125,957	Low	Very Low	1,047-1,222	7,141	Low	Very_Low	1,047
2019	7,104	Low	113,855	Low	Very Low	1,047-1,222				

Performance in terms of relative stability will be inherently different when the abundance of either survey is within the specified range of the breakpoints compared to scenarios where either or both surveys are approaching their breakpoints. **The dimensions of the look-up table and the policy choice on appropriate breakpoints impact how abrupt the year-on-year adjustment to the PSC limit could be.** In contrast, the continuous control rules defined by the DEIS action alternatives result in smaller incremental annual changes. A look-up table with additional dimensions (e.g., 5x5, 10x10) could mitigate inter-annual volatility. These choices are reflected in balancing different objectives for ABM. **Both the values in each cell and the thresholds delineating one index state from another (e.g., High vs. Medium vs. Low) would be decided by the Council.**

2.6.1 Additional breakpoint/threshold approaches in the BSAI FMP

Examples of other breakpoints in BSAI PSC limits include the Chinook salmon bycatch avoidance program which employs a lower cap after a threshold is reached and crab PSC limits for Bristol Bay red king crab (BBRKC) and EBS Tanner crab where PSC limits are set at thresholds of annual abundance (stairsteps).

BSAI Groundfish FMP Amendments 91/110, implemented in 2011 (A91) and revised (A110) in 2016, was developed by the Council to create a comprehensive Chinook and chum salmon bycatch avoidance program for the Bering Sea pollock trawl fishery. The original A91 program set up a series sector-level annual threshold amounts for a performance standard and PSC limits in conjunction with incentive program agreements by sector (IPAs) which is discussed further in this paper under Section 3.2.1. Amendment 110 modified this program to provide for additional management actions during specific months of historically high bycatch as well as lower caps in times of low Chinook abundance based upon a breakpoint analysis described below. Specifically, the program includes regulations by which the performance standards and PSC limits are dropped when a three-river index of Western Alaska in-river run abundance (Unalakleet River, Upper Yukon River, and Kuskokwim River) falls below a 250,000 Chinook salmon threshold, based on the State of Alaska's post-season in-river Chinook salmon run size assessment[8]. In 2019 the fleet for the first time operated under the lower PSC limits as a result of the combined three-river index dropping below that threshold. In 2020 the index was above the threshold and the fleet resumed operations under the higher levels.

The threshold (or breakpoint) that was developed under A110 is the following: A positive linear relationship between the 3 System Total Run Index and total Western Alaska adult equivalents, or AEQ, (combined AEQ of Coastal Western AK (CWAK), Upper Yukon, and Middle Yukon) was identified as the basis for determining a threshold. Outlier years where AEQ was higher than would have been expected based on run abundance were excluded (2006-2009). The Council chose a 250,000 Chinook salmon threshold based on a natural break in the data, distinguishing historically very poor run years in Western Alaska (2000 and 2010-2012).[9]

In 2018 the model used to estimate the Kuskokwim run was updated and the relationship between the 3-system total run index and AEQ was re-run (ADFG, 2018). While the relationship was upheld, the natural break in the data was less apparent. This demonstrates the possibility of establishing a breakpoint in regulations based on data that may be less obvious as changes in estimation methodology occur or new years of data are added. Additionally, when the three-river index was compiled historically using the new estimates of the Kuskokwim model as input to the index, it demonstrated that the index would have been below the threshold in every year since the implementation of A110 (as well as all years in the analysis of the impacts of A110 from 2010 on).

For BBRKC and Tanner crab, PSC limits are based upon stairstep thresholds indexed to mature crab and/or effective spawning biomass.[10] For BBRKC the three thresholds and their associated limits are based upon similar thresholds in the State of Alaska harvest strategy for this stock. For Tanner crab there are four thresholds associated with eight different PSC limits (four each in Zones 1 and Zone 2 area closures). These thresholds were negotiated and proposed by an industry workgroup. The Tanner crab stairstep PSC limits were essentially developed from historical bycatch data under different abundance levels. The proposed lower threshold limits were based upon the average observed bycatch for the stock at that level of abundance (NPFMC 1996). The highest level for each zone represented the previous static PSC limits under high abundance conditions. The upper range of the limit was based on negotiated amounts when the stock was at a high abundance in 1988 (NPFMC 1996). The middle "step" level was established at an intermediary level between Steps 1 and 3 (NPFMC 1997).

---

[9] Secretarial Review Draft Environmental Assessment/Regulatory Impact Review/Initial Regulatory Flexibility Analysis for Proposed Amendment to the Fishery Management Plan for Bering Sea Aleutian Islands Groundfish Bering Sea Chinook and Chum salmon bycatch management measures, March 2015.
[10] BBRKC employs both mature female biomass and effective spawning biomass in the threshold definition while for Tanner crab it is simply based on modeled total abundance of crabs.

For both BBRKC and Tanner crab, PSC limits have been fairly stable in recent years. Since 2012 the PSC limits for BBRKC have not changed. For Tanner Zone 1 PSC limits have been stable at the highest abundance-based level since 2012, except when they dropped to the second highest level 2016-2018. Tanner Zone 2 PSC levels also dropped from their highest thresholds to the second and third lowest thresholds between 2016-2018, back up to the highest thresholds in 2019 and 2020. The relative use of BBRKC and Tanner crab PSC has generally been orders of magnitude lower than the limits for the groundfish fisheries and generally not constraining, with the exception of the A80 sector exceeding the limit for Zone 2 Tanner crab in 2011.

2.7 Implementation considerations

Groundfish harvests are managed subject to annual catch limits on the amounts of each species or species group that may be taken. The annual harvest specifications also set or apportion PSC limits. Each year at its October meeting the Council recommends proposed groundfish and PSC limits for the BSAI groundfish fisheries. In December, the Council recommends final groundfish and PSC limits that are published in the Federal Register after Secretarial approval. Index values generated from the EBS trawl survey would be known at the October Council meeting and could be published in the proposed harvest specifications. Index values generated from the IPHC setline survey would not be available until late November at the earliest. As such, the final PSC limits under the look-up table approach would not be known until the December Council meeting. If the IPHC survey data were available by the December Council meeting, then the PSC limit could be published in the final harvest specifications. As noted previously, and in the preliminary DEIS (NPFMC 2020), in 2020 the annual EBS trawl survey and the IPHC EBS survey component were cancelled due to the COVID-19 pandemic; a reduced survey effort was completed in the GOA and other regions. At this point it is unknown if surveys will occur as regularly planned in 2021. In the absence of new data, the Council may wish to set the limits at the PSC limit from the previous year. Should there be multiple years without additional survey data, the Council could consider an adjustment to the limit (higher or lower) depending upon the trend in survey data from previous years. **The Council should clarify how it would set annual PSC limits in the absence of one or more years of survey data.**

Final harvest specifications are usually effective with publication in the Federal Register in late February or early March. The groundfish fisheries open on January 1 for non-trawl gear and on January 20 for trawl gear. It is unlikely that the Amendment 80 sector will exceed their annual halibut PSC limit in the first two months of the fishing year, even at the lowest limit since currently all participants in the Amendment 80 sector are in one cooperative. However, each year during the application process participants may decide to form more than one cooperative or participate in the Amendment 80 limited access sector. Halibut PSC limits for these participants may be at amounts that could be reached before the final harvest specifications are effective. The PSC limits from the previous years' harvest specifications are used to open the fisheries until superseded by the final harvest specifications PSC limits.

To cover the time between the opening of the groundfish fisheries and the publication of the final harvest specifications, the NMFS Regional Administrator may use the Inseason Adjustment authority under § 679.25 to adjust a PSC limit based on a determination that such adjustment is necessary to prevent the taking of a prohibited species that, on the basis of the best available scientific information, is found by NMFS to be incorrectly specified. The use of the Inseason Adjustment authority may be warranted since data from the IPHC survey used to inform index values are not available until after the proposed harvest specifications are presented to the Council at their October meeting.

3 Performance Standard

The Council is evaluating a performance standard that could modify the A80 sector's halibut PSC limit based on recent bycatch mortality in the fishery. The limit would be assessed and potentially adjusted on an annual basis. **This approach presumes a static A80 "base" halibut PSC limit of 1,745 t**, equal to the status quo. In this sense, the performance standard can be viewed as an alternative to the ABM approach analyzed in the DEIS (NPFMC 2020). The Council also directed staff to consider how a performance standard might be incorporated into the abundance-based discrete control rule described in Section 2 ("3x2 look-up table"); that topic is addressed in Section 3.3.

The A80 PSC limit would remain at 1,745 t *if and only if* mortality is below the selected annual threshold in at least three of the most recent five years, assessed on a rolling basis. The language of the Council's motion for this performance standard reads: "If [the A80 sector] has maintained its PSC usage to less than [an annual threshold] in three of the preceding five years, the sector will be permitted to use up to its full limit [1,745 t] in the coming year." The annual thresholds under consideration are:

Option 1 – 80% of the 1,745 t limit (1,396 t)
Option 2 – 90% of the 1,745 t limit (1,571 t)

Given the static nature of a base PSC limit, the status quo limit of 1,745 t could be viewed as a ceiling and the level of the selected threshold (Options: 1,571 t or 1,396 t) could be viewed as the PSC limit floor.

The performance standard approach would not apply in years when the IPHC specifies the directed halibut fishery catch limit for Areas 4CDE at 2 million net pounds or greater. In those years, the A80 PSC limit would be set at 1,745 t by default. The Area 4CDE commercial catch limit was below 2 million pounds from 2013 through 2018. The limit reached 2.04 million net pounds in 2019 but fell back to 1.73 million net pounds in 2020 (see Figure 3-1 and Table 3-1). Predicating the A80 PSC limit on a halibut fishery catch limit determination made by the IPHC – at least in some years – complicates how NMFS will administer the A80 fishery since the trawl season commences before IPHC annual catch limits are set (circa February each year). This issue is further addressed in Section 3.3.

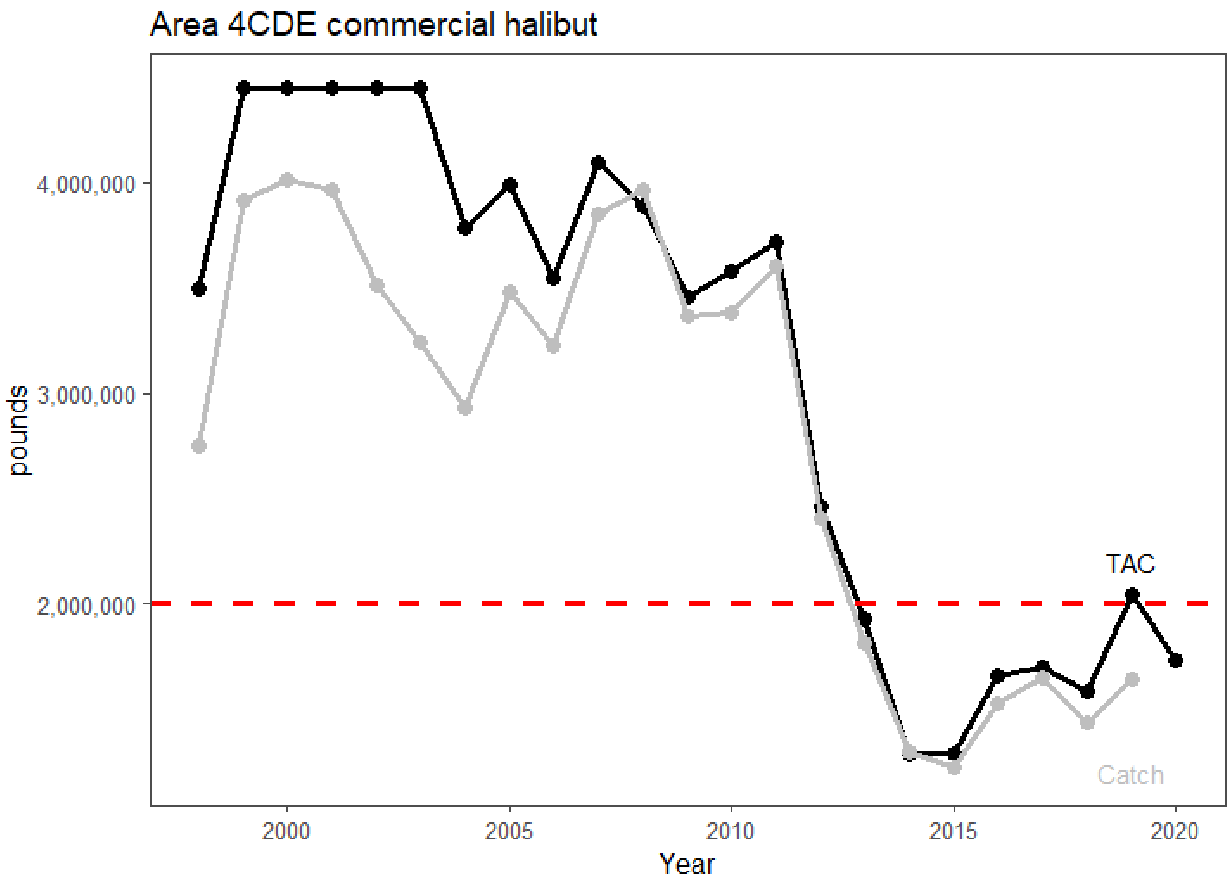

Figure 3-1 Area 4CDE Commercial halibut catch limit (TAC) in black and catch in grey. Red dashed line indicates Performance standard threshold of 2 million pounds. Performance standard would have applied for years 2013 through 2018 and 2020.

Table 3-1 reports the halibut IFQ and CDQ catch limits and the percentage landed in IPHC Areas 4CDE from 2010 through 2020. The total catch limit for the 4CDE areas was greater than 2 million t from 2010 through 2012 and in 2019 (see Table 3-1).

Table 3-1 IPHC Areas 4CDE IFQ and CDQ catch limits (lbs.) and harvest rates (%), 2013 through 2020. The total catch limit for the 4CDE areas was greater than 2 million t from 2010 through 2012 and in 2019 (bolded**).**

	Area	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
IFQ Catch	**4C/4D**	1,950,000	2,028,000	1,328,827	1,030,800	715,920	715,920	880,320	902,400	880,200	1,092,000	919,200
Limit		*93%*	*91%*	*91%*	*89%*	*96%*	*96%*	*96%*	*96%*	*90%*	*82%*	-
CDQ	**4C**	812,500	845,000	553,678	429,500	298,300	298,300	366,800	376,000	366,751	455,000	383,000
Allocation		*	*	*	*	*	*	*	*	*	*	-
	4D	487,500	507,000	332,207	309,240	178,980	178,980	220,080	225,600	220,050	273,000	229,800
		92%	*89%*	*86%*	*52%*	*67%*	*65%*	*82%*	*99%*	*72%*	*97%*	-
	4E	330,000	340,000	250,290	212,000	91,800	91,800	192,800	196,000	113,000	220,000	198,000
		125%	*134%*	*132%*	*132%*	*166%*	*	*62%*	*	*	*	-
4CDE Total		**3,580,000**	**3,720,000**	**2,465,002**	1,981,540	1,285,000	1,285,000	1,660,000	1,700,000	1,580,001	**2,040,000**	1,730,000
%CDQ landed 4BCDE		*95%*	*95%*	*96%*	*86%*	*98%*	*90%*	*85%*	*94%*	*91%*	*83%*	-

Source: https://www.fisheries.noaa.gov/alaska/commercial-fishing/fisheries-catch-and-landings-reports-alaska#ifq-halibut/sablefish

* Confidential data

Notes: IFQ landings in Areas 4C and 4D are combined because 4C allocation may be fished in 4C or 4D. Harvest is debited from the account for the reported harvest area but the combination in this report is a better representation of activity in the 4C/4D areas. For CDQ, 4D allocation may be fished in 4D or 4E and 4C allocation may be fished in 4C or 4D. This may cause landings to appear overharvested in 4E or 4D, or underharvested in 4C or 4D.

The remainder of this section provides a retrospective assessment of how the proposed A80 performance standard annual threshold options would have been applied over the 2010 through 2019 period and references existing performance standard management tools in other Federal fisheries off Alaska.

3.1 A80 historical PSC use relative to considered standards

Figure 3-2 and Figure 3-3 illustrate how Options 1 and 2, respectively, would have been applied during the 2010 through 2020 period. With a performance standard annual threshold set at 80% of the status quo PSC limit, the A80 sector would have operated under a 1,396 t PSC limit in all years for which the Area 4CDE catch limit was less than 2 million pounds because there was no series of years where three of five met the threshold (Figure 3-2). With a performance standard annual threshold set at 90% of the status quo PSC limit, the sector would have operated under a 1,571 t PSC limit from 2013 through 2017 because the 4CDE catch limit was less than 2 million pounds *and* the sector had not accumulated three years below the threshold. The sector would have fished under the status quo PSC limits from 2018 through 2020 based on consistent achievement of the performance standard from 2015 through 2019. The sector would theoretically be guaranteed a PSC limit of 1,745 t through 2022 regardless of performance in 2020 and 2021 due to the sector's performance from 2017 through 2019.

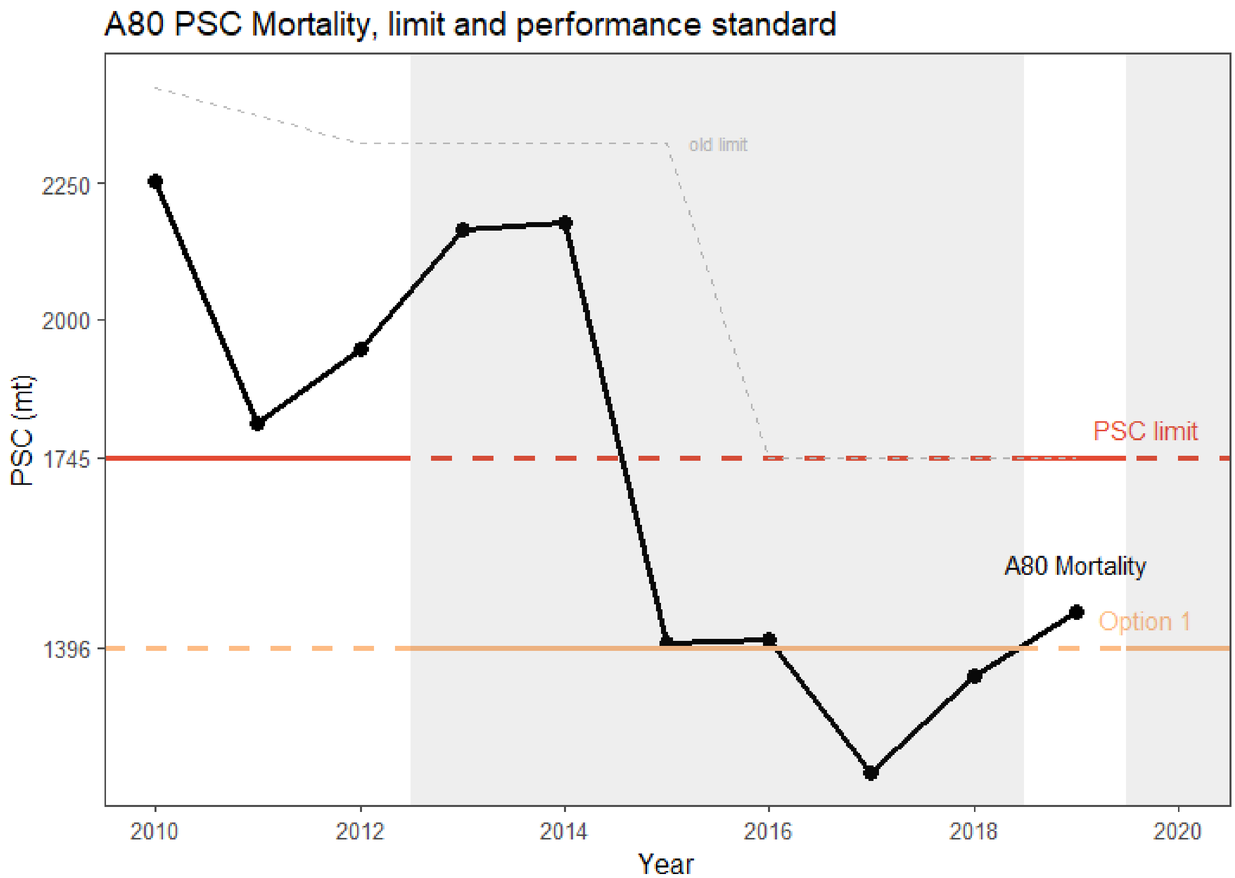

Figure 3-2 A80 PSC mortality and potential PSC limits under performance standard annual threshold Option 1. Grey box indicates years when 4CDE TAC was less than 2 million pounds (performance standard could apply). Solid red and orange lines indicate PSC limit that would have been applied based on the performance standard.

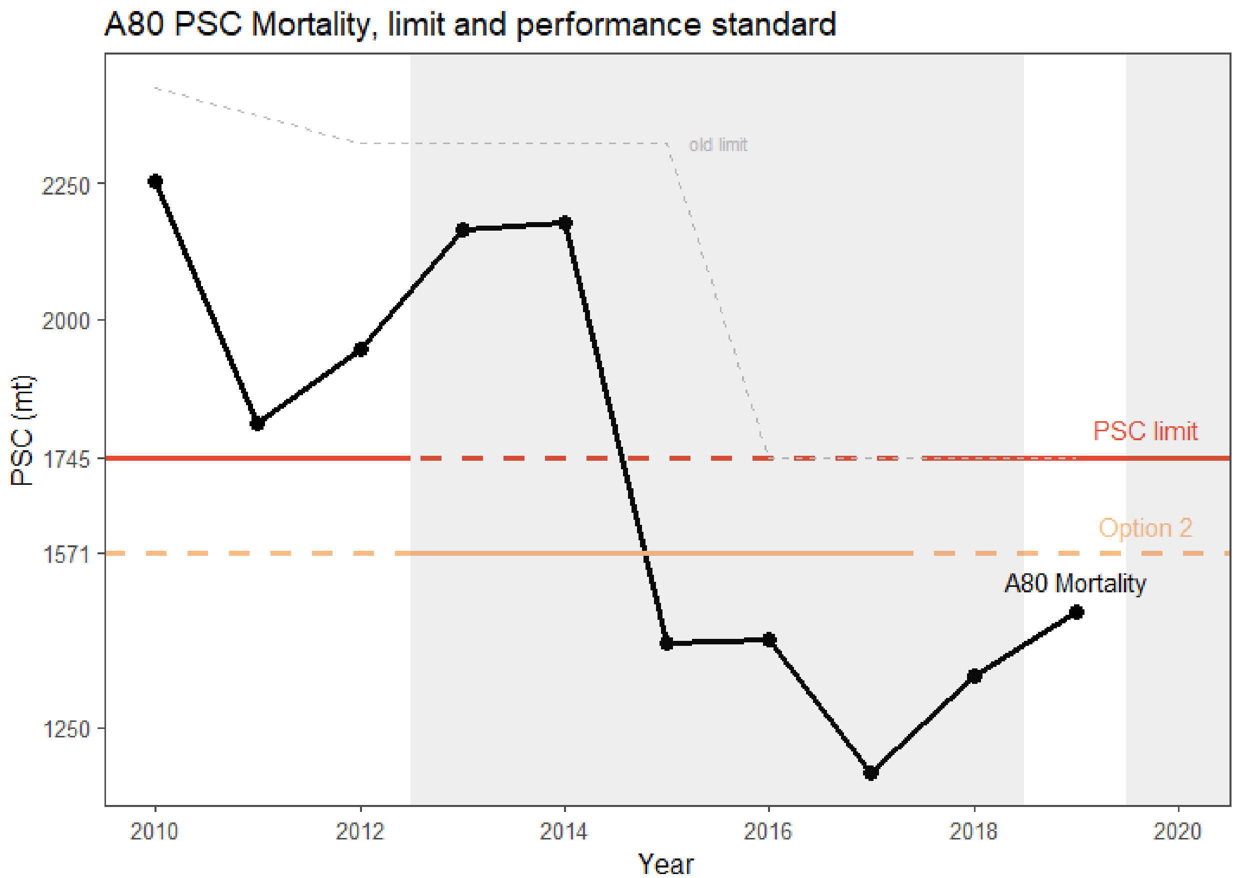

Figure 3-3 A80 PSC mortality and potential PSC limits under performance standard annual threshold Option 2. Grey box indicates years when 4CDE TAC was less than 2 million pounds (performance standard could apply). Solid red and orange lines indicate PSC limit that would have been applied based on the performance standard.

Table 3-2 reports A80 halibut PSC usage and groundfish catch volume for the analyzed historical period. The table shows the percentage of each performance standard annual threshold option that the A80 sector attained during the 2010 through 2019 period. This table and the figures above illustrate that A80 sector-level PSC use has been close to or below the annual threshold levels since deck sorting and other active mortality mitigation measures became more prevalent in the fishery around 2015 or 2016. In the years since 2015 – highlighted with the orange box in Table 3-2 – the A80 sector would not have exceeded the 90% threshold (Option 2 – 1,571 t) in any year. The closest that the sector would have come to the 90% threshold was 1,461 t in 2019 (93% of the standard). The A80 sector would have exceeded the 80% threshold (Option 1 – 1,396 t) in three of the five years beginning with 2015. This table is merely a data report, and the analysts do not ignore the fact that the A80 fleet might behave differently to the extent practicable if a performance standard were in place for future years. The year with the lowest total PSC, 2017, also stands out as the year with the lowest total groundfish catch, lagging other recent years by 10,000 to 20,000 metric tons. Lower catch and PSC in that year may be partly attributed to less total effort since several vessels were not fully participating as they had been purchased from an A80 company that no longer exists and spent some time undergoing refurbishment. The total number of A80 hauls in 2017 was the second lowest during the 2016 to 2019 period – a period when the fleet generally made more total annual hauls as part of the sector's halibut mortality mitigation strategies (see Table 3-21 in the DEIS (NPFMC 2020)).

Table 3-2 A80 Halibut PSC mortality (t) and total groundfish catch (1,000 t), 2010 through 2020*

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020*
A80 PSC	2,254	1,810	1,944	2,166	2,178	1,404	1,412	1,167	1,343	1,461	646
% of 80% Std.	161%	130%	139%	155%	156%	101%	101%	84%	96%	105%	46%
% of 90% Std.	143%	115%	124%	138%	139%	89%	90%	74%	85%	93%	41%
A80 GF Catch	305.2	302.2	307.4	306.8	308.0	289.2	298.4	278.8	290.2	288.3	-

* 2020 year to date through August 4, 2020

The Council may consider whether a performance standard threshold that incentivizes continuous halibut mortality minimization is one set at, above, or below "expected" PSC use based on recent years that reflect the current operational nature of the sector. The analysts note that using past performance as a projection of future PSC use does not account for external factors that influence PSC encounter rates and effective mortality such as halibut abundance, distribution, and comingling with groundfish target species to name only a few. Other factors that could influence future PSC use include groundfish TAC levels and catch-per-unit-effort – whereby a greater number of hauls required to meet groundfish harvest goals could result in higher levels of gross halibut encounter. In short, taking an "all else equal" approach to projecting future PSC use based on past performance is not a precise methodology; historical PSC usage years that came close to a performance standard threshold (plus or minus) could easily have fallen on the other side for reasons that are not accounted for when simply looking at the annual total.

When thinking about a performance standard threshold that is set at, above, or below recent A80 PSC use, the Council may also consider whether the purpose of the threshold selected is to, in effect, codify the sector's recent achievements or to drive further reductions. As evident in Table 3-2, the A80 sector has made substantial strides in PSC usage relative to the first seven years of the program (2008 through 2014). This signals that the A80 sector is already responding to strong direction from the Council and the stakeholding public to minimize mortality, even at a cost. Section 3.4.4 of the DEIS details the methods that the sector has put in place and acknowledges the operational and monetary costs of those methods. Recent history is evidence that the sector responds to a PSC limit when the limit could be reasonably expected to constrain groundfish fishing, and that the sector responds to Council directives to the extent practicable. The analysts are limited in what can be concluded about the practicability of further PSC usage reductions – in other words, whether the sector is mitigating PSC mortality to the greatest extent practicable or whether further reductions could be predicted if the limit was effectively lowered by a performance standard. The DEIS presents some evidence that the A80 sector is at least close to maximizing PSC mitigation efforts without forgoing gross harvest volume. Figure 3-38 in Section 3.4.4 of the DEIS shows that over 90% of A80 catch was deck sorted in 2018 and 2019; Figure 3-39 shows that deck sorting is occurring on all – or nearly all – flatfish hauls and on over 75% of roundfish hauls (Atka mackerel and POP). The total haul counts in DEIS Table 3-21 show that the sector is catching fewer fish with more hauls relative to the earlier years in the 2010 through 2019 period; this is a rough indicator that vessels are trading off harvest efficiency for bycatch mitigation.

While there is evidence that the A80 sector has performed to the limit, applying an A80 PSC performance standard – i.e., a lower limit – at the sector-level does not attempt to account for the heterogeneity of individual participants within the sector. The Council has often applied sector-level tools when the affected participants are part of a cooperative that is able to make internal groundfish or PSC transfers without regulatory restrictions. That said, the analysts recognize that some stakeholders within the A80 sector are relatively more exposed to an effective PSC limit with less "head room" when considering historical PSC usage. If the Council were to recommend a performance standard approach to the A80 PSC limit and set the threshold at or below historical sector-level use, the Council should also consider the internal dynamics of the A80 cooperative to the extent that those dynamics are publicly known through annual reports and public testimony. A truly benevolent intra-cooperative market could efficiently reallocate halibut PSC quota to companies that rely more heavily on flatfish species or to companies whose vessels encounter halibut at unexpectedly high rates. In reality, the A80 cooperative is a collection of companies that are in limited competition with one another. While there are few regulatory barriers to intra-cooperative transfers, the analysts presume that internal reallocation is priced in some manner. For example, a company would be justifiably hesitant to relinquish quota for constraining species (e.g., halibut or Pacific cod) early in the fishing year if its business plan relies on late-year targeting of A80 species that have higher expected or intrinsic bycatch rates (PSC rates by target species are reported in Table 3-20, Section 3.4.1 of the DEIS (NPFMC 2020)).

Figure 3-4 illustrates the range of historical species dependency for the groups of vessels that comprise the five fishing companies in the single Amendment 80 cooperative that is currently operating within the sector (and includes all active A80 vessels).[11] The figure shows stacked, unweighted percentages representing the composition of each anonymized company's catch (metric tons) and gross wholesale revenue (2018$) for the 2010 through 2019 period. Aggregate percentages for all A80 companies/vessels during the period are shown for comparison ("Sector Total").[12] Across all vessels, from 2010 through 2019, flatfish accounted for 60% of harvest by volume and 48% of gross wholesale revenue. Roundfish accounted for 23% of harvest and 31% of wholesale value. Pacific cod accounted for 9% of harvest and 13% of wholesale value. The analysts note that Pacific cod is not only valuable for its direct contribution to gross revenue, but is also a key quota to hold in order to access species in the flatfish complex as the two species-types are commonly comingled. That said, there is not a clear correlation between the percentage of harvest in the Pacific cod and flatfish categories when comparing across companies. Finally, non-AFA pollock caught on A80 vessels accounted for 8% of harvest and 8% of wholesale value.

[11] Flatfish includes yellowfin sole, rock sole, flathead sole, arrowtooth flounder, Alaska plaice, Kamchatka flounder, Greenland turbot, and "other flatfish". Roundfish includes Atka mackerel, Pacific ocean perch, northern rockfish, rougheye/shortraker rockfish, "other rockfish," and sablefish. Other species that are accounted for in the percentages but are not shown in the figure include squid, skates, sculpins, octopuses, sharks, and "other species".
[12] NMFS Catch Accounting System (via AKFIN) shows that several A80 vessels made relatively small amounts of harvest within the AFA pollock fishery; those data have been excluded.

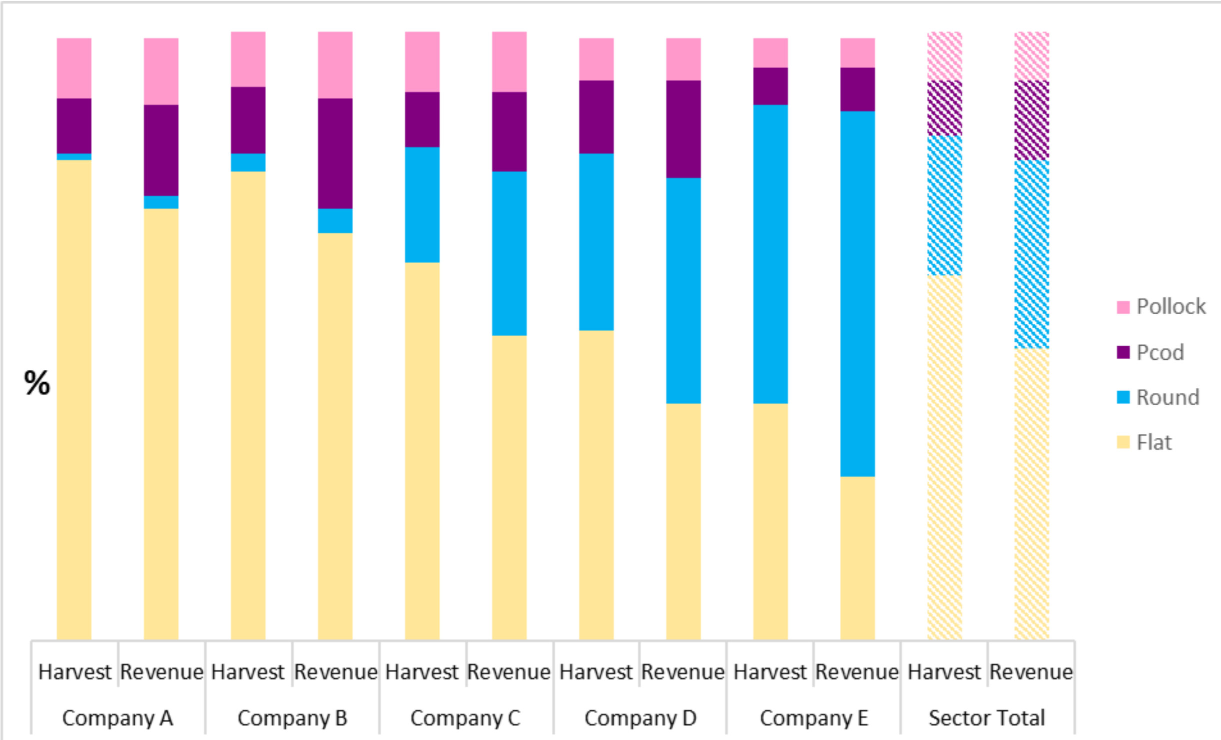

Figure 3-4 Aggregate 2010-2019 percentage of A80 harvest (t) and gross wholesale revenue (2018$) by species group for fishing company fleets as comprised in 2020 (Sources: NMFS Alaska Region Catch Accounting System, data compiled by AKFIN in Comprehensive_BLEND_CA; Vessel company affiliations taken from Alaska Seafood Cooperative Reports).

3.2 Examples of PSC performance standards (Chinook salmon)

3.2.1 Chinook and chum salmon management in the EBS pollock fishery

Amendment 91 established two Chinook salmon PSC limits/thresholds for the Bering Sea pollock fishery: 60,000 fish limit and 47,591 fish threshold. The PSC limit is an overarching hard cap while the threshold is an annual threshold that is evaluated as a performance standard. Both the limit and the annual threshold are applied at the sector level. The sector-level performance standard ensures that the IPA is effective and that sectors cannot fully harvest the Chinook salmon PSC allocations under the 60,000 (or 45,000) Chinook salmon PSC limit in most years. Each year, each sector is issued an annual threshold amount that represents that sector’s portion of 47,591 (or 33,318) Chinook salmon. For a sector to continue to receive Chinook salmon PSC allocations under the 60,000 (or 45,000) Chinook salmon PSC limit, that sector can only exceed its annual threshold amount two times within any seven consecutive years. Under the current program, if a sector fails this performance standard, it will continue to be allocated a portion of the 47,591 (or 33,318) Chinook salmon PSC limit each subsequent year. NMFS would issue transferable allocations of the 47,591 (or 33,318) Chinook salmon PSC limit to all sectors, cooperatives, and CDQ groups, if no IPA is approved, or to the sectors that exceed the performance standard.

The PSC limits/thresholds are lowered in years of low Chinook abundance to 45,000 and 33,318 Chinook salmon (Amendment 110).[13] For each PSC limit, NMFS issues A-season and B-season Chinook salmon PSC allocations of the PSC limit to the catcher/processor sector, the mothership sector, the inshore cooperatives, and the CDQ groups. When a PSC allocation is reached, the affected sector, inshore

[13] See Section 2.6.1 of this paper for additional information on the threshold for determination of a low abundance year.

cooperative, or CDQ group is required to stop fishing for pollock for the remainder of the season even if its pollock allocation had not been fully harvested.

NMFS issues transferable allocations of the 60,000 (or 45,000) Chinook salmon PSC limit to the sectors that participate in an Incentive Plan Agreement (IPA) and remain in compliance with the performance standard.[14] Sector and cooperative allocations would be reduced if members of the sector or cooperative decided not to participate in an IPA. Vessels, cooperatives, and CDQ groups that do not participate in an IPA would fish under a restricted opt-out allocation of Chinook salmon. If a whole sector does not participate in an IPA, all members of that sector would fish under the opt-out allocation. If a vessel, cooperative, CDQ group, or sector opts out of an IPA, NMFS allocates that entity's portion of the 28,496 opt-out caps to the opt-out allocation for that fishing year and the entity would fish under that opt-out allocation. NMFS would manage the opt-out allocation as an open access PSC limit and close the pollock fishery to opt-out vessels when the Chinook bycatch by those vessels approaches that allocation.

The IPA component was created to encourage participants to design their own agreements with incentives for each vessel to avoid Chinook and chum salmon bycatch at all times and maintain Chinook salmon bycatch at levels below the regulatory PSC limits. Each IPA entity is required to provide an annual report to the Council that evaluates whether the plan was effective at providing incentives for vessels to avoid Chinook salmon at all times while fishing for pollock. 50 CFR 679.21(f)(13) stipulates that IPA entities report annually on the following:

- Incentive measures in effect in the previous year to avoid Chinook and chum including rolling hot spot program and salmon excluder use;
- Measures to ensure that chum salmon were avoided in areas and at times where chum salmon are likely to return to western Alaska;
- How incentive measures affected individual vessels;
- Restrictions or penalties that target vessels that have consistently higher Chinook PSC rates relative to other vessels;
- Restrictions or performance criteria to ensure Chinook PSC rates in October are not significantly higher than other months;
- How incentive measures affected salmon savings beyond current levels;
- IPA amendments approved by NMFS since the last annual report and the reasons for amendments;
- Sub-allocation to each participating vessel;
- Number of Chinook PSC and amount of pollock (mt) at the start of each fishing season;
- Number of Chinook PSC and amount of pollock (mt) caught at the end of each season;

[14] Note the definition of the performance standard is as follows (from § 679.21(f)(6)): “Chinook salmon bycatch performance standard. If the total annual Chinook salmon bycatch by the members of a sector participating in an approved IPA is greater than that sector’s annual threshold amount of Chinook salmon in any three of seven consecutive years, that sector will receive an allocation of Chinook salmon under the 47,591 PSC limit in all future years except in low Chinook salmon abundance years when that sector will receive an allocation under the 33,318 Chinook salmon PSC limit. (i) Annual threshold amount. Prior to each year, NMFS will calculate each sector’s annual threshold amount. NMFS will post the annual threshold amount for each sector on the NMFS Alaska Region Web site (http:// alaskafisheries.noaa.gov). At the end of each year, NMFS will evaluate the Chinook salmon bycatch by all IPA participants in each sector against that sector’s annual threshold amount. (ii) Calculation of the annual threshold amount. A sector’s annual threshold amount is the annual number of Chinook salmon that would be allocated to that sector under the 47,591 Chinook salmon PSC limit, as shown in the table in paragraph (f)(3)(iii)(B) of this section or the 33,318 Chinook salmon PSC limit in low Chinook salmon abundance years, as shown in the table in paragraph (f)(3)(iii)(D) of this section.. If any vessels in a sector do not participate in an approved IPA, NMFS will reduce that sector’s annual threshold amount by the number of Chinook salmon associated with each vessel not participating in an approved IPA.”

- In-season transfers among entities of Chinook salmon PSC or pollock among AFA cooperatives;
- Transfers among IPA vessels; and amount of pollock (mt) transferred.

3.2.2 Chinook salmon PSC in GOA non-pollock trawl fisheries

In 2015 NMFS implemented Chinook salmon PSC limits for non-pollock trawl catcher vessels and catcher processors, including the Central GOA Rockfish Program (79 FR 71350). Part of that package was an "incentive buffer" that is, in effect, a performance standard. In contrast to the BSAI salmon performance standard and the performance standard proposed in this paper, the GOA trawl incentive buffer functions as an earned year-to-year carry-over rather than a conditional reduction in the fishery/sector PSC limit.

The total annual PSC limit across three GOA non-pollock trawl sectors – CP, CV, and Rockfish Program CV – is 7,500 Chinook salmon. The total limit of 7,500 Chinook salmon is apportioned as follows: 3,600 for CPs (covering fishing both within the Rockfish Program and the limited access directed non-pollock fisheries), 2,700 for CVs operating outside of the Rockfish Program, and 1,200 for CVs operating within the Rockfish Program. Those apportionments equate to the following proportions of the 7,500 Chinook limit: CPs – 48%, non-Rockfish Program CVs – 36%, and Rockfish Program CVs – 16%. The incentive buffer is based on a threshold for each of the three sectors, individually. A sector's threshold – or performance standard – is equal to its apportionment percentage multiplied by 6,500 Chinook salmon. For example, the threshold for CPs is 3,120 Chinook (48% * 6,500). The Council's goal was to incentivize each sector to perform to a standard that, if met across all sectors, would result in a maximum PSC level of 6,500 as opposed to the regulatory limit of 7,500. A sector's "reward" for meeting its threshold is an incentive buffer of additional Chinook PSC in the next year. Again using the CP sector as an example, if GOA trawl CPs accrue fewer than 3,120 Chinook salmon then the sector's limit in the following year is increased by 480 Chinook (equal to the difference between the base limit of 3,600 and the threshold of 3,120), resulting in a PSC limit of 4,080 Chinook. The arithmetic for the non-Rockfish Program CVs is similar: the base limit is 2,700 Chinook; if the sector accrues fewer than 2,340 Chinook in one year then its limit is increased by 360 Chinook for the following year (3,060 Chinook PSC limit).

The GOA incentive buffer must be "earned" in every year. In other words, a sector cannot compile additional PSC allowances and roll them to future years in a cumulative manner. The limit will never exceed the base limit plus the buffer amount. The purpose of this design is to incentivize PSC avoidance in every year and not to allow a scenario where a sector can accumulate additional PSC credits that, if all taken in one year, could theoretically allow the combined non-pollock trawl fisheries to exceed the total annual cap of 7,500 under any circumstances.

Section 3.6.4.1 of the GOA Groundfish FMP states that the "intended effect of [the incentive buffer] is to increase the opportunity to harvest groundfish TACs before established PSC limits are reached by encouraging vessels to maintain average bycatch rates within acceptable performance standards and discourage fishing practices that result in excessively high bycatch rates."

3.3 Implementation considerations

Regulations would continue to define the annual A80 sector halibut PSC limit as 1,745 mt. A provision would be added to indicate that if the sector used less than or equal to 80% or 90% of this limit in three out of five years it would be allowed to use the full limit in the following year. If the sector does not meet that performance standard it would be limited to 80% or 90% of the base PSC limit in the following year. This provision could be included at § 679.91(d)(1) and would follow a format similar to that of the Chinook salmon bycatch performance standard for the Bering Sea pollock fishery described at § 679.21(f)(6). In years when the A80 halibut PSC limit would be reduced under the performance standard, the NMFS Regional Administrator could use the Inseason Adjustment authority under § 679.25. If a reduction is not warranted in a given year, the halibut PSC limit for the Amendment 80 sector would revert to 1,745 t. To streamline the regulatory revision process, all references to the annual halibut PSC limit for the A80 sector could be directed to Table 35 of 50 CFR part 679 in the Federal Register. Alternatively, any reference to the 1,745 t A80 halibut PSC limit could have language added to reference the annual performance standard at § 679.91(d)(1).

Should a performance standard based on PSC mortality be implemented, the effective annual A80 PSC limit would likely not deviate from the default base limit of 1,745 until at least three years have accrued post-implementation. Legal case history suggests that new standards cannot be retroactively applied to fishing years that occurred prior to implementation of the standard. In other words, the analysts presume that a performance standard implemented in 2022 could not result in an A80 PSC limit of less than 1,745 t until at least 2025. This statement does not imply a legal opinion by NMFS and should be reviewed by NOAA General Counsel if the Council pursues a performance standard approach.

The proposed performance standard would not apply if the Area 4CDE catch limit is specified at greater than or equal to 2 million net pounds. The IPHC typically makes mortality limit decisions for the directed fisheries in February of the same year that the limits would apply and, in that process, predicted bycatch for that year is used to allocate the mortality among the directed commercial fishery and other users (e.g., subsistence). The IPHC would know whether an annual threshold is to be implemented when it is determining mortality limits; that information could be used to provide a better prediction of the bycatch mortality. From the Federal groundfish management perspective, not knowing whether the IPHC will set the Area 4CDE catch limit above or below 2 million net pounds until after the A80 season begins on January 20 necessitates some inseason management flexibility. In practice, it is likely that NMFS can open the A80 season under a provisional PSC limit that will be revised to the annual threshold, if applicable, after the IPHC's annual meeting. The PSC limit "floor" under a performance standard cannot be reasonably expected to be achieved in the first month of the A80 fishing year. The analysts think it unlikely that A80 business planning and fishing behavior would be significantly altered during the late-January to mid-February window based on a final PSC limit of 1,745 t or – at a minimum – 1,396 t.

Finally, the Council directed staff to consider how a performance standard might be applied to an abundance-based PSC limit that is governed by the look-up table described in Section 2 of this paper. The Council could choose to link the 80% or 90% threshold to the limit as dictated by the look-up table in a given year. Because the limit may change from year to year based on the abundance index values, the Council would need to clearly state that attainment or non-attainment of the standard is assessed annually and cannot be retroactively changed if the PSC limit shifts to a different value in the look-up table at some point during the rolling five-year assessment period. In other words, a year would count as a positive mark towards the three-of-five performance standard if the A80 sector performed at or below 80% or 90% of the limit for that year. A year where the A80 sector performed to the standard could not retroactively be marked as a non-attainment year if the limit shifted to a lower PSC limit in the look-up table at some subsequent point in the rolling assessment period. Section 2 also described how survey abundance indices are, or could be, revised retroactively based on additional data that are input into a dynamic spatiotemporal model. The analysts similarly presume that a prior year's attainment or non-attainment could not be retroactively modified because the PSC limit – as based on the look-up table – "should have been" at a different level, given a more recent space-time model of abundance.

4 CDQ compensation concept

The Council's motion for Part 3 of this discussion paper requests the following:

In a year when the Area 4CDE catch limit is set below 1 million net pounds, the halibut PSC limit for the Amendment 80 sector will be reduced at a rate equal to 50 metric tons of halibut PSC for each 100,000 net pounds that the 4CDE catch limit is below 1 million net pounds.

For each metric ton reduction in the halibut PSC limit under the above provision, 1,000 pounds of directed halibut quota in Area 4CDE will be allocated to the CDQ groups in addition to their annual CDQ allocations, prorated among those groups in proportion to the annual division of CDQ quota.

The Council's motion states that the base annual halibut PSC limit for the A80 sector would remain static at 1,745 t under this approach, similar to the performance standard concept described in the previous section.[15]

When initially discussing this concept, the Council noted that the intent is to consider the ways that available tools can be utilized to provide for Area 4CDE catch when halibut abundance is low. The first subsection describes the IPHC allocation process and conceptually how such an adjustment to the Area 4CDE catch limit could occur in terms of process, as well as some issues with the assumptions embedded in the rate reduction as proposed. The following subsection identifies legal limitations that would not currently authorize direct allocation to the CDQ groups without changes to the MSA.

4.1 Explanation of concept

Currently, the IPHC determines a Total Constant Exploitation Yield (TCEY consisting of all mortality except under-26 inch (U26) bycatch) for each IPHC Regulatory Area – 2A, 2B, 2C, 3A, 3B, 4A, 4B, and 4CDE. Within each of those areas, predicted over 26-inch bycatch (O26 bycatch) is subtracted from the TCEY and the remainder is allocated to directed fisheries. Figure 4-1 (from Chapter 4 of the DEIS) illustrates the distribution of TCEY to the IPHC Regulatory Areas in region 4 and the Area 4CDE Catch Sharing Plan (CSP) that allocates catch limits to additional sectors. The first step of distribution within Area 4 is IPHC decisions on the TCEY in IPHC Regulatory Areas 4A, 4B, and 4CDE. Predicted non-directed commercial discard mortality for Pacific halibut over 26 inches (e.g., bycatch mortality) is accounted for at this point and is subtracted from the TCEY, leaving directed fishery mortality limits. Note that the IPHC's predicted bycatch mortality is not the same as the fixed A80 PSC limit, and in fact is typically less than that limit because it predicts PSC *usage*. The lower levels of the Figure 4-1 flowchart address distribution within Area 4CDE. Also note that the figure is incorporating a provision that is in place when the catch limit for that combined 4CDE Area is above a certain threshold (4CDE catch limit > 1,657,000 lbs.). If that threshold is not met, the fishery CEY (FCEY) for those combined areas is distributed by the percentages shown with no 80,000 lbs. adjustment applied.

[15] The Council motion includes an advisory note to staff that "a round pound of halibut is 75% of the dressed weight for purposes of converting gross pounds to net pounds." Staff highlights this as a typographical error; a net pound is generally calculated as 75% of a round pound. IPHC and the ADF&G Division of Sport Fish use the 75% conversion. ADF&G Division of Subsistence use a 72% conversion based on a 1993 study (Crapo et al.) that reported the average weight of a dressed halibut with the head removed is 72% of round weight with a range of 68% to 80%. In sum, the analysts find the 75% assumption noted in the Council motion to be acceptable and backed by previous study and practice.

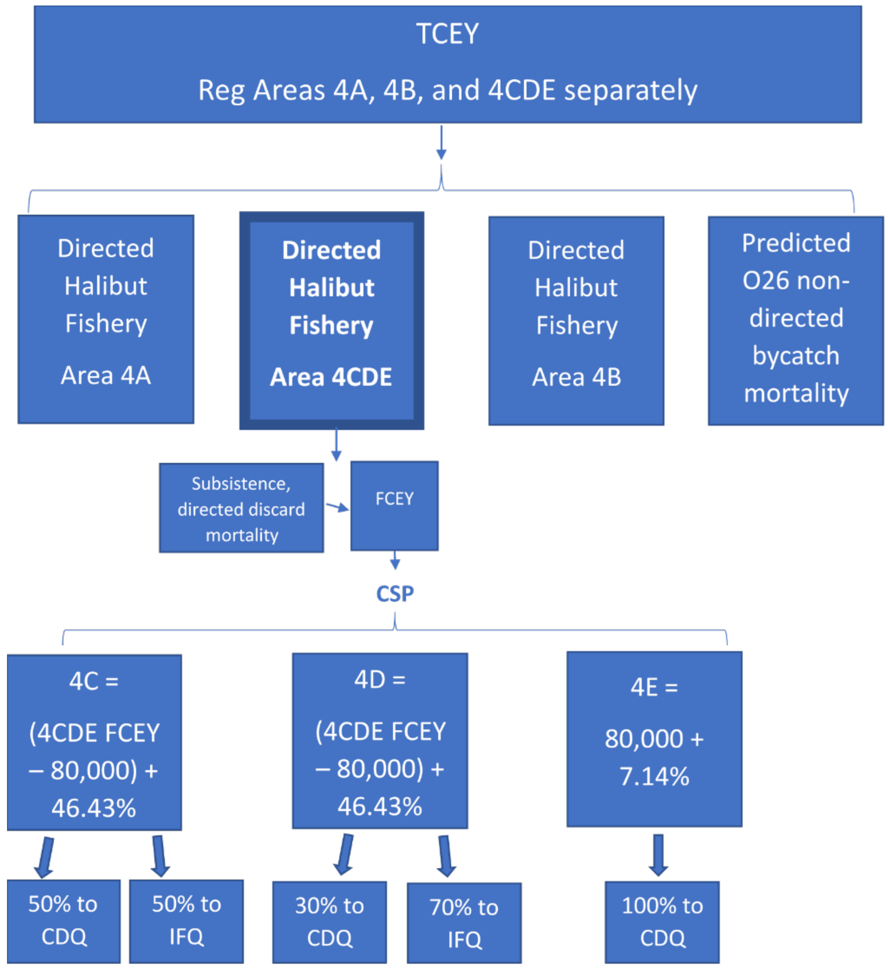

Figure 4-1 Distribution of TCEY to directed fishery users in IPHC Area 4 when the 4CDE catch limit is greater than 1,657,600 lbs. Note that '+' designates the proportional percentage allocation after the 80,000 has been either added to or reduced from the allocation under the CSP

Figure notes: CSP = Area 4 Catch Sharing Plan; TCEY = Total Constant Exploitation Yield, or Total mortality minus U26 bycatch mortality; FCEY in Area 4CDE = commercial catch limit (TCEY minus subsistence and O26 non-directed commercial discard mortality ("bycatch") and directed commercial discard mortality).

The Council requested that staff calculate the CDQ reserve allocations under various combinations of Area 4CDE catch limits and A80 PSC limits that would occur when the IPHC sets 4CDE at 1 million net pounds or less. Table 4-2 performs that arithmetic and provides a comparison to actual A80 PSC usage from 2010 through 2019 (also shown in Table 3-2).[16] First, Table 4-1 shows the proportion of the Area 4CDE catch limit that has been allocated to the CDQ reserve through the CSP, as illustrated in Figure 4-1. The average proportion of 4CDE TAC that goes to CDQ groups is 46%; annual values do not vary widely so 46% is used as an assumption for Table 4-2. The fact that only 46% of the additional directed fishery pounds associated with a reduction to the A80 PSC limit accrues to the CDQ groups may be in tension with the intent of the proposal – that PSC limit reductions result directly in additional catch opportunity for particular user groups in western Alaska. Without amendment, the CSP dictates that A80 PSC

[16] The analysts assume that the Council's motion intends for the trade-off between A80 PSC and directed fishery catch limits to occur on a continuous scale, and not as a step-function. In other words, the A80 sector PSC limit would not be reduced by 50 t if the IPHC were to set the 4CDE catch limit at 999,999 lbs.

reductions would benefit CDQ and non-CDQ directed halibut stakeholders as well as non-commercial stakeholders.

Table 4-2 applies the proposed PSC-to-4CDE transfer to scenarios where the IPHC sets the Area 4CDE catch limit at 1 million pounds or less. The left-hand panel shows the concept of exchanging 50 tons of PSC per 100,000 pounds of halibut TAC. The Area 4CDE catch limit, which has not been set lower than 1 million pounds during the analyzed historical period, would have to fall to 300,000 to 500,000 pounds for the A80 PSC limit to be reduced to the level of usage observed during the 2015 through 2019 period (right-hand panel). The reader can draw his or her own conclusion about the A80 PSC limit "floor" under this proposal, given the starting point of a 1,745 t PSC limit. However unlikely, a 4CDE catch limit of less than 500,000 lbs. would result in an A80 PSC limit in the range of 1,200 to 1,500 t. For comparison, average A80 PSC usage from 2015 through 2019 was 1,357 t and median usage was 1,404 t. The center panel of Table 4-2 applies the transfer described in the Council's motion, where 1,000 net pounds of halibut is added to the 4CDE IFQ/CDQ catch limit for each metric ton of reduction to the A80 PSC limit. In the table, "4CDE Limit +" represents the commercial catch limit for IFQ and CDQ, combined; "4CDE CDQ Reserve" applies the 46% assumption based on Table 4-1. Table 4-2 shows that at 4CDE catch limits of less than 1 million pounds the 4CDE CDQ catch limit would top out around 450,000 pounds. The lowest level that the 4CDE CDQ catch limit reached during the analyzed period was 569,000 pounds in 2014 and 2015.

Table 4-1 Area 4CDE catch limit and amount allocated to CDQ groups (1,000 lbs.), 2010 through 2019

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
4CDE Catch Limit	3,580	3,720	2,465	1,982	1,285	1,285	1,660	1,700	1,580	2,040	1,730
4CDE CDQ Reserve	1,630	1,692	1,136	951	569	569	780	798	700	948	811
% CDQ	46%	45%	46%	48%	44%	44%	47%	47%	44%	46%	47%

Table 4-2 Area 4CDE halibut catch limits (total, CDQ) under proposed transfer mechanism when IPHC sets 4CDE at or below 1 million net pounds

Scenario		Adjusted (lbs.)		A80 PSC Usage	
4CDE Limit (lbs.)	A80 PSC Limit (t)	4CDE Limit +	4CDE CDQ Reserve	Year	Tons
1,000,000	1,745	1,000,000	460,000	2010	2,254
900,000	1,695	950,000	437,000	2011	1,810
800,000	1,645	900,000	414,000	2012	1,944
700,000	1,595	850,000	391,000	2013	2,166
600,000	1,545	800,000	368,000	2014	2,178
500,000	1,495	750,000	345,000	2015	1,404
400,000	1,445	700,000	322,000	2016	1,412
300,000	1,395	650,000	299,000	2017	1,167
200,000	1,345	600,000	276,000	2018	1,343
100,000	1,295	550,000	253,000	2019	1,461

The Area 4CDE CDQ reserve shown in Table 4-2 would then be further allocated across CDQ groups within each area. Figure 4-10 in Section 4.4.1.1 of the DEIS shows haw the CDQ reserve is divided among CDQ groups. Within Area 4C, CBSFA is allocated 85% of the reserve and APICDA is allocated 15%. Within 4D, NSEDC is allocated 30%, BBEDC is allocated 26%, CVRF is allocated 24%, and YDFDA is allocated 20%. Within 4E, CVRF is allocated 70% and BBEDC is allocated 30%.

When setting TCEY, the IPHC predicts O26 bycatch based on average bycatch mortality (usage) for the three most recent years – not based on the A80 PSC limit. This process complicates the concept of reducing the A80 sector PSC limit in order to redistribute catch limits to other sectors in Area 4CDE. Mortality limits for halibut are determined using total mortality from all sectors and for all sizes. However, as mentioned, only predicted O26 bycatch mortality is used to determine directed fishery catch limits directly from the TCEY. Predicted U26 bycatch is listed in the IPHC mortality table and is part of the total mortality (see Appendix IV of IPHC-2020-AM096-R).

Given that the intent of this measure is to provide for additional directed catch in Area 4CDE, the reduction should be to the projected usage, not the PSC limit. In order for the transfer of A80 PSC tons to directed fishery pounds to be more effectual, the A80 sector might need to agree to a usage assumption that can be the basis of a pound-for-pound exchange so the IPHC can use that figure when setting TCEY. Another way to think about this is that, because the IPHC already bases 4CDE catch limits on predicted *usage*, the directed fishery is already benefiting from lower PSC (2015-present) to the extent that it can. The proposed A80 PSC *limit* reductions linked to the 4CDE catch limit – shown in the left-hand panel of Table 4-2 – would not result in greater catch opportunity for directed halibut users unless the 4CDE limit fell to an unprecedented and untenable level.

The projected total bycatch is typically less than the PSC limit and the method used to project total bycatch as well as the U26 and O26 components can be modified and improved by the IPHC secretariat when necessary. For example, currently projected PSC usage is determined using a 3-year average of recent bycatch, but previously it had simply been determined from the most recent year's usage. Modifying this can be proposed at either the interim or the annual meeting of the IPHC and implemented in the calculation for the upcoming year. Another example of the IPHC modifying its usage assumption when setting TCEY occurred in 2015. The Council made its final recommendation to reduce the PSC limit for A80 and other sectors (Amendment 111) in June but the reduction was not effective until the 2016 fishing year. The IPHC considered this regulatory change and the A80 sector's own proposals to reduce PSC usage during its interim/annual meeting cycle in 2015/16. Note that the IPHC interim meeting typically occurs in November and the IPHC annual meeting typically occurs in late January or early February. These dates are important when considering how a mechanism based on Area 4CDE catch limits could be integrated with the setting of the annual halibut PSC limit for the A80 sector; this was previously addressed in Section 2.7 of this paper.

Once set, the Area 4CDE catch limit is distributed through the Council's Catch Share Plan (CSP) as shown in Figure 4-1. In order to modify the A80 PSC limit when the directed fishery catch limit is set below one million pounds, as proposed, it is important to consider the catch limit and PSC setting processes. PSC limits would be determined at the December Council meeting prior to the start of year for which the catch limits apply (see Section 2.7). The TCEY is determined by IPHC in January or February of the year the catch limits apply, after the PSC limits have already been determined. **The modification to the PSC limit when the directed fishery catch limit is less than one million pounds would have to occur after the initial PSC limit is determined and PSC accrual has already begun in the BSAI groundfish fisheries (see Section 2.7).**

The IPHC uses an SPR-based harvest policy to determine catch limits (spawning potential ratio). This method maintains a constant fishing intensity, accounting for the mortality of all sizes and from all sources. When reallocating mortality between sectors that have different selectivity patterns, it is likely that there is not a 1:1 relationship between pounds reduction in one sector to the pounds gained in another. For example, Stewart et al (2020) found that the pounds gained by the commercial sector when bycatch mortality was reduced were variable across years and ranged from 86% to 139% (gain to the commercial sector for each pound of bycatch reduced). The population size structure, weight-at-age, maturity, and other factors are important determinants of this relationship. Therefore, simply shifting pounds from one sector to another without rebalancing the fishing intensity will cause a change in the fishing intensity and potentially a departure from the harvest strategy.

The CSP defines allocation to the directed fishery sectors and may need to be changed to account for a reallocation to specific areas (4CDE) that is based on the catch limit. Changes to the CSP require FMP and regulatory amendments. In discussing this motion, the Council also reflected some concerns about linking the A80 PSC limit, which is specified annually by NMFS, to an IPHC decision that is based on both biological and policy objectives.

The motion recommends using an assumption that 60% of halibut PSC is O26 when evaluating the theoretical exchange between A80 PSC and impacts on Area 4 CDQ and IFQ directed halibut fishery catch limits. This assumption is similar to the percentage of O26 observed in 2019 extrapolated using the weighted estimation process described here (see Table 4-3). The estimation process follows the hierarchical sampling design used by observers to estimate the proportion of O26 halibut discards.[17] Halibut length data collected at the haul level are expanded within each level of the sampling hierarchy, within each sampling strata. Since sampling rates vary not only at each level of the hierarchy but also between sample units (e.g. proportion of halibut measured varies between hauls on a fishing trip), this weighting is important to ensure unbiased estimation. To estimate the proportion of O26 halibut discards, the estimates of the O26 proportion are weighted by the total weight of discarded halibut estimated at each level. The estimated proportion can then be multiplied by the halibut discard (or mortality) to estimate the amount of O26 halibut discarded. This methodology is similar to the one that is now used in the estimation of halibut discard mortality rates. Table 4-3 shows the relative percentage of O26 halibut PSC calculated as a straight average of observer data and by the weighted method described above. There is a trade-off between PSC usage and halibut fishery catch because the halibut fishery catch is the TCEY (mortality limit of O26 halibut) minus the O26 PSC usage as described previously. Therefore, a larger percentage of PSC that is O26, results in a lower halibut fishery catch. If such an A80 PSC limit reduction as proposed were to move forward, **the assumption about the proportion of O26 fish in trawl bycatch requires careful consideration**.

Table 4-3 Three-year average percentage of O26 halibut PSC by weight as calculated by straight average of observer data and weighted average based on sampling hierarchy, 2010 through 2019. These results include data from the deck sorting EFP years (2016 through 2019). No DMRs are applied.

	% O26 bycatch by weight	
Year	**Straight**	**Weighted**
2010	55.6%	34.2%
2011	64.7%	43.0%
2012	62.5%	50.9%
2013	61.6%	52.4%
2014	63.3%	51.5%
2015	50.0%	38.4%
2016	65.7%	28.2%
2017	70.2%	46.3%
2018	62.5%	49.6%
2019	75.8%	60.5%
Average 2010-2019	69.5%	52.1%

4.2 Potential legal issues with concept

The second part of this proposal refers to a direct allocation of any additional directed halibut catch limits to the CDQ groups. Legislative action under Section 305(i)(1)(C) of the MSA enabled allocation to CDQ

[17] See Cahalan et al. (2015) for a description of the sampling and estimation hierarchy.

groups of groundfish, halibut, crab, and bycatch species. A required decennial review allows for program and allocation adjustments. On July 11, 2006, the Coast Guard and Maritime Transportation Act of 2006 (Coast Guard Act) amended the MSA to establish percentage allocations for groundfish, crab, and halibut allocated among the CDQ groups at the percentage allocations in effect on March 1, 2006. The percentage allocations for prohibited species quota (PSQ) allocated among the CDQ groups were not affected by those amendments to the MSA and continue in effect under an administrative determination issued by NMFS.

However, given that Bering Sea and Aleutian Islands directed fishery allocations to CDQ Groups are fixed under the MSA, as enacted by the aforementioned Coast Guard act, **the Council does not have the authority to accommodate the second part of the request absent additional Congressional action**. The Council could continue to examine how this could occur with the understanding that the action is not presently within the Council's authority. The Council has, in the past, considered actions for which it does not presently have the legal authority to recommend (e.g. for crab rationalization).

There are other measures that could be considered if the Council's intent is to provide additional opportunities to participants in the areas where the CDQ Groups are located. For instance, the Council is authorized to develop limited access regulations under the Halibut Act as long as all applicable requirements in the Halibut Act are met. The Council could pursue actions to increase available catch to Area 4CDE per discussion of the first part of this concept, but that catch would accrue to both CDQ and IFQ participants according to the formula in the CSP, thus attenuating the benefit to CDQ stakeholders.

5 Potential effects of lower PSC use, limits on Area 4 halibut fishery

The analysts have no reason to believe that the PSC limit approaches considered in this paper would have a different effect on Area 4 halibut fishery users than what was described in the DEIS, insofar as they reduce A80 PSC use. Any decrease in A80 PSC usage under current halibut stock status conditions would result in some increase to the available directed fishery catch, whether through lower – potentially constraining – limits under the look-up table or through induced bycatch reduction below current usage due to a performance standard approach. As noted in Section 3, current A80 PSC usage is generally at or below the proposed annual thresholds under a performance standard approach. The A80 sector as a whole is likely to take measures to keep PSC usage under the standard threshold, either under the incentive structure or by regulation if the performance standard is triggered based on three of the five most recent years.

Any reduction in A80 PSC usage in the BSAI could indirectly result in an increase to Area 4 directed fishery limits but will also affect catch limits for various sectors within and outside of Area 4. The sectors included in the Area 4 CSP include subsistence and recreational fishing in addition to commercial IFQ and CDQ fishing. Any specific directed fishery catch increase to Area 4CDE must go through the CSP and therefore only the proportional allocation to CDQ in each Regulatory Area will be implemented. In other words, if the Council's objective is to increase available CDQ harvest through a reduction in A80 PSC usage, the Council should acknowledge that the gains from A80 PSC usage reductions flow not only to CDQ users but also to non-CDQ commercial IFQ holders and the subsistence/recreational sectors. Beyond that, any additional catch that accrues to Area 4CDE as a result of lower A80 PSC usage would not accrue at a 1:1 relationship because of the differences in selectivity between the sectors. As described in Stewart et al (2020), the pounds of gained directed fishery yield for a one-pound reduction in bycatch mortality has been variable over time (ranging since 2010 from 0.86 to 1.39). In the most recent years, the yield-gain ratio has been approximately a 1.2 pound gain to the coastwide directed fishery for a one-pound reduction in coastwide bycatch mortality. This relationship likely differs among IPHC regulatory areas. The IPHC uses an SPR-based fishing intensity to determine catch limits, thus there is no impact to the halibut spawning biomass when shifting catch between user groups (i.e. PSC usage to directed fishery catch) provided that SPR is held constant. A reduction in A80 PSC usage would be more likely to positively affect the halibut spawning biomass if coastwide abundance and halibut fishing intensity were lower and recruitment was substantially higher, but under the present conditions (e.g., low recent recruitment) the gains from reduced bycatch mortality are likely to flow more directly to halibut fishery users. This is consistent with the conclusions of the DEIS under the current recruitment conditions to which the operating model is tuned. The analysts again note that benefits to directed halibut fishery users in current and future years associated with reductions in PSC mortality are dispersed across IFQ, CDQ, and non-commercial user groups due to the CSP, and is dispersed across areas in future years (inside and outside the BSAI) due to movement of halibut.

6 References

Alaska Department of Fish and Game (ADFG). 2018. Updated Relationship of the 3 System In-River Total Run Index and Total Western Alaska AEQ. Discussion paper presented to the NPFMC June 2018. Accessible at: https://meetings.npfmc.org/CommentReview/DownloadFile?p=502f5588-9492-41ab-b986-acb2ecca9cdf.pdf&fileName=D3%20Three-system%20index%20update.pdf

Cahalan, J., J. Mondragon, and J. Gasper. 2014. Catch Sampling and Estimation in the Federal Groundfish Fisheries off Alaska: 2015 Edition. NOAA Tech. Memo. NMFS-AFSC-286, 46 p. Accessible at: http://www.afsc.noaa.gov/Publications/AFSC-TM/NOAA-TM- AFSC286.pdf.

NPFMC. 1996. Environmental Assessment/Regulatory Impact Review/Final Regulatory Flexibility Analysis for Amendment 37. Measure 1: Establishment of a Bristol Bay red king crab savings area; Measure 2: Management of Red King Crab (*P. camtschaticus*) Bycatch Limits in Bering Sea Groundfish Trawl Fisheries; Measure 3: Establishment of a Trawl Closure Area in the Nearshore Waters of Bristol Bay. November 1996. Anchorage, AK. Accessible at: https://repository.library.noaa.gov/view/noaa/18178

NPFMC. 1997. Environmental Assessment/Regulatory Impact Review/Final Regulatory Flexibility Analysis for Amendment 41 Management of Tanner Crab (C. bairdi) bycatch limits in Bering Sea Groundfish Trawl fisheries an Amendment to the Fishery Management Plan for the Groundfish of the Bering Sea and Aleutian Islands Area. February 1997. Anchorage, AK. Accessible at: https://repository.library.noaa.gov/view/noaa/18184

NPFMC. 2019. BSAI Halibut Abundance-Based Management (ABM) of PSC Limits – Initial Review Draft. Accessible at: https://meetings.npfmc.org/CommentReview/DownloadFile?p=24ed20d5-4180-4d68-aea2-55afb25df194.pdf&fileName=C1%20Halibut%20ABM%20Analysis.pdf.

NPFMC. 2020. BSAI Halibut Abundance-Based Management (ABM) of PSC Limits – Initial Review Draft. Accessible at: https://meetings.npfmc.org/CommentReview/DownloadFile?p=efba112b-89e9-4fa8-b1e0-6854bb7cc1a2.pdf&fileName=C6%20ABM%20Draft%20DEIS%20Analysis.pdf

Stewart et al., 2020. Analysis of the effects of historical discard mortality in non-directed fisheries. IPHC-2020 AM096-INFO6. Accessible at: https://iphc.int/uploads/pdf/am/2020am/iphc-2020-am096-inf06.pdf.