North Pacific Fishery Management Council

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FINAL
SCIENTIFIC AND STATISTICAL COMMITTEE
to the
NORTH PACIFIC FISHERY MANAGEMENT COUNCIL
September 29-October 1, 2008

The SSC met during September 29-October 1, 2008 at the Sheraton Hotel, Anchorage, Alaska. Members present were:

Pat Livingston, Chair *NOAA Fisheries—AFSC*	Keith Criddle, Vice Chair *University of Alaska Fairbanks*	Troy Buell *Oregon Department of Fish and Wildlife*
Bill Clark *International Pacific Halibut Commission*	Robert Clark *Alaska Department of Fish and Game*	Sue Hills *University of Alaska Fairbanks*
Anne Hollowed *NOAA Fisheries—AFSC*	George Hunt *University of Washington*	Gordon Kruse *University of Alaska Fairbanks*
Kathy Kuletz *US Fish and Wildlife Service*	Seth Macinko *University of Rhode Island*	Franz Mueter *University of Alaska Fairbanks*
Lew Queirolo *NMFS—Alaska Region*	Farron Wallace *Washington Dept of Fish and Wildlife*	Doug Woodby *Alaska Department of Fish and Game*

Members absent were:

Terry Quinn II
University of Alaska Fairbanks

B-1(g, h, i) Plan Team Nominations

The SSC reviewed the nominations of: Dr. Nancy Friday (NMFS-AFSC), Dr. Paul Spencer (NMFS-AFSC), and Dr. Michael Dalton (NMFS-AFSC) to the GOA groundfish plan team; Dr. Dana Hanselman (NMFS-AFSC) and Dr. Alan Haynie (NMFS-AFSC) to the BSAI groundfish plan team; Dr. Brian Garber-Yonts (NMFS-AFSC) to the BS crab plan team; and, Dr. Henry Cheng (WDFW) to the GOA and BSAI groundfish plan teams. **The SSC recommends approval of these nominations by the Council.**

C-2 (a) Crab plan team report, Crab SAFE, OFLs

The SSC received a report from Diana Stram (NPFMC) highlighting activities and outcomes of the September Crab Plan Team (CPT) meeting, which included a review of the status of BSAI crab stocks and OFLs. The SSC also received an updated version of the BSAI Crab SAFE report, which included some revisions to the draft document provided to us in June 2008.

The SSC agrees with the plan team's recommendations for OFLs, and provides a few specific comments in regards to individual stocks below.

The SSC commends the CPT for the detailed review of the revised stock assessments conducted at its September meeting. In particular, the SSC supports the CPT's intention to compile the checklist of items

to be included in stock assessment documents as a template for authors. The SSC especially appreciates the CPT's identification of the need to include tables of annual survey estimates of abundance, including a standardized measure of precision.

The SSC supports the CPTs recommendation to conduct a stock assessment workshop this winter to resolve issues related to the weighting of data sources, such as appropriate weights for different likelihood components and the most appropriate ways to estimate effective sample sizes for length and size composition data. The SSC recommends that the workshop include both crab and groundfish stock assessment scientists as these issues pertain to all model-based assessments.

Following the adoption of Amendment 24 and the current implementation of the new OFL specification process, **there are three BSAI crab stocks with rebuilding plans that need to be revised. Of these, the Pribilof Island blue king crab rebuilding plan most urgently needs revision** to prepare for the ACL implementation deadline of 2010 for overfished stocks. The two other plans, for St. Matthew blue king crab and EBS snow crab, also need revision.

Comments specific to individual stock assessments are as follows (no comments were made for Pribilof Islands blue and golden king crab):

EBS Snow Crab

In June, 2008, the SSC requested further work on refining estimates of selectivity and natural mortality, with the expectation of seeing the results in June, 2009. To clarify, we request that attention be given to the treatment of survey selectivity, noting that the model estimates of selectivity, which are close to 1 (Figure 24), are in conflict with the results of the underbag experiment shown in that Figure.

Bristol Bay Red King Crab

The SSC suggests that the authors address ecosystem considerations beyond predation by groundfish on crab (which was well covered). This section should also address apex predators, such as seabirds that rely on juvenile crab during winter, which might be affected by changes in the crab population. Although data on crab predation from apex predators may not be specific to this stock, there are data available for the region.

EBS Tanner Crab

During the June, 2008 meeting, the SSC was presented with an analysis for calculating gamma based on selectivities set equal to values given in the overfishing EA. The most recent three years of data suggest that selectivities in both the directed fishery and pot fisheries differ significantly from those used in the EA and therefore the June 2008 analysis may provide misleading results and should not be used. The SSC therefore concurs with the CPT and author to set gamma=1 for OFL and that B_{ref} be estimated as the average male mature biomass (MMB) at the time of mating for the period 1969-1980.

Pribilof Islands Red King Crab

The SSC appreciates the SAFE authors' response to our request to see an estimate of a proxy BMSY based on the 1980-2007 time period for comparison to the value estimated using the 1991-2007 period. The SSC does not disagree with the CPT and SAFE authors' choice of the 1991-2007 base period.

St. Matthew Island Blue King Crab

Jie Zheng (ADF&G) reported on an update of the assessment reviewed by the SSC in June, which included two new scenarios. The Crab Plan team selected the scenario with q and M fixed but with M estimated for the one anomalous year, 1999.

For the upcoming assessment cycle, and in concurrence with the CPT, the SSC would like the author to explore alternative models in which M is held constant and the anomaly in 1999 is handled differently.

The 1999 data point may be the result of the combination of low temperatures and an early survey in that year. Some other stocks appear to show the same 1999 anomaly.

Norton Sound Red King Crab

Jie Zheng (ADF&G) presented an overview of the Norton Sound red king crab model.

The SSC provides the following recommendations for exploration of the model in the upcoming assessment cycle.

1. The analyst should examine the implications of dropping the preseason survey from the model.

2. The analysts should examine the tradeoffs between the assumption of higher M for the last length class and lower selectivity for the last length class after 1992. In addition, the model should provide a rationale for changing selectivities in 1993.

3. The analyst should conduct a sensitivity analysis on the weights applied to the different data sources. A rationale for the values used to account for the aggregation effect should be provided. It is not clear why the weights used were appropriate corrections for aggregation effects.

4. It would be useful if reference points F_{MSY} proxy and B_{MSY} proxy were included on a phase plot of fishing mortality and mature male biomass.

5. The SSC encourages continued exploration of likelihood profiles on the natural mortality rate including runs with fixed natural mortality for all length classes.

6. The SSC requests a justification of the assumption of zero handling mortality for this stock.

AI Golden King Crab

M.S.M Siddeek (ADF&G) presented an overview of the AI golden king crab assessment model that he has recently developed. Dick Tremaine (Norton Sound Economic Development Corporation) and Linda Kozak (Catcher Processor - Patricia Lee) provided public testimony.

The SSC encourages further development of the model in the upcoming assessment cycle. The SSC reviewed the CPT recommendations for improvements to the model and made the following additions to their advice:

1. Standardization of the CPUE data prior to their incorporation into the model is desirable. The SSC recommends that effort be standardized for soak time, area, vessel, and season. The SSC also suggests that a "core" fleet approach be investigated as an aid to understanding changes in fishery performance.

2. The SSC agrees that temporal partitions in fishery selectivity should be incorporated into the model to account for changes in the mesh size used in crab pots since 1999, provided that there is evidence that changes in mesh size were adopted by all or nearly all of the fleet.

3. The SSC notes that the inclusion of the tagging data did not make marked improvements to the model.

4. The SSC recommends that the weights applied to different components of the model (e.g. retained CPUE, discard CPUE, pot survey CPUE, catch biomass, recruitment deviations and

natural mortality penalties) be explored in a systematic manner. The selection of "arbitrary" weights is not recommended.

In addition to the comments above, the SSC notes that if this model is approved, continuation of the ADF&G pot survey will be an important element of future assessments.

The SSC encourages research on the size selectivity of pots with different mesh types. The SSC also encourages ADF&G to adopt a protocol for collection of information regarding the condition of pots that might influence CPUE, especially whether the pot is incapable of retaining crab, for example, due to premature failure of biodegradable twine.

Adak Red King Crab

The SSC notes that the procedure for setting the OFL in the upcoming assessment cycle should be reviewed to address the undesirable attributes of the current method, including erratic swings in MSY resulting from the inclusion of zero catches if the fishery remains closed, and the lack of rationale for excluding the 1984/85 catch. The catch history illustrates that directed fishing can occur on this stock and that recent high levels of catch cannot be sustained. There is an urgent need for systematic survey data for this stock, to move the stock from Tier 5 to Tier 4. The SSC recommends that analysts design a survey that would provide reliable biomass estimates. In addition, the analysts should provide an estimate of the cost and amount of crab required to implement either an industry cooperative test fishery or an agency directed survey.

C-2 (c) BSAI crab 3-yr review

Mark Fina (NPFMC) and Mike Downs (EDAW) presented a summary of the 3-year review report on the BSAI crab rationalization management plan. Ron Felthoven (NMFS-AFSC) provided an overview of a time series analysis of king crab prices, as well as an analysis of post-rationalization restructuring of crew opportunities. Public testimony was provided by Frank Kelty (City of Unalaska), Arni Thomson (Alaska Crab Coalition), and Dick Tremaine (Norton Sound Economic Development Corporation).

3-Year Review

The report provides a useful description of changes in catch, annual average exvessel prices, number of participating vessels and crew, overages, patterns of participation and deliveries, pot usage, pot soak times, etc. Understandably, but regrettably, the report does not present quantitative estimates of changes in net benefits to the Nation, changes in net revenues to catchers and processors, changes in the distribution of net revenues between catchers and processors, or changes in the regional economic impact of crab-fishery-related activities. Derivation of quantitative estimates of these effects cannot be completed until the BSAI crab EDR metadata have been appropriately assembled, documented, verified, and organized; this has not yet occurred. The SSC encourages every reasonable effort be made by analysts and industry to finalize the BSAI crab EDR metadata descriptions and to use the EDR data to develop sound quantitative estimates of the magnitude and distribution of costs and benefits of BSAI crab rationalization. **Without quantitative estimates of these changes, it is not possible to determine if implementation of crab rationalization has resulted in improvements or losses of net benefits to the Nation or if it has resulted in changes in the distribution of net benefits that have resulted in unintended harm to particular regions, communities, or segments of the fishery.** Certainly by the time the Council's 5-year program review is prepared, the SSC anticipates that rigorous quantitative estimates of these outcomes will be available. At that time, analyses that compare the impacts predicted in the Crab Rationalization EIS to actual impacts would be very useful.

Anecdotal evidence suggests that changes in fuel prices may have had important effects on fishing behavior. The report could benefit from inclusion of a table or figure that presents a monthly time series of representative fuel prices.

Time Series Analysis of King Crab Prices

The time series analysis of king crab prices is an interesting and useful approach to tease out changes in prices for U.S. king crab product as a function of changes in the volume of king crab imports from Russia and the implementation of the BSAI crab rationalization program. The shortness of the time series of observations reduces the power of the statistical analyses. The statistical results indicate that the hypotheses that U.S. king crab prices were unaffected by imports of Russian king crab or implementation of the BSAI crab rationalization program cannot be rejected at standard significance levels. However, it is important to remember that failure to reject the null hypothesis does not constitute proof of the alternate hypothesis. Thus the results should not be construed as positive evidence that U.S. wholesale prices have been unaffected by crab imports from Russia and unaffected by implementation of the BSAI crab rationalization program. The SSC encourages continued development of this model. Extending the data set, through use of panel data or through use of monthly or weekly observations, are promising avenues for investigation. Additional avenues for investigation could include expanding the VAR to include additional time series, such as prices for snow crab and Tanner crab, use of constrained indirect least squares (Wegge, L. 1978, *Econometrica*) or a similar pre-test estimator to conserve degrees for freedom through reducing the number of off-diagonal terms in the coefficient matrices, and use of mixed structural time series methods that combine simple approximate structural models and vector time series analysis of the structural residuals. In addition, consideration should be given to validating model performance through ex-sample testing.

Social Impact Assessment and Crab Crew Survey

The SSC offers the following comments on the SIA and the NMFS study of crab crew:

- The SIA is structured similar to a pre-implementation social assessment in terms of communities studied, methods, and substantive areas of inquiry. In theory, this similar structure should permit critical analyses of pre- and post-implementation changes in the structure of community ties to the crab fisheries. However, data confidentiality restrictions limit the questions that can actually be addressed and reported to the public using conventional data sources. The SSC commends the SIA analysts for supplementing these data sources with the results of field interviews that do permit examination of pre- and post-implementation changes (the interview data are incorporated into the narrative sections of the SIA). The SSC notes one caution in interpreting some of the information in the SIA. In some cases, data are presented that suggest direct ties to specific communities but this locational specificity may be misinterpreted. It is the understanding of the SSC that labels such as "Kodiak vessels" reflect only the reported residency of the vessel owner, not the homeport of the vessel or, perhaps more importantly, nothing about where the crab from that vessel is landed or earnings spent, etc.

- The NMFS crew study and the SIA are complementary in many instances and the replicability observed provides a measure of confidence in some of the reported findings. For example, both efforts found that one reason crew may not prefer jobs under the rationalization program compared to the derby conditions has to do with what is known as occupational pluralism. The extended season length under rationalization (which, in general, is regarded as a positive benefit of the program) is, for some crew, an unappealing aspect of the rationalized fishery because it can represent both lower remuneration per time invested and an impediment to a pattern of multiple employment options that is not possible if committed to an extended crab season.

- The SSC notes that consideration of the influence of rising fuel prices on structural changes within the crab fleet could be qualified (i.e., put into context) in terms of annual changes in the fishery based upon key variables (vessels in the fishery, crew positions) relative to annual changes in the price of fuel.

- The SSC recommends that estimates of crab crew position losses be retained in the report on the NMFS study. These data can be updated as further work of this kind is done and as the EDR data becomes available in the future.

C-2(d) Crab committee report/Crew proposals

Mark Fina (NPFMC) provided an update on the initial development of this analysis. There is nothing to review at this time. Public testimony was provided by Tim Henkel (Deep Sea Fishermen's Union of the Pacific).

C-2(e) BSAI Crab 90/10 alternatives and analysis outline

Mark Fina (NPFMC) provided an update on the initial development of this analysis. There is nothing to review at this time. Public testimony was provided by Tim Henkel (Deep Sea Fishermen's Union of the Pacific).

C-2(f) Report on Crab EDR Metadata

Mark Fina (NPFMC) provided an update progress of this effort. The crab EDR metadata remains a work in progress. These metadata descriptions have been much anticipated and completion of this task should be a priority. The metadata descriptions are important information that will aid analysts who are planning analyses using EDR data to assess the performance and consequences of the BSAI crab rationalization. The SSC anticipates reviewing a completed report on the successful development of the EDR metadata during the December, 2008 meeting.

C-3(a) GOA sideboards BSAI crab vessels

Jon McCracken (NPFMC) provided an overview of the public review analysis. Public testimony was not offered in relation to this agenda item. The SSC was unable (due to time constraints) to review the initial draft analysis during the June 2008 meeting. The current analysis is much improved and has incorporated comments provided informally to the analyst. It provides an appropriate discussion of the alternatives and their impacts that are sufficient for Council decision-making. The SSC offers a suggested revision to the generic boilerplate language regarding market failures in an appendix to this report (labeled "Miscellaneous").

C-3(b) GOA sideboards GOA rockfish

Diana Evans (NPFMC) presented the RIR/IRFA for the proposed amendment to the "stand down" provisions for catcher-processors in the Rockfish Pilot Program (RPP) established in December 20, 2008, under GOA FMP Amendment 68. Public testimony was received from Todd Loomis (Cascade Fishing).

Initial review of this item was on the SSC agenda in June 2008, but owing to the press of other business, the SSC was unable to formally take the report. Individual comments were informally supplied to the author. The Final Action draft now presented to the SSC reflects a well-designed and informative presentation of the issues, objectives, and available alternatives. The document now provides sufficient information for Council decision-making.

The SSC notes that the document calls for clarification of Council intent (regarding integration with the CDQ program) but that this issue is now up for final action. The document should be edited to reflect that the problem statement has now been adopted by the Council. The SSC repeats earlier comments stressing that the Council should be articulating their problem statements, rather than having staff attempt to intuit

Council goals and objectives. The SSC offers a suggested revision to the generic boilerplate language regarding market failures in an appendix to this report (labeled "Miscellaneous").

C-3(c) Initial review sideboards Am 80 PSC

Jon McCracken (NPFMC) presented the on an initial draft analysis RIR/IRFA proposed to adjust the 3rd season deep-water halibut prohibited species catch (PSC) sideboard allowance for Amendment 80 vessels. Public testimony was offered by Julie Bonney (Alaska Groundfish Data Bank) and Todd Loomis (Cascade Fisheries).

This action pertains to a proposed change in the halibut PSC bycatch mortality accounting, associated with Amendment 80 catcher processors (CPs) participating in the Rockfish Pilot Program (RPP) "limited access" fishery in the Gulf of Alaska (GOA). The Council has not yet adopted a Problem Statement, nor identified a suite of alternatives for this action, both of which are necessary steps before the SSC can offer an informed judgment as to whether the document sufficiently explains and provides alternatives that address the problem statement.

Specific deficiencies were noted. The status quo is not well-defined. More explanation of Amendment 80 history and intent with respect to the reasons behind the original Amendment 80 PSC allocations needs to be added. Staff has proposed a "possible" problem statement, as well as "straw man" alternatives. Among the "draft" alternatives under consideration are actions which the SSC notes, would fundamentally alter the basic Amendment 80 Sideboard Limit structure, adopted by the Council and implemented only recently. Given the exceedingly brief period during which this program has been in place, it may be appropriate to ask whether the true effects of the sideboards are likely to have yet fully emerged. If they have not, the SSC wonders how the Council will judge whether modifying the status quo enhances or diminishes its original purpose in setting Amendment 80 PSC sideboard limits?

It is not clear from the document as to the purpose of this specific PSC sideboard limit. The Amendment 80 sideboards may primarily serve to limit strictly any spill-over impacts resulting from fixed allocation of target quota amounts to the qualifying CP fleet, as defined under Amendment 80. In the specific case at hand, it is the halibut PSC mortality sideboard limit that is at issue. There appears to be a clear distinction between a sideboard "allocation" and a sideboard "PSC allowance". The former imparts a harvest "use privilege", while the latter must be regarded as a "prohibition" against harvest (to the maximum extent practicable), with an absolute cap. No "use privilege" is implied by a PSC Sideboard Limit. Instead, every practicable effort is required to be made to avoid use of this PSC, and if avoidance is not possible, to minimize its occurrence. These distinctions are especially relevant to this proposed action, particularly with respect to meeting the intent of National Standard 9.

According to the preliminary analysis, when the Council established the GOA Rockfish Pilot Program (RPP), it consciously apportioned the Amendment 80 CP sideboard limit for halibut PSC between CPs that entered into a fishing cooperative structure in the RPP, and those that did not. Halibut PSC mortality incurred by CP co-op members was expressly not to be counted against the Amendment 80 halibut PSC sideboard limit. According to the analysis, the reason for this decision was to provide a strong "incentive" to encourage cooperative formation. Based upon experience with other fishing cooperatives, the expectation of the Council was that this incentive would lead to sufficient improvements in operational efficiency and bycatch management by co-ops in the Am-80/RPP fishery, to adequately compensate for the reduced accounting of RPP CP co-op removals from the Amendment 80 halibut PSC Sideboard Limit. No equivalent expectation concerning PSC sideboard management, and therefore no accounting accommodation, was attached to the AM-80/RPP CP limited access fishery.

Thus, the intent for this disparate bycatch accounting appears to have been to offer a choice to individuals in the CP sector to join a co-op and benefit from the incentive provision, or not to join and operate under

the Amendment 80 halibut PSC Sideboard Limit provisions in the "limited access fishery." If this is not the correct interpretation, there would, in effect, be "no incentive" to the Council's incentive program. This clearly is illogical.

Because of these inconsistencies and deficiencies in the document, **the SSC believes this draft document is not yet ready for release to the public for review.**

C-5 Arctic FMP

Bill Wilson (NPFMC) and Grant Thompson (NMFS-AFSC) presented a draft Fishery Management Plan for Fish Resources in the Arctic and the accompanying EA. Melanie Brown (NMFS-AKR) presented the RIR/IRFA. Public testimony was provided by Chris Krenz (Oceana).

The SSC compliments the preparers of these documents for their excellent work. The EA/RIR/IRFA is well developed. The SSC comments on the previous draft reviewed in February 2008 have been addressed.

The SSC offers the following comments to be addressed before the documents are sent out for public review. Because our list of suggested changes is extensive, the SSC wishes to review the Arctic FMP and EA/RIR/IRFA one more time before it is released, preferably after response by NOAA General Counsel to legal questions about Option 2. Moreover, in scheduling a desired completion date for the revised draft FMP, it would be helpful if the timeline for revision did not coincide with the conclusion of the stock assessments. If completion of the Arctic FMP is not urgent, perhaps completion could be deferred until after the December Council meeting.

Much of the SSC discussion focused on the two options. Option 2 has much appeal, but it represents a new approach. At the time of our review, there was uncertainty about whether it is a legally valid approach. As noted by Option 2, there is too much uncertainty in the estimation of MSY to use these estimates for fishery management. Possibly, a simpler approach is to specify an MSY near 0 because no fisheries are established. Therefore, the SSC recommends adding a suboption to Option 2 that initially sets MSY near zero, leaving some room for subsistence harvest, bycatch in state fisheries and an allowance for exploratory surveys. At a minimum, the MSY estimates generated by comparison to the Barents Sea should be removed, as the SSC feels that differences between the Barents Sea and Arctic Ocean renders these estimates invalid. Baffin Bay in eastern Canada may be a more suitable comparison.

In Option 1, the procedures for estimating MSY are quite elegant and the preparers are to be commended for their ingenuity. However, many uncertainties lead to low confidence in these estimates, as well, including: (1) the number of assumptions to be made that are not informed by data, (2) the 1990 survey did not fully cover the region, so CPUEs were extrapolated to unsurveyed areas, (3) the Arctic has undoubtedly changed since the 1990 survey, so that the biomass estimate from 1990 likely does not reflect the current unfished biomass and B_o is unlikely to be constant, and (4) biological parameters have not been estimated for Arctic cod, saffron cod, nor snow crab in this region. For instance, snow crabs do not grow as large as they do in the eastern Bering Sea and may not even attain maturity. Use of Bering Sea parameter estimates for snow crabs in the Chukchi and Beaufort Sea is likely to lead to overestimates of growth and productivity in the analysis.

For these reasons, the SSC recommends adding some text that qualifies the parameter estimates, including MSY. The text should also outline the expected steps by which uncertainty would be reduced in the future as new information becomes available. These include analyses of more recent (2008) survey data, which presumably will provide much better estimates of B_o, research on the included species to estimate area-specific biological parameters, and ultimate accumulation of survey time series and non-commercial

fishery information, allowing the migration to age-structured analyses of the type applied in the GOA and BSAI.

The SSC recommends that the steps for designating a new target fishery listed in Option 2 should also be included in Option 1. Some of the more likely fisheries in the Arctic may be those on southern stocks (e.g., pollock), should range extensions occur. So, the document should indicate how fisheries may be developed on species at the northern tails of their geographic distribution. Likewise, the groundfish tier system of Option 2 should also be included in Option 1. The SSC notes that modified tiers have been developed for crab and these should be included in both Options 1 and 2. The crab tier system in both cases would need to be modified to include ABC determinations.

The SSC offers the following additional editorial comments on the draft Arctic FMP:

1. P. ES-3. Delete the last phrase in the box for permit pertaining to State of Alaska.

2. On p. 6 (item B), the list of those groups who may potentially provide a petition differs from the list provided on p. 23. The two should be reconciled.

3. On p. 7, several instances of "Alternative" should be changed to "Option" under Option 1. Note typos in first paragraph under Option 2.

4. Table 3-1, p. 12. The second sentence in the header for Table 3-1 should be deleted, as no ratio is provided. Also, the header should clarify whether the comparison between 1990 and 1991 pertains only to the 8 stations in common or the full set of stations.

5. Section 3.4.2.1.2 (p. 16). It might be noted that the estimate of B_{msy}/B_o (fraction of unfished biomass corresponding to maximum production) is equal to the fraction of unfished biomass at which fishery thresholds are typically set to close crab fisheries because of concerns about stock status.

6. P. 19-20. Revisit the section on non-consumptive use and consider expanding the discussion. Non-consumptive use may be valued more highly than indicated, particularly if the non-consumptive use of resources as a whole, rather than individually, are considered. Significant impacts will be difficult to define, given the lack of information on these populations.

7. P. 29, item a under 3.8.1. Define what "significant" means in the case of birds and mammals.

8. P. 31, under 3.15.1, no. 2. Include birds and mammals here. Also, consider adding references to ecosystem-based management.

9. P. 34, second paragraph, third sentence. Replace "although" with "because" and replace "can limit" with "limits".

10. P. 115. The section on likelihood of a large oil spill can be improved, perhaps borrowing from estimates and literature on other regions. The FMP cites an MMS report concluding that the threat of a spill is "very low". If the MMS report provides an estimate of the probability, that estimate should be included in the FMP. Although it is not the responsibility of the FMP to analyze threats from oil spills, both catastrophic and chronic spills can have cumulative effects. A discussion of how oiling could impact fisheries and their "ecosystem components" is warranted here.

The SSC offers the following comments on the EA/RIR/IRFA:

1. Comments offered above for the draft FMP should also be considered in the appropriate sections of the EA/RIR/IRFA.

2. Please clarify how management may differ if red king crabs were managed under the Arctic FMP versus the Crab FMP (i.e., Alternative 3 vs. 4). Also, clarify what is meant by "same size and scope" when referring to the purported historic red king crab fishery in the Chukchi Sea, and how these criteria will be quantitatively estimated.

3. For accuracy, replace "Alaska EEZ" with wording such as "EEZ off Alaska".

4. New information is now available on bearded seals, and the SSC will provide this information to the authors.

5. Mammal diets are provided in Table 7-4. Please point to this table earlier in chapter 7.

6. Consideration of non-consumptive value should be included in the RIR. In particular, it may be non-trivial, when considered in a cumulative manner.

C-6 Research Priorities

The SSC compiled a list of research priorities at the June, 2008 Council meeting for those research topics needing attention within one year and this list was provided to the North Pacific Research Board for its consideration in developing its annual request for proposals. The priority list (attached as an appendix to these minutes) includes an update of that list, but incorporated into a new format. The new format is intended to be a list of 5-year research priorities mandated by the MSA that will be updated annually. This list is intended to meet the needs of both the NPRB and the Council. The major changes incorporated in this new format are the differentiation of critical and strategic issues, and the removal of the extensive listing of additional research priorities identified by the groundfish, crab, and scallop plant teams. Removal of the additional priorities identified by the plan teams does not diminish the importance of the many specific issues the teams have listed; rather, the list below is the SSC's determination of the most important critical and strategic issues, many of which came from plan team recommendations.

Public testimony was provided by Michelle Longo-Eder (U.S. Arctic Research Commission and North Pacific Research Board member).

C-7(a) Groundfish plan team reports and new model reviews:

Diana Stram (NPFMC) and Grant Thompson (NMFS-AFSC) presented the BSAI and GOA groundfish plan team reports. New models presented at the plan team meetings were also presented to the SSC for review and comment. The SSC provides the following advice to stock assessment authors and the plan teams on these models:

<u>BSAI and GOA Pacific cod</u>
Grant Thompson (NMFS-AFSC) presented alternative assessments that had been shown and discussed at the groundfish plan team meetings. Public testimony was given by Craig Cross (Freezer Longliner Coalition) and John Warrenchuk (Oceana).

During the last two years there has been a lot of scrutiny of various aspects of the Pacific cod assessments, particularly the form of selectivity schedules, the appropriate value of natural mortality, the possibility of bias in the age readings, and the value of trawl survey catchability. For purposes of specifying ABC and OFL, the SSC has requested model fits that use an externally estimated rate of

natural mortality based on life history theory (set by the author at 0.34) and that include the age composition data in the fit. The SSC has not taken a position regarding selectivity schedules or trawl survey catchability, both of which can have a large effect on the estimates of abundance.

Five model configurations were reported for the BS/AI. Model 1 was the reference model used in the 2007 assessment. This model was endorsed by the SSC in December except for the method used to calculate average recruitment. (The calculation took in the 1974-2006 year-classes rather than the standard 1977-2006.) Models 2 and 3 were variants of Model 1 intended to respond to team comments. Model 4 was a purely length-based model requested in public comment. Model 5 was an exploratory model that, among other things, incorporated time-varying commercial selectivity. Only one version of this model was reported although the author considered a large number of alternative configurations.

At the team meetings the author posed, and the teams answered, a number of questions bearing on model choice. The SSC concurs with almost all of the teams' recommendations. In particular, we agree that estimating parameter L2 (length at age 20) externally is not worthwhile (Model 2), and that setting a lower bound of 5 on parameter P4 of trawl survey selectivity (which determines the width of the descending limb) is not advisable (Models 3 and 5). Except for this last feature, we also agree that Model 5 is an improvement on Model 1, because commercial fishery selectivity really does appear to vary over time. As a reference model for this year's BS/AI specifications, the SSC would therefore like to see a fit of Model 5 in which the constraint on parameter P4 is removed or relaxed. Because of continuing questions about the age data (including poor model fits to the age data), we would also like to see a fit of this modified Model 5 that does not include the age data. We do not need to see updated fits of Models 1, 2, or 3.

Three models were reported for the GOA. Models 1 and 2 were recycled versions of much earlier assessments that were not received enthusiastically at the time and were not used for specifications, but were carried forward because work on the BS/AI assessment had precluded any attention to the GOA. Model 3 was a new exploratory model similar to BS/AI Model 5. Only one version was reported, although the author had examined a large number of configurations. Recently retrieved commercial length composition data for years before 1990 were also added to the data file for Model 3.

As a reference model for the GOA specifications, the SSC would like to see a fit of a model analogous to the BS/AI reference model, namely GOA Model 3 with the constraint on parameter P4 removed or relaxed. The SSC would also like to see a fit of the reference model without the added length composition data, if time permits. The SSC is concerned about the inability of the present Model 3 to estimate a credible value for trawl survey catchability but do not expect that the author will have time to find a solution in the near term if that behavior persists.

BSAI rougheye rockfish

Grant Thompson (NMFS-AFSC) presented results from a new age-structured model for BSAI rougheye rockfish that was last assessed in 2006 within a shortraker/rougheye rockfish complex. The current rougheye rockfish assessment is now composed of two species including rougheye rockfish and a newly classified species, blackspotted rockfish. A variety of information on growth, mortality, age and size composition, area specific size-at-age and length are incorporated into this assessment. This assessment provides better information on population dynamics and setting of ABC and OFL's.

Blackspotted and rougheye rockfish were first differentiated in the 2006 AI trawl survey, and in 2008 in the EBS slope survey. The survey biomass estimates show that blackspotted rockfish comprised more than 90% of the blackspotted/rougheye rockfish biomass in the AI, while the proportion of blackspotted rockfish biomass in the EBS is approximately 60%. The SSC agrees with Plan Team recommendations for development of an additional model inclusive of data for the AI to better capture the population dynamics for a complex that is largely composed of blackspotted rockfish. The SSC notes that data are

insufficient to develop the same for the EBS and that ABC calculations for the EBS would need to be based upon Tier 5 calculations. The SSC would like to see both the combined BSAI model and the AI model with the Tier 5 BS options move forward to the plan teams in November.

BSAI skates

Grant Thompson (NMFS-AFSC) presented an update of the age-structured model for Alaska skate in the BSAI management area. The SSC reviewed the first iteration of this model in October 2007 and determined at the time that the model was not yet adequate for the purpose of ABC specifications. Most of the concerns expressed by the SSC have been addressed in the current version. The model provides a reasonable estimate of current biomass. In particular, concerns about historical catch data prior to the 1990s are no longer relevant as the authors chose to limit the analysis to the post-1991 period. Another concern relating to the lack of a spawner-recruitment relationship was addressed by fixing the steepness of the Beverton-Holt model at 1, which effectively assumes constant recruitment over the range of observed spawner abundances.

The SSC commends the authors for their creativity in dealing with the life history specifics of skates and their responsiveness to SSC concerns. We look forward to seeing an updated model incorporating 2008 survey data in December. The SSC has some remaining concerns and specific recommendations:

1. The fit to the size-at-age data has improved but remains biased: the LVB model tends to consistently overestimate length-at-age of younger fish and underestimate length-at-age of older fish (Fig. 35), probably due to limitations of the assumed growth model. This bias appears to result in an overestimation of the number of skates in intermediate size classes and an underestimation of the number of skates in larger size classes (Fig. A13). Because skates mature at relatively large sizes (Fig. A10), underestimating the abundance of large skates may greatly underestimate spawning biomass. It is our understanding that the new version of SS2 can accommodate more flexible growth models and we encourage the authors to fit one of these more flexible models to improve the fit to size-at-age data. For some elasmobranchs, growth rate shifts at or near size of maturity, and models (e.g., two-stage von Bertalanffy) have been developed to handle such situations. In addition, we encourage the author to explore and document the sensitivity of the model to the assumption that L_1 is fixed at 22 cm, given the large uncertainty (CV) of this parameter (Table A6).

2. The authors present output from a single model that was based on a number of assumptions that are difficult to evaluate. In particular, the authors make a strong assumption about the limited level of recruitment variability (fixed at $\sigma_R = 0.3$). The authors argue that skate recruitment should display low variability because skates are equilibrium strategists. However, recruitment is effectively estimated at age-4 by the model and variability in egg deposition and in the survival between egg deposition and emergence could easily lead to considerable variability in age-4 recruitment. The authors chose $\sigma_R = 0.3$ "…on the basis of improved model fits", but differences in model fits were not presented (last year's model assumed $\sigma_R = 0.1$). Therefore, the SSC recommends that the authors document the sensitivity of the model to the specification of σ_R or provide a stronger rationale for their choice. For example, alternative models with different levels of σ_R or a likelihood profile for σ_R could be presented.

3. The authors assume that egg case development takes 3.6 years based on a study by Hoff (2006). The SSC requests that the authors include a brief description of the available evidence for this determination, including some discussion of the reliability of skate aging data and of the methods used to determine development times and age determinations.

4. There should be some discussion on the sensitivity of model results to the assumptions that were made regarding selectivity parameters. The SSC notes that many of these parameters were

arbitrarily bounded and parameter estimates were often near their specified bounds (e.g., p1 for longline length selectivity; and, p3, p4 and p6 for trawl length selectivities, Table A6).

Other, minor points:

1. Fig. A20: It would be useful to display biomass and spawning biomass on the same scale.

2. Table 6: Clarify which of the listed values are on the log-scale (e.g. CV of L2 is negative and appears to be on log-scale).

3. The authors should be careful in using statistical nomenclature. For example,

    - p. 5: "The level of recruitment … results from…". It should be clarified that recruitment is not deterministic but there is some variability around the predicted recruitment from the Beverton-Holt model.
    - p.5: "Weighting of individual likelihood components was not performed…". More likely, weights were assumed to be 1 for each component.
    - It was stated that no priors were used for any parameters. However, SS2 requires the specification of bounds and assumes uniform priors within those bounds if no other prior is specified

C-7(b) Approve initial groundfish harvest specs

The SSC reviewed and approved the proposed specifications for 2009-2010 that are used to establish the proposed rule. The SSC agrees with the Plan Team approach of rolling over the actual specification set for 2009 for both 2009 and 2010 for the proposed rule.

The SSC notes that the 2008 acoustic midwater trawl winter surveys of the Shumagin Islands, Chirikof and Shelikof Strait areas suggest that the increase in proposed 2009/10 specifications may not be realized in the final ABC and OFLs. The SSC requests that a report documenting the results of the annual EIT surveys is provided to the Plan Teams in September and to the SSC in October.

D-2(a) Committee report on Comprehensive Data Collection

This agenda item was not presented or discussed.

D-2(d) BS/AI Pcod area split

In response to a request from the SSC in February 2008, staff at the Alaska Fisheries Science Center compiled all available evidence for separate Pacific cod stocks in the Aleutian Islands and in the Eastern Bering Sea. The groundfish plan team reviewed this information in September 2008. Plan team discussions of the issue were summarized for the SSC by Grant Thompson (NMFS-AFSC). Public testimony was provided by David Fraser (self) and Donna Parker (Arctic Storm).

Evidence for a biological split between EBS and AI Pacific cod include, among others, (1) an increase in genetic difference with distance of separation in Alaska, as well as along the entire coast of North America, although a clear break is not evident, (2) differences in the fatty acid composition of egg polar lipids between the BS and AI, which probably reflects genetic differences, (3) a clear gap in spawning locations between the two areas, (4) larger size at age in the AI than in the BS, and (5) a lack of small fish in AI length frequencies compared to the large number of smaller fish present in the BS. The latter feature suggests that even if there are different stocks, AI juveniles may rear in the BS.

Based on a review of the biological information and comments from the groundfish plan team, the SSC feels that there is sufficient justification for a split in Pacific cod between the BS and AI areas. The SSC recommends that a precautionary approach should be taken by specifying separate ABCs for this species.

To facilitate the move towards an assessment model for AI Pacific cod the SSC encourages the modeling efforts of Kinzey and Punt (UW). We also recommend that ongoing tagging studies to assess movements of adult Pacific cod be continued.

Miscellaneous

a. Public testimony on issues not included in the SSC agenda

Public testimony was provided by Hans Radtke regarding C-1(b)—charter halibut catch sharing plan.

b. Comments on market failure rationale included in recent RIR/IRFA analyses

Several recent RIR analyses (e.g., the GOA sideboards analyses) include a section titled "Market Failure Rationale." The inclusion of this new section is in response to recent requirements instituted by the President's Office of Management and Budget (OMB). It appears to the SSC that this section is intended, primarily, as a *pro forma* response to this new OMB mandate, rather than as a rigorous treatment of specific sources of potential market failure in the context of specific proposed regulatory actions. Nevertheless, the section could benefit from some additional detail and precision in the description of sources and consequences of market failure. The SSC recommends that the following paragraphs be used in RIR documents prepared for the NPFMC.

OMB guidelines for the preparation of economic analyses under E.O. 12866 state:

> "… in order to establish a need for the proposed action, the analysis should discuss whether the problem constitutes a significant market failure. *If the problem does not constitute a market failure, the analysis should provide an alternative demonstration of compelling public need such as improving governmental processes or addressing distributional concerns*. If the proposed action is a result of a statutory or judicial directive (sic) that should be so stated" (emphasis added).

The proposed regulatory action under review in this RIR is initiated in response to a market failure.[1] The following provides a general description of market failure that is characteristic the BSAI (GOA) groundfish (shellfish, etc.) fisheries. The presence of this market failure directly reduces net national benefits. Elimination of this market failure would be expected to lead to an increase in net national benefits. Therefore, addressing this market failure is a compelling reason for undertaking the proposed regulatory action.

Market failure is defined as circumstances or conditions where voluntary private transactions are unlikely to result in economically efficient outcomes. That is, it may be possible to increase benefits to one or more parties to a transaction by modifying the bundle of entitlements and obligations attached to the good or service being transacted, or by imposing constraints that affect the terms of the transaction. Market failure may arise when: (1) price does not reflect all of the costs or all of the benefits of production or consumption (externalities); (2) some of the benefits are non-rivalrous (public goods); (3) there is an asymmetry in information available to participants in the transaction; or (4) one or some parties to the transaction have market power. While examples of each of these forms of market failure can be found in

[1] A different suite of arguments will need to be presented if the proposed regulatory action is intended to improve governmental processes, address distributional concerns, or satisfy a statutory or judicial directive.

fisheries, a form of market failure that has attracted most attention in fisheries is the externality that arises when: (1) individual fish are unowned until they are reduced to possession, (2) catch shares are determined under a first-come-first-served allocation rule, and (3) the quantity of fish that harvesters are willing and able to catch exceeds nature's capacity. This externality is often mislabelled "the tragedy of the commons", but is better described as the "race-for-fish" or "derby". Under conditions that lead to the race-for-fish, competition among harvesters (commercial, sport, etc.) is intensely rivalrous (fish harvested by one person cannot be harvested by another) and has frequently led to overcapitalization (more gear and vessels than is optimal to harvest the quantity of fish that is available for harvest), combat fishing, excessive harvesting, and other inefficiencies.

c. Appendix A. Five-Year Research Priorities

The SSC has identified priorities for research in the next 1 to 5 years as those activities that are the most important for the conservation and management of fisheries in the Gulf of Alaska, Aleutian Islands and the eastern Bering Sea. This listing of priorities is intended for two purposes: 1) to meet the requirements of the revised Magnuson-Stevens Act for the Councils to identify research that is needed in the next 5 years, and 2) to provide guidance on research priorities to the research community and to funding agencies.

The research priorities are separated into two categories: critical and strategic. Critical issues include activities that must be addressed to satisfy federal requirements and to address pressing fishery management and ecosystem issues related to fishery management. Strategic issues include research that needs to be conducted to advance the Council's fisheries management goals as defined in the Groundfish PSEIS, other strategic documents of the Council (i.e., FMPs, AI FEP, and EFH, crab, salmon bycatch, and other EISs) and NMFS. Strategic research priorities include efforts on which the assessment models depend for their annual updates. For example, without the survey information, the annual process of setting ABCs and OFLs for the managed stocks would be compromised. The SSC sees these efforts as needed on an ongoing basis, and constituting the time series on which management is based. It should be recognized that research in these categories is being conducted or may be conducted through Federal, State of Alaska, North Pacific Research Board and other funding sources.

Critical Issues

I. Fisheries

A. <u>Fish and Fisheries Monitoring</u>

1. Design and implement an improved observer delivery program that allows accurate estimation of the catch by season and sector (Also see Strategic Priority II.A.1)

2. Improvements are needed in in-season catch accounting for crab in non-directed fisheries with high incidental catch rates.

B. <u>Stock Assessment</u>

1. Improve species identification in catches by both processors and observers for priority species within species complexes to avoid misidentifications, and to reduce the large numbers of unidentified individuals.

C. Fishery Management

1. An evaluation is needed of economic effects from the recently adopted crab rationalization program on Gulf of Alaska coastal communities, including Kodiak. This includes understanding the economic impacts (both direct and indirect impacts) and how the impacts are distributed among communities and economic sectors, conducting qualitative research to assess changes in community participation and effort in fisheries, and estimating net economic benefits.

2. As Kodiak is likely to be at the center of controversy over the likely consequences of Gulf rationalization, research should be designed to use Kodiak in addition to other Gulf communities as case studies in prospective analyses of the potential effects of Gulf rationalization options on fishing behavior, participation, and economic impacts.

II. Fisheries Interactions

A. Protected species

1. There is a need for studies of local fishery interactions. Whereas global fishery control rules may generally prevent overfishing on a broad regional basis, non-random patterns of fishing may cause high rates of removals in local areas important to apex predators such as Steller sea lions, ice seals, northern fur seals, spectacled eider, Steller's eider, and short-tailed albatross. More studies are needed to fully evaluate potential local effects of fishing on other components of the ecosystem (e.g., marine mammals, seabirds, and the impact on benthic habitat and fauna by bottom contact gear).

2. Further research is needed on gear modifications and fishing practices for reducing bycatch, particularly of PSC species (e.g., salmon).

III. Habitats

A. Evaluate habitats of particular concern:

1. Assess whether Bering Sea canyons are habitats of particular concern by assessing the distribution and prevalence of coral and sponge habitat, and comparing marine communities within the canyon areas, including mid-level and apex predators (such as short-tailed albatrosses) to neighboring shelf/slope ecosystems.

2. Assess the extent, distribution, and abundance of important skate nursery areas in the EBS to evaluate the need for designation of new HAPCs.

B. Arctic baseline habitat assessment

1. Dynamic ecosystem and environmental changes, on a pace not observed in recorded time, are occurring in the Arctic (among other regions). Given the establishment of a new FMP for the Arctic, assessment of the current baseline conditions is imperative. This effort should not supplant the regular surveys in the BSAI and GOA, which are the most important.

Strategic Issues

I. Fisheries

A. Fish and Fishery Monitoring

1. Continuation of State and Federal annual and biennial surveys in the GOA, AI and EBS, including BASIS surveys and crab pot surveys, is a critical aspect of fishery management off Alaska. It is important to give priority to these surveys in light of recent proposed federal budgets in which funding may not be sufficient to conduct these surveys. These surveys provide baseline distribution, abundance, and life history data that form the foundation for stock assessments and the development of ecosystem approaches to management. These surveys are considered the highest priority research activity contributing to assessment of commercial groundfish fisheries off Alaska.

2. Plan and implement routine surveys into the northern Bering Sea and conduct baseline surveys of the Arctic Ocean. These surveys will become increasingly important under ongoing warming ocean temperatures, because range expansions of harvested fishery resources are anticipated. If range expansions occur, data will be needed to adjust standard survey time series for availability.

3. Continue and expand cooperative research efforts to supplement existing surveys to provide seasonal or species-specific information for use in improved assessment and management. The SSC places a high priority on studies that provide data to assess seasonal movements of fish and shellfish for use in studies of species interactions in spatially explicit stock assessments.

4. For groundfish in general, and rockfish in particular, continue and expand research on trawlable and untrawlable habitat, to improve resource assessment surveys. For example, improved surveys, such as hydro-acoustic surveys, are needed to better assess pelagic rockfish species, including GOA POP stocks.

5. Continue research on the design and implementation of appropriate survey analysis techniques to aid the Council in assessing species that exhibit patchy distributions and, thus, may not be adequately represented (either over or under estimated) in the annual or biannual groundfish surveys.

6. Identification and recovery of archived data (e.g., historical agency groundfish and shellfish surveys) should be pursued.

7. There are needs to improve biological data collection (e.g., age, size, maturity, and sex) of some bycatch species (e.g., sharks, skates, octopus, squid, sculpins, and grenadiers) to better quantify potential effects of bycatch on these stocks.

8. Continue and expand existing efforts to collect maturity scans during fisheries that target spawning fish.

B. Stock Assessment

1. Assess discard mortality rates of Tanner crab by size, month, sex, and fishery type.

2. Improve information (specifically, natural mortality, size at maturity, and other basic indicators of stock production/productivity) for "other species" and data-poor stocks of crab to allow application of Tier 5 or Tier 4 assessment criteria. Two possibilities that would require dedicated research for development are: (1) directly estimate fishing mortalities through large-scale tagging programs; and (2) habitat-based estimates of abundance based on local density estimates in combination with large-scale habitat maps. Little information is available, especially for sculpins, skates, octopuses, squids, grenadiers, and some sharks.

3. Collect data to improve natural mortality (M) estimates. Estimates of M (obtained independently from models) are needed for several stocks, including Pacific cod and BSAI crab stocks.

4. Quantify the effects of climate variability and climate change on recruitment and growth by developing standard environmental scenarios for future variability based on observed patterns. There is also a clear need for information that covers a wider range of seasons than is presently available.

5. There is a need for the development of advanced stock assessment modeling techniques. Specifically, there is a pressing need to develop techniques for linking uncertainty into stock assessments, including both scientific uncertainty (measurement error, process error or model misspecification) and implementation error (enforcement and catch monitoring).

6. There is a need for the development of projection models to evaluate the performance of different management strategies relative to the Council's goals for ecosystem approaches to management. Projection models are also needed to forecast seasonal and climate related shifts in the spatial distribution and abundance of commercial fish and shellfish (see Strategic Priority IV.A.1.a "Climate variability" below for more detail).

7. To identify stock boundaries, expanded studies are needed in the areas of genetics, reproductive biology, larval distribution, and advection. Expanded tagging efforts are needed to support the development of spatially explicit assessments. High priority species for spatially explicit models include: walleye pollock, Pacific cod, sablefish, yellowfin sole, rock sole, arrowtooth flounder, Pacific Ocean perch, and Atka mackerel (see element 5 in Expanded Ecosystem Studies below). Specific issues include: a) an evaluation of the location of potential boundaries for an AI – EBS split that would be needed to assess the implications of the creation of a separate Aleutian Island management area, and b) stock delineation for estimation of adult equivalence to appropriately account for the impact of incidental catches of salmon in pollock fisheries on salmon populations.

8. There is a need to investigate whether scallop beds coincide with retention zones, as determined by circulation patterns, and how this relates to stock structure. There is also a need to investigate movement of scallops within beds to determine whether scallops can and do fill in areas that have been previously harvested.

C. Fishery Management

1. Evaluate the effectiveness (e.g., potential for overharvest or unnecessarily limiting other fisheries) of setting ABC and OFL levels for data-poor stocks (Tier 5 and 6 for groundfish and Tiers 4 and 5 for crab) (e.g., squid, octopus, shark, sculpins, other flatfish, other rockfish, skates, grenadier, and crab).

2. Develop forecasting tools that incorporate ecosystem indicators into single or multispecies stock assessments to conduct management strategy evaluations under differing assumptions regarding climate and market demands. Standardization of "future scenarios" will help to promote comparability of model outputs.

3. Development of an ongoing database of product inventories (and trade volume and prices) for principal shellfish, groundfish, and salmon harvested by U.S. fisheries in the North Pacific and Eastern Bering Sea.

4. Analyze current determinants of exvessel, wholesale, international, and retail demands for principal seafood products from the GOA and BSAI;

5. Conduct pre- and post-implementation studies of the benefits and costs, and their distribution associated with changes in management regimes (e.g., changes in product markets, characteristics of quota share markets, changes in distribution of ownership, changes in crew compensation, as a consequence of the introduction of dedicated access privileges in the halibut/sablefish, pollock, and crab fisheries). "Benefits and costs" include both economic and social dimensions. For example, analyses are needed of the magnitude and distribution of economic effects of salmon bycatch measures for the Bering Sea pollock fishery. In this case, it is important to understand the ability of pollock harvesters to adapt their behavior to avoid salmon bycatch under various economic and environmental conditions and incentive mechanisms.

6. Conduct prospective analyses of the robustness and resilience of alternative management strategies under varying environmental and ecological conditions.

7. Conduct prospective and retrospective analyses of changes in the spatial and temporal distribution of fishing effort in response to management actions (e.g., time/area closures, marine reserves, bycatch restrictions, co-ops, IFQs).

8. Develop a framework for collection of economic information on commercial, recreational, charter fishing, and fish processing to meet the requirements of the MSFCMA sections 303(a)(5, 9, 13), 303(b)(6), and 303A.

II. Fisheries Interactions

A. Bycatch and Observer Issues

1. Improve estimation of total bycatch for marine mammals, seabirds, non-target groundfish and crab, and protected species. At present, it is clear that observer coverage in some fisheries is insufficient for estimation of total bycatch. Further, observer coverage must be analyzed to compare, to the extent possible, the total catch, bycatch, and fishing behavior between observed and unobserved fishing vessels. Examples include the CV trawl fisheries, sablefish longline fishery, Pacific cod pot and longline fisheries, halibut longline fishery, and guided recreational fisheries. Improved accuracy of identifications and enumerations of bycatch species is necessary. The current program results in imprecise bycatch (mortality) estimates for species such as skates, sharks, yelloweye rockfish, and sablefish in halibut longline fisheries, and discards in sport fisheries. Improved methods should include direct and alternative monitoring options (e.g., electronic logbooks, video monitoring), particularly on smaller groundfish, halibut, and commercially guided recreational fishing vessels.

B. Protected Species Interactions

1. Population dynamics, life history, and assessment of protected species, particularly Steller sea lions and northern fur seals, are a high priority. In particular, investigation of factors contributing to changes in natality of Steller sea lions is an important area of research.

2. Economic, social, and cultural valuation research on protected species (i.e., non-market consumptive use, passive use, non-consumptive use).

III. Habitat

A. Habitat Mapping

1. Improved habitat maps (especially benthic habitats) are required to identify essential fish habitat and distributions of various substrates and habitat types, including habitat-forming biota, infauna, and epifauna.

2. Begin to develop a GIS relational database for habitat, including development of a historical time series of the spatial intensity of interactions between commercial fisheries and habitat, which will be needed to evaluate impacts of changes in EFH on the growth, reproduction, and distribution of fish and shellfish.

3. Assess the extent of the distribution of Primnoa corals in the GOA.

B. Function of Habitat

1. Evaluate relationships between, and functional importance of, habitat-forming living substrates to commercially important species, including juveniles.

2. Develop a time series of the impact of fishing on GOA, AI, and EBS habitats that could be used to assess: a) the impact of changes in management on the rate of habitat disturbance, and b) the impact of habitat disturbance on the growth, distribution, and reproductive success of managed species.

3. Evaluate effects of fishing closures on benthic habitats and fish production. There are many closures that have been in effect for various periods of time for which evaluations have not been conducted. Recent example include slope HAPCs designated in the western Gulf of Alaska.

IV. Other areas of Research Necessary for Management

A. Expanded Ecosystem Studies

1. Environmental influences on ecosystem processes

a) Climate variability: Changes in ocean temperature may affect managed species, upper level predators, and lower trophic levels.

(1) Sea ice: If recent changes in ice cover and temperatures in the Bering Sea persist, they may have profound effects on marine communities. Development and maintenance of indices of the timing and extent of the spring bloom is a high priority. For this, maintenance of moorings, especially M-2, is essential.

(2) Zooplankton production: Apparent declines in zooplankton wet weight over the shelf, measured by the Oshoro Maru, could imply the loss of critical copepod and euphausiid prey of important commercial species, such as pollock, as well as the ESA listed North Pacific right whale.

(3) NMFS and BSIERP scientists should evaluate EBS survey data collected in 2008 during the summer trawl survey, acoustic surveys, and the BASIS cruises to assess whether these surveys will provide reliable estimates of zooplankton species composition and abundance for the Eastern Bering Sea. Evaluate the potential of collaborative research with Japanese and Russian investigators to assess species composition and abundance in samples archived abroad.

(4) Fish composition: NMFS and BSIERP scientists should complete proposed analysis of existing data sets (bottom trawl surveys, acoustic trawl surveys, and BASIS surveys) to quantify changes in relative species composition of commercial and non-commercial species, identify and map assemblages, and monitor changes in the distribution of individual species and assemblages. Additional monitoring may be necessary in the Aleutian Islands and other areas of the Gulf of Alaska.

(5) Assess the movement of fish, to understand the spatial importance of predator-prey interactions in response to environmental variability.

2. Trophic interactions.

a) Diet information, from seasons in addition to summer, is needed to assess spatial and temporal changes in predator-prey interactions, including marine mammals and seabirds. The diet information should be collected on the appropriate spatial scales for key predators and prey to determine how food webs may be changing in response to shifts in the range of crab and groundfish.

b) Ecosystem structure studies: Studies are needed on the implications of food web interactions of global warming, ocean acidification, and selective fishing. For instance, studies are needed to evaluate selective removal of some components of the ecosystem (e.g., Pacific cod, pollock, and crab) relative to others (e.g., arrowtooth flounder).