SSC Minutes
D-1 BSAI Halibut Abundance-Based PSC

The SSC received reports about a discussion paper and a workshop on efforts to develop abundance-based Prohibited Species Catch (PSC) limits for BSAI halibut from Diana Stram (Council staff), Allan Hicks (IPHC), Jim Ianelli (AFSC) and Kotaro Ono (AFSC). Public testimony was provided by John Neilson (AMCC and CBSFA), Linda Behnken (ALFA) and John Gauvin (Alaska Seafood Cooperative).

The Council, as per its Purpose and Needs statement, "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". At the request of the Council, the discussion paper lays out some options for developing indices and control rules to meet these objectives. The discussion paper included an additional objective to ensure stability in the PSC rates to avoid large year-to-year variations if they are not warranted. The Council should clarify whether this is an explicit objective as it could be seen to be in conflict with the desire to "provide a responsive management approach at varying levels of halibut abundance" and will affect the choices for appropriate indices and control rules.

The Council requested that the analysts first develop an index or indices as the basis for determining PSC limits. However, the SSC emphasizes, as noted by the analysts, that indices of abundance can only be considered and evaluated in the context of a control rule. The SSC found it difficult to comment on the utility of specific abundance indices in the absence of an analysis to evaluate their performance in the context of meeting multiple, and sometime conflicting, objectives. Therefore, the SSC stresses the importance of maintaining flexibility and evaluating a suite of potential indices and control rules in the analyses before selecting the best index or combination of indices to meet the Council's objectives. The SSC agrees with the analysts that candidate indices and control rules should be transparent and easily understood, and that they need to be available in advance of the December meeting.

The SSC appreciates the analysis and discussion of a number of candidate indices that were presented in April and at this meeting. The discussion paper and public workshop held at the AFSC in September recommended an integrated abundance-based management (ABM) index. While the ABM index could be one potential candidate for setting PSC limits, the SSC pointed out some serious shortcomings of the ABM index and requests that a broader suite of options for candidate abundance indices and control rules be examined together in subsequent analyses, rather than restricting analyses to a single index like the ABM at this stage. With respect to the ABM index, the SSC notes that combining three indices with different types information is not transparent in that the index is not easily interpreted and it is unclear how it would trade off multiple, potentially conflicting objectives. As pointed out in public testimony, the index would likely have been ineffective at constraining PSC during the recent period of decline in coastwide halibut biomass. The ABM index combines a coastwide abundance index of large halibut from the IPHC survey with trawl survey indices of smaller halibut caught in the EBS and GOA trawl surveys. The SSC notes that equally weighting the two trawl-based indices may implicitly put more weight on a halibut in the GOA because the majority of smaller halibut occur in the EBS.

The SSC suggests that different indices may need to be considered to meet different objectives, which could then be combined in a control rule or decision making framework that allows the Council to evaluate the tradeoffs between protecting spawning stock biomass, constraining PSC, and providing opportunities for a directed fishery. Importantly, an abundance-based index should have a biological basis and be interpretable as a plausible link to BSAI halibut abundance. The SSC has the following suggestions for

developing indices and control rules that address Council objectives and can be evaluated in subsequent analyses. We provide examples of an approach that is amenable to analyses with one of the proposed modeling options, is transparent and simple to implement, and can be used to evaluate trade-offs among competing objectives. We emphasize that these are examples only and decisions about appropriate control rules for halibut PSC have both biological and allocation implications, are responsible for providing bycatch-avoidance incentives to the commercial groundfish fleet, and are subject to National Standard 9 requirements to minimize bycatch "to the extent practicable" and to conservation considerations at low levels of spawning halibut biomass.

With respect to protecting halibut spawning biomass, a control rule to limit total mortality at low levels of spawning biomass is needed. Since PSC mortality in the Bering Sea reflects a substantial portion of total mortality, particularly of younger halibut, this requires a rule to limit PSC when coastwide halibut abundances are low. Since the concern is at least in part a conservation concern, a rule similar to our standard harvest control rule for groundfish species should be considered that would reduce PSC to zero at very low halibut abundances (see example below). As a measure of coastwide spawning biomass, the analysts selected a survey-based index of the biomass of halibut over 32 inches (O32). The SSC supports this pragmatic choice, although a model-based index that takes into account additional sources of information should be considered, if it is available in time.

Because halibut PSC in the EBS largely consists of smaller fish, an obvious drawback of linking PSC to an index of coastwide spawning stock abundance is the delay between changes in PSC, once a decline in spawning biomass is detected, and their effects on future spawning biomass. Therefore, it is desirable to consider an index that quantifies the strength of incoming year classes well before they contribute to spawning biomass. For this reason, the analysts explored the use of size ranges corresponding to age-2, age-3 and age-4 halibut in the NMFS bottom trawl survey. However, while there is some consistency in these indices in that individual cohorts can be tracked over time, a clear relationship between these cohorts, as sampled by the survey, and future recruitment to the adult stock is not evident. The SSC encourages additional analyses on a survey- or model-based juvenile halibut index that can be evaluated under a chosen control rule for its effectiveness in protecting future spawning biomass. However, we realize that a suitable index of juvenile abundance may not be available at this time. A potential drawback of linking PSC to a juvenile index is that any juvenile index is likely to fluctuate considerably from year to year, therefore some smoothing of the index or a control rule that results in a smoother change in PSC may be desirable in that situation. If a reliable juvenile index can be identified, it could be used either instead of or in addition to the index of coastwide spawning stock abundance.

Evaluating the other objectives, which relate to trading off PSC against opportunities for a directed halibut fishery, ideally requires indices that quantify the portion of the halibut stock that is encountered by the groundfish fleet (as an index of the ability of the fleet to avoid PSC) and the portion that is available to the directed halibut fishery. Candidate indices for the former were evaluated in the April document and the most suitable index was determined to be based on halibut catch rates in the EBS trawl survey, which has a similar footprint to the groundfish fleet and catches a similar size range of halibut. However, this index is not sufficient to evaluate trade-offs between PSC and the directed fishery because of the limited overlap between the size range encountered by the trawl survey and the size range in the directed halibut fishery, and because these two portions of the population display different trends. For example, in some years small fish may be abundant in the EBS survey and coastwide abundances may be high, but the exploitable halibut biomass in the EBS that is available to the directed fishery can be very low because of differences

in spatial distribution of halibut. We suggest that an index for the portion of the stock available to the directed halibut fishery could be based on IPHC analyses of the setline survey and other data sources that are used to determine exploitable biomass in different regions, which are readily available.

The SSC suggests that the multiple objectives of this action may require multiple indices and could be met by formulating control rules for each type of index (reflecting coastwide spawning biomass, encounter rates with the fleet, and availability to the directed fishery, respectively) that allow an evaluation of the tradeoffs between PSC, protecting the stock at low abundances, and providing opportunities for a directed fishery. For example, control rules for setting PSC at different levels of the spawning biomass index and different levels of EBS trawl survey abundance can be combined into a simple two-dimensional decision table to set a PSC level. Adding a third dimension may be necessary and would be straightforward. For example, a simple approach could associate low, intermediate and high levels of the spawning biomass with low, intermediate and high levels of PSC (similarly for the abundance index in the EBS trawl survey or the exploitable biomass index). PSC could then, for example, be determined based on the level of the index that is most constraining as illustrated below:

Example decision table to set PSC limits based on the level of two indices. The PSC limit is set at the level of the index that is most constraining. For example, at low levels of spawning biomass, the PSC limit is set at a low level regardless of the value of the trawl survey index.

		EBS exploitable biomass index		
		Low	***Medium***	***High***
Coastwide spawning biomass index	***High***	Low	Intermediate	High
	Medium	Low	Intermediate	Intermediate
	Low	Low	Low	Low

However, it may be preferable to formulate continuous control rules like those presented in the discussion paper that would avoid abrupt changes in PSC. These control rules could similarly be combined in a 2- or 3-dimensional framework for setting PSC limits as illustrated below and represent a simple extension of the decision table:

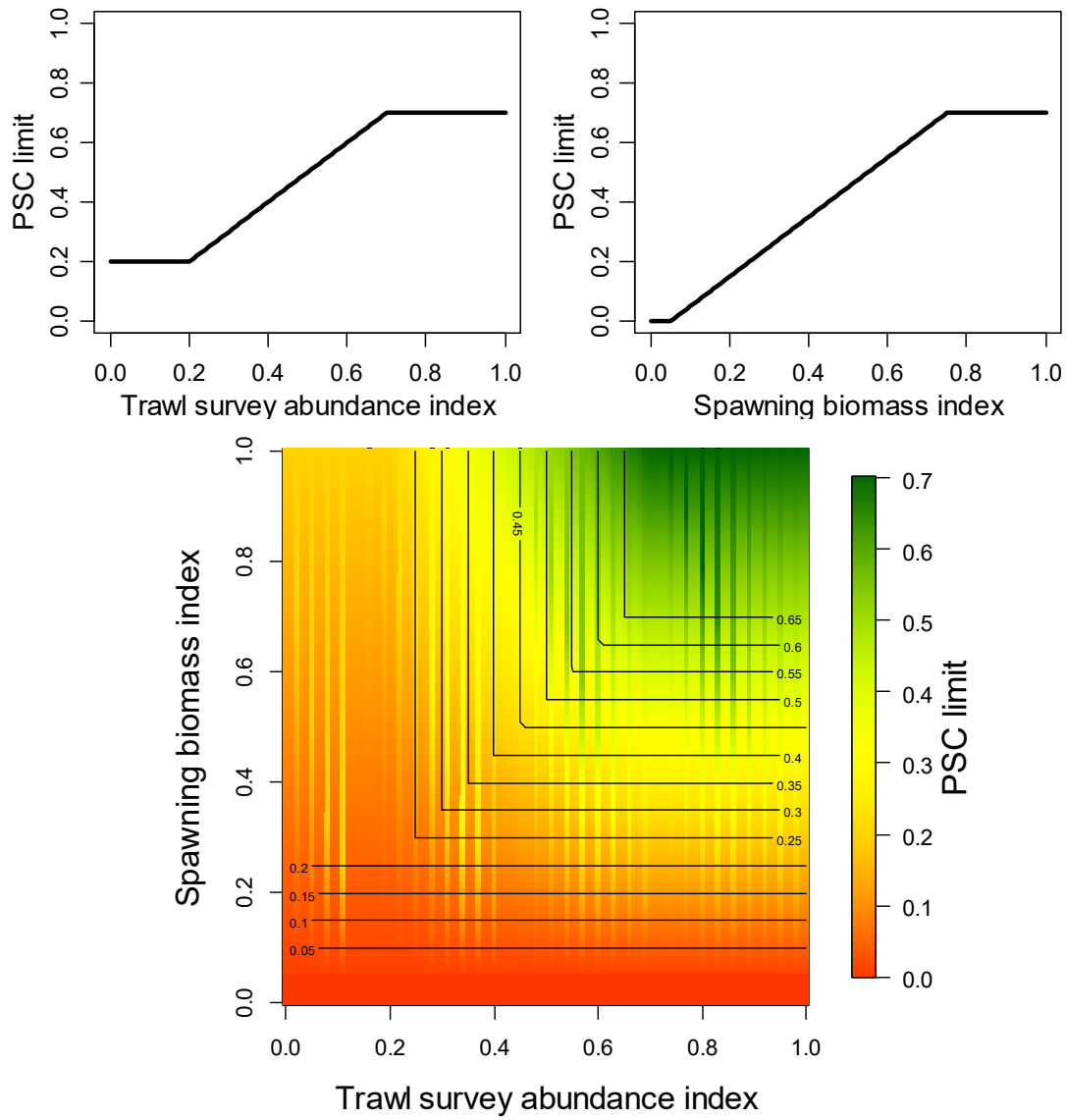

***Figure illustrating PSC control rules**. Top panel illustrates potential control rules linking PSC limits to a trawl survey abundance index and to a coastwide spawning biomass index, respectively. The control rules are combined in the bottom panel by setting PSC limits to the value for the index that is most constraining at a given combination of index levels. In this example, PSC limits are set to zero (red) at very low levels of spawning biomass, regardless of the level of the trawl survey abundance index. In contrast, at high values of the spawning biomass index, PSC increases with the trawl survey index according to the rule in the upper left panel and is not constrained by spawning biomass.*

This framework allows different control rules to address different objectives. For example, control rules that reflect allocation decisions would have a different shape, as determined by the Council, than a control rule to protect spawning biomass.

The SSC is encouraged by the continuing development of the technical interaction model (AFSC) and the Management Strategy Evaluation model for halibut (IPHC), both of which could provide suitable frameworks for evaluating the consequences of different bycatch control rules for the directed halibut fishery, for groundfish fisheries, and for the halibut stock. We did not have additional comments on these models at this point and look forward to their further development.

For additional comments on other aspects of the analysis we refer to our April 2016 minutes.