Abundance-based management for Pacific halibut PSC

June 2017[1]

1. Introduction and overview of materials provided

The following materials are provided in this paper with the goals and objectives of this review noted below:

1. Description of indices: A preliminary response to the SSC and Council's request for additional description of the Pacific halibut abundance indices and their qualities is provided. This section of the report shows how several indices are highly correlated and what components of the halibut stock they address. Ideally, based on this information the SSC might suggest a subset of indices to help the WG draft a suite of abundance-based management (ABM) alternatives to be considered in October.
2. Performance metrics: Revised draft performance metrics based on the February workshop along with public input are provided. Further review and input at this meeting will help the Inter-agency workgroup (WG) draft a suite of alternatives to be considered in October. Specifically, do these performance metrics (or additional ones to be brought forward in SSC review and public input) address the concerns the Council is balancing in drafting alternatives for abundance-based halibut PSC limits? These metrics will help the WG evaluate which individual indices (as listed in the description of indices section) might best be used.
3. Outline of October paper: A draft outline of information to be included in the October paper is provided for feedback on the breadth and necessity of including each of these items in a comprehensive discussion paper. A list of information previously provided and links to where it can be downloaded is also attached (Table 4). The WG is seeking feedback on what information should be brought forward in October to facilitate decision-making on a range of ABM alternatives at that time.

2. Description of indices

We considered several indices to address different aspects of the halibut population (Tables 1 and 2). Generally, biomass (weight) indices will pertain to a relatively older part of the population (older fish are larger and make up more of a biomass estimate) and have lower variability relative to indices in numbers. This lower variability is because the older mixture of age classes has been subject to fishing and natural mortality over time. Conversely, indices in numbers of fish will have higher variability because younger

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fish make up a high proportion of these indices (i.e., recent year classes that have been subjected to less fishing and natural mortality).

Indices developed for the EBS shelf survey were primarily intended to define the population segment vulnerable to the groundfish fishery and the directed Area 4CDE halibut fishery. Indices from outside the EBS were considered to account for reproductive status and success of the coastwide or Alaska-wide population and to account for the possible "downstream" movement of young halibut from the EBS shelf to other areas.

Index variability over time ranged from a low of about 17% for the AI trawl survey numbers and the EBS shelf biomass, to a high of 133% for the U12 EBS shelf survey numbers. Part of this variability arises from measurement error/sampling error but also includes "process error"—i.e., the extent that the true but unknown population component varies from year to year. For example, in a relative sense the process error for a recruitment index is expected to be much higher than say an index of adults which represents many age classes.[2]

In principle, the set of indices selected for use in a control rule to establish a BSAI halibut PSC limit should provide information on Pacific halibut stock components and groundfish bycatch encounters. Such data are input to an ABM control rule which can be tuned up to improve performance metrics relative to directed halibut and groundfish fishery objectives. The characteristics of relationships between indices is important to consider.

1) To consider the coastwide status of halibut, an index of abundance from the IPHC assessment and research products should be considered. Indices from their stock assessment model and their setline indices are virtually interchangeable due to their high **positive correlations** (Table 3). This contrasts with EBS trawl-survey indices which are negatively correlated (Figure 2). **Hence, EBS trawl survey indices appear to be unsuitable for tracking coastwide Pacific halibut stock status.**
2) **For indices that track Pacific halibut recruitment, or general presence of young fish, it is probably best to choose an index in numbers.** Such an index may likely be **uncorrelated** with stock status or an index of large fish. For example, the stock assessment estimate of spawning biomass is weakly correlated with a young fish index (U12.AK.Trawl.Num; Table 3, 0.053).
3) Combinations of indices may offset each other since some are highly **negatively correlated.** For example, the IPHC setline index for 4CDE as an index of adult fish and an index of young fish in the EBS (O12.EBSShelfTrawl.Num) are negatively correlated (Table 3, -0.812).

Generally, combining indices that are either uncorrelated or negatively correlated would have properties that would help in explaining different dynamics of the population. Choosing indices that are highly positively correlated would have the effect of adding emphasis to that population component and for simplicity, it would likely be better to use just one of them. Figure 2 shows that there are multiple indices available for each stock attribute being addressed and several are interchangeable.

[2] Index variability could be stabilized within a control rule. For example, ABM1 might be specified such that the b values are a function of the time series CV:

$b = \frac{1}{1+CV_{Index}}$ which could reduce sensitivity to the more variable indices.

Table 1. Description of Pacific halibut indices developed for consideration in creating alternative ABM control rule frameworks. Note that the naming convention follows roughly the size:area:gear:units format for Pacific halibut. Also noted are which indices are included in each ABM option from the April 2017 discussion paper

Pacific halibut Index Name	ABM Option	Description	Applies to what part of the halibut population
O26/O32.4CDE.Setline.Bio		Biomass of halibut over 32 inches from the IPHC setline survey in the BS/AI	Representative of mostly female mature fish, and fish targeted by the directed fishery in the EBS (Area 4CDE)
O26/O32.CW.Setline.Bio	**1, 2 3, 4**	Biomass of halibut over 32 inches from the IPHC setline survey in all areas	Representative of mostly female mature fish and as a proxy to coast wide stock status
SB.Assessment.Bio	**3**	Current estimate of spawning biomass from the stock assessment model	Stock assessment estimate of coastwide female spawning biomass, similar to stock status, also representative of large fish
Status.Assessment.Bio	**4**	Current level of spawning biomass relative to unfished from the stock assessment	Stock assessment estimate of coastwide stock status, representative of the relative amount of female spawners
Tot.EBSShelf.Trawl.Bio		Biomass of all sizes on the EBS Shelf trawl survey 2016	Representative of the trawl-vulnerable biomass in the EBS and what the groundfish bycatch fishery encounters.
Tot.AI.Trawl.Num		Biomass of all sizes on the AI Shelf trawl survey	Representative of younger population in the AI, possibly of fish successfully leaving the EBS shelf.
Tot.EBSShelf.Trawl.Num	**1**	Numbers of all sizes on the EBS Shelf trawl survey 2016	Representative of younger population in the EBS, for tracking recent higher recruitment to the EBS shelf.
Tot.GOA.Trawl.Num	**1**	Numbers of all sizes on the GOA trawl survey 2016	Representative of younger population in the GOA, possibly of fish successfully leaving the EBS shelf or coastwide recruitment success.
U12.AI.Trawl.Num		Numbers under 12 inches on the AI trawl survey	Representative of recruitment in the last two years in the AI, possibly indicative of coastwide recruitment success.
U12.AK.Trawl.Num	**2**	Combined numbers under 12 inches on the GOA/AI/EBS trawl surveys	Representative of recruitment in the last two years in the overall Alaska stock, probably indicative of coastwide recruitment success.
U12.EBSShelf.Trawl.Num		Numbers under 12 inches on the EBS Shelf trawl survey	Representative of recruitment in the last two years in the EBS, possibly indicative of coastwide recruitment success and fish to be encountered soon as bycatch in the EBS.
U12.GOA.Trawl.Num		Numbers under 12 inches on the GOA trawl survey	Representative of recruitment in the last two years in the GOA, possibly indicative of coastwide recruitment success.
O12.EBSShelf.Trawl.Num	**2**	Numbers over 12 inches on the EBS Shelf trawl survey	Fish older than 2 in the EBS that could be encountered by both groundfish and directed fisheries
U26.AI.Trawl.Num		Numbers under 26 inches on the AI trawl survey	Representative of younger sub-legal fish in the AI and indicative of recent recruitment.
U26.EBSShelf.Trawl.Num	**3, 4**	Numbers under 26 inches on the EBS Shelf trawl survey 2016	Representative of younger sub-legal fish on the EBS shelf vulnerable to the groundfish fishery and indicative of recent recruitment.
U26.GOA.Trawl.Num		Numbers under 26 inches on the GOA trawl survey	Representative of younger sub-legal fish in the GOA and indicative of recent recruitment or movement from the EBS.
U26.AK.Trawl.Num		Combined numbers under 26 inches on the GOA/AI/EBS trawl surveys	Representative of younger sub-legal fish in in Alaska waters, and indicative of recent coastwide recruitment success.

Table 2. Characteristics of indices developed for consideration in creating alternative ABM control rule frameworks. Column labeled “2016 value” represents the “multiplier” or value from the standardized index defined as the index value divided by the index mean from 1998-2016. Index variability is the measure of interannual variance, which contains elements of process and measurement error.

Pacific halibut Index Name	ABM Option	Units	2016 Value	Index CV	Range	Frequency
O26/O32.4CDE.Setline.Bio		Biomass	0.95	25%	1998-2016	Annual
O26/O32.CW.Setline.Bio	**1, 2,3, 4**	Biomass	0.69	36%	1998-2016	Annual
SB.Assessment.Bio	**3**	Biomass	0.73	40%	1998-2017	Annual
Status.Assessment.Bio	**4**	Biomass	0.72	40%	1998-2017	Annual
Tot.EBSShelf.Trawl.Bio		Biomass	1.00	17%	1982-2016	Annual
Tot.AI.Trawl.Num		Numbers	0.72	17%	1980-2016	Biennial
Tot.EBSShelf.Trawl.Num	**1**	Numbers	0.88	38%	1982-2016	Annual
Tot.GOA.Trawl.Num	**1**	Numbers	0.96	27%	1984-2015	Biennial
U12.AI.Trawl.Num		Numbers	0.94	62%	1980-2016	Biennial
U12.AK.Trawl.Num	**2**	Numbers	0.57	75%	1984-2016	Annual*
U12.EBSShelf.Trawl.Num		Numbers	0.43	133%	1982-2016	Annual
U12.GOA.Trawl.Num		Numbers	0.72	53%	1984-2015	Biennial
O12.EBSShelf.Trawl.Num	**2**	Numbers	0.98	32%	1982-2016	Annual
U26.AI.Trawl.Num		Numbers	0.68	15%	1980-2016	Biennial
U26.EBSShelf.Trawl.Num	**3, 4**	Numbers	0.84	47%	1982-2016	Annual
U26.GOA.Trawl.Num		Numbers	0.83	31%	1984-2015	Biennial
U26.AK.Trawl.Num		Numbers	0.83	33%	1984-2016	Annual*

*Alaska-wide trawl indices use the previous year’s estimate for areas that are in an off year of their biennial cycle (i.e., Aleutians in odd years and Gulf of Alaska in even years).

Table 3. A subset of all the pairwise correlations between halibut indices. Strong positive and negative between indices (>0.8), and the weakest correlations (<0.1). 53.3% the 135 pairs of correlations were positive

Index 1	**Index 2**	***r***	**Type**
O12.EBSShelf.Trawl.Num	O32.4CDE.Setline.Bio	-0.812	**Strong Negative**
Tot.EBSShelf.Trawl.Bio	U12.AI.Trawl.Num	-0.803	
Tot.EBSShelf.Trawl.Num	U12.GOA.Trawl.Num	-0.098	**Uncorrelated**
U12.EBSShelf.Trawl.Num	O32.CW.Setline.Bio	-0.093	
O32.CW.Setline.Bio	U12.EBSShelf.Trawl.Num	-0.093	
Status.Assessment.Bio	U12.AK.Trawl.Num	-0.053	
SB.Assessment.Bio	U12.AK.Trawl.Num	-0.052	
U12.AI.Trawl.Num	U12.EBSShelf.Trawl.Num	-0.05	
U12.GOA.Trawl.Num	U26.EBSShelf.Trawl.Num	-0.042	
Tot.AI.Trawl.Num	Tot.GOA.Trawl.Num	-0.022	
Tot.EBSShelf.Trawl.Bio	Tot.GOA.Trawl.Num	-0.006	
U12.AI.Trawl.Num	U26.GOA.Trawl.Num	-0.003	
Tot.AI.Trawl.Num	U12.EBSShelf.Trawl.Num	-0.002	
Tot.AI.Trawl.Num	U12.AK.Trawl.Num	0.008	
Tot.AI.Trawl.Num	U12.GOA.Trawl.Num	0.027	
O32.CW.Setline.Bio	U12.AK.Trawl.Num	0.054	
Tot.AI.Trawl.Num	U12.AI.Trawl.Num	0.064	
U12.EBSShelf.Trawl.Num	U12.GOA.Trawl.Num	0.066	
O12.EBSShelf.Trawl.Num	U12.AK.Trawl.Num	0.089	
O12.EBSShelf.Trawl.Num	Tot.EBSShelf.Trawl.Num	0.81	**Strong Positive**
Tot.GOA.Trawl.Num	U26.Tot.Trawl.Num	0.84	
Tot.EBSShelf.Trawl.Num	U26.Tot.Trawl.Num	0.871	
U26.EBSShelf.Trawl.Num	U26.Tot.Trawl.Num	0.891	
O32.4CDE.Setline.Bio	O32.CW.Setline.Bio	0.922	
U26.GOA.Trawl.Num	U26.Tot.Trawl.Num	0.924	
U12.AK.Trawl.Num	U12.EBSShelf.Trawl.Num	0.94	
Tot.GOA.Trawl.Num	U26.GOA.Trawl.Num	0.958	
Status.Assessment.Bio	O32.4CDE.Setline.Bio	0.961	
O32.4CDE.Setline.Bio	Status.Assessment.Bio	0.961	
O32.CW.Setline.Bio	Status.Assessment.Bio	0.986	
O32.CW.Setline.Bio	SB.Assessment.Bio	0.987	
Tot.EBSShelf.Trawl.Num	U26.EBSShelf.Trawl.Num	0.995	

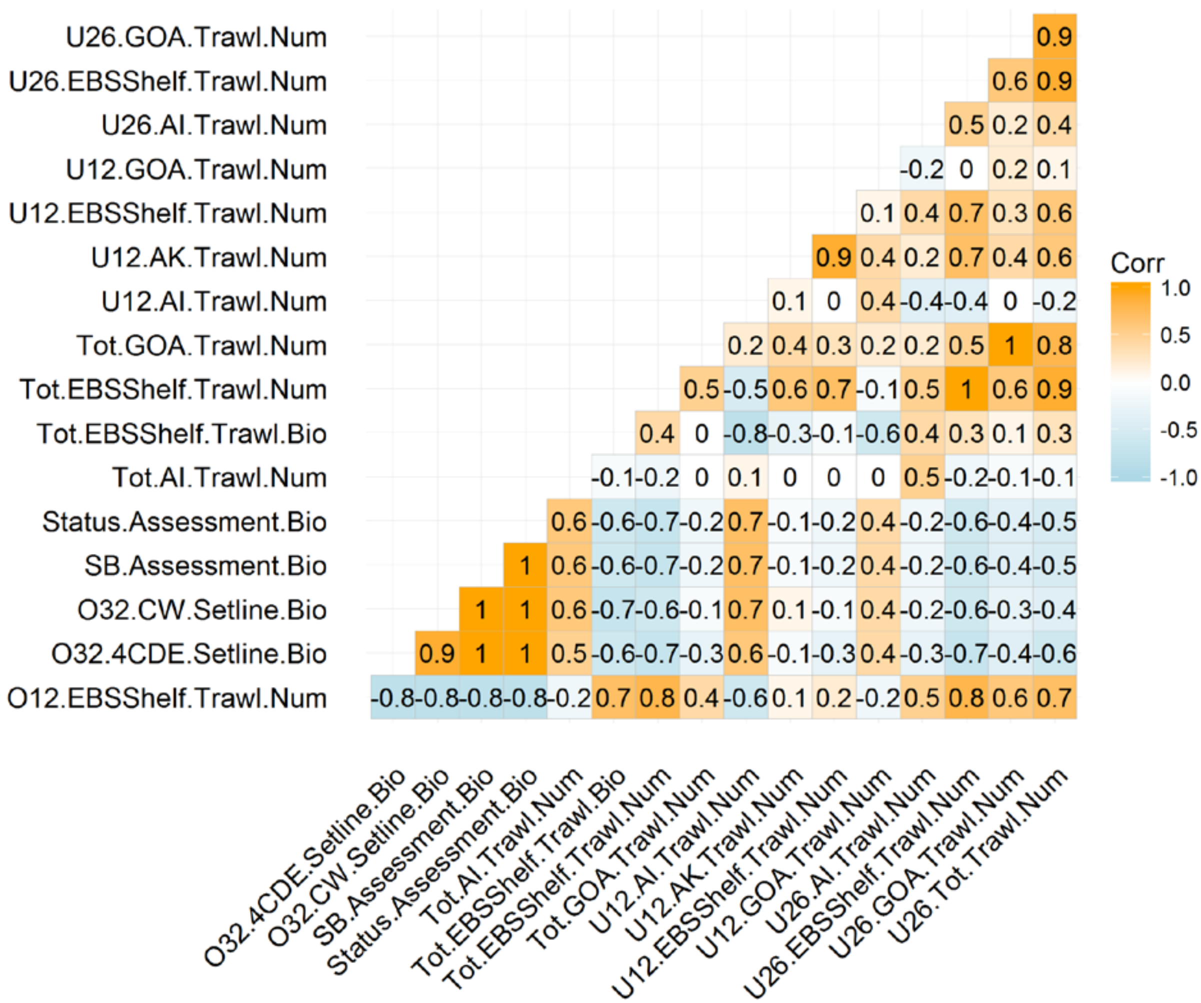

Figure 1. Complete pairwise correlations among indices. Orange is positive and blue is negative.

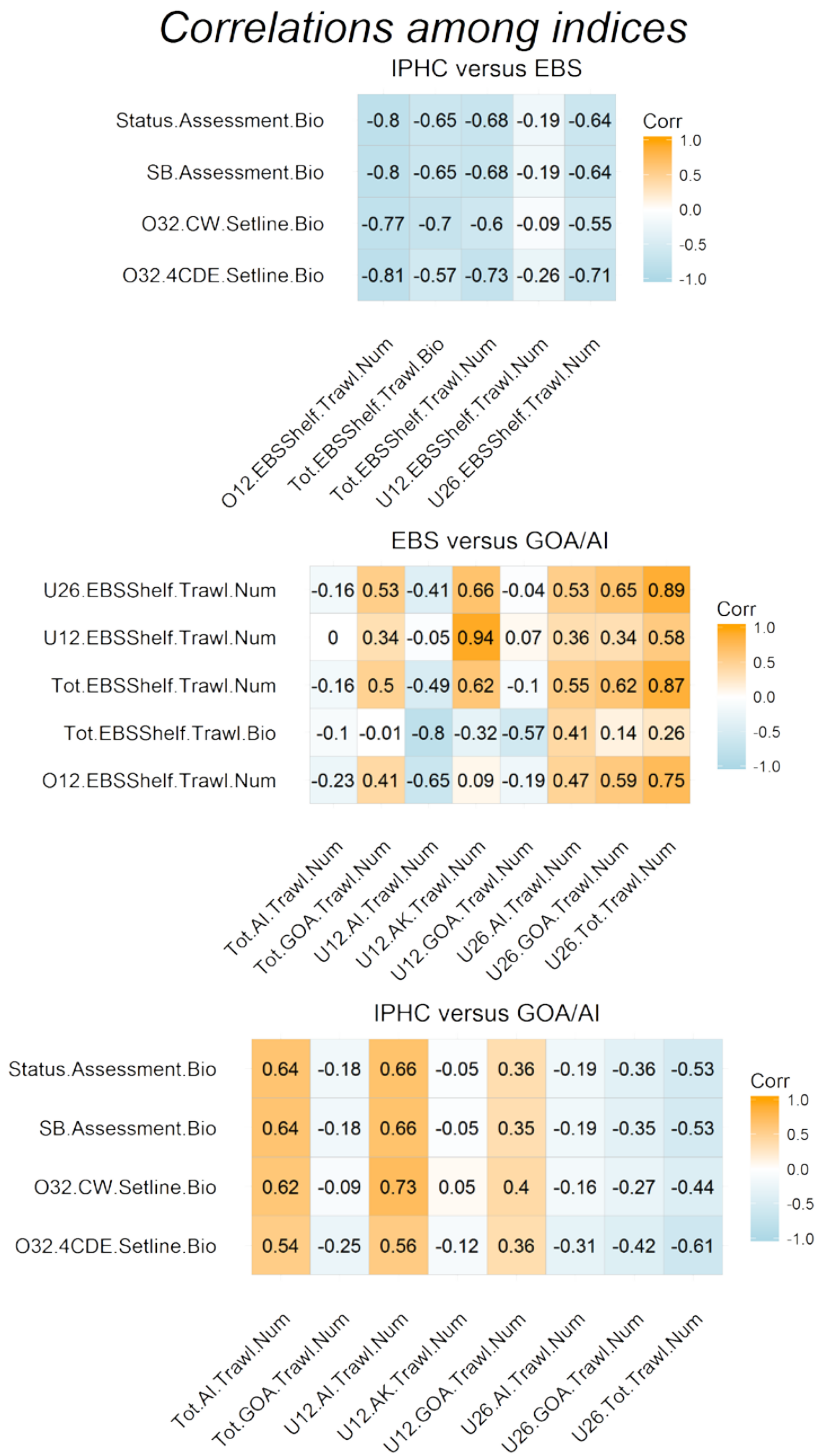

Figure 2. Correlations between groups of indices (IPHC longline, inside the EBS, and outside the EBS).

3. Performance metrics review

Choosing between different ABM management alternatives can be done by comparing how each alternative meets defined objectives. Therefore, it is important to define detailed objectives with measurable outcomes. This can be difficult, and should involve input from stakeholders and decision-makers. Typically, overarching goals are defined first and translated into measurable objectives, and there may be multiple measurable objectives for each goal. Sometimes it is helpful for analysts to ask stakeholders and decision-makers questions which can then lead to measurable objectives. For example, a question related to an overarching goal of "maintaining a healthy fish stock" may be "Is there a minimum spawning stock abundance that is desired?" which may lead to a measurable objective of "keeping the spawning stock above a certain abundance for a specified number of years with a specified probability." This measurable objective has an outcome ("a certain abundance"), a time-frame ("a specified number of years") and a probability or acceptable risk level. A performance metric can then be defined to evaluate whether a measurable objective has been achieved (e.g., the probability that the spawning stock abundance is above a certain level over a specific number of years).

3.1. Council Purpose and Need (adopted April 2016)

"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, provide an opportunity for the directed halibut fishery, and protect the halibut spawning stock biomass, particularly at low levels of abundance. The Council recognizes that abundance-based halibut PSC limits may increase and decrease with changes in halibut abundance."

Council objectives inferred from the Purpose and Need for this action to form overarching goals:

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

These overarching goals in the attached tables were then used to formulate draft measurable objectives from which to derive performance metrics incorporating feedback from stakeholders at the February 2017 workshop. These overarching goals may be in competition with each other. To best design and evaluate alternatives which can be compared in a future risk assessment to assist policy-level decision-making, specific measurable objectives for this action must be defined. As noted above, measurable objectives are best defined in conjunction with stakeholder input.

3.2. Summary of performance metrics

Table 3 lists performance metrics and features relative to Council objectives (and how they might be measured). Relative to consideration of individual indices the WG noted the following in considering elements of Table 3:

Index is proportional to halibut abundance that it is meant to measure
Index is not subject to an unreasonable amount of uncertainty
Index is available in a timely manner
Information to derive index is easily obtained.
Which Council objectives does index relate to?

For combinations of indices (integrated index) the objectives in Table 3 should be evaluated using simulations and consider old and young population components (with correlations between indices considered) and also the coastwide stock status and geographic range.

3.3. Glossary of terms

Council Objectives A list of overarching goals for abundance-based halibut PSC management that were inferred from the Council's Purpose and Need Statement.

Measurable Objective An objective that can be specified explicitly (e.g., ensure the spawning biomass stays above a minimum threshold) and evaluated with a performance metric (e.g., ensure the spawning biomass stays above 20% of the unfished spawning biomass with 90% probability) which reflects and is linked to the Council objectives. Performance metrics are used to judge policy alternatives relative to these objectives. An additional quantity as part of the measurable objective may be a probability (level of tolerance) which to evaluate against. Probabilities are framed as a risk (something undesirable happening).

Threshold A value or range of values that must be achieved to meet a measurable objective.

Time Frame There are two concepts here. The first is how far into the future is considered (e.g., short-term or long-term). The second is a range of years over which the measurable objective is to be evaluated. This can be short-term, long-term, annual, a period of 10 years, etc.

Performance Metric Metric or statistic that is used to evaluate whether a measurable objective is achieved. Performance metrics are used in scientific analysis to gauge success in meeting measurable objectives. The Performance Metric is determined from the Threshold and Time Frame.

Other Terms:

AAV Average Annual Variability

ABM Abundance based management specifically for Pacific halibut

Control Rule A function relating a metric of stock status to a resulting management limit, such as a catch, fishing mortality, or effort limit

BCR Bycatch control rule; a control rule for setting the limit of a bycatch (PSC) species based on a specified metric of stock status

PSC Prohibited species catch (for halibut, synonymous with bycatch)

SPR Spawning potential ratio; the ratio of spawning biomass per recruit at a particular level of fishing mortality to the spawning biomass per recruit under an assumption of no fishing. Spawning biomass per recruit is the amount of future spawning biomass that can be expected as the result of a fish spawning over the course of its lifetime, assuming a particular level of constant fishing mortality.

SSB Spawning stock biomass

Table 3. Council objectives and overarching goals (first column) and measures and characteristics of performance metrics that might apply for contrasting future alternative PSC management measures.

Council Objectives	**Measurable objective**	**Threshold**	**Time Frame**	**Performance metric**
There should be flexibility provided to avoid unnecessarily constraining the groundfish fishery particularly when halibut abundance is high	Average PSC limit	NA	short and long term	Average (PSC limit)
	The PSC limit is below the 2016 PSC limit a certain percentage of time.	3,515 t	short and long term	P(PSC limit < 3,515t)
	The PSC limit is below the 2016 PSC catch a certain percentage of time.	2,337 t	short and long term	P(PSC limit < 2,337t)
	Maintain CPUE above a minimum value to reach the TAC (and below PSC)		short and long term	P(CPUE < ???)
Provide for some stability in PSC limits on an inter-annual basis.	Achieve a level of inter-annual variability in PSC levels that is below an acceptable level	NA	short and long term	Average annual variation (AAV) in halibut PSC limit P(AAV < ???%)
Halibut spawning stock biomass should be protected especially at lower levels of abundance	Measure the impact on spawning biomass	NA	short and long term	Fishery-specific SPR
	Not allow the impact on the spawning biomass to exceed a specific level.		short and long term	P(SPR < ???)
	Maintain the spawning biomass above a value		short and long term	P(SB < ???)
	Maintain a diversity of sizes in the population.		long-term	
	Maintain the spawning biomass above critical levels	20% of equilibrium	short and long term	P(SB < 20%)
Provide for directed halibut fishing operations [in the Bering Sea].	A minimum FCEY in 4CDE			P(FCEY < ???)
	A target FCEY in 4CDE		short and long term	P(FCEY < ???)
	The proportion of the directed fishery catch limit is greater than X% of the total catch limit (floor and ceiling?)		short and long term	P(FCEY/TCEY < ???)
Halibut PSC limits should be indexed to halibut abundance	The change in PSC limit has a minimum level of variation relative to the indices		General	Slope (b) of combined control rule > ???
	The range of the index for which a minimum level of variation is achieved.		short and long term	P(floor used) P(ceiling used)
	PSC is proportional to halibut abundance		short and long term	PSC limit change relative to halibut biomass
	Incorporate appropriate size ranges to index the important components		short and long term	Indices apply to segments of population (e.g., U12, O26)

4. DRAFT outline for October 2017 halibut ABM discussion paper

The following outline is provided for discussion and recommendations on the sections for inclusion in the paper to be developed for the October Council meeting to best facilitate decision-making. For background Table 4 lists previous papers and information on ABM work done for the Council for reference purposes.

- I. Background information
    - a. Council purpose and need
    - b. History of this action
    - c. Halibut fishery management in the BSAI
    - d. Halibut PSC in the BSAI groundfish fisheries
- II. Components of abundance-based halibut PSC management
    - a. Indices of halibut abundance
        - i. All available
            1. Listing of indices with characteristics, proportion of population
            2. Qualities of indices (units, 2016 value, variability, frequency)
        - ii. Workgroup proposed ABM strawman alternatives (note this will include additional formulation as suggested by the Council and SSC such as alternative approaches to SSB than 30:20, range of recruitment alternatives)
    - b. Preliminary evaluation of combination of indices (all else equal analysis) using single example control rule across combinations
    - c. Control rules to establish halibut PSC limits
        - i. Features of control rules (slope, floor, ceiling, starting point, etc.)
        - ii. Examples of features used based upon measurable objectives (from feedback in June)
- III. Developing ABM alternatives
    - a. Main considerations
    - b. Selection of indices
    - c. Application of control rules
- IV. Analysis of ABM alternatives
    - a. Tools for analysis of alternatives
    - b. Council objectives translated to measurable objectives
    - c. Performance metrics
    - d. Impacts of alternatives on groundfish fisheries (including impacts on incentives to avoid halibut PSC)
    - e. Impacts of alternatives on directed fisheries

To develop ABM alternatives, the Workgroup recommends that the Council in October identify options for the following program elements:

- **Abundance index** – Options could include determining PSC limit based on changes in one halibut abundance index and/or combinations of different abundance indices.
- **Maximum PSC limit** (ceiling) - Options could be based on current or historical PSC limits or use.
- **Minimum PSC limit** (floor) - Options could be based on current or historical PSC limits or use.
- **Starting point for PSC limit** (starting PSC limit that will be adjusted based on changes in abundance index/indices) - Options could be based on current or historical PSC limits or use.
- **Stability of PSC limits** – Options could be included to limit the annual change in PSC limits, such as specifying a maximum percentage change or using a rolling average of index values to smooth inter-annual variability.

The Workgroup identified the following examples of ABM elements and options for illustration:

Element 1 – Abundance index

Option 1. EBS trawl survey
Option 2. EBS trawl survey U26 and IPHC O32 setline survey
Option 3. EBS trawl survey, GOA trawl survey numbers and IPHC O32 setline survey
Option 4. EBS trawl survey and IPHC SSB
Option 5. Other combinations to be identified by WG/SSC

Element 2 - Maximum PSC limit *(ceiling)*

Option 1. 2016 PSC limit (3,515 t)
Option 2. 20% - 50% increase from 2016 PSC limit
Option 3. Average of 2008 – 2016 PSC limit

Element 3 - Minimum PSC limit *(floor)*

Option 1. No floor (PSC goes to 0)
Option 2. 20% - 50% reduction from 2016 PSC limit
Option 3. Average of 2014 - 2016 PSC use

Element 4 – Starting point for PSC limit

Option 1. 2016 PSC limit (3,515 t)
Option 2. Average of 2008 - 2016 PSC limit
Option 3. Average of 2008 - 2016 PSC use

Element 5 – Stability of PSC limits

Option 1. PSC limit varies directly with change in abundance index
Option 2. Limit PSC change to a maximum percentage
Option 2. Change PSC only every x number of years
Option 3. Use rolling average of index values to smooth interannual variability

Table 4. Information contained in previous materials provided April 2016-April 2017:

Information	**Date and document available**	**Link**
Data sources from which to derive indices including strengths and weaknesses of each	April 2016 discussion paper	April2016
Fishery characteristics (halibut PSC by target; observed trawl and longline effort, CPUE, PSC rates)	Supplement to April 2016 discussion paper	Supplement April2016
Description of potential abundance indices IPHC assessment; EBS trawl survey; combined and applied in a control rule	April 2016 discussion paper and attachment	April2016
Control rule background	April 2016 discussion paper; October 2016 Discussion paper; April 2017 Discussion paper	April2016 October2016 April2017
Control rule features	April 2016 discussion paper; October 2016 Discussion paper; April 2017 Discussion paper	April2016 October2016 April2017
Control rule examples already in use	April 2016 discussion paper; April 2017 Discussion paper	April2016 April2017
Performance metrics	February Workshop materials; April 2017 discussion paper	February2017 April2017
Incentives	April 2017 Discussion paper	April2017
Example ABM alternatives	April 2016 discussion paper; October 2016 Discussion paper; April 2017 Discussion paper; Supplement April 2017 Disc paper	April2016 October2016 April2017 SupplmntApr17
Management issues	October 2016 Discussion paper	October2016
Analytical considerations and example scenarios	April 2016 Discussion paper Supplemental presentation on model October 2016 Discussion paper April 2017 Discussion paper Supplement to April 2017 Discussion paper (example calculations)	April2016 Supplement ppt October2016 April2017 SupplmntApr17