North Pacific Fishery Management Council

Stephanie Madsen, Chair
Chris Oliver, Executive Director

605 W. 4th Avenue, Suite 306
Anchorage, AK 99501-2252

Telephone (907) 271-2809

Fax (907) 271-2817

Visit our website: http://www.fakr.noaa.gov/npfmc

Certified:_____
Date:_____

SCIENTIFIC AND STATISTICAL COMMITTEE
to the
NORTH PACIFIC FISHERY MANAGEMENT COUNCIL
April 3-5, 2006

The Scientific and Statistical Committee met during April 3-5, 2006 at the Hilton Hotel in Anchorage, AK. Members present were:

Gordon Kruse, Chair *University of Alaska Fairbanks*	Pat Livingston, Vice Chair *NOAA Fisheries—AFSC*	Keith Criddle *Utah State University*
Steven Hare *International Pacific Halibut Commission*	Mark Herrmann *University of Alaska Fairbanks*	Anne Hollowed *NOAA Fisheries—AFSC*
George Hunt *University of Washington*	Seth Macinko *University of Rhode Island*	Steve Parker *Oregon Department of Fish and Wildlife*
Terry Quinn II *University of Alaska Fairbanks*	Farron Wallace *Washington Dept of Fish and Wildlife*	Doug Woodby *Alaska Department of Fish and Game*

Members absent:

Sue Hills *University of Alaska Fairbanks*	Franz Mueter *University of Washington*	Ken Pitcher *Alaska Department of Fish and Game*

D-1(a) Initial Review of EA/RIR for GOA dark rockfish

Diana Stram (NPFMC) presented a draft EA to remove dark rockfish from the GOA groundfish FMP and defer management responsibility for dark rockfish to the State of Alaska. There was no public testimony.

Dark rockfish were officially recognized as a distinct species from dusky rockfish in 2004 and the Council initiated the EA in 2005 following recommendations by assessment authors, Plan Team and SSC for removing dark rockfish from the FMP and transferring management authority to the State of Alaska. The rationale for removing dark rockfish provided in the EA was analogous to that used in similar action to remove black and blue rockfish from the GOA FMP (Amendment 46) because this species is assumed to inhabit nearshore, shallow waters, and could be locally overfished within the larger PSR complex TAC. Most of the available information is from the shelf trawl survey, offshore commercial fishery and at least recently from the black rockfish commercial jig fishery.

The SSC finds the information insufficient to determine the geographic and depth distribution of this species. Limited information suggests that there are no conservation concerns at this time. **The SSC recommends that the EA include an alternative to delegate management authority to the State of**

Alaska while retaining the species in the FMP and that the analysis should encompass both the GOA and BSAI FMPs for consideration. Because of the extensive nature of recommended revisions and because there appears to be no urgent action needed before public review, the SSC wishes to review a revised EA prior to public release. The SSC understands species level catch will be collected beginning in 2006 and this information will be necessary for further development of the EA.

The SSC offers the following comments and suggestions as future EA revisions:

- Revise and/or reformat trawl survey distribution figures to be more informative.
- Provide trawl survey catch and biomass detail to the lowest possible resolution.
- Provide a comprehensive detail of efforts to improve catch information and present current total mortality estimates (state and federal waters) by gear type, depth strata, and highest spatial resolution.
- Provide detailed information on the targeted black rockfish fishery especially with respect to bycatch of non-target species and discard (management and/or market produced).
- Provide a summary of State management measures for black rockfish and efforts to collect information to meet management and assessment needs.
- **Strengthen the rationale for the proposed action and align it with current knowledge and uncertainties concerning the distribution of this species.** The rationale also assumes that the State of Alaska will actively manage dark rockfish and that dark rockfish will be provided with additional protection from overfishing compared to the status quo. This assumption and associated caveats should be explicitly evaluated. Further, the EA rationale should provide a clear explanation why dark rockfish should be removed from the FMP, while other species such as widow and yellowtail rockfish should remain. These issues may best be discussed as part of the non-target species group.
- In evaluating effects of the alternatives, the EA should describe the management options available if a conservation need arose.
- The EA should explore trends in landings by fishery presented in Table 18, as these may influence the variability of incidental catch levels of dark rockfish. Recent observed changes in prevalence of dark rockfish in the catch and in the trawl survey, if sustained, may have implications for the evaluation of the alternatives.

D-1(b) Review of EFP for longline for silvergray rockfish

The SSC received an EFP presentation by Dan Falvey (Alaska Longline Fishermen's Association) and a draft EA presentation from Jason Gasper (NMFS-AKR) to test shrimp fly troll gear to target rockfish in the SE Outside district of the GOA from 2006-2009. There was no public comment.

The SSC encourages these types of cooperative studies between industry and scientists to improve information on undersampled species, develop fishing techniques that reduce bycatch and seabird interactions, and to help address the National Standards of the Magnuson-Stevens Act.

The objectives of the EFP are to: 1) collect information on age, growth, and distribution for shelf and slope rockfish species, 2) document gear selectivity for available species and 3) develop harvest techniques for underutilized POP, PSR, and OSR while minimizing incidental catch of halibut and sablefish. The long-term objective of the project is to develop a targeted fishery for selected species in the PSR and OSR complexes.

Based on previous EFP data, the most likely target species is silvergray rockfish in the OSR assemblage, although targeting of black and dusky rockfish may also occur. This assemblage consists of 15 species,

most at the northern part of their range. The SSC expresses concern about expanding directed fishing on un-assessed rockfish species with little direct knowledge of population status. We note that two of these species are overfished off the West Coast (darkblotched rockfish and bocaccio). Due to economic incentives to target silvergray in the current EFP, further development of gear to target POP is unlikely.

The SSC seeks clarification whether or not groundfish catch under EFP provisions will count toward the assemblage TAC or will be outside the TAC. If catch counts against the TAC, the SSC is concerned that the combined EFP and incidental OSR catch in other fisheries would trigger placement of OSR on prohibited species status with the result that other fisheries would be forced to discard marketable incidental catch. If the catch is accounted outside the TAC, then EFP catch would not limit retainable catch in other fisheries. The EA needs to clarify the catch accounting process and the implications of attaining the TAC during the lifespan of the EFP.

Sampling design considerations

Collection of biological information on these lightly exploited rockfish populations will provide important baseline data for future assessments. **The EFP should develop a priori sampling goals to provide optimal sample sizes, incorporate vessel variability, and document spatial and seasonal distribution changes in order to adequately describe the targeted populations.** The usefulness of the biological data would be greatest if it covered the largest geographical scale feasible.

Economic data collection

The SSC discussed data that would be made available to evaluate fishery economics. Collecting information on costs would be useful, but are not planned.

Observer coverage

The SSC views at-sea data collection as critical to the success of this experimental fishery. Ideally, 100% observer coverage is necessary to capture rare bycatch events, represent the various fishing techniques used to target different species effectively, and to ensure compliance with EFP full retention rules. Therefore, the SSC recommends the highest level of coverage possible. The use of video monitoring may be a feasible alternative to enhance the ability to document and analyze bycatch and seabird interactions for vessels lacking observer coverage in the fishery. Given the number of vessels participating in the fishery, and their inherent variability, comprehensive data collection is important to assess the success of the experiment.

Specific observer deployment guidelines and sampling procedures for both at-sea and shoreside sampling should be developed prior to implementing the EFP to ensure sampling consistency and adherence to overall sampling design. At-sea observers should record the presence and absence of seabird interactions with the gear during deployment and retrieval. On retrieval, it appears possible to detail any interactions between seabirds and hooks with and without fish, including noting any damage to fish to determine how seabirds may influence product quality.

D-1 (c,d) Progress Report on BSAI salmon bycatch amendment and Salmon Research Workshop

Diana Stram (NPFMC staff) provided an overview of the problem statement and suite of alternatives for amendment package 84B. Public testimony was received by Karl Haflinger (SeaState), Jennifer Hooper (Association of Village Council Presidents), Mike Smith (Tanana Chiefs Conference), and Becca Robbins (Yukon River Drainage Fisheries Association).

Analysis and refinement of the current salmon savings areas may be necessary in the event pollock vessels either surrender or lose their exemption and return to fishing under the regulatory salmon bycatch program. There is a need for development of more effective alternatives to the voluntary rolling hot spot

system (VRHS). Amendment packages B-1 and B-2 are intended to provide those additional alternatives. Amendment package B-1 would be to establish new regulatory salmon savings systems that take into account the most recent available salmon bycatch data. Amendment package B-2 would be to develop a regulatory individual vessel salmon bycatch accountability program.

Salmon Workshop

The SSC conducted a salmon research workshop intended to aid in the discussion and development of bycatch management alternatives, such as biomass-based caps, updated salmon savings areas, and analysis of the current system under VRHS. Jim Ianelli (AFSC) provided a report on salmon bycatch patterns in the Bering Sea pollock fishery. Jim Murphy (AFSC) presented BASIS survey results on distribution and abundance of salmon in the Bering Sea. Richard Wilmot (AFSC) presented information on the stock origins of salmon caught in the Bering Sea groundfish fishery. Jim and Lisa Seeb (ADF&G) presented work on development of standardized DNA baselines for identifying mixtures of salmon stocks. Tony Gharrett (UAF) reported on genetic methods for determining salmon stock origins. Gene Sandone and Dan Bergstrom (ADF&G) presented information on Chinook and chum salmon stock status in the AYK region. Lastly, Alan Haynie (AFSC) presented information on incentives for bycatch avoidance. Summaries of the workshop presentations will be posted on the NPFMC website by Council staff.

SSC Discussion

The ensuing SSC discussion focused on attempting to address the following questions:
1) How to craft biomass-based caps?
2) What are innovative ideas for salmon savings systems and how to craft them to be more responsive to changing conditions?
3) What are appropriate milestones and standards for effective bycatch reduction?

Given the recent bycatch rates and presentations at the workshop, it is clear that the current state of knowledge is in flux so the Council should anticipate that additional changes may be required as research projects are completed.

How should we craft biomass based caps?
The SSC notes that developing a basis to establish biomass-based caps will be difficult and perhaps years away. Improved escapement enumeration and identification of salmon to stock of origin are required. Progress is being made in these areas.

To establish an abundance index, time trends of average run size from regions that correspond to the origins of salmon in the bycatch would be needed. This would allow analysts to assess whether increases in the encounter rate of salmon in the pollock fishery are a function of population trends. If an index of this type could be developed, then bycatch caps could include adjustments for the status of salmon runs likely to be contributing to bycatch.

In addition to run size indicators by stock, it may be possible to utilize the BASIS survey to infer future returns of Alaskan origin salmon in the EBS. If the survey is used in this manner, NMFS should attempt to standardize the start date and station grid used for the BASIS survey to reduce the potential for missing out-migrations of salmon in some years. Such projections would need to adjust for natural mortality rate and migration. NMFS should also review the station spacing to assess whether the station allocation is appropriate for a comparative analysis of distribution and abundance of chum and Chinook salmon.

The information on the stock origin by age was informative, and the SSC recommends that the data collected from the EBS shelf be re-evaluated to assess the potential impact of age on the composition of

home stream origin. The analysis of the home stream origin of salmon appeared to reveal that the regional contribution to the sample changed with age. This suggested that older salmon might have a different regional breakdown than younger salmon. This makes sense on two grounds: (1) younger salmon may not be fully mixed with the adult population, and (2) adult salmon from different regions may occupy different parts of the Bering Sea and sub-arctic Pacific thus, at older age groups we would see different regional contributions to the sample. Perhaps there are other explanations for the result. The bottom line is that there appears to be an age effect on regional partitions of home stream of origin. If this is the case, then the samples from the Bering Sea need to be re-examined to evaluate whether this effect could be impacting our samples.

Genetic analyses indicate that salmon from a broad geographic range of stocks contribute to salmon bycatch in pollock fisheries. Future cap calculations should reflect the likelihood that the origin of salmon captured as bycatch varies with season and location over the EBS shelf and slope. The SSC commends the collaboration of state, federal and academic geneticists and encourages these scientists to continue to work together to develop SNPs and microsatellite markers to assess home stream origin of salmon captured as bycatch. It is also recommended that geneticists work together with the industry on a sampling plan that will provide a reasonable representation of the annual bycatch. Given the apparent dependence of home stream origin on age, and the potential for shifts in the spatial distribution of pollock fishing, this study should include multiple years of sampling. The investigators should also determine the desired sample size necessary to assess home stream origin of schools encountered by commercial groundfish fisheries.

The SSC recommends devoting research to oceanographic factors influencing the spatial and temporal distribution and concentration of salmon. This includes an investigation of prey distributions relative to spatial distribution of salmon over the EBS shelf.

Other research should be devoted to examining vessels with a history of low bycatch rates. Factors such as gear configuration, deployment procedures or other fishing methods might be important determinants of salmon bycatch rates. If such factors can be associated with "clean" fishing then those might be more broadly applied to the fleet.

Dr. Ianelli recommended that a robust cap linked to an index of the catch rate in the pollock fishery could be considered. The SSC also considered the possibility of using in-season bycatch rates to establish in-season caps. Several problems with this approach were noted including: the lack of evidence that bycatch rates are an indicator of abundance and the possibility that the bycatch rate could be intentionally influenced to inflate the cap. The SSC noted that bycatch rates may vary with changes in abundance or density or both.

Given the current state of knowledge and potential difficulties in achieving research results in the near-term, the SSC discussed the possibility of setting an interim precautionary – arbitrary cap. The SSC concluded that setting an arbitrary cap was not a scientific issue but something that the Council would need to negotiate among the interested parties.

Innovative ideas for a salmon savings area

The SSC noted that the existing rolling hotspot approach is a logical way to attempt to control bycatch at the current time. A problem with the current situation is that the base rate continues to change. **Incentives should be considered to get fishers to move back into closed areas after they are reopened to collect post-closure bycatch rates in those areas.** It was noted that both bycatch rate of salmon and catch rate of pollock decrease at night but the drop in salmon bycatch is greater than the drop in pollock catch. However, it is not clear that a shift to night-time fishing is practical.

Historical salmon spatial bycatch patterns should be analyzed to determine if there are coherent shifts that might allow for periodic adjustment of closure areas. The Council may wish to consider techniques, including whether shifts in the A and B fishing season apportionments can yield additional salmon savings.

Individual vessel accountability programs

The SSC briefly discussed individual bycatch quotas. One idea put forward, given the lack of data, would be to put the fleet in competition to reduce salmon bycatch by posting a bond that would be distributed back to a portion of the fleet with the lowest bycatch rates of the end of the season (and perhaps affected Alaska communities). Any individual vessel accountability strategy would put a focus on getting good counts of salmon in the catch, which might put additional pressure on observers. Any vessel accountability program would also require a mechanism to limit catch and the identification of a target cap.

SSC Comments on Workshop

The SSC appreciates the efforts of the Council staff to organize the workshop, and extends thanks to all the presenters for providing us with the most up to date information on their research efforts. It is clear that the combined efforts of the several research programs are leading us towards a much better understanding of the origins of salmon taken as bycatch and their distribution in the Bering Sea.

D-2 Crab Management

Diana Stram (Council staff) provided an overview of a two-day crab-overfishing workshop held in Seattle at the end of February. There was no public testimony. The purpose of the workshop was to provide advice and discussion to the four members of the Crab Workgroup, who are working on an amendment to revise overfishing definitions. Unresolved issues among these members created an impasse making further progress impossible, so the workshop was developed as a way to resolve problems (see SSC minutes, October 2005). The workshop idea came out of a teleconference with Council staff, SSC members, and the Crab Plan Team chair.

The workshop was expertly organized and set up due to the tireless efforts of Diana Stram and Jim Ianelli. Five SSC members attended (Kruse, Quinn, Hollowed, Livingston, Woodby) with additional outside expertise on crab biology by Bernard Sainte-Marine and Brad Stevens, on modeling by Andre Punt, and overfishing by Grant Thompson. Several other agency staff and Crab Plan Team members attended, as detailed in the workshop report.

The SSC notes that the workshop was successful in helping to resolve issues. The report contains helpful advice and recommendations on crab biology, modeling, and a simplified and clarified Tier system for defining overfishing.

Additional activity will occur between now and the June Council meeting. A CIE review will occur at the end of April and will be presented to the Crab Plan Team in May and SSC in June. Council staff will flesh out the EA, including the problem statement, alternatives considered, analysis of alternatives, and the process envisioned for Council consideration of alternative overfishing definitions. The Crab Workgroup will continue to enhance the analytical framework and to develop scenarios for analysis featuring important aspects of crab biology and dynamics.

The SSC endorses the workshop recommendations, subject to the following clarifications to the workshop report:

1. Page 5, summary point 2: Insert "necessary to" before "include."
2. Page 5, Spawning stock biomass, recommendations, point 2. The SSC recommends including a statement that the precise method to incorporate males in SSB should be left to the discretion of the stock assessment authors pending approval by an open peer review process.
3. Page 6, first sentence under summary points and first recommendation. The SSC had some confusion about reconciling this summary point and recommendation concerning female natural mortality. The SSC requests that the workshop organizers clarify the current maximum age being used and contact the session chair to resolve an apparent discrepancy in these two statements.

Other clarifications needed in the future:

1. On page 8 of the workshop report, there is a suggestion for additional technical guidance to the Crab Workgroup in the next few months. Such guidance could come from SSC members and others including Bernard Sainte-Marie, Andre Punt, and David Armstrong, among others. The SSC will consider the formation of a technical subgroup at the June Council meeting.
2. On page 9 of the workshop report, the necessity of coming up with a formal Council review process for crab overfishing is described (such as review by the Crab Plan Team, SSC, and Council annually). The SSC concurs with the workshop report that the EA will have to discuss this process. If the review is to start with the Crab Plan Team, then the composition of the Team should be examined to assure that it has the necessary expertise. In this regard, the Council should consider adding members to the Crab Plan Team who have expertise in stock assessment and crab biology.
3. The proposed Tier system includes a reduction in fishing mortality when the stock declines below B_{msy} or its proxy. The slope of the decline is controlled by the parameter α. A default value for α should be defined to be consistent with the goal of conservation of the resource.
4. In Tier 3, the workshop recommended MSY proxies from SPR values of 50 to 60%. After analysis by the Workgroup, a different and possibly flexible range of values may need to be used instead. A default value should be identified in the tier system to be consistent with the goal of conservation of the resource.
5. In Tier 4, a multiplier γ is used to scale natural mortality (unlike groundfish which has no multiplier) for calibration purposes, particularly in moving from total mature biomass of males and females to biomass of legal males or some other metric. After analysis by the Workgroup, a restricted range of values for γ may be useful, so that OFL is not too free-ranging.
6. The workshop report was very helpful in noting which issues should be left to the discretion of the stock assessment author, rather than being specified in the amendment. As with any stock assessment, the stock assessment authors need to be able to explore their choices of models or approaches. Deviations from workshop recommendations should be justified and will be subject to subsequent review.

D-3 Scallop SAFE report

The SAFE report for weathervane scallops was presented by Diana Stram (Council staff) and Jeff Barnhart (ADF&G). A video on the operation of the scallop fishery with commentary by Observer Program staffer Joe Chaszer was also shown to the SSC. There was no public testimony. The SSC commends the authors and presenters for providing the document well in advance of the meeting and a clear presentation. The SAFE document continues to improve and the incorporation of new elements in response to past SSC comments is appreciated.

Prices paid for scallops are at record highs, having surpassed $10/lb in Alaska, a trend that is likely to increase interest in the scallop fishery. The history of the scallop fishery shows that it is vulnerable to

overfishing, with three areas currently closed to fishing (Dutch Harbor, Alaska Peninsula and Semidi), ostensibly the result of large, unsustainable removals. Against that background it should be noted that commercial CPUE, one of the main indicators of the status of stocks, is at historic lows in 4 of the 6 areas where commercial harvest occurs (Area D, Area E, Cook Inlet, and Bering Sea). A number of cautions against interpreting low CPUE as an indicator of poor stock status were offered, including poor weather, presence of kelp on the grounds, etc. However, most of these factors are in play to some degree every year. The SSC recommends that a more detailed analysis of the CPUE data be undertaken to obtain a better understanding of the apparent declining trend in CPUE. For instance, based on a characterization of the data, a General Linear Model (GLM) approach would be feasible for attempting to standardize CPUE by taking into account explanatory factors (see Quinn and Deriso 1999, section 1.3 for methodology).

One of the most important considerations in determining an overfishing definition for scallops relates to the extent to which they form a unit stock or a collection of discrete stocks. **The SSC recommends that genetic and isotope studies to address this issue be given top priority.** Related to this is the issue of larval drift, a research topic the SSC has previously identified as important.

The dredge surveys assume 100% catchability of scallops within the path of the dredge. The effect of this assumption is to generate a conservative biomass estimate. Other (East Coast) scallop surveys use catchability values as low as 50% or less. Catchability is likely affected by several factors. **The SSC recommends investigating dredge survey catchability to improve the accuracy of biomass estimates.**

Presently, just two of the 10 scallop management areas are surveyed. Video survey assessment methodology is being developed and the SSC looks forward to seeing the results of the video surveys, which will be conducted again in 2006. **The SSC strongly supports extending video surveys to all regions, if possible, and suggests extending surveys to unfished, as well as fished, areas to more completely characterize scallop abundance.**

Discards from the scallop fishery include both other species as well as undersized scallops. In some areas, the undersized component can constitute as much as 50% of the catch. **The survivability of these discards is unknown and should be investigated.**

The SSC offers the following recommendations on the SAFE:

1. Provide standard errors for all CPUE indices.
2. Provide standard errors for the dredge survey biomass estimates.
3. The discussion under the Overfishing Definition (section 5.0) should be clarified with respect to the statement, “This appears to represent a disconnect between discrete scallop beds and fishing areas and the statewide overfishing definition.” It is not so much a disconnect, but rather a realization that development of status determination criteria on smaller spatial scales cannot be achieved until better survey methodology becomes standard in all areas.
4. In the Bycatch section (7.0), the statement is made that the scallop fishery has 100% observer coverage. This should be revised to reflect the actual situation.
5. The GHRs have changed over time in several areas. The rationale for these changes is not given in the SAFE and should be included as part of the history and management of the fishery.
6. Figures 20-22, which illustrate areas open and closed to scallop fishing along with NMFS trawl survey catches of scallops, should be redrafted so they are interpretable when reproduced in black and white.
7. Inclusion of an ecosystem impacts section. This could include discussion of such issues as the impact of the dredges on bottom habitat; the possible effects of discarding scallop shells in areas other than where harvested; inclusion of crab bycatch levels.

D-5 SSC 2006 Research Priorities

In assembling this list of research priorities, the SSC has focused on five broad themes: Stock Assessment, Stock Surveys, Ecosystem Studies, Social and Economic Data and Analyses, and Fishery Performance and Monitoring. In keeping with past practice, we have provided an extensive, but not exhaustive, list of critical gaps in data and analysis that would inform Council decision-making. It is not anticipated that all of these research priorities can be addressed in the upcoming year or that they could be addressed with funding from a single source. Instead, the SSC anticipates that state and federal agencies, universities, and foundations will consider this list in the context of their unique research missions and that these entities will incorporate elements of this list that overlap with their specific areas of interest and stewardship. In a departure from previous practice, we have highlighted a group of particularly timely or pressing research priorities within each of the broad themes; these highlighted research priorities represent gaps in data and analysis that we consider to be particularly important for addressing current or emerging management issues.

A. Critical Assessment Problems

The SSC notes that continued research on the life history of groundfish, crab and scallop should be considered an essential activity to improve stock assessments and management of managed resources. The SSC encourages research by academic and governmental agencies to collect this information. Critical life history research topics include: estimates of natural mortality (including temporal shifts in predation for target species), size-at-maturity or age-at-maturity (including environmental factors influencing maturity schedules), maternal effects (especially for Pacific cod and long-lived species such as rockfish), environmental impacts on growth, and environmental factors influencing reproductive success. The following lists identify high priority research for groundfish, crab and scallops.

<u>Groundfish (GPT number corresponds to the November 2005 plan team list)</u>

1. Rockfish – a general need for improved fishery independent estimates of abundance, catch, stock structure, and biological variables. (GPT A3)
    a. Supplemental trawl survey biomass estimates to address patchy distribution (also see section B).
    b. Age samples from the fishery, esp. POP, northern rockfish, and dusky rockfish. There is a need to increase the number of age determinations annually conducted for rockfish and to train researchers to make age determinations on species that are difficult to age.
2. Improved stock assessment of "other species." Items a through f below come from the Plan Teams, although item d has been revised by the SSC. The SSC ranks items a, d, and e very high because they form the basis for a tier 5 calculation. (GPT A2)
    a. Improved identification of priority species within each group in the fisheries by both processors and observers to avoid misidentifications, as well as categories containing large numbers of unidentified species.
    b. Species-specific identification of priority species on scientific surveys, including NMFS trawl and longline surveys, IPHC surveys, and ADF&G surveys.
    c. Improved biological data collection via enhanced survey sampling, fishery port sampling and at-sea observations, including collection of lengths and age structures for priority species.
    d. Alternative indices of abundance (and biomass) and fishing mortality are necessary for species for which standard surveys are inadequate. With an increase in the

number needed stock assessments, it will be critical to develop alternative estimates of abundance and/or direct estimates of fishing mortality. Two possibilities that 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.

e. Life history information (specifically, natural mortality, size at maturity, and other basic indicators of stock production) must be improved for many members of the others species complex to allow application of Tier 5 or Tier 4 assessment criteria. Little information is available especially for sculpins, skates, octopuses, squids, grenadiers and some sharks.

f. Improved catch histories for groups in this complex for improved stock assessment and application of Tier 6 criteria. Greater use of historical foreign observer data is needed, as part of this activity.

3. Research is needed to incorporate seasonal movements, and stock boundaries of managed species into stock assessments. Expanded genetic research is needed to identify stock boundaries. 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, Pacific ocean perch, and Atka mackerel,. (GPT A13, modified from GPT A6c)
4. Incorporating uncertainty into the stock assessment advice. This requirement was proposed in the PSEIS, but progress towards amending the groundfish guidelines to address this issue has not been started. Management strategy evaluations are also encouraged because these evaluations serve as useful tools to assess the efficacy of harvest control measures under different assumptions regarding stock production. (GPT A15).
5. Efforts to incorporate ecosystem considerations into stock assessments should be accelerated through research to improve knowledge of the functional relationship between environmental factors (e.g. physics, competition, and predation) and recruitment, growth, natural mortality and availability to surveys. (GPT C1)

Crabs

1. Natural mortality (M) estimates. Estimates of M (obtained independently from models) are needed for all stocks (except Bristol Bay red king crab), with highest priority assigned to Tanner and snow crabs. (ADF&G overall priorities (1), ADF&G Stock Productivity (1-9), AFSC (8).
2. Conduct field studies to improve knowledge of growth increments and the relationship between shell condition and age of Bering Sea Tanner and snow crabs. (ADF&G overall priorities 2, ADF&G Growth (14), AFSC (4).
3. Improve understanding of seasonal movements and natural mortality of crabs through mark recapture studies (ADF&G overall priorities (2), ADF&G Stock Structure (6), ADF&G Stock Productivity (1) and AFSC (1)).
4. Improve understanding of processes influencing the fertilization rate of egg clutches, including consideration of spatial dynamics of crab reproduction and contribution to reproduction by males as a function of size and time post molt. Primary emphasis is on snow and Tanner crabs, with secondary emphasis on red king crab. (ADF&G overall priorities 3, ADF&G Reproduction (18 - 24), AFSC (3, 15 and 16)

5. Conduct studies to improve crab aging using radiometric aging or lipofuscin. ADF&G Growth (10, 12, 16), AFSC (2, 10 and 12).
6. Improve understanding of processes controlling recruitment dynamics for all FMP crab species. Incorporate these processes into scenarios regarding temporal trends in recruitment. Perform a management strategy evaluation using variable recruitment scenarios. This is a very broad topic encompassing the need to identify and assess biological and environmental effects on egg production, egg hatching, and larval survival, as well as mechanisms controlling the abundance of juvenile crabs from settlement to recruitment into the fishery. Factors include larval transport, predation, competition, and habitat availability. Primary emphasis is on stocks currently declared overfished: eastern Bering Sea Tanner crab, St. Matthew Island blue king crab, eastern Bering Sea snow crab, and Pribilof Islands blue king crab. (ADF&G Settlement and Recruitment (25, 30), AFSC (18))

Scallops

1. Development of an age-structured model for assessment of abundance to be applied to each stock (e.g., Yakutat, Prince William Sound, Cook Inlet, and so forth).
2. Identify larval sources, as well as advective pathways, to evaluate the potential effects of fishing on recruitment for major beds.
3. Estimate survival rates for discarded scallops and of scallops that are encountered but pass through the dredge rings.
4. Investigate causes of high natural mortality recently observed in the Cook Inlet fishery, and of the "weak shell" syndrome observed in the Yakutat area.

B. Stock Survey Concerns

The SSC notes that continuation of annual or biennial surveys in the GOA, AI and EBS are a critical aspect of natural resource management. These surveys provide baseline distribution and abundance data that form the foundation for stock assessments and the development of ecosystem approaches to management. These surveys should be considered a high priority research activity.

Groundfish (GPT number corresponds to the November 2005 plan team list)

1. Direct observations (e.g., submersible and dive surveys) to compare fish densities, particularly for rockfish, between trawlable and nontrawlable habitats. (GPT B5 and B9).
2. Increase knowledge of the acoustic sign types and target strength to length relationships to allow assessment of other targets during hydroacoustic surveys. (GPT B12).
3. Expand surveys beyond typical boundaries to include the shelf break and the northern Bering Sea to evaluate the fraction of the stocks that are not assessed by the shelf survey. (GPT B3).
4. Improved surveys for minor rockfish species to verify range relative to standard surveys.
5. Expand the collection of underway oceanographic data and marine mammal sighting during standard assessment surveys (see C4).

Crabs (Source noted in parentheses)

1. Conduct calibration studies to assess survey selectivity and catchability of snow crab, Tanner crab, and blue king crab with current trawl survey gear and new survey net. ADF&G over all priorities (4), ADF&G (5 &6), and AFSC (5 and 6).

Scallops (SPT number corresponds to numbered list in Appendix E of Scallop FMP)

1. Expansion of the recently developed remote video survey method for two objectives:
   a. To estimate densities and abundance in major fishing areas as well as in nearby unfished areas (to monitor environmental effects independent of fishing), and
   b. To estimate catchability coefficients for commercial and research dredges.

C. Expanded Ecosystem Studies

In developing a "short list" of priority research questions for ecosystem studies, we had to select from a large number of valuable research questions brought forward by the Plan Teams. The research priorities brought forward by the SSC were seen as potentially having impact on management decisions. (For reference the GPT number corresponds to the November 2005 Groundfish Plan Team list.)

1. Habitat mapping. Improved habitat maps are required to identify essential fish habitat and to support habitat-based models of distribution and abundance. Such models have great potential to lead to improved estimates of stock size and will help resolve the spatial structure of stocks and ecosystems. (This includes current research topic GPT C12). Especially for demersal fishes and shellfish, the distribution of habitat types may interact with changes in water column characteristics, such as temperature, to constrain future distributions and abundances of these species.
2. Forage fish. Understanding the dynamics of important pelagic and benthic forage species, such as capelin, herring, myctophids, euphausiids, shrimp, squid, and juvenile pollock remains a high priority for understanding energy flow to commercially important species and to protected species, including seabirds and mammals. Innovative approaches to assessing such stocks are needed and may include novel acoustic techniques (e.g. low-frequency sound), air-borne surveys, and indices based on the diet of predators, including seabirds or marine mammals. (Current research topic GPT C6 and item (3) under GPT C8).
3. Ecological effects of bycatch and discards. Selective removal of certain species of certain size ranges can affect the relative abundance of fish communities, perhaps with consequences on their ecological interactions. Moreover, fishery discards can favor scavenging species over others, perhaps with consequences on groups, such as seabirds and benthic communities.
4. Climate change and fish communities. If recent changes in ice cover and temperatures in the Bering Sea persist, they may have profound effects on marine communities. Existing data sets (bottom trawl surveys, BASIS surveys) can be used 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. (GPT C18, as well as GPT C9)
5. Environmental effects on recruitment and growth. Studies on effects of climate on recruitment and growth (GPT C1) could include the development of standard environmental scenarios for future variability based on observed patterns (GPT C2). There is also a clear need for information that covers a wider range of seasons than presently available (GPT C8).

6. Nutrients and lower trophic levels. There is limited information regarding nutrient dynamics and phytoplankton/zooplankton dynamics on the Bering Sea and Gulf of Alaska shelves (e.g., supply of nutrients to the shelf, interannual variability and changes in nutrient supply, potential for HABs, etc.). Recent advances in technology such as towed undulating vehicles with various sensors and plankton recorders allow high-frequency sampling of both nutrients and plankton. Such sampling could support detailed process studies as well as the development of relatively low-cost monitoring programs in conjunction with existing surveys or through new surveys. (Some of GPT C3).
7. Advancing ecosystem approach to fisheries management. This includes development of suitable indicators and indicator species (including novel approaches such as using corticosterone levels in predators as an indicator of prey availability (GPT C20), developing ecosystem reference points, including OY cap considerations (CPT C11), and improvements of current ecosystem models (GPT C8). Standardization of "future scenarios" (GPT C2) will help to promote comparability of model outputs. Process-oriented research focused on local impacts of fishing on prey availability for top trophic level consumers will also be informative.

D. Social and economic research

The need for the development and continued maintenance of basic social and economic information databases on the fisheries and fisheries dependent communities of GOA and BSAI is made ever more pressing as the Council continues to adopt actions that are intended to improve the long term net benefits derived from fisheries. This information is required for establishing a baseline to be used in identifying stakeholders to be included in the distribution of dedicated access privileges (e.g., harvesting quotas and processing quotas), a baseline to be used for projecting the likely consequences of alternative management measures, and as a baseline for retrospective analysis of management actions that have been taken.

Particularly pressing research needs include:

1. Development of an ongoing database of product inventories (and trade volume and prices) for principal shellfish, groundfish, and salmon harvested by US fisheries in the North Pacific and Eastern Bering Sea.
2. Analyses of current determinants of exvessel, wholesale, international, and retail demands for principal seafood products from the GOA and BSAI;
3. Pre- and post-implementation studies of the benefits and costs, and distribution of benefits and costs 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.
4. Prospective analyses of the robustness and resilience of alternative management strategies under varying environmental and ecological conditions; and,
5. 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).

Kodiak is at the center of controversy associated with the recently adopted crab rationalization program. What were the direct and indirect impacts and how were the impacts distributed throughout the community? As Kodiak is also likely to be at the center of controversy over the likely

consequences of Gulf rationalization, it would be particularly advantageous if research could be designed to use Kodiak or other Gulf communities as case studies in analyses of the effects.

Additional important research needs include:

1. Development of longitudinal data sets of:
    a. Transaction level observations of exvessel, wholesale, and retail prices;
    b. Daily or weekly, firm-scale data on production by species and product form;
    c. Trip-scale data on variable costs (e.g., fuel, labor, supplies, etc.) for catcher vessels, catcher-processors, and sportfishing charters (this data should be matched with existing data on catch, catch composition, and production);
    d. Daily or weekly plant-scale data on variable processing costs (e.g., fuel and power, labor, supplies, packaging, etc.) for shore-based and floating processors;
    e. Annual vessel- or plant-level data on fixed costs (e.g., capital replacement, maintenance, repair, upgrades, insurance, etc.);
    f. Trip-scale information about the location and duration of fishing (e.g., VMS records, or observer information on steaming time, fishing time, etc.);
    g. Weekly or monthly data on patterns (location and magnitude) of expenditures associated with harvesting, processing, and sportfishing charters;
    h. Pay-period scale, vessel- and plant-level data on employment and income of fishery participants, especially crew and processing plant workers;
    i. Socioeconomic and demographic data for fishery dependent communities (income levels and distributions, population levels and distributions); and,
    j. Community- and regional-scale annual data on the distribution and magnitude of tax receipts and transfer payments associated with commercial and sport fishing.
2. Analyses or the development of models to evaluate:
    a. The evolution of community social and economic structure in response to alternative management actions:
        i. Baseline assessments of selected communities and industry sectors relative to social considerations identified by the Council and the Advisory Panel;
        ii. Field studies to elucidate the full array of linkages between fisheries and social and economic life in fishery dependent communities;
        iii. Regional economic models of activities and impacts associated with commercial, sport and subsistence fisheries;
        iv. Prospective and retrospective studies of the social and economic impacts of alternative management actions;
        v. Development of better methods for determining the social costs and benefits of management actions (e.g. through the use of non-market valuation techniques);
    b. The benefits, costs, and the distribution of benefits and costs associated with consumptive and non-consumptive uses of resources supported by the North Pacific and Eastern Bering Sea ecosystems:
        i. Cost functions for harvesting, processing, and sportfishing charters;
        ii. Producers and consumers surpluses associated with commercial fisheries under current and alternative management regimes;
        iii. The magnitude and distribution of benefits and costs associated with sport and subsistence harvests under current and alternative management regimes;

iv. Existence and option values associated with corals, seabirds, and marine mammals;

v. The value of ecosystem services;

c. Evaluation of alternative management strategies:

i. The cumulative efficiency and equity consequences of management actions that apply time/area closures;

ii. Management strategies and optimal yield for multi-use fisheries, e.g., commercial, sport, and subsistence fisheries for halibut and salmon;

iii. The relationship between sampling strategies and the confidence of bycatch estimates associated with individual and pooled bycatch quotas and the economic and social costs of bycatch;

iv. Changes in catch efficiency and operating costs associated with gear modification and avoidance behaviors intended to reduce bycatch;

d. Evolving seafood markets:

i. Mechanisms for providing and costs of traceability systems for certifying product and production process attributes of seafoods;

ii. Consumer demand for seafood ands its associated byproducts harvested from stocks that have been certified as sustainably managed.

E. Fishery Performance and Monitoring

The Groundfish Plan Team brought forward an expanded set of research needs to address bycatch and fishery monitoring (Sections E and F from the Groundfish Plan Team's November 2005 list). The SSC saw commonality among needs to describe bycatch and fishery catch, and developed the following merged set of top priorities for fishery performance and monitoring.

1. Improved onboard observations. Improvements in at-sea observations are needed in several areas:

   a. Observer deployment and coverage. There is a long-standing need to review the allocation of observers among fisheries to adequately characterize the total catch, as well as a review of sampling procedures (e.g., basket versus whole haul) employed by observers that form the basis for total catch estimation.

   b. At present, it is clear that observer coverage in some fisheries is insufficient for estimation of total bycatch. Examples include the sablefish longline fishery, skate fishery, Pacific cod pot and longline fishery, and halibut longline fishery. This results in imprecise bycatch estimates for species, such as skates, sharks, yelloweye rockfish, and sablefish in halibut fisheries.

   c. Conduct research on mechanisms to supplement observer program information. Improved means of data collection are needed, especially on small vessels. Research is needed on utility of other data collection methods, such as at-sea video monitoring, port sampling, and other direct methods.

   d. Improved biological data collection. There are needs to improve biological data collection (e.g., age, size, sex) of some bycatch species (e.g., sharks, skates, octopus, squid, sculpins, grenadiers) to better quantify potential effects of bycatch on these stocks. Better estimates of stock of origin are needed for salmon bycatch.

2. Research on discard mortality rates. Better estimates of discard mortality rates by gear and fishery is needed to estimate more accurately total bycatch mortality for all discarded species, with an emphasis on such species as crabs, skates, sharks, rays, and octopus.

3. Improved estimation methods for total catch (including bycatch) and fishing mortality of all target and non-target species. Two levels of improvements are needed:
    a. Improved estimation at the stock and fishery level. Assessment and management depend critically on catch estimates. More rigorous statistical methods for catch estimation need to be implemented (e.g., Miller 2005). Specifically, identifying sources of variability in actual and estimated bycatch rates is needed. Approaches to integrate estimates of variance on the observed portion of the fisheries into the total catch estimates are needed.
    b. Improved detailed estimation of catch for specific management programs. Some management programs (e.g., IFQ, cooperatives, other rationalization programs) require extensive record keeping to increasingly finer degrees of resolution (e.g., vessel, subareas). Research is needed to evaluate the effectiveness of reporting systems to newly developed management groups or practices.
4. Efficacy of bycatch mitigation measures. Research is needed on the efficacy of bycatch mitigation measures (e.g., PSCs, time/area closures) and their effects on populations of the bycatch and target species, effects of changes in abundance of bycatch species on bycatch rates, and methods for assessing the economic and social costs of bycatch.
5. Gear technology. Further research is needed on gear modifications for reducing bycatch, such as research that has been conducted to protect salmon, halibut, rockfish and seabirds.