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 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	