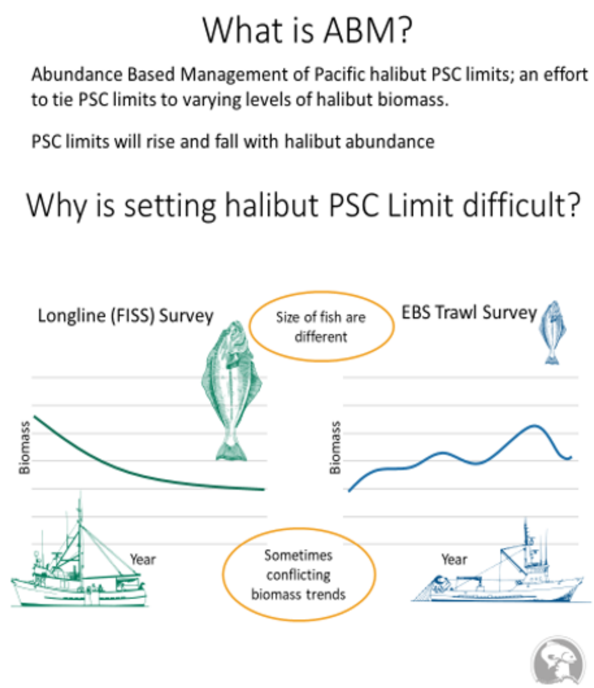
Executive Summary

This document analyzes proposed management measures to index the Amendment 80 sector's Pacific halibut prohibited species catch (PSC) limits in the Bering Sea and Aleutian Islands (BSAI) groundfish fisheries to halibut abundance. The Amendment 80 sector comprises trawl catcher processor vessels in the BSAI that target groundfish species other than pollock. Indexing to abundance refers to setting PSC limits that will fluctuate to some degree with an estimate of halibut abundance. The objective of modifying PSC limits is to index PSC limits to halibut abundance in order to provide flexibility to the groundfish fisheries in times of high halibut abundance, protect spawning biomass of halibut especially at low levels, and stabilize inter-annual variability in PSC limits. Achievement of these objectives could provide additional harvest opportunities in the commercial halibut fishery.

Pacific halibut (*Hippoglossus stenolepis*) is utilized in Alaska as a target species in subsistence, personal use, recreational (sport), and commercial halibut fisheries. Halibut has significant social, cultural, and economic importance to fishery participants and fishing communities throughout the geographical range of the resource. Halibut is also incidentally taken as bycatch in groundfish fisheries.

The Council is examining abundance-based approaches to set halibut PSC limits for the Amendment 80 sector in the BSAI. Currently halibut PSC limits for groundfish fisheries are set in the BSAI Groundfish FMP at a fixed amount of halibut mortality, in metric tons (t). When halibut abundance declines, halibut PSC becomes a larger proportion of total halibut removals and can result in lower catch limits for directed halibut fisheries. While other groundfish sectors are also subject to PSC limits, this action is limited to the Amendment 80 sector as that sector is responsible for the majority of BSAI halibut mortality in the groundfish fisheries. Both the Council and the International Pacific Halibut Commission (IPHC) have expressed concern about impacts on directed halibut fisheries under the status quo and identified abundance-based halibut PSC limits as a potential management approach to address these concerns.



The Council has set other PSC limits (crab, herring) based upon abundance of the stock in the BSAI. However, this action was complicated by consideration of how to index the BSAI portion of the coastwide halibut stock (see inset on What is ABM). In October 2017, the SSC recommended, and the Council selected two abundance indices to track Pacific halibut abundance and guide setting PSC limits in the BSAI groundfish fisheries. These are from the NMFS AFSC EBS shelf bottom trawl survey and from the IPHC setline survey covering IPHC Areas 4ABCDE. Both indices represent the best available scientific information on halibut abundance.

Purpose and Need

The Council articulated the following purpose and need statement for this action in October 2017:

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.*

The Council derived the following objectives from the purpose and need statement to guide the development of appropriate management measures:

- 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

These objectives have not been prioritized by the Council and certain objectives may be in opposition to others, as a result, designing a management program that meets all objectives has inherent challenges. **The Council may also wish to revisit their purpose and need statement and objectives in light of changing this action to only directly modify PSC limits for the Amendment 80 sector.** The goal of this analysis is to evaluate how well each alternative meets the purpose and need statement, competing objectives, and the National Standards contained in the MSA.

The Council has been managing Pacific halibut bycatch by a range of measures since the inception of the BSAI FMP (Figure ES 1).

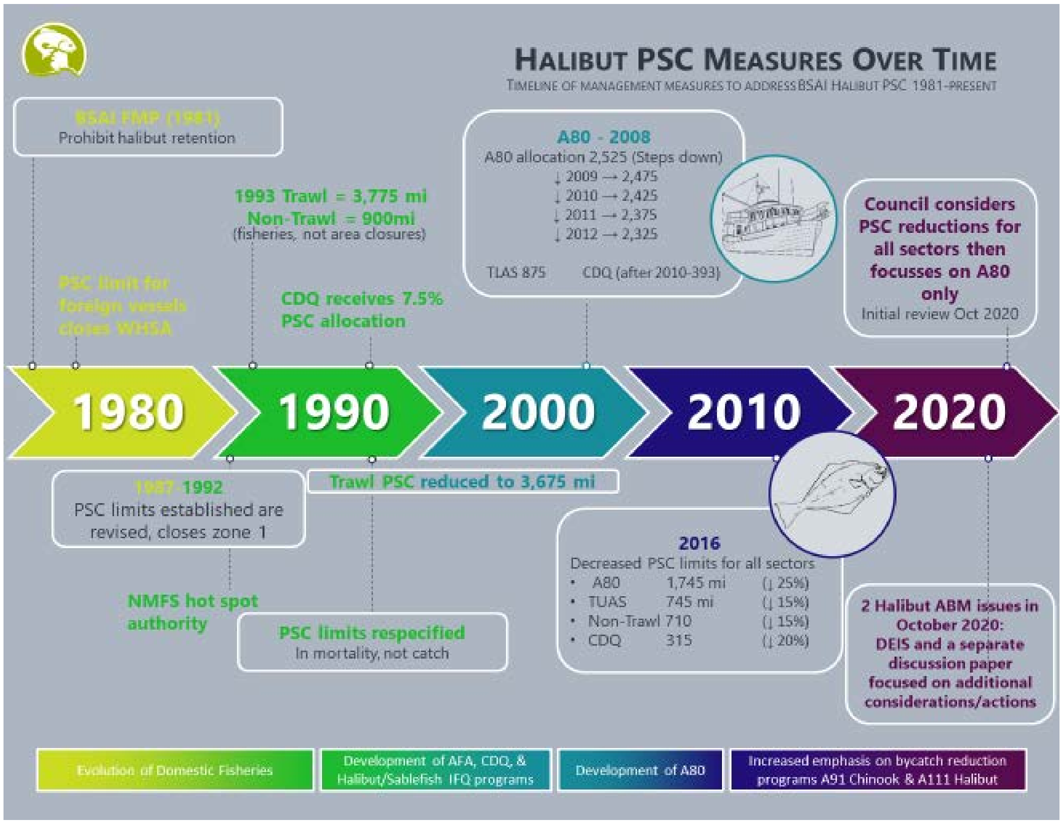


Figure ES 1 Timeline of BSAI halibut PSC management

Alternatives

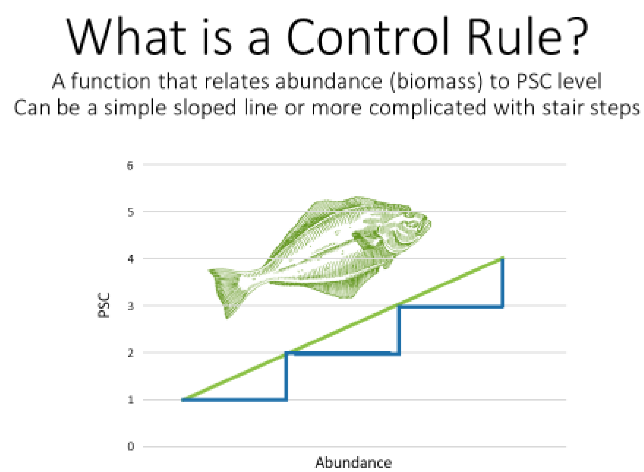
There are four Alternatives under consideration by the Council. These have been developed through multiple discussion papers and Council considerations, and consultation with stakeholders. These Alternatives range from status quo with fixed halibut PSC limit for the Amendment 80 sector to a range of PSC limits indexed to BSAI halibut abundance. This action modifies the PSC limit for the Amendment 80 sector only.

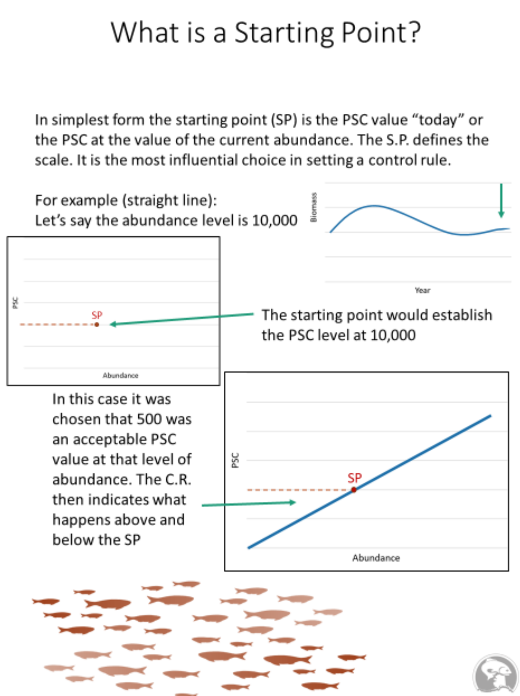
Alternative 1: Status Quo. BSAI halibut PSC limits are fixed at 3,515 t total for all sectors, with the Amendment 80 (A80) limit set at 1,745 t.

Alternatives 2 through 4

In Alternatives 2, 3 and 4, PSC limits are established for the Amendment 80 sector using a control rule applied to a biomass index. The indices are the NMFS EBS bottom trawl survey index (for Alternative 2) and the IPHC Area 4 setline survey index (for Alternatives 3 and 4). PSC limits for all other sectors do not change from status quo PSC limits.

Alternatives 2 through 4 have a similar suite of overarching Elements and Options to define the shape and behavior of the control rule that will define the PSC limit (see inset "what is a control rule?"). The Elements and Options identify each of the necessary decision points that define the control rule.





These decisions include the Starting Point (Element 1) which defines the value of the PSC limit prescribed by the control rule when the index or indices are at the current year value (see inset for "What is a Starting Point?"). Additional decisions are where to set the maximum PSC limit or 'ceiling' (Element 2) and the minimum PSC limit or 'floor' (Element 3). These two elements define the bounds over which the maximum and minimum PSC limit can vary regardless of levels of abundance (see inset for "Floors and Ceilings").

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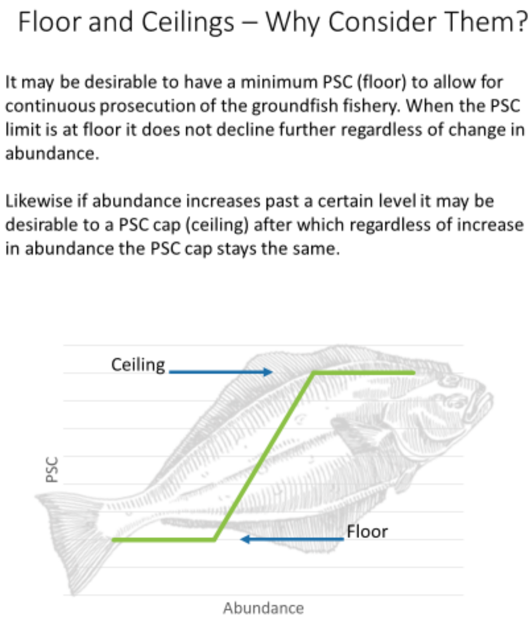
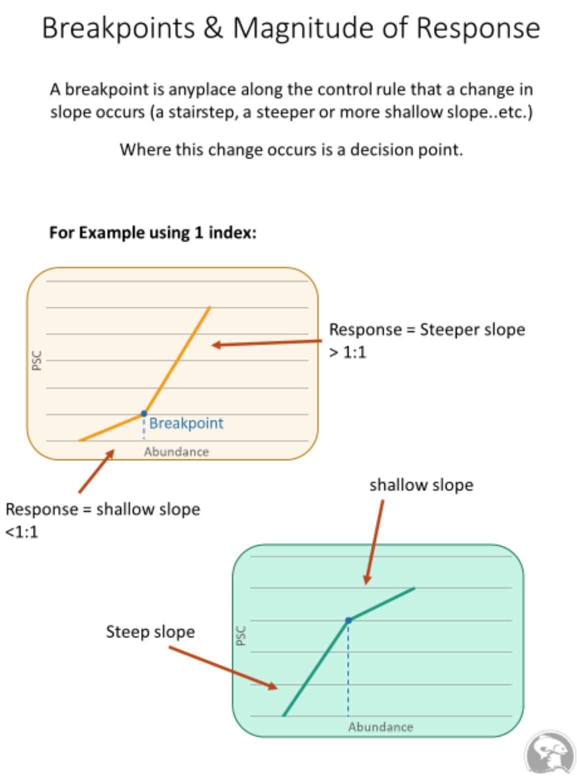




The first three elements specify the starting point for the PSC limit (**Element 1**), maximum PSC limit (**Element 2 Ceiling**), and minimum PSC limit (**Element 3 Floor**). An additional Element (**Element 4**) may be selected if breakpoints for the index are desired. The magnitude of the response (**Element 5)** must be specified for the index (see inset for "Breakpoints & Magnitude of Response"). The response (or slope) defines how the PSC limit changes relative to the change in the index. **Element 6** offers an optional provision to set how responsive the PSC limit will be to annual abundance changes by limiting the possible year-on-year percentage change in PSC limits. **Element 7** specifies breakpoints that may be specified in a lookup table rather than breakpoints and responsiveness in Elements 4 and 5 (where the PSC limit is defined continuously along the control rule). Finally, **Element 8** is specifically intended to further protect halibut spawning stock biomass at low levels of abundance by having the PSC limit decline proportional to abundance. For Element 8, some coordination with the IPHC would need to occur in order to determine whether the Coastwide SSB is below $B_{30\%}$ in order to apply the proportional reduction to the PSC limit if necessary. This determination could be made at the annual IPHC meeting in January with any resulting modification to the calculated PSC limit taken the following year. **Note the Council should clarify how it intends to implement this Element in order to coordinate with the IPHC on stock status.**

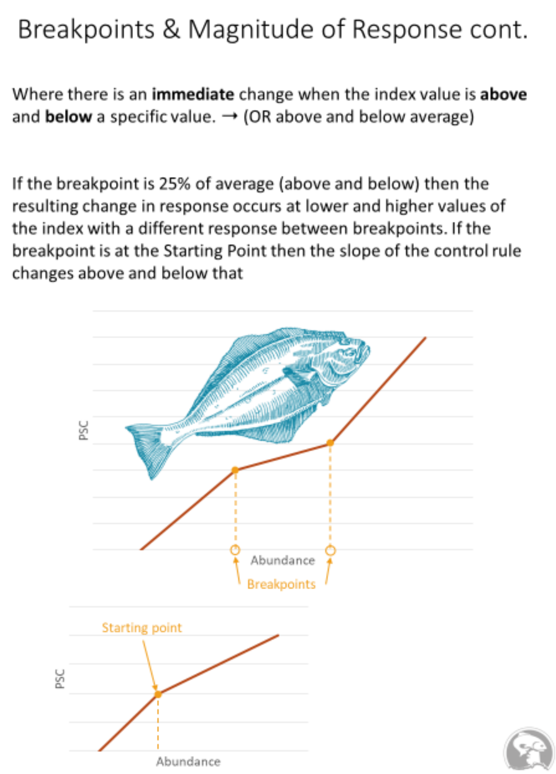


Table ES-1 provides the range of Elements and Options selected for the three action alternatives in the October 2020 analysis as well as the No Action alternative (status quo).

Table ES-1 Range of Elements and Options that are used to create Alternatives 2 through 4 as well as whether a particular Element is optional or not.

Element	Description	Range	Optional?
1	Starting Point	1,167-1,745 mt	N
2	Ceiling	1,745-2,325 mt	N
3	Floor	664-1,412 mt	N
4	Breakpoint	< or > -25% average -average	Y
5	Response	1:1 >1:1 <1:1	N (unless Element 7 selected)
6	Constraint	5-25%	Y
7	Look up Table	Up to 12 breakpoints; standard to mean or 2019	Y
8	SSB at low levels of abundance	PSC limit declines proportional to biomass when SSB,$B_{30\%}$	Y

Range of Alternatives

Table ES-2 shows the Elements and Options selected for the three action alternatives in the October 2020 analysis as well as the No Action alternative (status quo). Note that Alternative 2 is indexed to the EBS Trawl survey (BTS) while Alternatives 2 and 3 are indexed to the FISS (setline) survey. These alternatives were initially developed by stakeholders and modified by the Council.

Table ES-2 Summary of selection of Elements and options under Alternatives 2 through 4 as well as which stakeholder group first proposed the specific combination of Elements and Options for that Alternative (as modified by any subsequent Council action).

Alternative	Previously numbered (Oct 2019)	Source	Survey Index	E 1 Starting point	E 2 Ceiling	E 3 Floor	E 4 Breakpoint	E 5 Magnitude	E 6 Constraint	E 7 Look-up Table	E 8 SSB low levels of abundance
1	1	Status Quo	NA					1,745 fixed PSC limit			
2	2-2	A80	Trawl	1,745	2,325	1,412	3 specified	Stairsteps	2 yr avg	NA	NA
3	2-4	FVOA	Setline	1,255	1,745	664	1,255	1:1 above 2:1 below	15% max	NA	NA
4	3-3a_update	Directed halibut users	Setline	1,167	1,745	664	NA	1:1	20% max	NA	Yes

Figure ES-1 shows the trend in the two surveys (Area 4 FISS and EBS trawl survey) while Figure ES-2 indicates what the PSC limits associated with the alternatives in Table ES-2 would have been if applied historically.

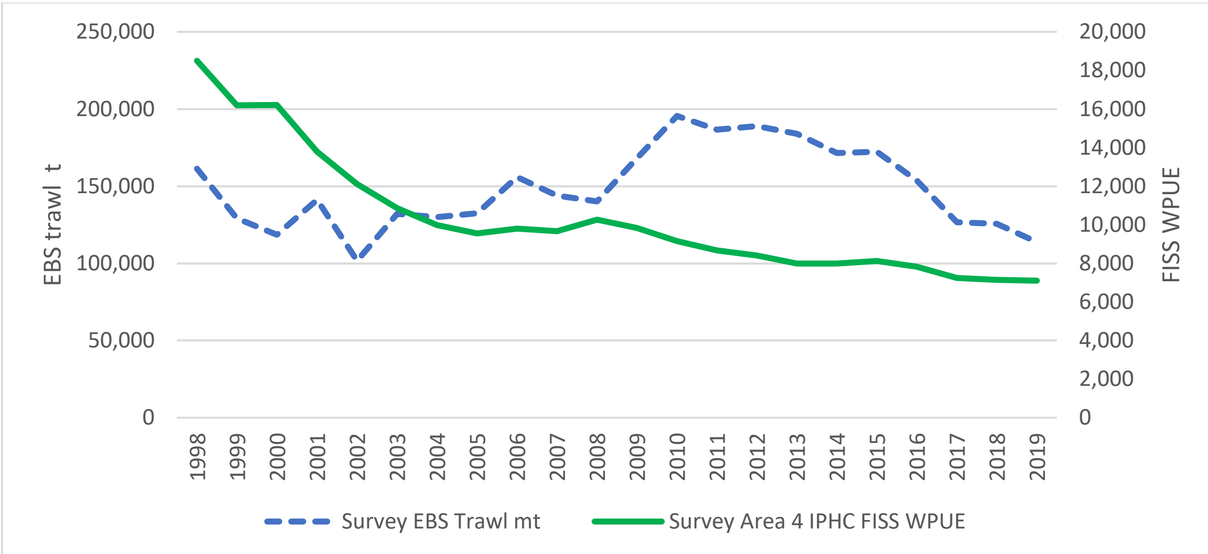


Figure ES-1 Historical trends in the two surveys, EBS trawl survey and Area 4 FISS survey 1998-2019

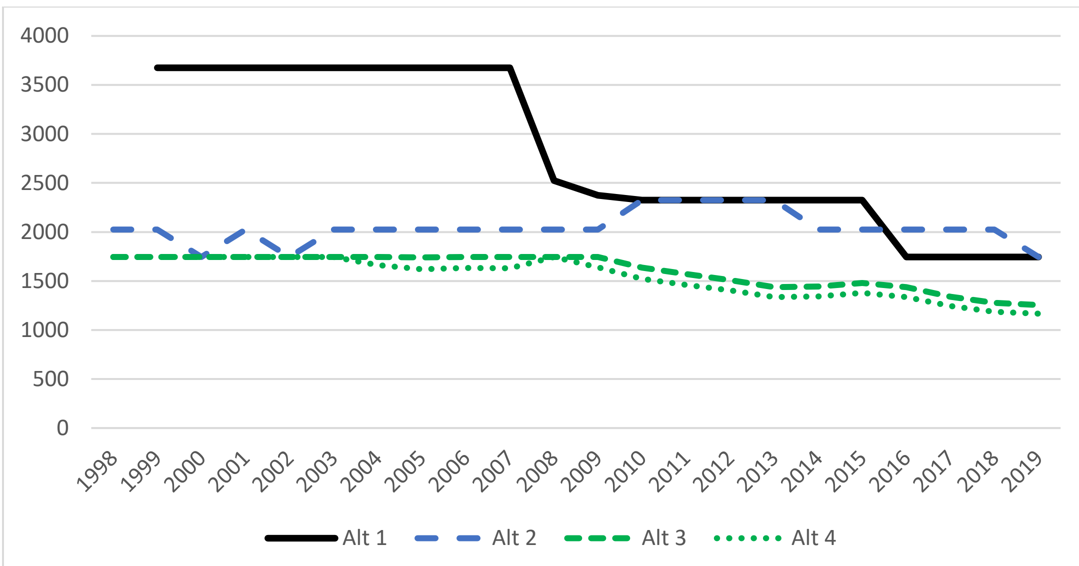


Figure ES-2 Alternative PSC limits (t) calculated based on historical biomass trends (for Alternatives 2-4) from the two surveys shown in Figure ES-1. Note that for Alternative 1 Status quo the limit prior to 2008 applied to all trawl. From 2008 on the limit shown applies only to Amendment 80. Alternative 2 is indexed to the trawl survey while Alternatives 2 and 3 are indexed to the FISS survey

Further information on the alternative PSC limits projected forward in this analysis are included in the section below on comparison of alternatives for decision-making (Table ES-3).

Summary of analytical conclusions

Based upon the base case model simulations, consideration of fleet constraints, and a revenue analysis, the main conclusions are:

1. Short-term (10 years) PSC Limit: Alternative 2 PSC limits trend upwards with trawl survey biomass according to the specified stair steps until reaching and remaining at the ceiling; PSC limits under Alternatives 3 and 4 initially decline before trending upwards with the survey after 2024. No PSC limits reach their specified floor. In the 10 year time horizon shown the PSC limits

for Alternatives 3 and 4 do not reach the same level as for Alternative 2 nor reach Alternative 1 (Status Quo).

2. Longer-term: PSC limits for Alternative 2 will increase over the time horizon while BSAI halibut fishery catch declines relative to status quo. Alternatives 3 and 4 perform similarly, with initially declining PSC limits compared to status quo and slightly increased TCEY (total constant exploitation yield).
3. Given the information available on Pacific halibut recruitment projected forward, PSC limits within the projected range negligibly impact subsequent SSB. Lower PSC limits are projected to result in greater directed halibut fishery catches (albeit not at a 1:1 ratio), but near-term trends in SSB vary mainly based on the current IPHC assessment age structure. Under a hypothetical scenario of low recruitment (where numbers-at-age for ages up to age 6 are set to zero initially, and a low PDO phase was assumed throughout the simulation), the use of a 30:20 harvest control rule for TCEY determination failed to improve the SSB projection. The stock only falls below 30% of unfished SSB when the TCEY or PSC limits are high relative to stock dynamics, which only occurred in extreme demonstrations of model behavior that are well outside of the expected range of stock dynamics and catch limits. Element 8 had little impact on the behavior of Alternative 4 (however, for illustration some low recruitment scenarios were investigated and the influence of Element 8 and the 30:20 harvest control rule for TCEY could be seen clearly; See **Appendix 2**).
4. There is limited contrast between alternatives in terms of the metrics that reflect the Council's ABM objectives. Generally, Alternative 2 performs better in flexibility and stability while Alternatives 3 and 4 perform better in terms of indirectly providing for increased harvest opportunity in the BSAI directed halibut fishery.
5. Lower PSC limits under Alternatives 3 and 4 are expected to reduce gross revenues for the groundfish sector, even when presuming PSC use rates that are low relative to historical performance. The impact of lower PSC limits is likely to vary across Amendment 80 participants (companies, vessels); revenue impacts would be greater for participants that are relatively more dependent on target species that are historically associated with higher halibut encounter rates.

Methodology

The Pacific halibut simulation model

A simulation framework was used to compare the Pacific halibut stock trends and PSC limits across the set of alternatives.

The model consists of a two-area, age- and sex-structured model of Pacific halibut population dynamics with the BSAI modeled as one area and the remaining components of the range of the halibut stock comprising the aggregate "other" area (this includes the GOA, British Columbia, and US West Coast). Recruitment is assumed to occur at the coastwide level and the proportion of new recruits that settle in the BSAI is time-varying and temporally autocorrelated. The model allows adult movement between the two areas. The model includes five fishing fleets: the halibut fishery in the BSAI, the halibut fishery in the aggregate other area, the BSAI trawl PSC fishery, the BSAI hook-and-line (HAL) PSC fishery, and the bycatch fishery in the aggregate other area. Model outputs on SSB, PSC limits, PSC usage directed halibut fishery catches, and survey indices are shown to characterize the results of the alternatives (including status quo).

The Council and SSC reviewed the model in October 2019. Some changes from the 2019 model include the following:

(a) A 30:20 harvest control rule for TCEY determination was added to the model.

(b) The IPHC changed its definition and calculation of unfished spawning biomass for the 2019 assessment to a dynamic calculation. In a low recruitment year, unfished spawning biomass is also low, and in a high recruitment year, unfished spawning biomass is higher. Hence, changes in stock status are insensitive to changes in recruitment regimes, and other life history changes and only sensitive to changes in fishing mortality levels. In these results, this means that the population is unlikely to fall below 30% of unfished spawning biomass unless the TCEY or PSC limits are large.

(c) For the base case model, variability in PSC use was incorporated, leading to increased uncertainty in key quantities such as PSC use and spawning biomass.

(d) The relationship used between historical spawning biomass and total mortality (to estimate the harvest control rule for TCEY determination) was updated according to SSC comments leading to less responsiveness in coastwide TCEY with changes in spawning biomass.

(e) A single future Pacific Decadal Oscillation (PDO) scenario was modeled to examine the population effects of periodic changes in the PDO.

(f) Sensitivity analyses were conducted to test for the ability of the results to respond to different levels of low (and some cases highly improbable) recruitment scenarios (See **Appendix 2**).

(g) Additional sensitivity analyses were conducted, including incorporating temporal autocorrelation in assessment results which led to less variability in spawning biomass over time, modeling PSC usage as a function of PSC limits, and exploring alternative trawl PSC selectivity curves.

Details on model assumptions, formulations as well as detailed model validation discussion and results are contained in **Chapter 5** as well as in **Appendices 2, 3 and 4** to the preliminary DEIS.

Revenue impact estimation

Analysts estimated the distribution of potential Amendment 80 gross wholesale groundfish revenues under a range of potential PSC limits that correspond to the status quo (Alt. 1) and the starting points/ceilings/floors for Alternatives 2, 3, and 4 as well as the step in Alternative 2. Fishing years were simulated using a random resampling-of-hauls approach subject to two constraints: (1) the PSC limit and (2) one of two imposed A80 groundfish catch limits (TAC). The simulated groundfish limits were run at 290,000 t and 310,000 t. A total A80 catch limit of 290,000 t approximates the sector's groundfish catch totals in the most recent years (2018 and 2019) and a total catch limit of 310,000 t approximates maximum sector groundfish catch in any of the analyzed years (2010 through 2019). In total, seven potential PSC limits were simulated under each TAC. For each of those combinations, simulations were run drawing data from one of three sets of historical A80 hauls: 2010-2014 "high PSC use analogy"; 2010-2019 (excluding 2015[2]) "all data"; and 2016-2019 "low PSC use analogy" (Figure ES-5). The range of PSC limits analyzed in this manner covers the entire range of modeled median limits for 2021 through 2030 (Table ES-3).

The median BSAI halibut directed fishery catch limits projected by the Operating Model for 2021 through 2030 (Table ES-5) are multiplied by AKFIN's average annual ex-vessel value estimates for IPHC Area 4. Table ES* (following Table ES-6) uses the scalar multiplier $4.43 per IFQ pound (headed and gutted net weight), which is an estimate based on ADF&G Fish Ticket data for Area 4 landings in 2019. Values are converted to 2018 dollars to be consistent with other revenue data in this analysis. The analysts note that 2019 was a low-value year for halibut relative to the entire analyzed period. The multiplier based on

[2] 2015 data were not included in the sample frame because haul-level data were not comparable to other years. Under an Exempted Fishing Permit (EFP), 2015 haul data for vessels practicing deck sorting were reported through logbooks rather than Observer Program data.

average Area 4 ex-vessel values for the 2015 through 2019 period would be $5.57 per IFQ pound (not shown in Table ES*).

Comparison of Alternatives for Decision-making

As shown in Figure ES-3 the FISS survey is projected to decline in the next five years before trending upwards while the EBS bottom trawl survey trends upwards over the next 5 years before leveling off. This has a direct result on the trend in the calculated PSC limit under each of the alternatives (Table ES-3) where PSC limits under Alternative 2 trend upwards with the trawl survey biomass according to the specified stair steps until reaching and remaining at the ceiling, while PSC limits under Alternatives 3 and 4 initially decline before trending upwards with the survey after 2024. For comparison, an alternative was simulated in which the floor imposed under Alternative 4 Element 3 is removed to evaluate the performance of Element 8.

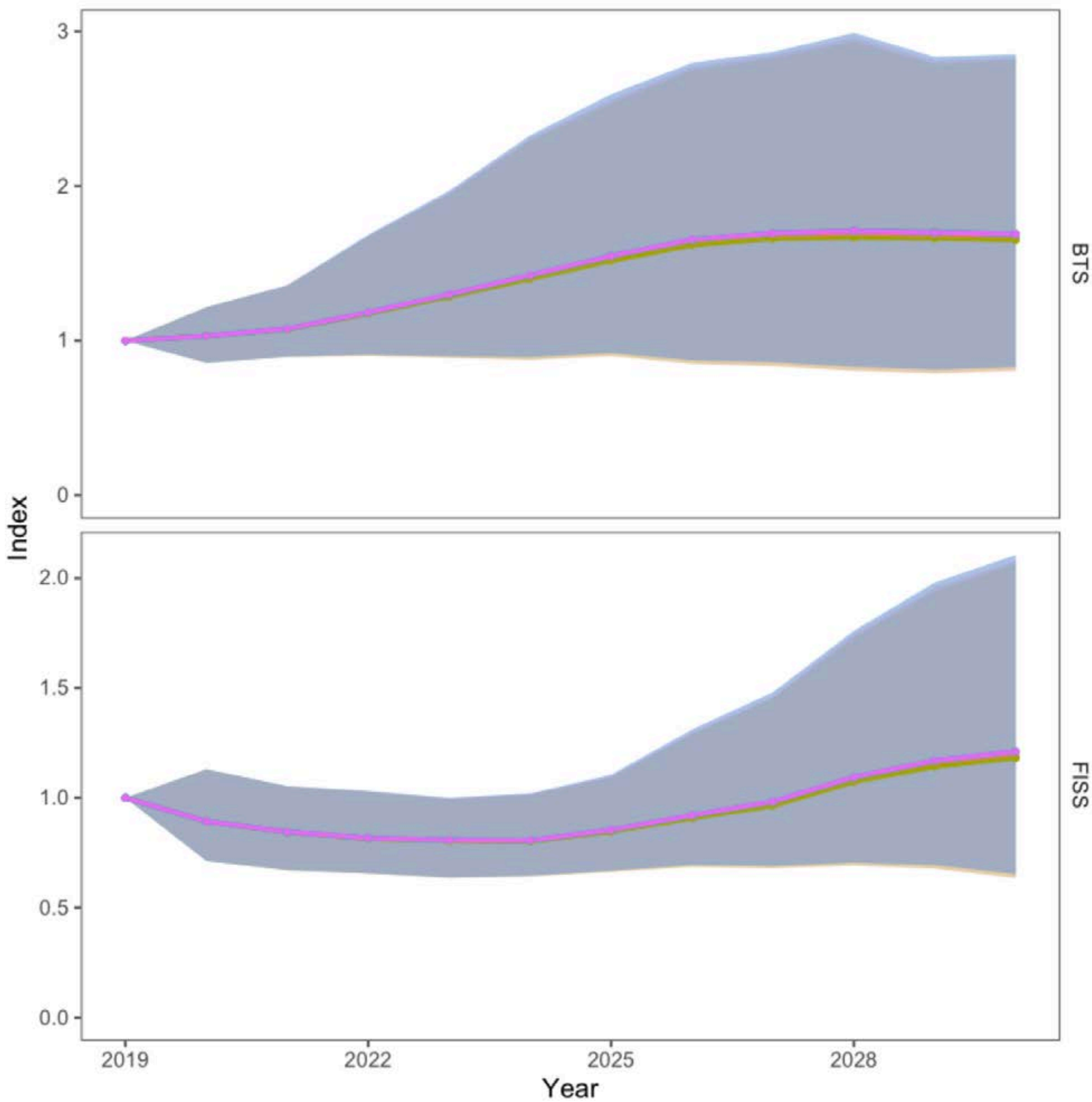


Figure ES-3 Short-term projected Bottom Trawl Survey (BTS) and Fishery Independent Setline Survey (FISS) indices for all alternatives from 2019 – 2030.

Table ES-3 Comparison of Pacific halibut A80 PSC limits (t) by alternative from 2021-2030. Grey shaded values represent the ceiling for that alternative. None of the Alternatives as projected out in median values for these years have reached their floor. Bolded values are greater than the status quo PSC limit; red indicates a PSC limit less than status quo.

Year	Status quo (Alt. 1)	Alt. 2	Alt. 3	Alt. 4	Alt. 4 w/o floor
2021	*1,745*	1,745	1,261	1,117	1,117
2022	*1,745*	**2,025**	1,072	956	956
2023	*1,745*	**2,025**	911	945	945
2024	*1,745*	**2,025**	849	939	939
2025	*1,745*	**2,025**	890	982	982
2026	*1,745*	**2,325**	930	1,047	1,047
2027	*1,745*	**2,325**	1,000	1,126	1,126
2028	*1,745*	**2,325**	1,097	1,234	1,234
2029	*1,745*	**2,325**	1,214	1,329	1,329
2030	*1,745*	**2,325**	1,336	1,386	1,386

Figure ES-4 show the simulated median results for the three main quantities of interest: PSC limit, directed fishery catch and spawning stock biomass (SSB) across all four alternatives. Note that while the limit changes over time throughout the simulation there are very little clear differences across the alternatives (for the median value shown) for the other quantities. Recall that Alternative 2 is indexed to the trawl survey while Alternatives 3 and 4 are indexed to the FISS survey and trends in these indices for the simulation are also shown. A summary across the results by the three quantities is summarized below.

Spawning stock biomass (SSB): Results for Alternative 1 show an initial decline in SSB in both areas followed by more stable SSB thereafter. This result is common across all alternatives and occurs because the 2019 numbers-at-age for young fish from the 2019 IPHC coastwide long assessment were estimated to be relatively low in recent years. As halibut grow to comprise a portion of the spawning biomass, the spawning biomass declines. This simulation model is meant to approximate the general behavior of halibut population dynamics and should not be used to forecast the spawning biomass of halibut in future years; rather, the model is meant to compare the SSB across alternatives under a variety of spawning biomass values. Results show that changes to the SSB across the range of alternatives under consideration are negligible. Lower PSC limits (even PSC limits of zero) failed to generate increases in spawning biomass but did lead to increases in directed fishery catches. The inclusion of the 30:20 harvest control rule for TCEY determination had no effect on spawning biomass, PSC limits, PSC usage, or directed halibut fishery catches for the base case scenario and the current alternatives.

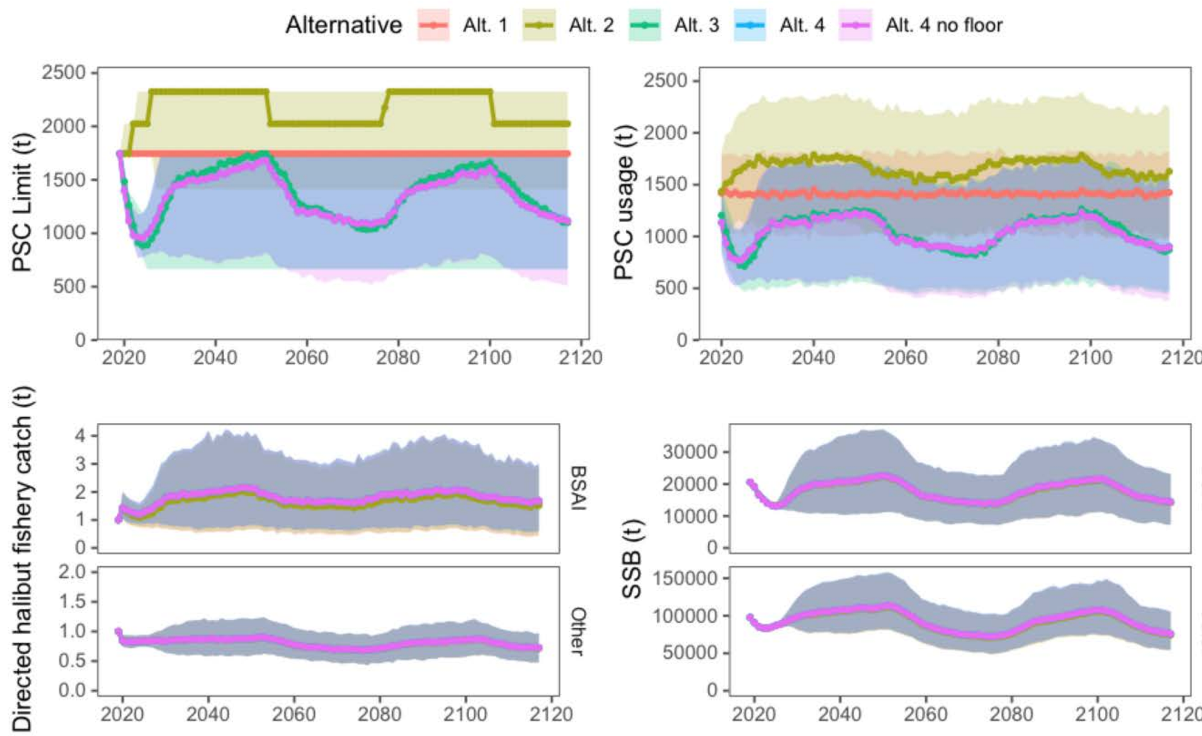


Figure ES-4 Simulation results across all four alternatives (as well as the scenario of Alternative 4 without a floor applied to it). Results are shown as PSC limit (top left), trends in indices (top right), directed fishery catch (bottom left) and spawning stock biomass (SSB) bottom right). The color-coded legend for each alternative is shown at the top. Gray shading represents the range of variability in the individual modelled results while the solid lines for each alternative represent the median value. [REVISED VERSION 9/30/20]

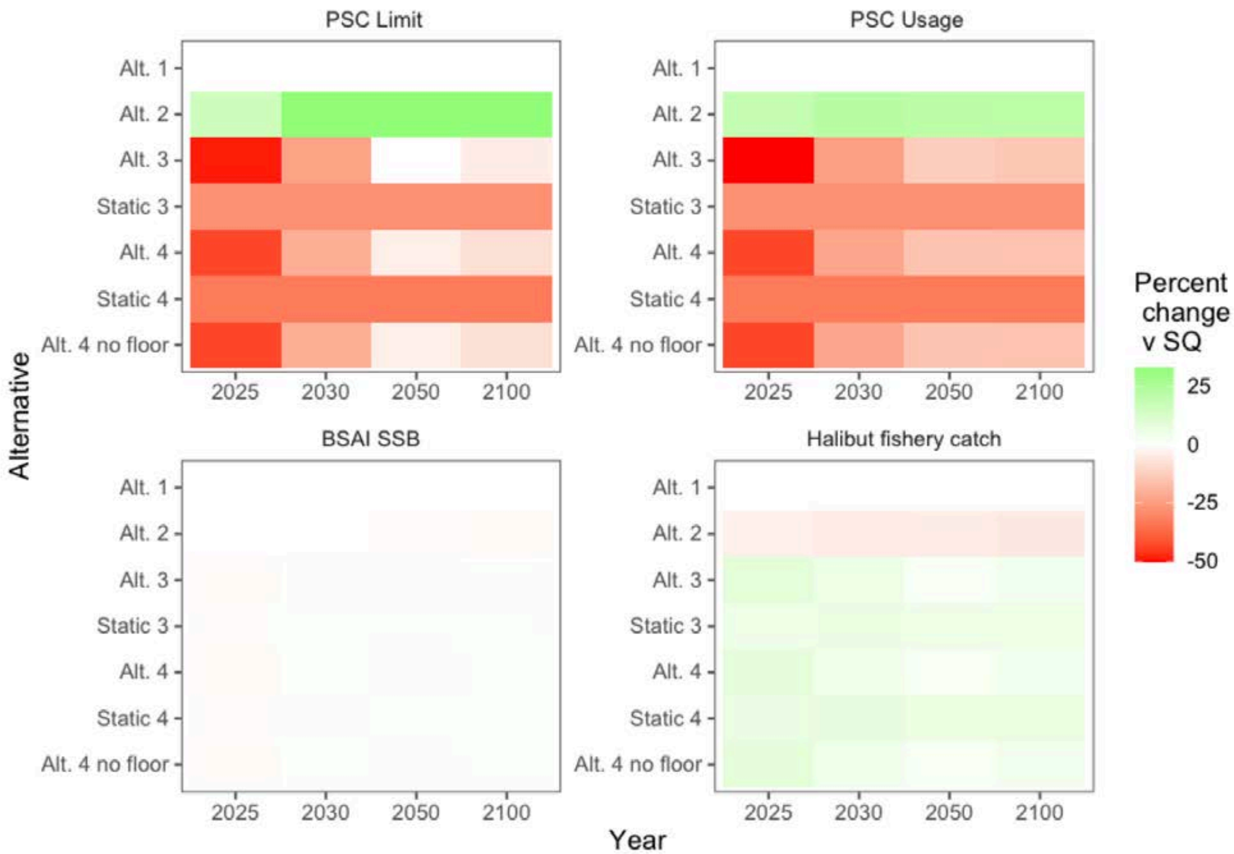
PSC limits and directed halibut fishery catches: Comparing general trends results across Alternatives 2 through 4 to the status quo projection (Figure ES-4) shows that PSC limits for Alternative 2 will increase over the time horizon while halibut fishery catch declines compared to status quo. Alternatives 3 and 4 perform similarly to one another in relative trends with initially declining PSC limits compared to status quo and slightly increased halibut directed fishery catches. There is some difference in Alternative 4 with and without a floor imposed as shown over the range of variability in the PSC limits (top left, where the pink shading drops below the floor), however median results do not show any difference in PSC limits with or without a floor (Table ES-3).

PSC limits and usage: PSC limits and PSC use are inversely correlated with directed halibut fishery catches. Changes in PSC limits are larger in proportion than changes in directed halibut fishery catch limits.

General simulation trends: In summary, differences in PSC limits (and usage) projected by the model relative to Alternative 1 (status quo) were greater than for related impacts on spawning biomass (SSB) and directed halibut fishery catches. Table ES-4 indicates that using Alternatives 2, 3, 4, or 4 with no floor in place of the status quo static PSC limits would likely have little impact on halibut spawning biomass. In contrast, the alternatives impose some large percentage changes in PSC limits relative to status quo limits and relatively smaller, negatively correlated changes in directed halibut fishery catches and catch limits. Static PSC limits set at the starting points for Alternatives 3 and 4 are also shown for comparison to the alternatives.

Calculated results are provided in **Chapter 6**. Those results include changes in halibut SSB, PSC limits, PSC usage, and directed halibut fishery catch relative to 2019 levels. Specific median estimates of the Amendment 80 halibut PSC limit and the BSAI halibut fishery TCEY are provided for the first 10 years of the model projection (2021 through 2030).

Table ES-4 Projected relative trends of PSC usage, Pacific halibut spawning biomass, Pacific halibut directed fishery catch, and PSC limit as estimated from the simulation model. Red shading indicates a lower trend relative to status quo within each measure green shading indicates higher. Rows labeled "Static 3" and "Static 4" are simulation runs with PSC limits fixed at their starting point values for alternatives 3 and 4, respectively. Note that median values for this shaded table are shown in Table 6-1 in Chapter 6. This table is intended to show trend only.



Revenue estimates: Figure ES-5 illustrates the distribution of revenue estimates under the simulated combinations of PSC limits, groundfish catch limits, and PSC use regimes. These results can be referenced against the A80 sector's gross wholesale revenues (2018$) from 2010 through 2019, which ranged between roughly $308 million (2013) and $379 million (2018). Under the relatively low PSC use in the most recent years (2016-2019; blue), more revenue is generated under every PSC limit than under the higher use scenario (2010-2014; red). Generally, there is a wider distribution of revenue estimates and greater uncertainty for PSC limits that fall in the middle of the range specified in the set of alternatives and elements. This pattern is the result of halibut bycatch constraining total groundfish catch under all scenarios at the lower PSC limits, while harvest is free to reach the groundfish catch limit when the PSC limit is not a constraint. At very low or moderately low PSC limits, the distribution of revenue estimates does not differ between the two groundfish catch limits. At higher PSC limits revenue appears strictly driven by available TAC, and what variation there is across simulations likely comes from the randomness of the historical hauls selected.

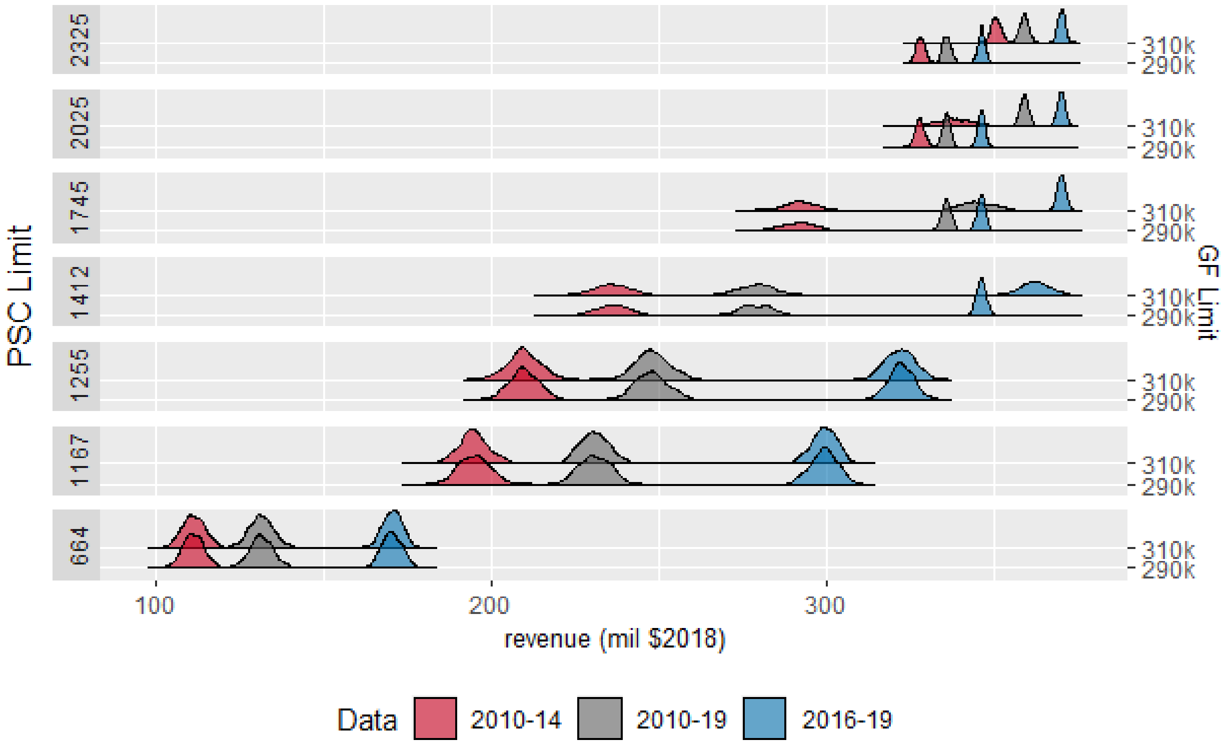


Figure ES-5 Distribution of gross wholesale revenue estimates under various PSC limits (2018$)

This document acknowledges likely distributional impacts within the Amendment 80 sector, which is described in Chapter 3. A key factor in assessing the extent to which a particular A80 stakeholder (company or vessel) could be impacted by a change in the halibut PSC limit is the mix of high- or low-PSC rate groundfish target species on which they rely. Figure ES-6 represents the five companies that comprise the A80 sector in 2020, anonymized, and the relative proportion of flatfish (higher PSC rate) and roundfish (lower PSC rate) that their vessels have harvested during the 2010 through 2019 period.

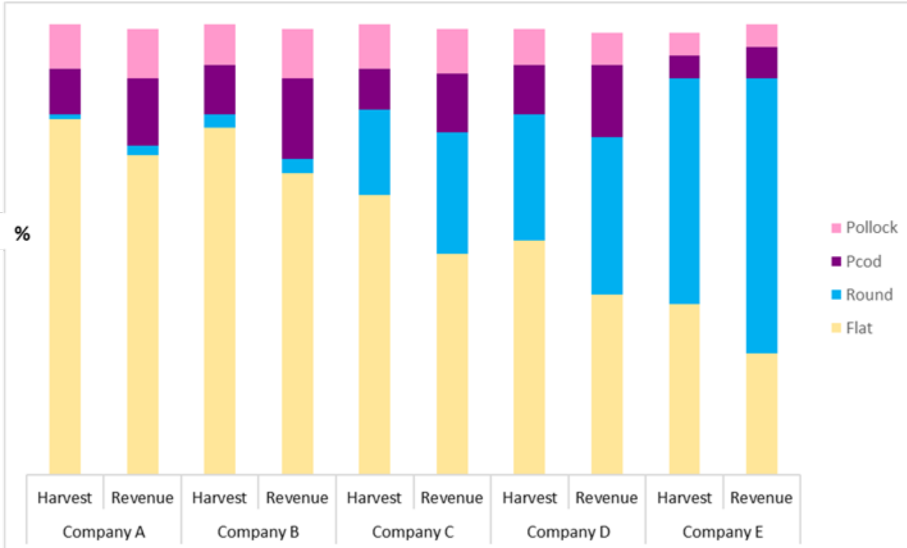


Figure ES-6 Aggregate 2010-2019 percentage of A80 harvest (t) and gross wholesale revenue ($) by species group for fishing company fleets as comprised in 2020

Lower PSC limits are associated with higher commercial catch limits for the directed halibut fishery, and vice versa. That basic conclusion is sufficient to understand the directional impact of the considered alternatives on halibut stakeholders in western Alaska. Table ES-5 reports the median projected BSAI halibut catch limits for each alternative over the next ten years and the percent-difference across alternatives in those years relative to projections under Alternative 1 (status quo) in each year. The BSAI catch limit is translated from the model output (round weight tons) to millions of net weight pounds, which is the typical unit for the TCEYs established by the IPHC. Alternatives 3 and 4 perform similarly, resulting in higher projected halibut catch limits. Alternative 2 is projected to result in lower directed halibut catch limits relative to Alternatives 3 and 4.

Table ES* converts the values in the top panel of Table ES-5 to gross ex-vessel revenues in adjusted 2018 dollars using a scalar multiplier of $4.43 per IFQ pound (headed and gutted net weight). The per-unit values of halibut (dollar per ex-vessel pound) observed during the analyzed period may not be a reliable predictor of values in the near-term future due to significant market disruptions. Nevertheless, for purposes of comparison, Area 4 gross ex-vessel revenue in 2018-dollars ranged from $32.6 million to $54.6 million from 2010 to 2012 but has been between $16.9 million (2018) and $24.9 million (2016) in more recent years. Finally, the analysts note that the values in Table ES* likely overestimate gross value because the table assumes 100% usage of the Area 4 catch limit. From 2012 through 2019 the Area 4 catch limit utilization rate was roughly 91%.

Table ES-5 Commercial halibut fishery projected BSAI directed halibut catch limits (millions of pounds, net weight; top panel) and percent change relative to the status quo (Alternative 1) projection; bottom panel. Columns labeled “Static 3” and “Static 4” are runs with PSC limits fixed at their starting point values for Alternatives 3 and 4, respectively. “Alt. 4 without floor” is the same as Alternative 4 but with the floor removed. The starting point for Alternative 2 is the same as status quo.

BSAI Pacific halibut fishery catch limit (net wt. million pounds)							
Year	Status Quo	Alt. 2	Alt. 3	Static 3	Alt. 4	Static 4	Alt. 4 w/o floor
2019	4.09	4.09	4.09	4.09	4.09	4.09	4.09
2020	5.83	5.83	5.83	5.83	5.83	5.83	5.83
2021	5.30	5.28	5.47	5.62	5.53	5.68	5.53
2022	4.85	4.81	5.12	5.13	5.21	5.19	5.21
2023	4.65	4.58	5.00	4.90	5.05	4.96	5.05
2024	4.54	4.44	4.91	4.79	4.93	4.84	4.93
2025	4.84	4.68	5.27	5.10	5.25	5.15	5.25
2026	5.08	4.85	5.57	5.38	5.52	5.43	5.52
2027	5.29	5.05	5.79	5.62	5.76	5.68	5.76
2028	5.98	5.69	6.45	6.33	6.42	6.39	6.42
2029	6.27	5.95	6.68	6.60	6.65	6.66	6.65
2030	7.00	6.65	7.41	7.44	7.33	7.52	7.33

Projected directed fishery catch limit change relative to status quo (Alt. 1)							
Year	Status Quo	Alt. 2	Alt. 3	Static 3	Alt. 4	Static 4	Alt. 4 w/o floor
2019	0%	0%	0%	0%	0%	0%	0%
2020	0%	0%	0%	0%	0%	0%	0%
2021	0%	0%	3%	6%	4%	7%	4%
2022	0%	-1%	6%	6%	7%	7%	7%
2023	0%	-1%	7%	5%	9%	7%	9%
2024	0%	-2%	8%	6%	8%	7%	8%
2025	0%	-3%	9%	5%	9%	6%	9%
2026	0%	-5%	10%	6%	9%	7%	9%
2027	0%	-5%	9%	6%	9%	7%	9%
2028	0%	-5%	8%	6%	7%	7%	7%
2029	0%	-5%	7%	5%	6%	6%	6%
2030	0%	-5%	6%	6%	5%	7%	5%

Table ES* **Projected gross ex-vessel value ($million) of BSAI directed halibut based on 2019 average IPHC Area 4 unit values adjusted to 2018 dollars, assuming 100% utilization.**

Year	Status quo	Alt. 2	Alt. 3	Static 3	Alt. 4	Static 4	Alt. 4 w/o floor
2019	18.12	18.12	18.12	18.12	18.12	18.12	18.12
2020	25.83	25.83	25.84	25.85	25.84	25.85	25.84
2021	23.49	23.41	24.22	24.90	24.49	25.16	24.49
2022	21.49	21.30	22.70	22.73	23.07	22.97	23.07
2023	20.59	20.29	22.13	21.71	22.37	21.95	22.37
2024	20.12	19.65	21.77	21.23	21.82	21.44	21.82
2025	21.44	20.72	23.34	22.61	23.26	22.82	23.26
2026	22.49	21.47	24.66	23.84	24.46	24.06	24.46
2027	23.42	22.35	25.63	24.88	25.52	25.15	25.52
2028	26.50	25.20	28.56	28.05	28.42	28.30	28.42
2029	27.77	26.35	29.59	29.24	29.47	29.52	29.47
2030	31.01	29.47	32.84	32.94	32.46	33.30	32.46

Performance metrics

Performance metrics were developed to characterize the Council-defined objectives for ABM. These objectives are listed in the bullets below. The order of listing these objectives does not convey prioritization:

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

A set of metrics are calculated for each alternative over the 20-100 years of the simulation to provide some additional comparison across the different alternatives to assess how well each alternative met a subset of the Council objectives. These performance metrics can be used to evaluate trade-offs amongst alternatives. Note that there is no model calculated metric for the objective "there should be flexibility provided to avoid unnecessarily constraining the groundfish fishery particularly when halibut abundance is high " and this is characterized qualitatively in the following tables based on ranking the alternatives for operational impacts on the groundfish fleet when the PSC limit becomes potentially constraining in the projected short-term as well as historically based on recent regimes of higher and lower halibut abundance.

Each Table ES-6 through Table ES-9 shows a shaded version of numerical results captured in Section 6.3.2 and Section 6.4.3 of the analysis. This is a qualitative evaluation and detailed results for each metric and discussion thereof are contained in those sections of Chapter 6 and not repeated here. These color-coded tables are intended to show a policy-level glimpse of the trade-offs inherent in addressing the different (and competing) objectives by alternative.

The relative shading for the simulated performance metrics reflects the following:

	Metric = best value Biomass= high correlation
	Metric = objective was somewhat met but did not produce the 'best' value
	Metric= improvement over the worst value but still in a lower range
	Metric= worst value for that metric Biomass= low correlation

Here, dark blue indicates which alternative had the best value for that metric among the alternatives. Light blue indicates that the objective was somewhat met but the alternative did not produce the 'best' value among alternatives. Dark orange indicates that the alternative was the worst value for that metric among alternatives, while light orange was an improvement over the dark orange value but still in a lower range for meeting the objective. In some cases, to show that there were some more subtle differences between results some intermediate shading (not pictured in the table above but between the ranges shown) was employed.

Index to Abundance: For the objective relating to "Index to Abundance" a correlation analysis with total and spawning biomass was provided in addition to the metrics contained in Section 6.3.2 to inform how well the alternatives address this objective. All of the alternatives were correlated positively with SSB but Alternatives 3 and 4 (for the FISS) were most correlated to spawning biomass than Alternative 2. None of the alternatives correlated well with total biomass so this metric was not included in the summary here (see Chapter 6 6.3 for correlations). Other metrics included for indexing to abundance as suggested by the Council relate to relative the rate of change in PSC limit relative to rate of change of total biomass and spawning biomass. These results are characterized for short and medium term simulations and shading is intended to reflect the difference among the values in Table 6-3 through Table 6-7 in Chapter 6. However, it should be noted that with the limited contrast in PSC limits as a result of various floors and ceilings and slopes amongst alternatives this metric is unlikely to be met well by any of the alternatives. For example, if any of the alternatives employed a simple 1:1 control rule between biomass and the PSC limit then this metric would perform well. Due to the fact that the control rules are not formulated that way and include floors, ceilings and in some cases breakpoints and stair steps, the values of the metric were similarly poor across all of the alternatives.

Table ES-6 Index to abundance: Summary of relative performance of Alternatives against Council objective to index PSC limits to abundance. Here are shown the correlation over the simulation of the alternative limits to SSB, mean relative change in PSC limit over the relative change in total biomass and spawning biomass over the short and medium term simulations. These trends are generally summarized from information contained in Table 6-7.

	PSC limit to SSB	PSC limit: total biomass 2025	PSC limit: SSB 2025	PSC limit: total biomass 2050	PSC limit: SSB 2050
Alt_1					
Alt. 2					
Alt. 3					
Alt. 4					
Alt. 4 no floor					

Stability: For the objective relating to providing for some stability in PSC limits on an inter-annual basis the short and long term metrics are the Average Annual Variation (AAV) in PSC limits for the first twenty years of the simulation (short term) and the following ten years (medium term). Status quo obviously has the best ability to meet this objective, as PSC limits are fixed and do not change over time. Of the action alternatives, Alternative 2 best met this objective. The lowest ranked trend was for Alternative 4 (without the floor).

Table ES-7 ***Stability*****: Summary of relative performance of addressing the Council objective to provide inter-annual stability in PSC limits. Average Annual Variation (AAV) in PSC limits for the first twenty years of the simulation (short term) and the following ten years (medium term). These trends are generally summarized from information contained in Table 6-3.**

	AAV 2021-2040	AAV 2041-2050
Alt_1		
Alt. 2		
Alt. 3		
Alt. 4		
Alt. 4 no floor		

Protect SSB: The metric to address protecting spawning stock biomass particularly at low levels of abundance was selected by the Council to be the proportion of time that the PSC limit is greater than the TCEY in the BSAI. Here the metric is shown for both short- and medium-term simulations (Table ES-8). The metric shows almost no contrast across the alternatives therefore differentiating between them may not be meaningful. Shading in Table ES-8 indicates only that the PSC limit is never larger than the TCEY for Alternative 4 with or without a floor, and the same is true of Alternative 3 for the medium term. However, the highest proportion of the time that the PSC limit is higher than the TCEY over all alternatives in either time window is 1.8% of the time for Alternative 1. This metric corroborates the result that within the range of alternatives in this analysis there is little to no impact on spawning stock biomass, and for this reason a low recruitment robustness test was included in the analysis to provide a view of how the alternatives would behave at lower levels of spawning biomass.

Table ES-8 ***Protect SSB*****: Summary of relative performance of addressing the Council's objective to protect spawning stock biomass particularly at low levels of abundance. The metric is the proportion of time that the PSC limit is greater than the TCEY in the BSAI for short and medium term simulations These trends are generally summarized from information contained in Table 6-4 and Table 6-5 of this document.**

	PSC limit >TCEY 2021-2040	PSC limit >TCEY 2041-2050
Alt_1		
Alt. 2		
Alt. 3		
Alt. 4		
Alt. 4 no floor		

Provide for a directed halibut fishery: Multiple metrics were used to characterize the objective of providing for a directed fishery in the Bering Sea. These include the probability that the directed halibut catch limit in the BSAI is less than 75% of the 2019 limit, the Average Annual Variability (AAV) in catch, the proportion of time that the percent change in directed halibut catch limit in the BSAI from the previous year is greater than or equal to 15% and the average percentage of the TCEY available to the directed fishery in the BSAI. All of these metrics were calculated for the short- and medium-term simulations as shown (except for the last which is for 2040 only). Here status quo and Alternative 2 generally perform worse than Alternatives 3 and 4. The proportion of TCEY shows very little change between alternatives (and results for Alternative 1 and 4 with no floor are identical) so shading likely overstates the magnitude of difference amongst the alternatives.

Table ES-9 ***Provide for directed fishery*****: Summary of relative performance of addressing the Council objective to provide for a directed fishery in the Bering Sea. From the left these include: the probability that the directed halibut catch limit in the BSAI is less than 75% of the 2019 limit, the Average Annual Variability (AAV), the proportion of time that the percent change in directed halibut catch limit in the BSAI from the previous year is greater than or equal to 15%, and the average percentage of the TCEY available to the directed fishery in the BSAI. All of these are calculated for the short and medium term (except for the last which is for 2040 only). These trends are generally summarized from information contained in Table 6-4 and Table 6-6 of this document.**

	Probability catch limit lower 2021-2040	Probability catch limit lower 2041-2050	AAV 2021-2040	AAV next 2041-2050	Time >15% first 2021-2040	Time >15% next 2041-2050	% TCEY to directed fishery 2040
Alt_1							
Alt. 2							
Alt. 3							
Alt. 4							
Alt. 4 no floor							

Flexibility: For the objective relating to ‘Flexibility to avoid constraining the groundfish fishery particularly when halibut abundance is high’ information from the revenue analysis is summarized to address the performance of alternatives against each other and status quo. Here, flexibility is taken to reflect the likelihood that the A80 sector can prosecute the fishery over a range of historically observed total groundfish TAC levels, considering the reasonably expected variation in halibut abundance and PSC encounter/use rates.

The revenue analysis in Chapter 6 (Section 6.4) evaluates seven potential PSC limits as points of reference that correspond to the status quo limit and the starting points, ceilings, floors, and steps within the alternatives (Figure ES-5). The analysis considers flexibility in terms of the level of the PSC limit and the likelihood of that limit being reached or approached. (The analysis notes the important caveat that not all groundfish participants are affected by a given PSC limit to the same degree; some stakeholders’ groundfish participation is relatively confined to higher-PSC target species by cooperative quota portfolios that are practically inelastic, even within the cooperative context.). Two alternative indications of flexibility are used to summarize performance at a general level across alternatives. For consistency, the degree to which alternatives address this objective is shown with a similar color-coded ranking as with metrics for other objectives. The first summary metric draws on the range of limits in the revenue analysis and is confined to the first ten years of estimated median PSC limits under the alternatives. Table 0-3 is shown for shaded values of the limits corresponding to the following ranges (note that flexibility below a 664 t PSC limit is not shown since there were no short-term median limits at that level). Table ES-10 provides a key to understanding the relative shading to indicate limits over the first ten years to assist in summarizing years 1-5 and 6-10 in PSC limits in Table ES-11.

Table ES-10 Shading to indicate how Table ES-11was summarized by limit range

	Ability to prosecute fishery at PSC limits ≥ 1,746 – 2,325 mt
	Ability to prosecute fishery at PSC limits ≥ 1,412 = 1,745 mt
	Ability to prosecute fishery at PSC limits ≥ 1,167 – 1,411 mt
	Ability to prosecute fishery at PSC limits ≤ 1,166 mt

Table ES-11 Summary of limits in years 2021-2030 based on Table ES-3 and the ranges associated with the legend shown above

Year	Status quo (Alt. 1)	Alt. 2	Alt. 3	Alt. 4	Alt. 4 w/o floor
2021	1,745	1,745	1,261	1,117	1,117
2022	1,745	2,025	1,072	956	956
2023	1,745	2,025	911	945	945
2024	1,745	2,025	849	939	939
2025	1,745	2,025	890	982	982
2026	1,745	2,325	930	1,047	1,047
2027	1,745	2,325	1,000	1,126	1,126
2028	1,745	2,325	1,097	1,234	1,234
2029	1,745	2,325	1,214	1,329	1,329
2030	1,745	2,325	1,336	1,386	1,386

Here the analysis assumes greater flexibility for the collective sector to harvest the TAC under higher projected PSC limits and, conversely, a higher likelihood of the limit constraining the fleet under lower projected limits. Under these alternatives the limit is increasing under Alternative 2 and decreasing (or lower in the near-term, relative to status quo) under Alternatives 3 and 4.

Table ES-12 Flexibility: PSC limits reached by alternative in the first ten years (2021-2030) broken into relative constraint in the first 5 years and the next 5 years.

	2021-2025	2026-2030
Alt_1		
Alt. 2		
Alt. 3		
Alt. 4		
Alt. 4 no floor		

A caveat on this assumption is that there is no measure to estimate encounter rates. Given that this objective is intended to address flexibility 'particularly when halibut abundance is high', the 2010-2014 period is used in the revenue analysis (see Table 6-13) as a proxy for a higher abundance/encounter/use period *relative to current conditions, not relative to historical periods of higher halibut abundance* (see Table 6-13). The 2016-2019 period is used as a proxy for lower abundance/use (recognizing that the use:encounter relationship has diverged due to the sector-wide implementation of deck sorting since 2015). The analysts cannot predict precisely how the A80 sector would respond to future changes in the governing environment of halibut abundance, encounter rates, and PSC limits. Rather, the analysis summarized in Section 6.4 is based upon A80 fishery haul data from 2010 through 2019 that are applied as proxies for halibut abundance and PSC use conditions. Summarized in color shading in Table ES-13 is the trend in reaching a limit under higher abundance/encounter/use (top panel in Table 6-13) contrasted with reaching the PSC limit under a lower abundance/use regime (lower panel Table 6-13). In a relatively low abundance/use environment, the sector would be expected to approach the status quo PSC limit (1,745 t) but not reach it. The analysts recognize that approaching the limit is likely to have operational impacts on the sector as a whole and, more importantly, would have distributed effects on companies within the A80 sector that are relatively more exposed to intra-sector halibut PSC limits based on their species quota portfolio and the sector's operational avoidance plans. Nonetheless, simulations based on historical data suggest that the A80 sector is not likely to reach a PSC limit that is set above the status quo level (e.g., 2,025 t or 2,325 t) when proxy data for lower abundance and PSC use are simulated. When simulating with proxy data for higher abundance, halibut encounter rates, and PSC use, the sector is expected to reach the status quo PSC limit. Under that same scenario, when total A80 groundfish TAC is high – meaning more hauls are likely to occur – the sector is also likely to reach a PSC limit of 2,025 t but would not reach a 2,325 t limit.

Table ES-13 Summary of percentage of A80 fishery haul-by-haul simulations that approached a defined PSC limit based on a higher (2010-14) and lower (2016-2019) PSC abundance/encounter/use regime and A80 groundfish TAC

	2010-2014	2016-2019
Alt_1		
Alt. 2		
Alt. 3		
Alt. 4		
Alt. 4 no floor		

A general summary of trends in addressing each of the individual performance metrics across all of the Alternatives is shown in Table ES-14. Note that this is a mere snapshot of performance simply to show context in the differences across how alternatives including status quo address competing objectives. There is limited contrast between alternatives in terms of the metrics that reflect the Council's ABM objectives. Generally, Alternative 2 performs better in flexibility and stability while Alternatives 3 and 4 perform better in terms of indirectly providing for increased harvest opportunity in the BSAI directed halibut fishery.

Table ES-14 Summary table of the trend in performance metrics (as shown in ES Table ES-6 **through Table ES-9) to meet policy level objectives for all metrics:**

Alternative		**1**	**2**	**3**	**4**	**4 no floor**
Objective	**Metric in brief**					
Flexibility	PSC limits 2021-2025					
	PSC limits 2026-2030					
	Higher abundance regime					
	Lower abundance regime					
Index to abundance	PSC limit to total biomass (2025)					
	PSC limit to SSB (2025)					
	PSC limit to total biomass (2050)					
	PSC limit to SSB (2050)					
Stability	AAV short					
	AAV medium					
Protect SSB	Limit: TCEY short					
	Limit to TCEY medium					
Directed Fishery	Lower catch limit short					
	Lower catch limit medium					
	AAV short					
	AAV medium					
	>15% short					
	>15% medium					
	% TCEY					

Roadmap for understanding EIS structure and RIR and MSA requirements

This document is a preliminary draft Environmental Impact Statement (DEIS). A preliminary DEIS provides assessments of the environmental impacts of an action and its reasonable alternatives as well as the economic benefits and costs of the action alternatives and their distribution. This preliminary DEIS addresses the statutory requirements of the Magnuson-Stevens Fishery Conservation and Management Act (MSA), the National Environmental Policy Act, and Presidential Executive Order 12866. A preliminary DEIS is a document produced by the North Pacific Fishery Management Council (Council) and the National Marine Fisheries Service (NMFS) Alaska Region to provide the analytical background for decision-making. A Social Impact Assessment (SIA) appended separately has also been prepared for this document.

This preliminary draft EIS is being prepared using the 1978 Council on Environmental Quality (CEQ) National Environmental Policy Act (NEPA) Regulations. NEPA reviews initiated prior to the effective date of the revised CEQ regulations may be conducted using the 1978 version of the regulations. The effective date of the 2020 CEQ NEPA Regulations was September 14, 2020. A Notice of Intent to publish an Environmental Impact Statement (EIS) for the proposed management measures was published in the Federal Register on December 12, 2017 (82 FR 58374). This review began on that date, and the agency has decided to proceed under the 1978 regulations.

The document is structured to streamline information required in a DEIS and to organize it to be most easily understood by the reader. **Chapters 1 and 2** contain a description of the purpose and need for the action, followed by a description of the alternatives. **Chapters 3 and 4** of this preliminary DEIS contain background information on the Amendment 80 groundfish fishery and the commercial halibut fisheries in IPHC Area 4 (IFQ and CDQ). Those sections characterize the fisheries as they exist under status quo management and provide the context within which the alternative management measures should be considered. Methods for the operating model for evaluating the alternatives are in **Chapter 5**. **Chapter 6** contains the impact analysis on the groundfish fishery and halibut fishery from these alternatives as well as the methodology for the revenue estimation. **Chapter 7** contains information and impacts to other affected resources.

Appended separately (**Appendix 1**) is a social impact assessment (SIA) that evaluates community and regional patterns of engagement in and dependency on the BSAI Amendment 80 groundfish commercial fishery and the BSAI/Area 4 halibut commercial fishery as well as the potential for community level impacts under the no-action and action alternatives. Potential impacts to regional subsistence and sport halibut fisheries in Alaska are also evaluated. Myriad communities in Alaska and the Pacific Northwest participate directly and/or indirectly in one or both commercial fisheries. Within Alaska, more communities participate directly in the BSAI/Area 4 commercial halibut fishery than in the Amendment 80 fishery; however, the Amendment 80 fishery touches multiple Alaska communities directly or indirectly in several ways including: being the location of product transfers, which generate tax revenues realized at the state and local level; being ports of call, which may generate local support service sector economic activity; and/or being industry partners for the harvest of CDQ multispecies groundfish quota, among others. The BSAI/Area 4 halibut fishery, on the other hand, is fundamentally important to the local fleets of multiple Alaska communities and regions and, in some cases, provides one of the few options for private sector employment and income opportunities in those communities. The findings of the SIA are summarized in the “Social and Environmental Justice” section of the DEIS.

Where are we in the process?

The Council has reviewed several discussion papers and a previous preliminary DEIS when the action was considered for all sectors (October 2019). This is the first review of an analysis in which the action pertains to only the A80 fleet. Figure ES-7 shows where this initial review of the DEIS fits into the overall Council and NEPA process and how decisions at this Council meeting might affect scheduling of this action moving forward.

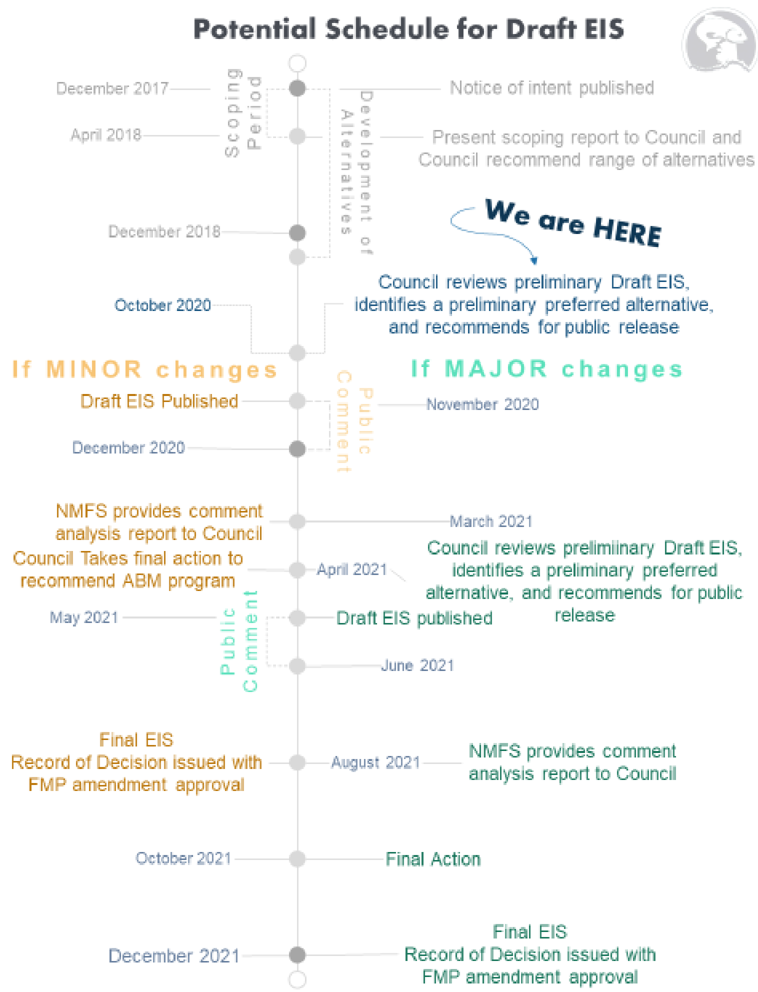


Figure ES-7 Previous Council considerations (grey), proposed NEPA schedule and potential Council schedule for DEIS