North Pacific Fishery Management Council

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SCIENTIFIC AND STATISTICAL COMMITTEE
Report to the
NORTH PACIFIC FISHERY MANAGEMENT COUNCIL
April 4th – 6th, 2016

The SSC met from April 4th through 6th at the Hilton Hotel, Anchorage, AK.

Members present were:

Farron Wallace, Chair *NOAA Fisheries—AFSC*	Robert Clark, Vice Chair *Alaska Department of Fish and Game*	Chris Anderson *University of Washington*
Jennifer Burns *University of Alaska Anchorage*	Lew Coggins *U.S. Fish and Wildlife Service*	Kari Fenske *Washington Dept. of Fish and Wildlife*
Brad Harris *Alaska Pacific University*	Anne Hollowed *NOAA Fisheries—AFSC*	George Hunt *University of Washington*
Gordon Kruse *University of Alaska Fairbanks*	Franz Mueter *University of Alaska Fairbanks*	Matt Reimer *University of Alaska Anchorage*
Ian Stewart *Intl. Pacific Halibut Commission*	Alison Whitman *Oregon Dept. of Fish and Wildlife*	

Members absent were:

Sherri Dressel *Alaska Department of Fish and Game*	Jason Gasper *NOAA Fisheries—Alaska Region*	Seth Macinko *University of Rhode Island*
Terry Quinn *University of Alaska Fairbanks*	Kate Reedy *Idaho State University Pocatello*	

B-1 Plan Team Nominations

The SSC reviewed the Plan Team nomination of Gretchen Harrington to the BSAI Crab Plan Team. The SSC finds Gretchen to be well qualified, with appropriate expertise that will assist the Plan Team. The SSC recommends that the Council approve this nomination.

C-1 Scallop SAFE

The Scallop SAFE was presented by Quinn Smith (ADF&G, Scallop Plan Team chair) and Jim Armstrong (Council). There was no public testimony.

The SSC supports the Scallop Plan Team's recommended OFL = 1.29 M lbs and ABC = 1.161 M lbs, which have been in place for recent years. Harvest for the 2014/15 season was only 308,888 lbs (27% of ABC) and the preliminary harvest for the 2015/16 season is 263,934 (20% of ABC). The recent low scallop catches are attributable to declining CPUE in most areas (except Yakutat and Kodiak Northeast) and closed beds in other areas (Prince William Sound and Cook Inlet). Despite reduced GHLs, the fishery continues to underperform, with the exception of increasing CPUE in Yakutat. During the 2014/15 season, the Shelikof Strait fishery was closed after attaining only 60% of the GHL due to Tanner crab bycatch. The fleet harvested less than half of the GHL in District 16 due to poor meat yield, and vessels stopped fishing in the Bering Sea due to low CPUE, poor meat quality, and evidence of a mass mortality event apparently associated with a parasite outbreak.

This rather grim status of scallop stocks in Alaska does not *necessarily* equate to a conservation concern, as scallops are distributed in many areas that have been closed to fishing to protect crab populations and in areas not defined as commercial beds. The fisheries are managed by GHLs that are informed with fishery performance information, particularly fishery CPUE. In Kamishak Bay (Cook Inlet) and Kayak Island (Prince William Sound), fisheries are managed using a conservative (generally 5%) harvest rate applied to biomass estimates generated by dredge surveys. Also, in some areas (Yakutat, Westward region), a bed-specific minimum performance standard has been developed. When the season cumulative CPUE at the half way point to the GHL is less than or equal to the minimum performance standard, the fishery is closed prior to attaining the GHL.

Although fishery management appears to be conservative, the SSC nonetheless remains concerned about declines in fishery CPUE in many areas. Mass mortality has been implicated in a couple of areas and years, but environmental drivers of recruitment remain unknown. The SSC is hopeful that new data collection efforts will help resolve the degree of association between scallop abundance and fishery CPUE. A better knowledge of scallop abundance is needed to improve understanding of the contributions of fishing, environmental and ecological factors in the scallop declines.

Several important changes are being proposed for future scallop stock assessments. Two changes in observer sampling protocols are proposed. First, sampling methods for shell age and length composition will be improved to correct for previous bias toward sampling large shells. Second, special sites will be identified, where captains will more accurately record start/stop times of dredge tows and where special sampling for meat weight, shell height and retained scallops will occur. This effort results in part from previous SSC comments.

An even bigger development is that ADF&G plans to implement a statewide scallop survey. This plan to expand the currently limited survey program to a statewide program has the potential to be the most significant breakthrough in scallop assessment in decades. The three-year plan includes many major scallop fishing grounds in Alaska. This will provide for fishery-independent GHLs that do not rely on standardization of fishery CPUE. The 8-foot research dredge will be fitted with a liner to retain small scallops, thus improving recruitment information for each surveyed area.

The SSC noted that after the initial three-year survey plan is completed, it may be possible to revisit the formulation of MSY/OFL/ABC estimates currently based only on historical landings and estimated discard mortality. The use of survey-based estimates for these quantities is considered preferable, despite questions about survey catchability, to those based only on historical catches. In the future, perhaps a modified Tier 6 approach based on minimum biomass estimates (akin that used to manage spiny dogfish in the Gulf of Alaska) can be developed.

The SSC appreciates the efforts of the SAFE authors, especially given the recent loss of key scallop staff positions. The SAFE, including plans to revise observer sampling protocols and statewide survey plans, was the result of extra efforts by staff with other responsibilities. These extra efforts are commendable.

The SSC offers the following comments to the assessment authors:

1. The SSC appreciates the reasoning for a moratorium on aging during the 2016/17 season while aging protocols are being worked out. However, the SSC recommends collecting specimens for aging in 2016/17 for subsequent aging once the protocols are developed.
2. Development of an aging protocol should be a high priority. Ideally, this work should include an age validation study confirming that rings are formed annually and a study of precision of age estimates among readers. An outcome could be that an age determination is precise up to some age beyond which age estimates become imprecise. If so, the aging protocol might specify to stop counting once some maximum count is attained after which a plus group is formed. Such a stopping point for age determinations could speed up, and reduce the costs of, processing of specimens, yet still provide valuable data for development of age-structured assessment models.
3. The SSC had been looking forward to development of an age-structured stock assessment for Kamishak Bay scallops for many years and was disappointed to hear that ADF&G staffing issues have prevented progress. In addition to direct application to fishery management, experience with age-structured scallop assessments will become even more important as the statewide scallop assessment program becomes operational. Given the lack of progress and ongoing agency staffing issues, a graduate student research project may be a practical approach to develop and implement such a model.
4. With regard to the SSC's 2015 Comment 1, the SSC appreciates plans to collect new observer data on meat weight, shell height, and discards. However, the other part of the SSC's comment was for the Scallop Plan Team to consider the potential merits of estimating CPUE based on numbers of retained scallops in the catch rather than based on meat weight. Also along these lines, during the Scallop Plan Team meeting, Jim Stone asked about the potential to manage scallops based on number of animals harvested rather than pounds of shucked meats. The SSC encourages the Scallop Plan Team to explore this possibility in the future. The SSC looks forward to more complete responses to some of the SSC's other previous comments after results from the data-limited symposium become published.
5. The SSC appreciates short summaries of recent and ongoing research reported in the Appendices. These Appendices should be cited in the body of the SAFE document so that the reader is aware of them. The Appendices included an exploratory analysis of relationships between fishery CPUE and scallop abundance estimates from dredge surveys. In many cases, fishery CPUE tracked trends in survey abundances fairly well with some exceptions (e.g., negative correlation for Kayak Island east). The SSC looks forward to more thorough analyses of these relationships including data from planned survey expansions in the future. Understanding such relationships could improve the use of survey and fishery data in fishery management. The SSC also looks forward to further development of the discard mortality rates introduced in the Appendices.
6. The SSC appreciates revisions to research recommendations undertaken by the Scallop Plan Team. The SSC offers a few additions. First, development of a statewide survey program elevates the need to estimate survey catchability, which may vary among areas with bottom type and other

factors. Second, as scallop fisheries in many areas suffer from declining CPUE, the SSC feels that research into metapopulation structure should be a priority to understand the degree of connectedness among scallop beds. Next generation genetic tools should be brought to bear on this question.

7. Future SAFE documents would be improved with the addition of the following: (1) a section that highlights new information since the last SAFE report, (2) expansion of the Executive Summary to include OFL and ABC recommendations, (3) a list of tables and figures in the SAFE, and (4) historical catches that show the derivation of MSY estimates.
8. The SSC requests some clarifications in next year's SAFE. On the top of p. 4, please clarify that no vessels have fished to date in the state waters open access fishery. On p. 16, please indicate the catchability coefficient that is used to calculate abundance from dredge surveys. On the bottom of p. 39, weights are given in round weights. Please equate these to meat weights for comparison. In particular, how does a round weight of 205,950 lb relate to the 15,000 lb GHL (meat weight)?
9. There are a number of typos in the SAFE. For example, Figure 1-1 appears twice on p. 5 and there are two versions of Figure 1-7 on p. 17 and p. 20. The paragraph in the middle of p. 5 begins with an incomplete sentence, the last sentence on p. 16 is incomplete, the figure caption on p. 17 is missing, and Table 2-2 and 1-1 cited in the middle of p. 51 should be Table 1-2 and 1-3. There are other typos.

C-4 Salmon Bycatch (PSC)

The SSC heard presentations on Bering Sea Aleutian Islands (BSAI) and Gulf of Alaska (GOA) Chinook and chum salmon prohibited species catch (PSC) genetics from Chris Kondzela (NMFS-AFSC), Chuck Guthrie (NMFS-AFSC), Jeff Guyon (NMFS-AFSC), Diana Stram (NPFMC), and Bill Templin (ADF&G). Public testimony was heard from John Gauvin (Alaska Seafood Cooperative). The presentations detailed the results of stock composition estimates of Chinook and chum PSC in BSAI and GOA fisheries in 2014, estimates of hatchery contributions to Chinook PSC in the GOA rockfish trawl fishery during 2013-2015, and an overview of a multi-agency genetics working group (WG) paper reporting results of a workshop that was held in March 2016. The information included results depicting spatial and temporal trends in GOA and BSAI PSC stock composition as well as WG recommendations addressing Council and SSC requests made in April 2015. The SSC was also provided with an estimate of the contribution of hatchery stocks in the Chinook salmon PSC from the GOA rockfish trawl fishery during 2013-2015 based on an analysis of coded-wire tag recoveries. A particularly notable briefing item was a description of recent capabilities developed by NMFS staff allowing assignment of sample size and potential PSC stock of origin estimates to the level of ADF&G statistical area during 2013-2015.

With regard to the BSAI PSC salmon stock composition monitoring program, it is clear that there is still significant uncertainty in exactly how to structure data analyses with respect to temporal and spatial strata and recommendations for the genetic sampling design. The working group specifically asked the SSC for guidance on analysis of 2015 data by asking the following questions:

- Is spatial or temporal resolution more important?
- Is relaxing sample size to an "acceptable" level preferable in order to provide finer spatial or temporal resolution?
- Is there interest in accurately estimating the proportion of smaller stocks or is the general pattern acceptable?

- What standards should be adopted for accuracy and precision of stock composition estimates?

The answer to these questions clearly requires consideration of a large number of factors, not the least of which are the management objectives associated with chum and Chinook salmon PSC in BSAI and GOA fisheries. In April 2015 the SSC noted:

> "… that a set of PSC management objectives would provide guidance for refinement of the genetics work. For example, is the objective to reduce PSC catch on specific US stocks (e.g., Yukon, ESA-listed stock), or the US stock complex as a whole, or on a given salmon species regardless of origin? Further clarification of specific management objectives will allow the analysts to characterize the logistic constraints (sample collection, processing time, and costs) relative to specific outcomes, and allow the SSC to determine if sampling fractions are appropriate to the objectives."

It appears these objectives are still unspecified and their absence remains an impediment to improvements in the salmon PSC genetics and monitoring program. Without such management objectives, the SSC does not believe it is possible to provide the WG with specific answers to the questions posed. However, it is also quite obvious that consideration of spatial and temporal patterns in salmon PSC is desirable and necessary when defining management objectives. Key to resolving this situation may be identifying which dimension (spatial or temporal) provides the most opportunity for reductions in salmon PSC through changes in fishing behavior. Thus, a dialogue would be essential between those providing information on PSC and those desiring PSC information to better inform management alternatives. The SSC believes that a productive way to continue this dialogue is for the analysts to conduct an exploratory data analysis (EDA) to attempt to depict spatial and perhaps temporal patterns of stocks of origin likely to be of most interest to the Council and industry. Fortunately, the new capabilities to estimate stock of origin based on ADF&G statistical area will be extremely useful to conduct this EDA. The SSC suggests that such EDA consider at a minimum the following analyses:

- BSAI "A" season Chinook PSC in ADF&G statistical areas that are in or adjacent to NMFS areas 509 and 517 associated with the pollock fishery (as was provided as examples in the spatial maps from the WG);
- BSAI "B" season chum PSC in ADF&G statistical area clusters identified in Figure 1 of the WG report.

Once these and other potentially useful EDA have been conducted by the WG and reported back to the SSC to revisit the topic of providing guidance on future analyses and monitoring program direction.

In April 2015 the SSC made a number of requests to the analysts related to future analyses and suggestions for report comments. In particular:

> "The SSC requests a formal evaluation and documentation of sample size determination with respect to these spatiotemporal concerns. This documentation should include a description of the sampling design and its historical evolution (similar to that described above) along with an evaluation of possible sources of bias and uncertainty not accounted for using basic sampling methodology (non-response bias, non-sampling or process errors in sampling terminology)."

While this analysis has yet to be completed, the increased capability to visualize PSC, sample size, and stock composition by ADF&G statistical area will be extremely useful for conducting this evaluation. Additionally, the SSC recommended a number of changes to the annual reports. The authors were responsive to many of these suggestions, but some remain to be addressed including: 1) summaries of

PSC totals by time and area, and 2) comparison of PSC at the finest scale of resolution possible (area of origin) against that river's total run and harvest, using the expected return year back calculations.

SSC's recommendations are motivated by our belief that while the specific stock composition documents are useful, they ultimately are raw-data reports of stock composition in the PSC. Chum and Chinook PSC are not mutually exclusive fishery management problems and it is difficult to move between the separate documents to understand how chum vs. Chinook PSC is distributed by time x area x stock x species. An additional summary document that discusses the results in the context of management would be useful. Other SSC comments and recommendations are:

- The SSC supports ongoing efforts to improve Chinook baseline data in Coastal Western Alaska to separate out Norton Sound, Lower Yukon, and Kuskokwim/Nushagak, and in the GOA for US West Coast Stocks and British Columbia, and improving the chum baseline in Norton Sound, Lower and middle Yukon, Kuskokwim, and Bristol Bay.
- The SSC recognizes that the current systematic sampling design is providing representative spatial and temporal coverage of fishery PSC in the BSAI. Further, it appears that this design allows for increased subsampling for genetic information potentially permitting composition estimates at finer temporal and spatial resolution.
- Public testimony indicated that it might be possible for the Amendment 80 fleet to sample their salmon PSC for genetic tissues in the BSAI. This would be helpful to facilitate a comparison of salmon stock grouping composition between this fleet and the pollock fleet.
- Although we encourage development of an AEQ analysis of Chinook salmon PSC in the GOA, we caution that it may not be feasible because of the large diversity of stocks with differing life histories and a higher incidence of hatchery contributions in the GOA than in the BSAI.
- It may not be necessary to monitor stock of origin every year, if stock composition and spatial/temporal distribution of PSC remain stable.
- A list of benefits and capabilities of the new NMFS analysis tool that uses ADF&G statistical areas should be developed and included in a report.
- We note that the hatchery contributions to the GOA PSC were estimated using recoveries of coded wire tags. While this is informative, the analysts should consider methods of including solely adipose clipped fish in estimates of hatchery contribution. Most of these fish are likely to be mass-marked hatchery fish.
- Report genetic classification accuracy for both chum and Chinook in the reports.

C-6 BSAI Halibut PSC Limit

In December 2015, the Council established an interagency staff workgroup to pursue approaches to abundance-based PSC management for Pacific halibut in the BSAI management region. The SSC received an initial discussion paper from the workgroup, which was presented by Diana Stram (Council staff) and Jim Ianelli (AFSC). They provided an overview of the issue and a summary of workgroup discussions. In addition, we received a presentation from Kotaro Ono (UW JISAO post-doc) on the AFSC multi-species technical interaction model (MST) that is currently being modified to incorporate BSAI Pacific halibut dynamics in the model to evaluate different bycatch control rules. Public testimony was provided by Gerry Merrigan (Freezer Longline Coalition).

The working group provided a discussion paper that outlines some of the issues that need to be considered for linking halibut PSC limits in the BSAI to halibut abundance. The overarching issues considered by the workgroup include:

1. The choice of a suitable abundance index or indices that reflect the current abundance of either the BSAI portion of the halibut stock, the coastwide stock of Pacific halibut, or both.
2. A bycatch control rule (BCR) that can be used to annually determine PSC limits based on the value of the abundance index or indices.
3. A framework for evaluating the consequences of different BCRs for the directed halibut fishery, for groundfish fisheries, and for the halibut stock.

During workgroup and SSC discussions, it became apparent that the analysis has the potential to become extremely complex and that there is currently no clear guidance on the goal of the abundance-based index that can be used to set PSC limits. **Therefore, the SSC requests that the Council develop a clear Purpose and Need statement to clarify the purpose of an abundance-based index and to help focus the analysis**. The workgroup was established in response to concerns about declining halibut abundances that have resulted in the majority of halibut caught in the Bering Sea being discarded. However, it is currently not clear if an abundance-based index would primarily serve to:

- Reduce bycatch pursuant to National Standard 9
- Improve utilization of the halibut resource by reducing PSC caps in times of low abundances
- Conduct a comprehensive revision of halibut PSC management in the BSAI area to meet these and/or other objectives
- Meet other objectives related to bycatch or optimum yield considerations

While the SSC realizes that the Council wishes to restrict the action to the BSAI management area at this point, any proposed action should be considered in the context of the coastwide Pacific halibut stock and PSC limits in the Gulf of Alaska.

With regards to the three key issues, the SSC offers the following observations and recommendations:

1. Abundance Index

Several options were discussed by the working group for developing suitable indices of abundance for use in abundance-based PSC limits, including survey-based indices for the Bering Sea shelf and slope as measures of regional abundance and Pacific halibut assessment estimates of coastwide halibut abundance. The choice of index will in part depend on the Council's intent for this action item.

The SSC recommends that at least two indices are considered in the analysis, specifically:

1. An index based on the EBS shelf trawl survey, which appears to best reflect the size composition of PSC in the BSAI
2. The coastwide biomass estimates from the IPHC assessment model.

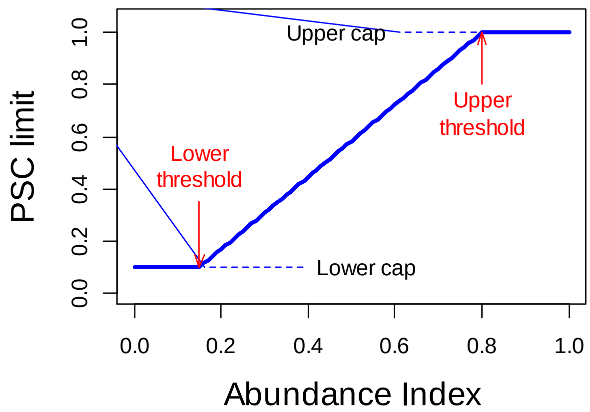
These indices form two 'bookends', reflecting (1) the subset of the stock directly vulnerable to being caught as PSC in the groundfish fisheries and (2) the coastwide stock that will ultimately be affected by changes in PSC limits in the Bering Sea. Therefore, a combination of these two indices could be used to address a variety of objectives that might be addressed by an abundance-based index. Both indices are readily and annually available, although the coastwide estimates have a one-year delay. We see little advantage to considering a combined index that includes the slope or longline surveys as it is not clear what relevant component of the overall population a combined index would reflect.

Preliminary analyses suggest that there is no straightforward relationship between the mostly smaller fish seen in the EBS shelf survey and the overall halibut stock, complicating impact assessments from abundance-based PSC limits. Moreover, there was an inverse relationship between halibut PSC in the groundfish fishery and abundance of halibut in the EBS shelf survey. It is unclear to what extent this counterintuitive relationship may reflect recent efforts by the industry to reduce PSC which could also mask relationships between bycatch rates and regional abundances. The SSC recommends further exploration of the relationship between the component of the population seen in the EBS survey data and the overall halibut stock. Specifically, an analysis of the proportion of young halibut occurring in the Bering Sea, and its variability, based on survey data from the Bering Sea, Aleutians, and Gulf of Alaska, would be very useful.

2. Bycatch Control Rule

The development of an appropriate BCR, like the choice of abundance indices, depends in part on the objective of the action. Clarification of the objectives by the Council will help to narrow and focus the choice of BCR. The discussion paper reviewed existing bycatch control rules for crab and salmon in the Bering Sea and proposed two alternative BCRs that could be considered. The SSC considered the shape, slope and upper and lower caps for developing a control rule.

- Regarding the shape of the control rule, the workgroup reviewed current abundance-based control rules for crab, herring and salmon PSC in the Bering Sea, including step-wise and sloping control rules. The SSC noted that these rules dictate usage of a much smaller fraction of the resource than a potential rule for halibut PSC. The SSC recommends a sloping control rule that changes relatively smoothly with changes in abundance, particularly if the chosen abundance index is prone to high interannual variability.
- The SSC recommends that both upper and lower caps be considered for setting PSC limits, but suggests that they should be analyzed separately:
  - To meet almost any reasonable objective related to utilization, bycatch, or conservation, an upper cap on PSC limits is sensible. Given previous, extensive analyses in support of PSC limits (e.g. Amendment 111), the SSC suggests that the Council may wish to establish upper caps through policy without the need for additional analyses.
  - At very low abundance of halibut, a lower PSC cap might also be required to accommodate some level of fishing for groundfish. We recommend that a reasonable range of options for a lower cap be analyzed in the impact evaluation.
- The workgroup provided some options for the shape and slope of the control rule to quantify how the PCS limit varies with abundance. The slope of a control rule can be informed by relating historically observed bycatch rates to relevant abundance indices. Additional analyses will be needed to determine a suitable range of slopes and suitable lower / upper thresholds. The simplest form of a control rule may be a lower PSC cap below some lower abundance threshold with a linear increase in PSC with abundance from the lower threshold to some upper threshold, similar to the control rule for snow crab PSC as illustrated below:



This form of a control rule has the advantage of being easily understood, transparent, and easy to implement given an appropriate abundance index.

- The discussion paper presented two candidate BCRs that are extensions of the above control rule such that PSC can depend on multiple indices, as well as on last year's PSC (BCR1):

$$PSC_{t+1} = PSC_t * w_0 + \alpha_1 * u_{1,t} * w_1 + \alpha_2 * u_{2,t} * w_2,$$

  where the weights (w_i) sum to 1, and $u_{1,t}$ and $u_{2,t}$ are two different abundance indices, for example a regional, survey-based index and a coastwide abundance index, and α_i denotes the rate at which PSC increases with the respective abundance index. The SSC supports the concept of including last year's PSC to constrain the magnitude of year-to-year changes, potentially integrating two alternative abundance indices into a single control rule, and allowing different weights to be applied to different indices. We suggest that this form of control rule, by applying different weights to each index as well as different slopes for each abundance index, provides a sufficiently flexible framework to allow the evaluation of a wide variety of control rules. For example, setting w_1 = 1 results in the special case with a single abundance index depicted above (if upper and lower PSC caps are also defined).
- The second proposed control rule (BCR2) is a further modification that would allow the PSC limit to vary relative to a reference abundance with potentially different rates of change in the PSC below and above the reference abundance. The approach requires defining a suitable reference point (which may or may not be updated annually), and a parameter adjusting the relative slope of the control rule above and below the reference point. While this potentially provides for a smoother change in PSC limits from year to year as illustrated for a hypothetical example in the discussion paper, it is not clear how much is gained relative to the simpler and more transparent BCR1. The SSC suggests that the simpler control rule (BCR1) may offer similar flexibility without the additional complexity and loss of transparency of BCR2.

3. Framework for evaluating impacts

We received an overview of the multispecies technical interactions model (MST) that was developed for management strategy evaluations, which includes Pacific cod, walleye pollock and yellowfin sole, and is being modified to include simplified halibut population dynamics. The SSC was encouraged by this development and the model provides a promising tool to evaluate the impacts of different harvest control rules for setting halibut PSC limits on groundfish fisheries and, to a limited degree, on the halibut stock. The SSC was excited to see a number of improvements to the MST model and its adoption for this purpose and encourages further development of the model. The MST models the Council's decision-making process, whereby the Council chooses TACs to maximize "net profits", subject to a number of constraints, across multiple ‘métiers’ (combination of fishing grounds, gear, and fish assemblages). Fleet behavior is subsequently modeled using linear programing, whereby the fleet assigns effort to métiers to maximize profits, subject to the TACs chosen by the Council. Métiers were empirically identified based on catch composition data for the BSAI from 2011-2014. The SSC had the following recommendations regarding the model:

- The profit function in the Council’s linear programming model uses “net prices”, which are determined through a calibration exercise that compares realized to predicted catches. The SSC recommends calibrating the model on the basis of realized and predicted TACs (‘intended’ catches) rather than actual catches.
- The profit function in the fleet’s linear program uses the same net prices as the Council linear program, implicitly assuming that the fleet and Council have the same preferences over métiers. The SSC recommends that different net prices should be used for the fleet linear program, which could be determined through a separate calibration exercise comparing, for instance, realized and predicted catches or métier choices.
- The structure and parameterization of the MST is largely informed by and based on empirical observations. To enhance the ability of the model to predict future catches and TACs, the SSC suggests that the developers explore mechanistic interactions where appropriate. The analysts should explore calibrating the model on the basis of past observable characteristics, for instance, allowing changes in catch composition and net prices to be functions of changes in abundance. By doing so, the MST would be readily available for producing out-of-sample predictions (e.g. one-year-ahead predictions). We also note that development of the model could benefit from interactions with AFSC economists.
- The SSC noted some issues with the proposed implementation of the halibut quota determination that need to be corrected. Specifically, the IPHC reduces total allowable catch for each regulatory area (TCEY) by subtracting all anticipated removals (such as PSC in other fisheries) to determine catch limits for the directed fishery (FCEY). This process can be reasonably approximated in the MST model for evaluating the effects on the directed halibut fishery in the Bering Sea, but results in reduced feedback of changes in PSC to the halibut stock dynamics.
- The SSC noted that in addition to recruitment variability at the coastwide level, and relative to the Bering Sea, size-at-age is an important driver of the dynamics of the halibut stock. The variability in size-at-age should be included in the MST.
- With regards to evaluating impacts, we note that the criteria will in part depend on the purpose of any proposed action on PSC limits. The SSC suggests the following broad criteria, but the relative importance of these criteria is largely a policy call and depends on the primary goals of an abundance-based index. Generally, the SSC prefers simple and transparent indices and control rules, hence the computational burden of implementation is expected to be small.
    - Impacts on Pacific halibut spawning capital (e.g. in terms of ‘footprint’ sensu Martell et al. 2015 discussion paper)
    - Impacts on groundfish fishery (e.g. probability that PSC limit is reached)
    - Ease of implementation (computational and regulatory)
    - Inter-annual variability in PSC limits

The SSC discussed several other issues related to abundance-based PSC limits and has the following recommendations:

- An important issue highlighted by the workgroup is the determination of an accurate length-frequency distribution for PSC. We agree with the workgroup that a standard protocol should be developed to account for when and where bycatch occurs and to weight observer samples appropriately. To the extent possible, strata for this analysis should be based on biologically or operationally meaningful strata to minimize within-stratum variability.
- The working group suggested that PSC limits could be specified in terms of numbers of halibut instead of biomass. For Pacific halibut, PSC limits have generally been specified in terms of biomass and the SSC recommends using biomass in the analysis. When evaluating impacts on halibut spawning potential, neither numbers nor biomass alone provide a good measure of spawning capital, but either measure can be evaluated in terms of its impacts on halibut spawning potential if that is part of the Council's objective.
- The discussion paper assumes that PSC limits would be updated annually. However, the Council and analysts may wish to consider other options for periodically updating the limits, particularly after a BCR has been in place for a few years. However, annual updates would likely provide a stronger incentive for reducing bycatch.
- The specification of discard mortality rates (DMRs) is currently under review and may change in the future. Changes in DMRs can have substantial impacts on total halibut mortality and the SSC suggests that uncertainty in DMRs should be considered in the analysis. However, analysts have suggested that it may be difficult to adequately quantify the variance of the current DMRs; therefore the SSC suggests exploring the impact of different DMRs in the context of different BCRs through a sensitivity analysis over a reasonable range of DMRs. This would ensure that the conclusions from the impact analysis remain if DMRs change in the future. There was some discussion about setting PSC limits without DMRs, but the SSC does not favor such an approach as it would remove any incentive to reduce mortality rates.

C-7 Halibut DMRs

The SSC received a presentation from Jim Armstrong (NPFMC) on the Halibut Discard Mortality Rate (DMR) interagency workgroup (WG) discussion paper. Public testimony was provided by Gerry Merrigan (Freezer Longline Coalition) and John Gauvin (Alaska Seafood Cooperative). This discussion paper is one part of a larger Halibut Management Framework (Framework) initiated by the Council to inform, support, and reflect Council decision-making on halibut issues. The Framework addresses the need to improve analytical methods for calculating DMRs, to update the empirical basis for rates, and to provide transparency for this process. The discussion paper first provides a description of current halibut DMR estimation, data collection methods, and in-season application of DMRs to management of groundfish fisheries. The WG goes on to critique each of these methods and processes, and identifies shortcomings in the unit of estimation, estimation methods, temporal smoothing of estimates, and duration of application of DMRs. Another potential shortcoming is the diminishing number of viability measurements taken in recent years. One of the key products of the discussion paper is a summary table (Table 10, pages 20-21) that describes potential short- and long-term alternatives to status quo methods for each of these issues in establishing and applying halibut DMRs in groundfish fishery management.

The SSC commends the WG for developing a well-organized discussion paper that presents a good start at defining the shortcomings of the current DMR estimation and implementation processes, provides for some initial changes to these processes, and suggests some longer term changes. **In general, the SSC supports these initial changes as described in the "Feasible Improvement" row of Table 10, especially the change in 2016 to collect viability data through the same sampling design used for other species by the Observer Program.** The SSC has the following comments and suggestions for proceeding with the WG recommendations:

- The SSC strongly supports using the same sampling design for viability data that is used for other species by the Observer Program. We note that this will increase transparency of the data collection and improve the representativeness of the sampled viabilities.
- The SSC supports the WG plan to develop a transparent DMR estimation workflow. This will decrease the potential for temporal mismatch between the estimation of DMRs and their implementation for management as predictions of DMRs, as well as ensure the repeatability of the estimation methods.
- The SSC supports exploring a change in the unit of estimation from the vessel to the haul, level, depending on the amount of among-haul or between-vessel variability. Within practical constraints, the unit with the least variability should be used in estimation.
- The SSC notes that the minimum number of viabilities needed to estimate DMRs needs to be examined and a statistical rationale developed for the sample size necessary when data come available from the revised 2016 sampling scheme.
- The SSC is concerned that the recent reduction in the number of viabilities within many target fisheries may be related to both observer protocols (requirement to assess fish at the point of release) and vessel layouts, potentially leading to biased sampling. This interaction and other potential reasons for the declining sample size should be examined to determine if the sampling protocols or design need to be changed.
- The SSC recommends the WG explore the feasibility of having observers document the specific viability indicators assessed for each halibut (following the currently used dichotomous key) rather than just reporting the final viability category. This will allow analysts to track the specific indicators (e.g. injuries) associated with fleet and fishing factors (e.g. vessel, fishery, gear type, area, depth), towards a better understanding of mechanisms influencing viability. These mechanisms could also help identify incentives for fleets to reduce their discard mortalities.
- The SSC recommends that the WG consider mechanisms (e.g. time on deck, depth, haul length) that may affect viability estimation, and subsequently the apportionment and expansion of DMRs. For example, partitioning the data by target species may actually be a proxy for fishing depth or area which are the factors expected to impact halibut viability or proportion in the catch. The DMR workflow should include a way to join the available fishing and environmental data related to these mechanistic factors being collected by observers.
- The SSC advises the WG to work with the Observer Program and vessel operators to explore the feasibility of documenting the target species for each haul. Comparison of these targets with those assigned by the current method based on haul catch composition may better inform the WG analysis.
- The SSC supports the WG recommendation to reanalyze the historic viability data and possibly re-estimate DMRs retrospectively using the new methodology. We also support use of these data

to examine relative variability in the variables of interest, such as gear, vessel, and target fishery. Simulations using these data could also be conducted to examine how the sampling design for assessing viabilities could be altered to take advantage of potential sampling strata where accuracy is maximized.

- The SSC considers the viability-based survival percentages to be highly uncertain. We recommend the WG examine the published literature on mortality rates within each category of viability assessment and consider using a range of mortality rates as a sensitivity exercise, based on these studies. This should be done in parallel with ongoing research being conducted on this topic by the IPHC.
- The SSC noted that there are problems with obtaining a representative sample of viabilities from longline vessels due to the inherent handling procedures and the sampling process (fish released at the rail versus being brought on board). Changes to the sampling protocol for obtaining these viabilities should be considered and/ or experiments conducted to assess the impacts of sampling.
- The SSC supports the use of statistical methods (e.g., Kalman filter or Random Effects models) for smoothing the time series of DMRs.
- The SSC also supports using a shorter time period for updating DMRs, especially early on as new information from the Observer Program is brought into the estimation process.
- The SSC supports new studies to estimate mortality rates of discarded halibut. Studies used to determine the currently used mortality rates by viability assessment category are dated and may not represent the actual mortality rates experienced by discarded halibut.
- The SSC suggests the WG consider the results of the ongoing deck-sorting EFP to inform future sampling methods, vessel characteristics associated with increased DMR, and current strategies to integrate sampling in the Observer Program with obtaining condition samples.
- The SSC noted that efforts to more accurately characterize discards and DMRs should not stand in the way of efforts to reduce discard mortality, particularly with regard to measurement at the point of release and operationalization of deck-sorting.

C-9 Charter Halibut RQE
The SSC received a presentation by Sarah Marinnan (NPFMC) and Jonathan King (Northern Economics) of the draft RIR/IRFA/EA document for proposed changes to the management of the Pacific halibut charter fisheries and commercial setline fisheries in International Pacific Halibut Commission (IPHC) Regulatory Areas 2C and 3A in the Gulf of Alaska. Public testimony was provided by Bruce Gabrys (self), Linda Behnken (ALFA), Tom Gemmell (Halibut Coalition), and Richard Yamada (ACA). The proposed action would allow the establishment of a recreational quota entity (RQE) to represent the common pool of charter anglers for acquiring quota shares (QS) from the commercial halibut sector.

The SSC appreciates the analysts' very thorough RIR assessment. The RIR adequately covers a complicated set of alternatives/elements/options/suboptions. It does an excellent job of characterizing the status quo for both the commercial and charter halibut fisheries, and in working through how different options before the Council may affect the charter sector and its management. However, due to time limitations and the large number of complex options under consideration, the document does not do an adequate job of relating changes in charter harvest limits to changes in the value of charter trips taken or the likely extent of RQE purchases. Further, it does not sufficiently characterize the effects on communities or the commercial fishery. Additionally, the EA is lacking substantial information on the potential impacts of the action to the Pacific halibut resource. **Therefore, the SSC recommends that the RIR/IRFA/EA not yet be released for public review.**

Issues identified by the SSC Include:
The first issue is characterizing the potential effects of the proposed measures on the charter sector. On the surface, it would appear that the “willing buyer, willing seller” nature of the proposed measure would ensure the charter sector was better off since QS purchases would only occur if the willingness to pay for QS was greater than the prevailing QS price. However, the structure of the RQE would give all guided anglers equal access to compensated reallocated QS since management measures for limiting charter halibut harvest (e.g., reverse slot limits and/or daily catch limits) apply equally to all anglers within an IPHC regulatory area. This process for allocating halibut across anglers in the charter sector could be a source of inefficiency if the angler population is heterogeneous, as it is assumed to be. For example, many out-of-state anglers want the experience of catching fish, while a few are pursuing large trophy fish and many in-state anglers are interested in filling their freezers on their charter trips.

The problem is then how to allow the subset of anglers who value catching more or larger fish to do so, without inefficiently providing more fish to people who are indifferent to it. Currently, the GAF program is the primary way in which this can be accomplished. Further, the structure of the RQE does not require that all charter operators are willing buyers: not all charter operators may find it worthwhile for their businesses to pay the costs associated with a significant fleet-wide RQE acquisition. Thus, the “willing buyer, willing seller” nature of the RQE may not benefit all operators in the charter sector and could result in fewer net benefits to the charter sector, relative to a program where QS could be acquired and paid for by the subset of clients who highly value the additional opportunities provided by the QS. Indeed, greater benefit to society may be achieved by providing mechanisms for those anglers willing to pay more for additional or larger fish to do so from within the existing charter allocation, or through a more usable GAF program (see Abbott, 2015).

Second, the peer reviewed literature (e.g., studies by Lew and Larson cited in the RIR) suggest there is not, on average, a significant willingness to pay more for liberalized harvest limitations in the charter sector. Lew and Larson do not segment demand for guided trips into different types of anglers. This makes it difficult to characterize how a given change in harvest limitations would result in changes in angler welfare, charter trip counts, and/or revenues (e.g. the value of “an inch of fish”). Absent this information, it is difficult to know how charter sector jobs, and associated tourism revenues to charter fishing communities, will be affected. The analysts suggest that industry could provide information on this through public testimony. While recognizing the high value of public testimony, the SSC emphasizes that testimony is a complement to data, rather than a substitute for it, in both ecological and social analyses. The analysts should make an effort to obtain this information through other means to include in the analysis.

Third, without estimates of the amount of QS desired by RQEs, it is also difficult to assess the effects of the RQE on the commercial sector. First, there is no information presented on whether, or which, commercial operations are likely to sell their QS, and therefore community impacts likely to arise from a reduction in commercial harvest, including effects on crew and processors who are not party to the decision to sell, are unknown. Second, we do not know the effect of charter sector demand on the market for QS. It is likely to increase the price of RQE-eligible quota, increasing the value of quota held by incumbent commercial harvesters, but also making it more expensive for them to expand their businesses and increasing barriers to new entrants. Since quota prices have been subject to recent Council scrutiny, this needs to be addressed in the document, to the extent possible.

Fourth, the EA was substantially underdeveloped, especially when compared to the RIR. The critical issue is a mismatch in the spatial scale of the EA discussion and the potential biological impacts of the action. While the action will most likely not impact the viability of the coastwide halibut stock, as is stated in the document, there is the potential for localized impacts at a smaller spatial scale. These could include more concentrated or changes in fishing effort, changes in the size compositions of retained halibut, changes in the encounters of smaller fish, and/or the possibility of localized depletion. While the EA mentions the potential for certain localized impacts, this section would benefit from being restructured to highlight these potential impacts. Further, there is a great deal of information available at a finer spatial resolution (e.g., the charter logbook program, ADFG creel surveys, the commercial fishery port sampling and logbook program). All of these data sources would permit a more extensive investigation of catch rates, fishing effort, size compositions, and encounter rates, on a finer spatial scale than IPHC regulatory area. Finally, these data would help determine whether there is some disparity in potential impacts, and the direction and/or magnitude of those potential impacts, within a regulatory area and would inform the community impacts deficiencies as well.

Finally, the document does not address the possibility that, with the increased demand for QS from the RQE, commercial fishery participants may be more likely to sell some of their QS and focus their fishing efforts in other fisheries. While the document does include an investigation of the overlap between commercial and charter halibut participants, the analysts should also include a description of the other fisheries in which the commercial fishermen participate. This is particularly relevant given that diversity in a fishery portfolio might change the magnitude of any potential changes arising from the establishment of a RQE.

The SSC also has the following recommendations for future iterations of the document:

- The RIR would benefit from highlighting the key points regarding the potential effects of the RQE, the potential winners and losers, and the relevant tradeoffs between the commercial and charter halibut sectors.
- The document would benefit from a clearer discussion regarding whether the potential benefits from the RQE differ greatly from those that could be realized from the GAF in the future or through modifications to the existing GAF program.
- A more thorough analysis of the potential community impacts from the RQE is needed to evaluate potential impacts of the action. For example, the analysts could consider the trades that have taken place under the GAF—over 1% of the 2014 QS trade volume in 2C—to characterize the types of IFQ and charter operators (e.g., vessel class, residency, port) who are likely to trade, and to explore the likely effect of charter demand within the market for QS. In addition, the analysts should explore different levels of aggregation to represent the geographical distribution of landings for both the commercial and charter sectors.
- The analysts should investigate whether the suboptions under Options 2 and 3 are likely to lead to market power concerns with the creation of the RQE. This investigation should distinguish

between the price increases in the market for QS that would normally be expected from increased demand versus price changes that could potentially arise if the RQE has significant buying power. An example of a metric for measuring market power includes potential changes in the Herfindahl-Hirschman Index (HHI), which measures the concentration of the market, as a result of the RQE entering the market for QS.

- There is a general lack of detail in the document regarding Alternative 3, and also a lack of information regarding the potential impacts of this alternative, and how/if it would interact with the options and suboptions under Alternative 2.

Abbott, J. K. (2015) ‘Fighting Over a Red Herring: the Role of Economics in Recreational-Commercial Allocation Disputes’, *Marine Resource Economics*, 30, 1–20.

D-1 EFH 5-year Review

A presentation of a 5-year review of Essential Fish Habitat was given by John Olson (NMFS-AFSC), Steve McLean (NMFS-AFSC), Chris Rooper (NMFS-AFSC), Scott Smeltz (Alaska Pacific University), and Brad Harris (Alaska Pacific University). Public testimony was provided by John Warrenchuk (Oceana).

EFH Designation

The analysts presented an update to EFH designations based on the use of Species’ Distribution Modeling to define Essential Fish Habitat. The SSC considers EFH mapping driven by covariates and environmental factors instead of catch distributions to be a major step forward. The new approach stems from EFH modeling which originated on the east coast and which is now supported by a substantial body of peer-reviewed literature. The analysts presented work conducted over 400 area- and life-stage-specific EFH definition models, cast as either General Additive Models (GAMs) or Maximum Entropy (MaxEnt) models. The SSC supports the analysts’ choice of a 30% zero threshold (more than 30% of the data are 0s) to apply the MaxEnt model versus the GAM model. We also support the modelers’ choice to withhold 20% of the data for model validation. The SSC commends the analysts on their work to incorporate a myriad of data sources and to employ analytical models to define EFH more systematically.

The SSC also reviewed the document "2016 Review of Essential Fish Habitat (EFH) in the North Pacific Fishery Management Council’s Fishery Management Plans”. In addition, three Technical Memoranda were made available on the application of the new EFH approach in the Bering Sea, Aleutian Islands and Gulf of Alaska. The authors described four levels of species descriptions included in the EFH mandate. In the previous EFH assessment, species were described at Level 1, where 95% of each species distribution range was determined using cumulative survey data and observed catch per unit effort. The new species distribution modeling framework provides data-driven predictions of the 95% -species-distribution-range, moving the species descriptions to Level 2, and promotes the possibility of habitat-based modeling in stock assessments.

The SSC supports the use of species’ distribution modeling for predicting species’ distributions. Given the extensive updating of distribution information, revisions to EFH definitions in the FMPs are warranted and the fishery management plans should be amended to bring them up to date.

The SSC recommends that annual EFH be defined, and that seasonal EFH maps be provided to support stock-author review of EFH designations, as well as assessment of fishing effects. Additionally, it may be appropriate to provide maps of the pelagic distributions of early life stages. Producing a distribution map of all species combined would be a helpful addition to that of individual species. This could reveal which habitats and places are important for numerous species.

There is still work to be done to allow this new approach to identifying EFH to reach its full potential and the SSC provides the following comments and recommendations.

- The SSC is pleased to see the analysts' efforts to provide seasonal EFH maps. Given the immense array of data types by season that were employed, the SSC recommends that the authors develop a data-support-product to characterize the number, type and age of samples supporting model predictions. This will be particularly important for the identification of data gaps that warrant future research priority and clear acknowledgement when EFH is used in subsequent analyses.
- The SSC understands that EFH information will become available online. The ability for users to select species for display and to overlay species' distributions would extend the value of this information.
- The SSC is aware of considerable new information that is sufficient to warrant an update of EFH for the Arctic Fishery Management Plan. For instance, there is new information on the early life stages of Arctic and saffron cod. Also, there is new information on snow crab distribution in the Chukchi and Beaufort seas. As currently defined, snow crab EFH in the Arctic FMP does not show any snow crabs in the Beaufort Sea. Also, many of the new snow crab data have been compiled into a recent doctoral dissertation prepared by Lauren Divine at UAF. The SSC contends that new information on Arctic and saffron cod and snow crab can be incorporated into the distribution model used to describe EFH for other species. Although updating EFH for the Arctic may not be urgent owing to the lack of commercial fisheries in this region, this information may be timely with regards to other ongoing and planned activities in the Arctic.

There are a number of issues raised in the SSC's February 2015 Minutes that still remain to be addressed. The SSC provides the current status of each issue and further comments and recommendations below.

• Any limitations to the data used in the modeling should be explicitly described and confidence bounds on predictions included, when possible. In cases where estimates of variability are not possible, including an author's recommendation as to what uses the model results can support (in terms of scale and data limitations) may be helpful, since very few data are available to estimate most parameters.
STATUS: This issue has yet to be addressed. The SSC recognizes that the availability of data on habitats used by fish varies hugely by region, and that, for some regions and seasons, few data are available. There should be a discussion of data availability and indications on habitat maps for individual species of the degree of certainty of the EFH projection. An automated screening method for instances where uncertainty is appreciably greater than the average across species, life stages, and seasons, may be helpful.

• The SSC believes that acoustic data should also be included when describing species distributions.

STATUS: The analysists examined the acoustic data and indicated additional modeling work was required (e.g. interpolating acoustic values between transect lines) to make these data usable in the EFH modeling framework. The SSC recommends the analysts continue to pursue using this data.

- The survey data could be compared to the fishery data, as an evaluation of the two data sets within the same season. STATUS: It would be useful to expand and present the results of validation studies.
- Model predictions that are based on presence/absence data from opportunistic surveys, or results from the literature may provide an incomplete description of a species distribution. In these cases, in may be necessary to use habitat association data (more than one variable may be necessary) to extrapolate the data to predict a more complete distribution. If this is done, delineating species distributions with and without extrapolation on the same map would be helpful. STATUS: There has been some progress to date but should be further examined.
- The SSC encourages authors to include organics in the sediment as a habitat characteristic in modeling. Because sediment organics relate to the presence of benthic animals that serve as prey for fish species, they may be a useful data source for EFH. Data on the distribution of sediment organics might be found in the literature and may require extrapolation to be used as a large-scale predictor. Authors should consider how to incorporate sediment organics data, given that their distributions may change over time. STATUS: The data are probably insufficient to address this issue.

The SSC understands the Scallop Plan Team chair’s decision not to consider an update to weathervane scallop EFH at this time. It may well be prudent to wait to reconsider scallop EFH in another 5 years following implementation of new statewide scallop surveys. However, the SSC wishes to point out that there already exist some new, relevant data that could be considered. Jessica Glass conducted a multivariate analysis of community composition on weathervane scallop beds in Alaska. Results may help fine-tune scallop EFH definitions. Significant ($p<0.05$) spatial differences in community structure were most strongly correlated with sediment, depth, and dredging effort. Temporal changes were weakly, yet significantly, correlated with freshwater discharge and dredging effort. Citation: Glass, J. R. 2014. Spatiotemporal variation of benthic communities on weathervane scallop (*Patinopecten caurinus*) beds with socioeconomic considerations of the commercial fishery off the coast of Alaska. University of Alaska Fairbanks, Master’s Thesis.

Determining Fishing Effects (FE)

The analysts presented work-to-date on the Fishing Effects (FE) model. The model is built on the both the Long-term Effects Index (LEI) model used for the 2005 and 2010 EFH fishing effects analysis and the Swept Area Seabed Impacts (SASI) model approach developed by the New England Fishery Management Council (NEFMC), both of which incorporate susceptibility and recovery dynamics for marine species. The new NPFMC FE model combines haul-level fishing effort information derived from the NMFS Catch-in-Areas database with literature-derived estimates of impact and recovery for 26 distinct biological or geological habitat features.

The impact and recovery parameters are based on a global literature review which included all North Pacific fishing impacts studies. The SSC notes that these parameters have been reviewed by the NEFMC SSC, which also commissioned an independent peer-review in 2011. The literature review methods and the resulting parameters were subsequently published in the peer-reviewed literature (Grabowski et al., 2014).

To operationalize the model the analysts used the Catch-In-Areas database and industry-based information on gear dimensions and bottom contact to estimate where and how much fishing contacted the seabed. Numerous sources of point data ware used to map five sediment-types (mud, sand, granule-pebble, cobble and boulder) for which a suite of habitat features (geological and biological) were defined. This structure allows the analysts to examine the impacts of fishing on the geological features separately from the biological features. The model calculates the habitat impact dynamics (impact and recovery) at 5x5 km (25 km2) grid on a 1-month time-step from 2003 – 2014 and produces an estimate of habitat reduction (in units of km2) in each grid cell and time-step. Data from 2003-2005 were looped 10 times (i.e. 30 years) to “burn-in” the model so that initial years reflected a fished condition.

The SSC notes that the increase in the FE model’s temporal resolution from annual (LEI model) to monthly allows analysts to tease apart the potential causes of habitat disturbance by location, time and fishery.. Further, the spatiotemporal resolution of the model allows the exploration of Council policy actions on fishing distributions and associated habitat impacts. For example, in preliminary model runs presented to the SSC, the implementation of Amendment 80 and the subsequent Bering Sea flatfish trawl sweep modifications are clearly evident in the time trend of fishing impacts and appear to result in a substantial decline in disturbed habitat.

The SSC considers the FE model to be an improvement over the LEI model and supports the use of the FE model in the Fishing Effects Analysis. The SSC supports continued development of the FE model and looks forward to reviewing the model’s performance and outputs once our recommendations are incorporated. Specific SSC FE model recommendations and concerns to be addressed include:

- The analysts asked the SSC to provide advice on whether or not to include long-lived species, such as corals and sponges in the FE model, and if so, how to address the lack of literature for characterizing the recovery of these features. The SSC recommends including these organisms and exploring the use of a range of recovery rates including very long recovery (>100 yrs) as well as parameters indicating no recovery. Further, the maximum recovery rate used in the FE model is currently 10 years. The SSC recommends the analysts explore whether the environmental conditions in North Pacific justify employing a longer maximum recovery time for the >5 year category.
- The SSC requests that the analysts examine how recovery rates might vary given the season in which the event occurred, particularly if the disturbance occurs at the start of the winter season.
- As parameterized, the model assumes that impact and recovery of habitat features is a two-state process (either disturbed or un-disturbed) and does not capture intermediate states. As such, it assumes recovery to be a return to a previous state (e.g. where seawhips are removed, seawhips grow back) at a given location. However, this may not always be the case – sufficiently spatially large, and or frequent disturbances have the potential to cause communities to transition to new states. This is particularly true for biological features, although similar impacts on geological features are also possible. Further, the manner in which recovery might occur is also likely influenced by the habitat in surrounding grid cells. The SSC recognized the literature on habitat

feature recovery is limited but suggests the authors examine ways to frame alternative recovery dynamics.

- As presented, the FE model explicitly deals with benthic biological and geological structures and does not address the pelagic environment. The SSC requests the analysts consider if and how the FE model could be applied to the pelagic environment, which remains critically important for many egg/larval/juvenile stages.
- Methods for assessing cumulative impacts are unclear, even before consideration of the impacts of non-fishing activities. The SSC suggests further examination of potential adverse impacts.

Once the FE model is finalized and run, the results will be provided to the stock-assessment authors for a determination of whether the estimated habitat reductions have an adverse effect (defined in regulation as "more than minimal and not temporary") on the fish stocks. In previous NPFMC EFH reviews, the Minimum Stock Size Threshold (MSST) was used to determine if adverse effects were occurring. This determination process was criticized by the Center of Independent Experts during the previous 5-year EFH review and alternative metrics are the subject on ongoing discussions. The analysts requested guidance on appropriate metrics and stock-author review guidelines. **The SSC recommends that a workgroup be formed to evaluate how the output from the Fishing and Non-fishing Effects models can be used to assess adverse effects.**

The SSC notes that the estimation of Non-Fishing effects on EFH has yet to be developed. This issue will need to be addressed, even though the necessary data for developing or parameterizing a model are not available.