Field type descriptions (in square brackets & red in the 'Field Type' column) refer to four types of fields:

- NUMERIC
- FIXED (drop-down list with a fixed set of succinct keywords/phrases)
- OPEN (drop-down list that we can add to, may have 2 levels, e.g. discipline/sub-discipline)
- TEXT (general text field, no limitation on length)

The other descriptor denote whether the field is required or not (i.e. may be left blank) and whether a single or multiple keywords/phrases may be listed!

Field Type	Fields	Notes
ID	ID number	*Unique ID number assigned to each research priority*
Primary Management Objective	Prevent overfishing Promote Sustainable Fisheries and Communities Preserve Food Web Manage Incidental Catch and Reduce Bycatch, Prohibited Species Catch, and Waste Avoid Impacts to Seabirds and Marine Mammals Reduce and Avoid Impacts to Habitat Promote Equitable and Efficient Use of Fishery Resources Increase Alaska Native Consultation Improve Data Quality, Monitoring and Enforcement	*These are the main management objectives as stated in Council documents and should be useful for organizing priorities.* *Research priorities may address several objectives but this field should identify a single, most relevant objective*
Secondary Management Objectives		*GLH suggested a field for one or more secondary management objectives, presumably with the same list of of objectives as above*

Field Type	Fields	Notes
Related Council action	Ongoing issues Harvest specifications Rebuilding plans Salmon PSC avoidance Crab PSC and bycatch avoidance Halibut PSC avoidance SSL protection and recovery Specific issues (examples) Halibut allocations HAPC canyons Arctic FMP Observer Program Crab rationalization Fishery Dependent Community Assessments ... General Other	*Description of ongoing/annual actions, current actions & anticipated future management actions* *Could flow from 3-meeting outlook and other council long-term planning?* *Should be relatively broad categories, yet specific enough to warrant prioritization in the short- to intermediate term. Will be a combination of ongoing mandates (e.g. harvest specs) and emerging/current issues.*
Management priority	High Medium Low Removed (no longer needed)	*This should be associated with the previous field and assigns priority to a **specific council action**, as determined by the Council! (This does not apply to the overall management objective, which are all high priorities!)*
Description	Short title Long title	
Scientific objective(s)	[50 words or less]	*List of objectives, a priority may address multiple different objectives*
SSC priority	High Medium Low Removed (no longer needed)	*Overall ranking of the research priority as determined by the SSC*
Approach		*Brief description of data needs/availability and/or possible analytical approach(es)*
Notes		*Specific description of a project, possibly hyperlinked to more detailed documents*
Research category	Monitoring and observing Process studies (field) Laboratory studies Modeling Retrospective analyses Other	*Other categories could be added later*

Field Type	Fields	Notes
Expertise	Oceanography – physical Oceanography – biological Etc Biology – genetics Biology – early life history Etc... Stock assessment Statistics Ecological modeling Economics Anthropology Fishery management	*Hierarchical drop-down field that includes broad, accepted disciplines and specific subdisciplines* *[NPRB website may provide example]* *Could also include taxon-specific expertise*
Plan Team Assignment	Groundfish PT; Crab PT; Scallop PT;	*Specifies which PT will annually review each research priority.* *Allow assignments to multiple teams!*
Plan Team Priority	GPT: High, Med, Low, Removed CPT: High, Med, Low, Removed SPT: High, Med, Low, Removed	*Plan Team ranking of this priority. May have multiple rankings if assigned to multiple teams.*
Ecosystem (LME)	Gulf of Alaska Bering Sea Aleutian Islands BSAI Arctic	*Fixed list of large marine ecosystems that also serve as management areas*
Specific region	SE Alaska Sitka PWS Kodiak Pribilofs St. Matthews Adak etc....	*Specific geographic regions – could be a port or any geographic region within the LMEs affected by an action or subject of the research priority*
Species / Group	Groundfish Crab Scallop Salmon Halibut Forage species Zooplankton Seabirds Marine mammals *[Specific species...]* Human Populations/Communities	*Taxonomic group(s) or species of interest and affected by an action or relevant to analyses pertaining to an action*

Field Type	Fields	Notes
Fishery / Sector	Major fisheries: Groundfish Crab Salmon Pollock ... Sectors: CVs CPs ... General	*Fisheries (broad category or single species) and/or fisheries sector primarily affected by an action*
Keywords	Other keywords	*Any other relevant keywords that may be useful for users to find specific priorities*
Year added		*(2012) means the priority was on the list in 2012 when spreadsheet was begun; in future will be more informative*
Research status flag	No action Listed on RFPs Partially underway Underway Completed	
	Comment field	*Can be used to provide additional detail, if appropriate*
Principle Investigator(s)		*Name (and contact information) for PIs on studies that are partially underway, underway, or completed. Funding source.*
	Comment field / Link to more info	*May include link to reports, study plans, research websites, etc*
Staff comments on 2012 list	[field to be deleted once SSC accepts new process]	*We tried to note priorities that had obvious duplication or needed to be reworded*
Spreadsheet tracking fields		

Agenda D-1 (c)

Move to approve the research priorities recommended by the SSC in Appendix A of their minutes for this meeting, with the following modifications.

Categorize research priorities that maintain core stock assessment surveys at current levels as Critical Priorities; this category includes numbers 115, 138, and 146.

Designate several categories as High Priority for Current Council Initiatives:

1) Build Integrated Ecosystem Management capabilities, priority numbers 110, 125, 142, 194, 198, 200, 203, 204, 205, 216, and 217.

2) Facilitate Council efforts to reduce impacts to Chinook salmon, priority numbers 119, 120, 184 and 188.

3) Increase knowledge of SSL fishery interactions and population dynamics, priority numbers 126, 127, 128, 129, 130, 182 and 310.

Add a new research priority as High Priority, titled 'Verify AFSC model projections of coral and sponge distribution throughout the Bering Sea slope and canyons'.

North Pacific Fishery Management Council

Eric A. Olson, Chairman
Chris Oliver, Executive Director

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July 20, 2012

Mr. William Michaels
Fisheries Service, Office of Science and Technology
1315 East-West Highway, F/ST4
Silver Springs, MD 20910

Dear Bill:

At its meeting in June 2012, the Council adopted its Five-Year Research Priorities Plan for 2012-2016 based on recommendations from the Scientific and Statistical Committee (Attachment 1). The Council identified its research priorities 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. The priorities focus on four broad themes: (1) fisheries; (2) fisheries interactions; (3) habitat; and (4) other areas of research necessary for management purposes. The priorities have been further separated into two categories: Immediate Concerns and Ongoing Needs.

I wanted to bring these research priorities to your attention, and hope they will be considered in your research planning process.

Sincerely,

Chris Oliver
Executive Director

Cc: William Chappell, Dr. Doug DeMaster, Ms. Molly McCammon, Dr. Jim Balsiger, Dr. Arthur Nowwell, Dr. Ussif Rashid Sumaila, Dr. Cynthia Suchman, Dr. Michael Castellini, Ms. Cora Campbell, Dr. Phil Mundy, Robert Foy, Ms. Nancy Byrd, Dr. Tara Riemer-Jones.

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Council's Five-Year Research Priorities: 2012 through 2016 (as approved in June 2012)

The NPFMC 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, eastern Bering Sea, and the Arctic. This listing of priorities has 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: **Immediate Concerns** and **Ongoing Needs**. **Immediate Concerns** include research activities that must be addressed to satisfy federal requirements and to meet pressing fishery management and ecosystem issues related to fishery management. Within these categories, we have has indicated those Research Priorities for which **Research is Underway**. These are Research Priorities for which NPRB grants have been awarded or for which it is known that one or more other agencies have undertaken the recommended research. These priorities will remain on the list until the recommended research is complete and evaluated in terms of its meeting the Research Priority that had been listed. **Ongoing Needs** include research 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 PSC, and other EISs) and NMFS. **Ongoing Needs** 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 Council 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.

Five-Year Research Priorities: 2012-2016

Immediate Concerns

I. Fisheries

A. Fish and Fisheries Monitoring

1. Non-recovering stocks. A pressing issue is why certain stocks have declined and failed to recover as anticipated (e.g., Pribilof Island blue king crab, Adak red king crab). Research into all life history components, including predation by groundfish on juvenile crab in near-shore areas, is needed to identify population bottlenecks, an aspect that is critically needed to develop and implement rebuilding plans.

2. Improvements are needed for catch accounting by sex and size for crab (genetic samples) in non-directed fisheries with high bycatch or PSCrates, particularly for blue king crab in the Pacific cod pot fishery in the Pribilof Islands.

3. Develop methods for reliable estimation of total removals (e.g., surveys, poorly observed fisheries) to meet requirements of total removals under ACLs. Improve species identification, by both processors and observers, for priority species within species complexes in catches. Methods that quantify and correct for misidentifications are desired.

4. There is a need to characterize the spatial distribution of male snow crab relative to reproductive output of females in the middle domain of the EBS shelf (partially underway)

5. Genetic and crab movement research for Blue King crab to evaluate determination if Blue King crab bycatch is comprised of Pribilof Island Blue King crab, Saint Mathews Blue King crab, or other Blue King crab stocks

B. Stock Assessment

1. Improve handling mortality rate estimates for crab and scallops. For crab, improved understanding on the post-release mortality rate of discarded crab from directed and non-directed crab pot fisheries and principal groundfish (trawl, pot, and hook and line) fisheries is required. The magnitude of post-release mortality is an essential parameter in the determination of total annual catch used to evaluate overfishing in stock assessment and projection modeling. For example, assess discard mortality rates of Tanner crab by size, month, sex, and fishery type. For scallops, conduct field studies to estimate scallop discard mortality (specifically the relationship between capture, release condition, and survival of scallops). (crab studies are partially underway: *Chionocetes* RAMP study)

2. Develop biomass indices for lowest tier species (Tier 5 for crab, Tier 6 for groundfish), such as sharks, and conduct net efficiency studies for spiny dogfish. Explore alternative methodologies for Tier 5 and 6 stocks, such as length-based methods or biomass dynamics models.

3. Owing to the lack of fishery-independent surveys for scallops, there is a need for analyses of fishery CPUE and observer data for use in assessing fishery performance and stock assessment. For instance, sharp declines in CPUE have occurred in some areas, such as Kayak Island and Alaska Peninsula, prompting concerns about local depletion. Additional new techniques may be desirable in regions with data-poor stocks.

4. New information and data are needed that would inform our understanding of the spawner - recruit relationship for groundfish and crab with sufficient precision to project year-class strength (e.g., Tanner crab, GOA pollock, sablefish, halibut). (Underway)

5. Conduct studies to determine stock structure and potential spatial management for BSAI pollock (e.g., movement).

6. Conduct district-wide surveys for demersal shelf rockfish in Southeast Alaska on an annual, biennial, or triennial basis.

7. Conduct a tagging study of red king crab in the region north of Bristol Bay to assess the movement between this region and the Bristol Bay registration area. Similar work on blue king crab in Bristol Bay relative to the Pribilof Islands is needed.

8. Research is needed on the vertical distribution of Pacific cod relative to the EBS bottom trawl and comparisons between the EBS and GOA trawl gear. (Underway).

9. Develop Pacific cod stock assessment for the Aleutian Islands region.

10. Tagging studies of Aleutian Islands Pacific cod and Atka mackerel are needed to create models of short-term movement of fish relative to critical habitat (tagging for Atka mackerel partly underway).

11. Studies are needed to validate and improve age determination methods for Pacific cod, Pacific sleeper sharks, and spiny dogfish. Conventional tagging studies of young of the year and/or one-year old Pacific cod would be useful in this regard (partially underway for cod and dogfish).

12. Maintain the core data from the eastern Bering Sea needed to support a diverse suite of models used to support the integrated ecosystem assessment program for the Bering Sea. Core data include inputs for single- or multi-species management strategy evaluations, food web, and coupled biophysical end-to-end ecosystem models (e.g. biophysical moorings, stomach data, zooplankton, age 0 surveys).

C. Fishery Management

1. Develop a research program that will facilitate evaluation of salmon (both Chinook and non-Chinook) PSC mitigation measures in the BSAI and GOA. This includes updated estimates of the amounts reasonably necessary for subsistence, timing of runs and openings relative to subsistence requirements, and access to cost data for the commercial pollock and salmon industries so that impacts on profits (not gross revenues) can be calculated.

2. Improve the resolution of Chinook and chum salmon genetic stock identification methods (e.g., baseline development, marker development), improve precision of salmon run size estimates in western Alaska, and initiate investigations of biotic and abiotic factors influencing natural mortality rate during ocean migration in the GOA and BSAI. (baseline development is nearing completion, more work on Cook Inlet Chinook and chums is needed)

3. Develop improved catch monitoring methods of fishery interactions including direct and alternative options (e.g., electronic logbooks, video monitoring), particularly on smaller groundfish, halibut, and commercially guided recreational fishing vessels, as well as an assessment of feasibility for small vessels. Investigate factors that affect angler demand in the guided angler sector of the halibut fishery resulting from regulatory changes or general economic conditions.(Underway)

4. Develop bioeconomic models with explicit age- or size-structured population dynamics for BSAI and GOA groundfish fisheries to estimate maximum economic yield and other bioeconomic reference points under uncertainty.

5. Research the benefits and costs of halibut and halibut PSC utilization in different fishing sectors. For halibut and other PSC and bycatch species, conduct research to better identify where regulations restrict the utilization of fish from its intended use and evaluate how changes in existing regulations would affect different sectors and fisheries. (partially underway)

6. Initiate/continue research on developing and evaluating thresholds for ecosystem indicators, including ecosystem-level management strategy evaluation.

II. Fisheries Interactions

A. Protected species

1. Studies of the localized interactions between fisheries and protected species, such as interactions between Steller sea lions and commercial fish species in the Central and Western Aleutian Islands (particularly areas 541, 542, 543), are needed. These studies should be conducted at appropriate spatial and temporal scales with an emphasis on seasonal prey fields, diet, and movement of sea lions and their prey.

2. Assess age- and size-specific vital rates (i.e., reproduction and survival) of Steller sea lions in the western and central Aleutians at sufficient frequency to track population dynamics in the western DPS.

3. Assess possible indirect effects of fisheries removals via periodic health assessments, indices of body condition, survival of pups and juveniles, and pup-non pup ratios of Steller sea lions in the eastern DPS.

4. Quantify killer whale predation of Steller sea lions, particularly in the western and central Aleutian Islands.

5. Develop new methods to estimate sea lion abundance, such as the use of unmanned aerial vehicles, which could increase the probability of acquiring abundance estimates in remote areas. (underway)

6. Assess the impact of the displacement of the groundfish fleet due to Steller sea lions protection measures on the prey availability, foraging ecology, diet, movements, and vital rates for Northern fur seals (partially underway).

7. Assess the extent and impact of seabird incidental takes in fisheries on bird populations, and develop methods to reduce seabird incidental takes, particularly of protected species, such as short-tailed albatross.

8. Determine potential impacts of fishing activities on North Pacific right whales and the Eastern North Pacific blue whales in the GOA, particularly in identified critical (NPRW) or essential (NPBW) habitat.

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 and above the canyon areas, including mid-level and apex predators to neighboring shelf/slope ecosystems. (partially underway)

B. Baseline Habitat Assessment

1. Dynamic ecosystem and environmental changes in the northern Bering Sea and Arctic are occurring on a pace not observed in recorded time. In response to the new Arctic FMP, assessment of the current baseline conditions and trophic interactions is imperative. This effort, while of great scientific importance, should not supplant the regular surveys in the BSAI and GOA, which are of critical importance to science and management. (partially underway)

C. Fishing Effects on Habitat

1. Research is needed on the effects of trawling on the distribution of breeding and ovigerous female red king crab and subsequent recruitment. Relevant studies include effects of potential habitat modifications on the distribution of females, particularly in near-shore areas of southwest Bristol Bay (partially underway), and environmental effects (e.g., trawling overlap in warm vs. cold years). Retrospective studies, the use of pop-up tags to identify larval release locations, and larval advection using Regional Ocean Modeling System would help address this need.

2. Impact of bottom trawl fisheries on invertebrate abundance and species composition in benthic habitats, especially as might be relevant to the foraging ecology of walrus (candidate species for listing under ESA), but also bearded seals (ESA determination due in July), and gray whales.

Ongoing Needs

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 federal budgets in which funding may not be sufficient to conduct these surveys. Loss of funding for days at sea for NOAA ships jeopardizes these programs. 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. ***Although an ongoing need, these surveys are considered the highest priority research activity, contributing to assessment of commercial groundfish and crab fisheries off Alaska.***

2. Conduct routine subsistence use, fish, crab, and oceanographic surveys of the northern Bering Sea and Arctic Ocean. These surveys will become increasingly important under ongoing warming ocean temperatures because range expansions of harvested fishery resources may occur. If range expansions or shifts occur, data will be needed to adjust standard survey time series for availability.

3. Explore alternative approaches to the triennial ADF&G Aleutian Islands golden king crab pot survey to acquire fishery-independent abundance data on stock distribution and recruitment, including the potential for future cooperative research efforts with industry.

4. 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 diets and movements of fish and shellfish, for use in studies of species interactions in spatially explicit stock assessments.

5. The HAPC action for skate egg case concentration sites included two recommendations that the Council suggested should be addressed during the annual research priority discussion: (a) skate egg case concentrations should be monitored every 2 to 3 years using non-invasive research design, such as in situ observation; and (b) skate conservation and skate egg concentration areas remain a priority for EFH and HAPC management and within Council and NMFS research plans.

6. 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 that are found in untrawlable habitat or are semi-pelagic species, such as northern and dusky rockfish.

7. Studies are needed to evaluate effects of the environment on survey catchability. For groundfish and crabs, studies are needed on catchability, as it directly bears on estimates of the stock size for setting of catch quotas. Research to refine the estimates of survey catchability, q, used to infer absolute, rather than relative, abundance would substantially improve the quality of management advice. Particular emphasis should be placed on Tanner crab, because of recent trends in stock status, and on fishery and fishing gear selectivity for Aleutian Island golden king crab to improve the stock assessment model.

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

9. Advance research towards developing a quantitative female reproductive index for the surveyed BSAI crab stocks. Research is needed on mating, fecundity, fertilization rates, and, for snow and Tanner crab, sperm reserves and biennial spawning, to develop annual indices of fertilized egg production that can be incorporated into the stock assessment process and to model the effects of sex ratios, stock distribution, and environmental change on stock productivity. Priority stocks for study are eastern Being Sea snow and Tanner crab and Bristol Bay red king crab. (Ongoing for snow crab and red king crab)

10. Expand existing efforts to collect maturity scans during fisheries that target spawning fish (e.g., pollock). Time series of maturity at age should be collected to facilitate the assessment of the effects of density-dependence and environmental conditions on maturity.

11. Identification and recovery of archived data (e.g., historical agency groundfish and shellfish surveys) should be pursued. Investigate integrating these data into stock and ecosystem assessments.

12. There is a need for fishery-independent surveys of scallops on major fishing grounds, e.g., Yakutat, other areas.

13. Develop a long-term survey capability for forage fish (partially underway).

C. Stock Assessment

1. Acquire basic life history information needed for stock assessment and bycatch/PSC management of data-poor stocks, such as scallops, sharks, skates, sculpins, octopus, grenadiers, squid, and blue king crab (Bering Sea), golden king crabs (Aleutian Islands), and red king crab (Norton Sound). Specifically, information is needed on natural mortality, growth, size at maturity, and other basic indicators of stock production/productivity). For octopus, there is particular need for estimates of mortality and abundance, including verification of the cod consumption-based approach. Tagging studies would provide information on growth and movement of scallops and growth and absolute abundance estimates for golden king crab.

2. Improve estimates of natural mortality (M) for several stocks, including Pacific cod and BSAI crab stocks. **Develop and validate aging methods for crabs to improve estimates of M, including improved independent estimates of stage-specific M (e.g., large red king crab in Norton Sound).**

3. Studies are needed to validate and improve age determination methods for Pacific cod, Pacific sleeper sharks, and spiny dogfish. (partially underway for Pacific cod and spiny dogfish)

4. Evaluate the assessment and management implications of hybridization of snow and Tanner crabs.

5. Quantify the effects of historical climate variability and climate change on recruitment and growth, and develop standard environmental scenarios for present and 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.

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. (partially underway)

7. To identify stock boundaries, expanded studies are needed in the areas of genetics, mark-recapture, reproductive biology, larval distribution, and advection.

8. Develop spatially explicit stock assessment models, where appropriate. High priority species for spatially explicit models include: snow crab, walleye pollock, Pacific cod, sablefish, yellowfin sole, rock sole, arrowtooth flounder, Pacific ocean perch, black spotted rockfish, rougheye rockfish, and Atka mackerel. (partially underway for some species)

9. Genetic studies to provide information on sources and sinks for scallop larvae are needed to improve our understanding of the rate of larval exchange between scallop beds. Age-structured models for scallop assessment are also needed.

10. Conduct multivariate analysis of bycatch data from the scallop observer program (haul composition data) to estimate abundance and trends of benthic communities on scallop beds and computerized image processing to facilitate scallop stock assessments from camera sled (CamSled) data.

D. Fishery Management

1. Refine methods to incorporate uncertainty into harvest strategies for groundfish for ACL estimation. Continue existing management strategy evaluations at the stock level. (underway)

2. Conduct studies documenting the subsistence harvest patterns, norms, and quantities in communities that depend upon resources that may be affected by Council action.

3. Examine interactions between coastal communities and commercial fisheries (e.g., subsistence-commercial linkages, adaptations to changes in resource use, economic opportunities for coastal communities).

4. 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). Research is needed to refine the basis for setting gamma for Tier 4 crab stocks. (partially underway)

5. Conduct retrospective analyses to assess the impact of Chinook salmon PSC measures on the BSAI pollock fishery. Analyses should include an evaluation of the magnitude and distribution of economic effects of salmon avoidance measures for the Bering Sea pollock fishery. In this case, it is important to understand how pollock harvesters have adapted their behavior to avoid Chinook and "other" salmon, under various economic and environmental conditions and incentive mechanisms.

6. 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.

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

8. Analyze current determinants of ex vessel, wholesale, international, and retail demand for principal seafood products from the GOA and BSAI.

9. 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, AFA pollock, and BSAI crab fisheries. "Benefits and costs" include both economic and social dimensions.

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

11. 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, PSC and other bycatch restrictions, co-ops, IFQs).

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

13. Continue to evaluate the economic effects from crab rationalization programs on coastal communities. This includes understanding economic impacts (both direct and indirect) and how the impacts are distributed among communities and economic sectors.

14. Improve estimation of fishery interactions (including catch) with marine mammals (e.g., state managed gillnet fisheries), seabirds, and non-target groundfish (e.g., sharks, skates), and protected species.

II. Fisheries Interactions

A. Protected Species Interactions

1. Economic, social, and cultural valuation research on protected species (i.e., non-market consumptive use, passive use, non-consumptive use), particularly in the Arctic.

2. Foraging ecology and vital rate studies of Steller sea lions in the Gulf of Alaska, Russian Far East, and Commander Islands, including at-sea tracking of older animals, and diet composition of sea lions throughout the region. Emphasis should be placed on the use of methods that allow population abundance estimates to be directly compared between Russia and Alaska.

3. Linkages between fishery-induced disturbance or local prey depletion for northern fur seals in the Pribilof Islands region. (underway)

4. Gear modifications and fishing practices to reduce bycatch and, particularly, PSC (e.g., salmon and crab). (partly underway)

5. Studies of sperm whale depredation of catch in long-line fisheries and surveys to improve the quality of long-line fish abundance estimates. (underway)

6. Monitor interactions between fishing fleet and protected seabirds, particularly, in Aleutian Islands and the eastern Bering Sea shelf edge where numbers of albatross have increased.

7. Assess the potential for increased interactions between protected species (i.e., large whales and post-breeding/migrating seabirds) and fishing efforts in essential habitats, in particular throughout migratory routes, and with respect to changes in fish stock distribution and/or expansion into Arctic waters.

B. Bycatch/PSC Issues

1. There is a need to analyze the effects of recent Council actions on bycatch and PSC, including:
    a. interaction among PSC reduction initiatives (e.g., halibut, salmon)
    b. quantifying the effects of PSC reduction in groundfish fisheries to the target fisheries (e.g., charter and commercial halibut fisheries, salmon fisheries)

c. Research approaches to create bycatch and PSC reduction incentives.

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 in the GOA, BS, and Arctic. (partially underway)

2. 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. Such time series are needed to evaluate the impacts of changes in fishing effort and type on EFH. Assess the extent of the distribution of *Primnoa* corals and skate egg case concentration sites in the GOA, and conduct routine monitoring of these areas.

B. Function of Habitat

1. Research is needed on the role of habitat in fish population dynamics, fish production (growth, reproduction), and ecosystem processes. Such research will improve the capability to identify and protect important habitats (including essential fish habitat and habitat areas of particular concern); help design effective habitat restoration efforts; improve the design and management of marine protected areas; improve fishery-independent population surveys; and improve stock assessments. Studies are needed to evaluate relationships between, and functional importance of, habitat-forming living substrates to juvenile and adult age classes of commercially important species and their preferred prey (forage fish). (partially ongoing)

2. Establish a scientific research and monitoring program to understand the degree to which impacts (habitat, benthic infauna, etc.) have been reduced within habitat closure areas, and to understand how benthic habitat recovery of key species is occurring. (This the objective of the EFH research approach for the Council FMPs).

IV. Other Areas of Research Necessary for Management

A. Ecosystem indicator development and maintenance.

1. Climatic indicators

a) Develop a multivariate index of the climate forcing of the Bering Sea shelf. Three biologically significant avenues for climate index predictions include advection, setup for primary production, and partitioning of habitat with oceanographic fronts and temperature preferences.
b) Develop bottom and water column temperature database for use in EBS, GOA, and AI stock assessments.
c) Maintain sea ice formation and retreat index for the EBS.

2. Lower trophic level community production data

a. Collect and maintain primary production time series in the EBS, AI, GOA, and Arctic; particularly in relationship to key climate and oceanographic variables.
b. Collect and maintain zooplankton biomass and community composition time series in the eastern Bering Sea. Develop, collect, and maintain time series of zooplankton biomass and community composition for the GOA, AI, and Arctic.

c. Collect and maintain data on forage fish community composition and abundance in the Bering Sea, GOA, AI, and Arctic.
d. Collect and maintain time-series data on the community composition, production and biomass of benthic invertebrate and vertebrate fauna.

3. Develop methods for incorporating ecosystem indicators into stock assessments and ecosystem assessments. Specifically:

a. Maintain indicator-based ecosystem assessment for EBS.
b. Develop indicator-based ecosystem assessments for AI (in progress), GOA, and Arctic.
c. Develop stock-specific ecosystem indicators and incorporate into stock assessments. (in progress)

4. Develop methodologies to monitor for new/emerging diseases among exploited species and higher trophic levels.

5. Assess the impact of increases in recovering whale populations (e.g. gray, humpback, and fin) on lower trophic level energy pathways.

6. Ecosystem indicator synthesis research.

7. Continue and expand cooperative research efforts to supplement existing at-sea surveys that provide seasonal, species-specific information on upper trophic levels (seabirds and marine mammals). Updated surveys to monitor distribution and abundance of seabirds and marine mammals are needed to assess impacts of fisheries on apex predators, improve the usefulness of apex predators as ecosystem indicators, and to improve ecosystem management.

8. Initiate and expand non-market valuation research of habitat, ecosystem services, and passive use considerations.

9. Assess the relative importance of non-commercially exploited species (invertebrates, fish, marine mammals, and seabirds) to human communities, particularly in Arctic.

B. Research on Environmental Influences on Ecosystem Processes

1. Climate variability: monitor and understand how changes in ocean conditions influence managed species.

a) Maintain moorings. 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. (underway)
b) Monitor seasonal sea ice extent and thickness: If recent changes in ice cover and temperatures in the Bering Sea persist, these may have profound effects on marine communities.
c) Measure and monitor fish composition: Evaluate 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, northern Bering Sea, and areas of the Gulf of Alaska.
d) Assess the movement of fish to understand the spatial importance of predator-prey interactions in response to environmental variability.

2. Improve understanding of ocean acidification and its effects on managed species

a) Collect and maintain time series of ocean pH in the major water masses off Alaska. (partially underway)
b) Assess whether changes in pH would affect managed species, upper level predators, and lower trophic levels. (partially underway for some species)

3. Species' responses to multiple environmental stressors
    a) Laboratory studies are needed to assess the synergistic effects of ocean acidification, oil, dispersants, and changes in temperature on productivity of marine species.
    b) Monitor contaminant flux and loads in lower and higher trophic levels, and assess potential for impact on vital rates.

C. Basic research on trophic interactions

1. Collect, analyze, and monitor diet information (species, biomass, energetics), from seasons in addition to summer, 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.

2. 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 differential exploitation of some components of the ecosystem (e.g., Pacific cod, pollock, and crab) relative to others (e.g., arrowtooth flounder).

3. In the last decade, many whale populations (e.g., gray, humpback, and fin) have increased dramatically, after being depleted by whaling. These increases in abundance have the potential to alter lower trophic level energy pathways in the region. In addition, we should investigate potential impacts to other upper trophic level groups (i.e., pinnipeds, seabirds, large predatory fish).

D. Ecosystem Modeling

1. Modeling studies of ecosystem productivity in different regions (EBS, GOA and AI).

North Pacific Fishery Management Council

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EXCERPT - FINAL REPORT
SCIENTIFIC AND STATISTICAL COMMITTEE
NORTH PACIFIC FISHERY MANAGEMENT COUNCIL
June 4th – June 6th, 2012

The SSC met from June 4th through June 6th at the Kodiak Inn Harbor Room, Kodiak AK.

Members present were:

Pat Livingston, Chair
NOAA Fisheries—AFSC

Henry Cheng
Wash. Dept. of Fish and Wildlife

Anne Hollowed
NOAA Fisheries—AFSC

Kathy Kuletz
US Fish and Wildlife Service

Jim Murphy
University of Alaska Anchorage

Kate Reedy-Maschner
Idaho State University Pocatello

Robert Clark, Vice Chair
Alaska Department of Fish and Game

Alison Dauble
Oregon Dept. of Fish and Wildlife

George Hunt
University of Washington

Seth Macinko
University of Rhode Island

Lew Queirolo
NOAA Fisheries—Alaska Region

Farron Wallace
NOAA Fisheries—AFSC

Jennifer Burns
University of Alaska Anchorage

Sherri Dressel
Alaska Department of Fish and Game

Gordon Kruse
University of Alaska Fairbanks

Franz Mueter
University of Alaska Fairbanks

Terry Quinn
University of Alaska Fairbanks

Members absent were:

Ray Webster
International Pacific Halibut Commission

D-1(e) Review and approve 5-year research priorities

During the June 2012 SSC meeting, it became clear that a more orderly process of submitting and prioritizing proposals for research priorities is needed. The SSC received the Council's list of research priorities from June 2011 and research priority lists from three Plan Teams, a halibut workshop report, a stakeholder-based research plan for the Aleutians, and staff summaries of EFH and protected species research. The lists were in different formats and some were quite lengthy. Thus, the SSC did not have time to fully consider all the lists and requested changes. In particular, we did not have sufficient time to review the research in the halibut workshop report and incorporate that into our priorities. We recommend that the BSAI/GOA Plan Teams consider the research recommended in that report and, as appropriate, incorporate those of merit into their research priorities list this fall. **The SSC provides its recommended list of research priorities to the Council in Appendix A,** which follows at the end of this June SSC report and will provide Council staff with a track changes and commented version of the

list. **In addition, the SSC proposes the following be considered for adoption by the Council as policy for the submission of Research Priorities to the SSC.**

The SSC will consider research priorities for inclusion in the annual NPFMC list of Research Priorities from the Plan Teams and members of the SSC. The SSC prefers to have Plan Teams be the initial filter for research priorities that come to the SSC. Sometimes EFH, protected species, and other issues relevant to a particular FMP may not be fully considered by each Plan Team, but the SSC recommends that Plan Teams make a more concerted effort to do so. Research priority lists should be provided by the Plan Teams in their Plan Team report, ideally to be received by the SSC no later than two weeks prior to the Council meeting at which the Plan Team Report is presented. The proposed research priorities should be entered in "Track Changes" in the Council's list of Research Priorities, as "published" in the minutes of the previous year's June Council meeting. The SSC will update a working copy of the Research Priorities list at each meeting at which it receives a list of priorities from a Plan Team, and will provide the Council with the full revised list at the June NPFMC meeting.

The SSC suggests that the Council consider adopting a process of evaluating and organizing the list of proposed Research Priorities using an Excel file or relational database type of system, with research priorities submitted on an Excel-based form to collect information about the proposed priority. When such a system is operational, the proposed research would include information on the question or data need to be resolved, whether the priority is an immediate concern or an ongoing need, relative rank (high, medium, low) among all priorities submitted by that Plan Team, impact on decision making, and species or fishery affected. Separate worksheets or database tables could be established for each Plan Team, the SSC, and the Council.

Revamp of SSC's research priorities process
Update: May 2013

SSC's goals, articulated at June 2012 meeting:

1. Develop a more orderly process of submitting and prioritizing proposals for research priorities.
   - *The SSC prefers to have Plan Teams be the initial filter for research priorities that come to the SSC.*
   - *Sometimes EFH, protected species, and other issues relevant to a particular FMP may not be fully considered by each Plan Team, but the SSC recommends that Plan Teams make a more concerted effort to do so.*
   - *Research priority lists should be provided by the Plan Teams in their Plan Team report, ideally to be received by the SSC no later than two weeks prior to the Council meeting at which the Plan Team Report is presented.*
   - *The proposed research priorities should be entered in "Track Changes" in the Council's list of Research Priorities, as "published" in the minutes of the previous year's June Council meeting.*
   - *The SSC will update a working copy of the Research Priorities list at each meeting at which it receives a list of priorities from a Plan Team, and will provide the Council with the full revised list at the June NPFMC meeting.*

2. Adopt a process of evaluating and organizing the list of proposed Research Priorities using an Excel file or relational database type of system
   - *Research priorities would be submitted on an Excel-based form to collect information about the proposed priority.*
   - *The proposed research would include information on 1) the question or data need to be resolved, 2) whether the priority is an immediate concern or an ongoing need, 3) relative rank (high, medium, low) among all priorities submitted by that Plan Team, 4) impact on decision making, and 5) species or fishery affected.*
   - *Separate worksheets or database tables could be established for each Plan Team, the SSC, and the Council.*

Proposed process, based on SSC direction:

1. Each existing research priority, and new ones as they are added, will be expanded as necessary to include:
   a) a description of the priority, including the data need to be resolved;
   b) relative urgency of priority (immediate or ongoing concern);
   c) relative ranking of priority (high, medium, low);
   d) how it relates to a Council action;
   e) which species, fisheries, or issues it affects;
   f) what is the current status of research with respect to this priority
2. Each existing research priority has been assigned to one or multiple Plan Teams (Groundfish, Crab, or Scallop) for review and prioritization. New research priorities will only be accepted from the Plan Teams (or, of course, will be adopted by the SSC and Council directly). Priorities put forward by staff or the public must be submitted to the Plan Team review process.
3. Annually, the Plan Teams will review the priorities assigned to them. They will propose revisions to language, or adjustments to priority, and may update the status of research, as appropriate. They may also submit new research priorities. Assuming their current schedules remain unchanged, the Groundfish PT will review research priorities in September, the Crab PT will do so in May, and the Scallop PT will review priorities in February.

4. The SSC will consider revisions to the SSC/Council's master research priorities list, based on Plan Team input, on an ongoing basis, generally at the Council meeting that follows the Plan Team's deliberation. Once a year, likely in June, the SSC will adopt and forward its master list of research priorities to the Council.

Progress to date:

- Staff met with an SSC and Plan Team subgroup in August 2012 to discuss the proposed process
- Staff has created a spreadsheet (could be turned into a database) using the SSC/Council's 2012 list of research priorities.
    - Each of existing research priorities has been entered into spreadsheet. Content is unchanged. In some cases, if a 'single' 2012 research priority encompassed multiple issues, the priority was split in two.
    - For each priority in spreadsheet, staff added descriptive fields as requested by SSC above, (related council action, species/fisheries/issues affected), as well as 'status of research' fields. A full list of fields is included at the end of this document.
- Staff suggests that the Plan Teams/SSC go through a cycle of reviewing, prioritizing, and setting research priorities under this new process, and using the new spreadsheet and descriptive attributes. Once the new process is approved, and the useful fields are nailed down, we can work on automating the process so that it is easy for the Plan Teams and the SSC to use directly.
    - We are proposing that the spreadsheet/database will be maintained by Pacific States Marine Fisheries Commission (AKFIN); they can prepare a web interface and standardized reports that would allow authorized users to propose and make changes to the priorities as part of the process
- The SSC met in April to review the progress to date, suggest revisions to the template and attributes fields and to review the submitted revised 2013 priorities by the Scallop and Groundfish Plan Teams. Their feedback is included in the meeting materials. The Crab Plan Team met in May and their revisions were sent to the SSC for review at this meeting.

Staff questions and comments for SSC consideration, as the new process is deliberated:

Comments about how existing research priorities are expressed, and what content we should track in the spreadsheet (which leads to how best we should design fields to track that content). Note some of these were addressed in conjunction with SSC discussion in April, some were left for further comments in June:

- There is often an inconsistency in the way the research priorities are described. In some cases, we identify the end product as the research priority (e.g., understanding life history), and in others, we identify the method to achieve it (e.g., tagging studies). Should this inconsistency be addressed among existing priorities? Should we be trying to identify both aspects for each research priority, or is it appropriate that some be expressed one way, and others another?
- How much explanation should be included to support each research priority? Currently, there are inconsistencies among the priorities with respect to whether a supporting rationale is provided. If we are encouraging a lengthy explanation, should we be considering a database that allows people to attach a supporting word document?
- Immediate vs ongoing categories. Should duplicates in the immediate and ongoing needs categories be addressed? Frequently, the application of a research priority to a single species may be an immediate need, but more generally, the research priority should continue as an ongoing need. Should these therefore be listed as separate research priorities? Is there a better way to distinguish among these? How does this category relate to the ranking of priorities (high-med-low)?
- In order to coordinate with other Council discussions, and with the concurrence of the SSC subgroup, staff added a section on 'Status of research' to the spreadsheet. This could be limited to

the level of information that is currently in the list (e.g. no action, partially underway, etc.), or could include supporting information. How much detail should be captured?

- The 2012 SSC list had two levels of category headings, and the new spreadsheet only uses one. There was a mismatch between how Fish/ Stock Assessment headings were labeled versus those for the Habitat/ Ecosystem categories. We kept those headings including the most detail, but some of the habitat and ecosystem headings should probably be combined.

Comments about the proposed process:

- Under the SSC's proposed process, all research priorities must be reviewed through the Plan Teams. One pitfall with this process is that there are certain Council actions and research needs that may not be within the scope of Groundfish, Crab, or Scallop Plan Team expertise: for example, issues to do with halibut fishery allocation, or the Arctic FMP. There may also be other Council actions that engender research needs, but are not thoroughly vetted through any Plan Team, and therefore the Plan Teams' assessment of relative priority may not accurately reflect the Council's interest in a better understanding of a particular issue.
- If the Plan Teams are to be the sole arbiters of new research priorities to be considered by the SSC for including in the list, they may want to consider how public or staff input is provided for this agenda item.
- Should the process allow a particular research priority to be assigned to multiple plan teams? This may result in conflicting information regarding relative priority that the SSC will need to resolve. While some effort has been made to split out 2012 research priorities that can easily be separated into distinct fishery issues, there is still considerable overlap, particularly between issues that are pertinent both to the Groundfish and Crab Plan Teams.
- It may be useful to consider what the best timing is for Council input to the research priorities, especially with respect to prioritization. The SSC evaluates the importance of proposed research priorities with respect to the Council's management objectives. In order to inform the relative ranking of priorities, however, it may be helpful for the Council to provide the SSC with guidance on the relative priority of management actions in advance, which would then allow the SSC to best align research priorities with management priorities in determining a final ranking. The Council discussed this in April and expressed an intent to discuss prioritization of management measures during each Council meeting to better communicate these priorities to the SSC.

Next steps:

- It is expected that the SSC will provide additional feedback on this proposed process, and the content of the new spreadsheet/database, following the SSC's adoption of a master list of research priorities for 2013 in June.
- Over the summer (2013), staff will hopefully be able to revise the spreadsheet based on SSC feedback, and design a process to automate a web-based dashboard for revising and inputting new research priorities, and for the production of reports. This dashboard would have different tools for Plan Teams that are reviewing research priorities, and SSC members that are reviewing Plan Team comments and finalizing SSC recommendations. There would be automated reports available, e.g. for each Plan Team (including only those priorities assigned to each team); for the SSC (to review Plan Team recommended revisions and priorities); or for the Council (amalgamating the SSC's final list of recommended priorities, or perhaps reporting on research priorities that have been on the list for a long time but remain unaddressed.)
- Staff also envisions that there could potentially be multiple web-based report formats that would be publicly available, based on a user's interest. For example, a member of the public could search for all research priorities that are related to salmon, or view the status of all research priorities that are underway. These report formats would ideally also be developed and made available over the summer.

Fields for research priorities spreadsheet (as revised by SSC following April 2013 meeting)

Field Type	Fields	Notes
ID	ID number	*Unique ID number assigned to each research priority*
Management Objective	Prevent overfishing Promote Sustainable Fisheries and Communities Preserve Food Web Manage Incidental Catch and Reduce Bycatch and Waste Avoid Impacts to Seabirds and Marine Mammals Reduce and Avoid Impacts to Habitat Promote Equitable and Efficient Use of Fishery Resources Increase Alaska Native Consultation Improve Data Quality, Monitoring and Enforcement	Maybe include specific 'sub-objectives' (as listed in FMPs?) in this field or in a separate field?
Related Council Action	Description of specific action (see field w/ same name below?)	
Management priority	Highest High Moderate Removed	
Category heading (becomes redundant??) See Objectives & 'discipline/expertise below'?	Fish and fisheries monitoring Stock assessment Fishery management Bycatch issues Protected species Habitat mapping Function of habitat Evaluate HAPC Baseline habitat assessment Fishing effects on habitat Ecosystem indicator dev and maintenance Envtl influences on ecosystem processes Basic research on trophic interactions Ecosystem modeling	A, B, etc. headings from SSC's 2012 list. Ignores I, II-level category headings (i.e., Fisheries, Fishery Interactions, Habitats, Other Areas of Research). *Note, some of the habitat and ecosystem headings should probably be combined. There was a mismatch between how Fish/ Stock Assessment headings were done, and Habitat/ Ecosystem headings.* *Combine with 'Related Council Action'?*
Description	Short title Long title	*Need to revise description of priorities to focus on objective for research rather than research activity itself*

Field Type	Fields	Notes
Discipline / Expertise	Oceanography – physical Oceanography – biological Etc Biology – genetics Biology – early life history Etc... Stock assessment Statistics Economics Anthropology Fishery management	Could be losts more specific (hierarchical drop-down?)
Scientific objective	Short description	
Approach	Brief description (may be blank)	Data needs/availability, analytical approach?
Urgency flags (delete field??)	Immediate concern Ongoing concern Removed (no longer a priority)	Not helpful? List monitoring needs separately? 'Removed' can go to 'priority' field?
Plan Team Assignment flags	Groundfish PT; Crab PT; Scallop PT; GPT/CPT; GPT/SPT; CPT/SPT; GPT/CPT/SPT	*Specifies which PT will annually review each research priority.* *Allow assignments to multiple teams? (If so, will need to modify spreadsheet for SSC to add individual columns for each PT's priority ranking.)*
SSC and PT research priority flags	Highest High Moderate Longterm (?) Removed (no longer a priority)	*Currently, only 1 SSC priority identified – SSC's #1 highest priority is surveys*
Related Council action/ Impact on Decisionmaking	Harvest specifications Rebuilding plans Halibut allocations Bycatch reduction Salmon bycatch Crab bycatch SSL protection Other mammal/seabird interactions Arctic FMP Habitat issues Observer Program Impacts analyses Economic impacts Subsistence analyses Community impacts analysis Ecosystem impacts General	*This list is pretty long – perhaps categories should be refined to a more general list?* *Redundancy with other fields. Could be shortened with other keywords in regon/species/fishery, etc* *Most of these things are included in 'objectives – maybe list specific council actions here? (Hence list will be long!)* *'Redundant with specific issues below & 'categories' above*

Field Type	Fields	Notes
Species, Fisheries, Issues Affected flags Replace with fields above ("specific action") + region + species + fishery affected	~~Groundfish~~ ~~Crab~~ ~~Scallop~~ ~~Salmon~~ ~~Halibut~~ ~~Arctic~~ ~~Habitat~~ ~~Econ/social~~ ~~Bycatch~~ ~~Protected Species~~ ~~Ecosystem/Environment~~ ~~Management~~	*Is this the right list of attributes?* *Other possibilities:* *BS* *AI* *GOA* *Stock assessment* *Modeling* *Both: geographic region* *taxonomic group*
Region	Gulf of Alaska Bering Sea Aleutians Arctic All	
Species / Group	(may be blank) Groundfish Crab Scallop Salmon Halibut	
Fishery / Sector	(may be blank)	*May be redundant with 'species / group' in combination with other fields?*
Keywords	Other keywords (?)	
Year added		*(2012) means the priority was on the list in 2012 when spreadsheet was begun; in future will be more informative*
Research status flag	No action Listed on RFPs Partially underway Underway Completed	
	Comment field	*Can be used to provide additional detail, if appropriate*
Staff comments on 2012 list	[field to be deleted once SSC accepts new process)	*We tried to note priorities that had obvious duplication or needed to be reworded*
Spreadsheet tracking fields	Create Date, Updated By, Update Date, Update Type, Sequence, Comments	

Minutes of the Joint Plan Teams for the Groundfish Fisheries of the Gulf of Alaska (GOA) and Bering Sea Aleutian Islands (BSAI)

March 26, 2013
North Pacific Fishery Management Council
605 W 4th Avenue, Suite 306
Anchorage, AK 99501

BSAI Team		GOA Team	
Mike Sigler	AFSC (BSAI co-chair)	**Jim Ianelli**	**AFSC REFM (GOA co-chair)**
Grant Thompson	**AFSC REFM (BSAI co-chair)**	**Diana Stram**	**NPFMC (GOA co-chair)**
Kerim Aydin	**AFSC REFM**	**Sandra Lowe**	**AFSC REFM**
Lowell Fritz	**AFSC NMML**	**Chris Lunsford**	**AFSC ABL**
Chris Siddon	**ADF&G**	**Jon Heifetz**	**AFSC ABL**
Alan Haynie	**AFSC REFM**	**Mike Dalton**	**AFSC REFM**
Jane DiCosimo	**NPFMC (Coordinator)**	**Kristen Green**	**ADF&G**
Bill Clark	**IPHC (retired)**	Tom Pearson	NMFS AKRO
Brenda Norcross	UAF	**Mark Stichert**	**ADF&G**
Mary Furuness	**NMFS AKRO**	**Paul Spencer**	**AFSC REFM**
David Barnard	**ADF&G**	**Nancy Friday**	**AFSC NMML**
Leslie Slater	**USFWS**	**Leslie Slater**	**USFWS**
Dana Hanselman	**AFSC ABL**	**Craig Faunce**	**AFSC FMA**
Vacant	WDFW	**Ian Stewart**	**IPHC**
		Elisa Russ	**ADF&G**
		Vacant	WDFW

Introduction

The joint meeting of the Gulf of Alaska (GOA) and Bering Sea Aleutian Islands (BSAI) Groundfish Plan Teams convened Tuesday, March 26, 2013 at 1:00 pm (ADT) via webex. Team members who attended all or part of the meeting are noted above in **bold**. Others in attendance included Diana Evans from NPFMC.

Agenda

The Joint Groundfish Plan Teams convened to adopt recommendations to revise groundfish (and halibut) research priorities. Jim Ianelli chaired the meeting on behalf of both teams.

In response to a SSC request in June 2012, Council and AKFIN staff (Diana Stram, Diana Evans, and Mike Fey) developed a new approach that has been endorsed by the Plan Teams, Advisory Panel, SSC, and Council. This new process allows for evaluation of an organized list of research priorities using a relational database; the proposed research includes information on the question or data need to be resolved, whether the priority is an immediate concern or an ongoing need, relative rank (high, medium, low), impact on decision making, and species or fishery affected. The SSC is scheduled to consider the Teams' recommendations during the April 2013 meeting, as it develops its recommendations for Council consideration of research priorities for 2013 through 2017.

Plan Team members were organized into 7 groups based upon categories of research prior to the meeting in order to facilitate the review by the Joint Teams. The categories are listed below. Each group provided

draft revisions to the existing priorities and proposed prioritization. The meeting then consisted of a summary of draft revisions, by individual group, followed by comments and recommended changes by additional PT members on proposed revisions and prioritization.

Group	Category description
1	Fish and Fisheries Monitoring
2	Stock Assessment
3	Fishery Management
	Bycatch issues
4	Protected Species
5	Habitat mapping
	Function of Habitat
	Evaluate Habitats of Particular Concern
	Baseline Habitat Assessment
	Fishing Effects on Habitat
6	Ecosystem indicator development and maintenance
	Environmental influences on Ecosystem Processes
7	Basic research on trophic interactions
	Ecosystem modeling

Overall summary and discussion of process

While the Teams evaluated over 100 items and prioritized them *within* categories, time was insufficient to complete a comparison of rankings *across* categories. Highest priorities items across categories will be extracted for review and discussion at the April SSC meeting. The Teams noted some ambiguity in using "immediate needs" versus "ongoing needs" as categories. It was noted that these classifiers would likely disappear after prioritization (since some immediate needs are also ongoing).

The Teams summarized some issues to be considered by the SSC and Council:

1. Some clarification on the relationship between SSC (and Plan Team) stock-specific requests to authors and these research priorities would be useful. For example, whether SSC requests for individual SAFE chapters should appear in the list of research priorities?
2. When a priority is deemed to be sufficiently well underway, what would be the process for removing it from the list?
3. Prioritization: the Teams were unable to compare the final priorities over all categories during the meeting (time ran short). Had the Teams been able to compare over all categories it is likely that some of the rankings would have changed. Guidance on the process for evaluating the relative rankings would be welcome; in particular, how best to relate and align the Council's management priorities to research priorities.
4. Some priorities cross categories and it was noted that this would be easily dealt with given that a database has been designed and developed.
5. The Teams were unsure when to categorize things as "*partially* underway" versus "underway."
6. Halibut issues could be put into a separate category.

Halibut research priorities

The Teams noted that the SSC requested that the Groundfish Plan Teams provide research priority recommendations based on research recommendations that were compiled during the 2012 Halibut Bycatch Workshop, as part of its groundfish recommendations. A joint Plan Team halibut subgroup was tasked with developing halibut research priorities at the next opportunity.

Wrap-up and timing for report finalization

Diana Stram noted that the report must be finalized prior to the SSC meeting convening on April 1. Comments noted in the research priorities will not be provided as part of the report to the SSC but will be provided verbally in explanation should the SSC require additional information regarding the noted modifications to the existing descriptions. The final report was approved by the Chairs of the Teams.

Adjourn

The meeting adjourned at 4:30pm on March 26th, 2013.

Table of "high" priority items identified from the meeting:

ID	Category	Description
103	Fish and Fisheries Monitoring	Methods for reliable estimation of total removals
109	Stock Assessment	Age determination methods for Pacific cod, Pacific sleeper sharks, and spiny dogfish
117	Stock Assessment	Vertical distribution of Pacific cod
118	Stock Assessment	Pacific cod stock assessment for the Aleutian Islands
119	Fishery Management	Evaluation of salmon PSC mitigation measures
120	Fishery Management	Improve knowledge for salmon bycatch impact assessment
126	Protected Species	Localized interactions between fisheries and protected species
127	Protected Species	Age- and size-specific vital rates of Steller sea lions
128	Protected Species	Indirect effects of fisheries removals on Steller sea lions
138	Fish and Fisheries Monitoring	Continuation of State and Federal annual and biennial surveys
151	Stock Assessment	Acquire basic life history information (e.g., natural mortality, growth, size at maturity) for data-poor stocks.
163	Stock Assessment	Expanded studies to identify stock boundaries
164	Stock Assessment	Develop spatially explicit stock assessment models
167	Fishery Management	Refine methods to incorporate uncertainty into harvest strategies for groundfish
168	Fishery Management	Conduct prospective and retrospective analyses of changes in the spatial and temporal distribution of fishing effort in response to management change
169	Fishery Management	Develop a framework for collection of economic information
175	Fishery Management	Retrospective analysis of the impact of Chinook salmon bycatch measures on the BSAI pollock fishery
179	Fishery Management	Conduct pre- and post-implementation studies of the benefits and costs, and their distribution, associated with dedicated access privileges
181	Protected Species	Economic, social, and cultural valuation research on protected species
182	Protected Species	Foraging ecology and vital rate studies of Steller sea lions
184	Protected Species	Gear modifications and fishing practices to reduce bycatch
191	Habitat Mapping	Improved habitat maps
194	Function of Habitat	Research the role of habitat in fish population dynamics, fish production (growth, reproduction), and ecosystem processes
195	Function of Habitat	Evaluate efficacy of habitat closure areas and habitat recovery
203	Ecosystem indicator development and maintenance.	Maintain indicator-based ecosystem assessment for EBS.
204	Ecosystem indicator development and maintenance.	Develop indicator-based ecosystem assessments for AI (in progress), GOA, Arctic.
205	Ecosystem indicator development and maintenance.	Develop stock-specific ecosystem indicators and incorporate into stock assessments.
214	Environmental Influences on Ecosystem Processes	Measure and monitor fish composition
215	Environmental Influences on Ecosystem Processes	Assess the movement of fish to understand the spatial importance of predator-prey interactions in response to environmental variability.
218	Environmental Influences on Ecosystem Processes	Assess the synergistic effects of ocean acidification, oil, dispersants, and changes in temperature on productivity of marine species.
NEW - GPT	Bycatch Issues	Evaluate current and alternative Council PSC / bycatch reduction measures
NEW - GPT	Fish and Fisheries Monitoring	Effects of changes to the observer program

Fish and Fisheries Monitoring

~~2012~~2013 Research Priorities - Immediate Needs

Res_Title	
Fish and Fisheries Monitoring	
103	**Methods for reliable estimation of total removals (H)** **Underway** Develop methods for reliable estimation of total removals (e.g., surveys, poorly observed fisheries) to meet requirements of total removals under ACLs. Catch Accounting System now provides total removals annually. Improved reporting on some data such as subsistence catches and Pacific cod bait in crab fisheries is needed.
XXX	**Effects of changes to the observer program (M) [also included in stock assessment]** **Partially underway** Evaluate the effects of changes to data collection protocols that occur because of the observer restructuring. Ensure that data can be compared easily to the previous data collection methods and time series remain intact. Improved biological data collection including representative length and age samples from ~~the~~ all sectors of the fleet.
104	**Improve species identification (L)** **Partially underway [include in ongoing]** Improve species identification, by both processors and observers, for priority species within species complexes in catches, to meet requirements of total removals under ACLs. Methods that quantify and correct for misidentifications are desired.

~~2012~~2013 Research Priorities - Ongoing Needs

Res_Title	
Fish and Fisheries Monitoring	
138	**Continuation of State and Federal annual and biennial surveys (H)** **Underway**

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 federal budgets in which funding may not be sufficient to conduct these surveys. Loss of funding for days at sea for NOAA ships jeopardizes these programs. 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. Although an ongoing need, these surveys are considered the highest priority research activity, contributing to assessment of commercial groundfish and crab fisheries off Alaska. Budgetary concerns have resulted in cuts to not only days at sea, which increases uncertainty, but also the deepest strata have been commonly cut, which threatens the value of trawl surveys as a synoptic ecological survey.

139 **Conduct routine subsistence use, fish, crab, and oceanographic surveys (M)**

Partially Underway

Conduct routine subsistence use, fish, crab, and oceanographic surveys of the northern Bering Sea and Arctic Ocean. These surveys will become increasingly important under ongoing warming ocean temperatures because range expansions of harvested fishery resources may occur. If range expansions or shifts occur, data will be needed to adjust standard survey time series for availability.

140 **Identification and integration of archived data (e.g., surveys) (L)**

Partially underway

Identification and recovery of archived data (e.g., historical agency groundfish and shellfish surveys) should be pursued. Investigate integrating these data into stock and ecosystem assessments. Some archival acoustic data has been cataloged, and most trawl surveys have been included in databases. Some one-time research surveys remain neglected.

142 **Survey capability for forage fish (M)**

Partially underway

Develop a long-term survey capability for forage fish (partially underway). The NPRB funded GOA and Bering Sea Projects are~~is~~ currently describing the ~~spaitial~~spatial and temporal variability in the structure of forage fish communities and the effect of this variability on predators. This work should be continued and methods for long-term monitoring should be developed.

144 **Expand ~~cooperative~~ research efforts to assess seasonal diets and movements of fish and shellfish (M)**

No Action

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 diets and movements of fish and shellfish, for use in studies of species interactions in spatially explicit stock assessments.

~~145~~ ~~Monitor skate egg case concentration sites (L) or strike?~~[move to HAPC section as appropriate]

~~No Action~~

~~The HAPC action for skate egg case concentration sites included two recommendations that the Council suggested should be addressed during the annual research priority discussion: (a) skate egg case concentrations should be monitored every 2 to 3 years using non-invasive research design, such as in situ observation; and (b) skate conservation and skate egg concentration areas remain a priority for EFH and HAPC management and within Council and NMFS research plans.~~

146 **Improve surveys in untrawlable habitat, particularly for rockfish (M)**

Partially underway

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 that are found in untrawlable habitat or are semi-pelagic species such as northern and dusky rockfish. A number of publications specific to untrawlable grounds and rockfish sampling have been published recently, but have not been incorporated directly into stock assessment our routine survey designs.

147 **Effects of the environment on survey catchability, particularly for Tanner crab and Aleutian Islands golden king crab (M)**

Partially underway

Studies are needed to evaluate effects of the environment on survey catchability. For groundfish and crabs, studies are needed on catchability, as it directly bears on estimates of the stock size for setting of catch quotas. Research to refine the estimates of survey catchability, q, used to infer absolute, rather than relative, abundance would substantially improve the quality of management advice. Particular emphasis should be placed on Tanner crab because of recent trends in stock status and on fishery and fishing gear selectivity for Aleutian Island golden king crab to improve the stock assessment model. Empirical estimates of catchability have been estimated for some groundfish species, including rockfish, Pacific cod, and flatfish.

~~148~~ ~~Research on survey analysis techniques for species that exhibit patchy distributions (L) or strike~~

~~No Action~~Underway

~~Continue research on the design and implementation of appropriate survey analysis techniques, to aid the Council in assessing species (e.g., some crabs and rockfish) that exhibit patchy distributions and, thus, may not be adequately represented (either over- or under-estimated) in the annual or biennial groundfish surveys. A number of publications have examined survey designs for patch distributions, specifically with respect to rockfish. No changes have been incorporated directly into routine surveys.~~

XXX

150 **Collect maturity scans during fisheries that target spawning fish (M)**

Underway[reword to improving maturity estimates]

Expand existing efforts to collect maturity scans during fisheries that target spawning fish (e.g., pollock). Time series of maturity at age should be collected to facilitate the assessment of the effects of density-dependence and environmental conditions on maturity. Maturity information for rockfish species near Kodiak has been collected recently both during the fishery and dedicated scientific cruises. A dedicated survey to examine spawning sablefish was also conducted. Continued efforts to collect maturity for rockfish and other species should continue

Stock Assessment

~~2012~~2013 Research Priorities - Immediate Needs

Stock Assessment	Res_Title
108	**Tagging studies of Aleutian Islands Pacific cod and Atka mackerel (M)** Partially Underway Tagging studies of Aleutian Islands Pacific cod and Atka mackerel are needed to create models of short-term movement of fish relative to critical habitat (tagging for Atka mackerel partly underway).
109	**Age determination methods for Pacific cod, Pacific sleeper sharks, and spiny dogfish (H)** Partially Underway Studies are needed to validate and improve age determination methods for Pacific cod, Pacific sleeper sharks, and spiny dogfish. Conventional tagging studies of young of the year and/or one-year old Pacific cod would be useful in this regard (partially underway for cod and dogfish).
110	**Maintain the core biological and oceanographic data ~~from the eastern Bering Sea~~ (e.g. ~~biophysical~~ moorings, stomach data, zooplankton, age 0 surveys) (M) [Move to ongoing]** Underway Maintain the core data ~~from the eastern Bering Sea~~ needed to support ~~a diverse suite of models used to support the~~ integrated ecosystem assessment ~~program s~~for ~~the Bering Sea~~. Core data include inputs for single- or multi-species management strategy evaluations, food web, and coupled biophysical end-to-end ecosystem models (e.g. biophysical moorings, stomach data, zooplankton, age 0 surveys).
111	**Biomass indices and alternate methodologies for lowest tier species (M)** Underway Develop biomass indices for lowest tier species (Tier 5 for crab, Tier 6 for groundfish), such as sharks and octopus. ~~, and conduct net efficiency studies for spiny dogfish.~~ Explore alternative methodologies for Tier 5 and 6 stocks such as length-based methods, catchability experiments (e.g., net selectivity), or biomass dynamics models.
113	**Research on ~~spawner-~~stock~~-~~recruit relationship (L)** Underway

	New information and data are needed that would inform our understanding of the ~~spawner~~ stock–recruit relationship for groundfish and crab with sufficient skill to project year-class strength (e.g., Tanner crab, GOA pollock, sablefish~~, halibut~~). ~~(Underway)~~
114	**Stock structure and potential spatial management for BSAI pollock (M)** Underway Conduct studies to determine stock structure and potential spatial management for BSAI pollock (e.g., movement). Evaluate interactions with Russian waters.
115	**District-wide survey for demersal shelf rockfish in Southeast Alaska (M)** No Action Conduct a district-wide survey for demersal shelf rockfish in Southeast Alaska in a single assessment year to help inform density estimates in specific subdistricts in other assessment years.
117	**Vertical distribution of Pacific cod (H)** Underway Research is needed on the vertical distribution of Pacific cod relative to the EBS bottom trawl and comparisons between the EBS and GOA trawl gear..
118	**Pacific cod stock assessment for the Aleutian Islands (H)** Underway Develop Pacific cod stock assessment for the Aleutian Islands region.
XXX	**Effects of changes to the observer program (M)** **No Action [also appears in Subgroup 1 priorities]** Evaluate the effects of changes to data collection protocols that occur because of ~~the~~ observer restructuring. Ensure that data can be compared easily to the previous data collection methods and time series remain intact.

~~2012~~2013 Research Priorities - Ongoing Needs

Res_Title	
Stock Assessment	
151	**Acquire basic life history information (e.g., natural mortality, growth, size at maturity) for ~~data-poor and data-moderate~~ lower information stocks. (H)** Underway

Acquire basic life history information needed for stock assessment and bycatch management of data-poor stocks, such as scallops, sharks, skates, sculpins, octopus, grenadiers, squid, and blue king crab (Bering Sea), golden king crabs (Aleutian Islands), and red king crab (Norton Sound). Specifically, information is needed on natural mortality, growth, size at maturity, and other basic indicators of stock production/productivity).

~~152~~ ~~Acquire estimates of mortality and abundance for octopus (M)~~

~~No Action~~[see 151]

~~For octopus, there is particular need for estimates of mortality and abundance, including verification of the cod consumption-based approach.~~

156 **Improve estimates of natural mortality (M) for Pacific cod and crab stocks. (M)**

Partially underway

Improve estimates of natural mortality (M) for several stocks, including Pacific cod and BSAI crab stocks.

158 ~~Validate and improve age determination methods for Pacific cod, Pacific sleeper sharks, and spiny dogfish (H for cod, L for others)~~

[see immediate needs]

~~Studies are needed to validate and improve age determination methods for Pacific cod, Pacific sleeper sharks, and spiny dogfish. (partially underway for Pacific cod and spiny dogfish)~~

160 **Develop and evaluate ~~standard~~ GCM climate variability scenarios on recruitment and growth (M)**

Underway

Quantify the effects of historical climate variability and climate change on recruitment and growth, and develop standard environmental scenarios (e.g., from global climate change models (GCMs) for present and future variability based on observed patterns.

161 **Climate information covering a wider range of seasons is needed. (L)**

No Action [cloudy, needs clarification]

There is also a ~~clear~~ need for climate information that covers a wider range of seasons than is presently available.

162 **Development of projection models to evaluate (a) the performance of different management strategies and (b) to forecast seasonal and climate related population shifts (M)**

Underway

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.

163	**Expanded studies to identify stock and management boundaries (H)**

Underway

To identify stock boundaries, expanded studies are needed in the areas of genetics, mark-recapture, reproductive biology, larval distribution, and advection. Such boundaries are to be evaluated so that consequences of management and risks are clear.

164	**Develop spatially explicit stock assessment models (H)**

Partially underway for some species, No Action on others

Develop spatially explicit stock assessment models, where appropriate. High priority species for spatially explicit models include: snow crab, walleye pollock, Pacific cod, sablefish, yellowfin sole, rock sole, arrowtooth flounder, Pacific ocean perch, black-spotted rockfish, rougheye rockfish and Atka mackerel.

Fishery Management

~~2012~~2013 Research Priorities - Immediate Needs

Res_Title	
Fishery Management	
119	**Evaluation of salmon PSC mitigation measures** Underway (H) Develop a research program that will facilitate evaluation of salmon (both chinook and non-chinook) PSC mitigation measures in the BSAI and GOA. This includes updated estimates of the amounts reasonably necessary for subsistence, timing of runs and openings relative to subsistence requirements, and access to cost data for the commercial pollock and salmon industries so that impacts on profits (not revenues) can be calculated.
120	**Improve knowledge for salmon bycatch impact assessment** Underway (H) Improve the resolution of Chinook and chum salmon genetic stock identification methods (e.g., baseline development, marker development), improve precision of salmon run size estimates in western Alaska, and initiate investigations of biotic and abiotic factors influencing natural mortality rate during ocean migration in the GOA and BSAI. (baseline development is nearing completion, more work on Cook Inlet chum needed)
121	**Investigate factors affecting the guided angler sector of the halibut fishery** Underway (M) ~~Develop improved catch monitoring methods of fishery interactions including direct and alternative options (e.g., electronic logbooks, video monitoring), particularly on smaller groundfish, halibut, and commercially guided recreational fishing vessels, including an assessment of feasibility for small vessels.~~ Continue to iInvestigate factors that affect angler demand in the guided angler sector of the halibut fishery resulting from regulatory changes or general economic conditions.~~(Underway)~~
122	**Improve methods of monitoring fishery interactions** Underway (H) Develop improved catch monitoring methods of fishery interactions including direct and alternative options (e.g., electronic logbooks, video monitoring), particularly on smaller groundfish, halibut, and commercially guided recreational fishing vessels, including an assessment of feasibility for small vessels.
123	**Develop bioeconomic models** Partially Underway (M)

Develop bioeconomic models with explicit age- or size-structured population dynamics for BSAI and GOA groundfish fisheries to estimate maximum economic yield and other bioeconomic reference points under uncertainty.

124 **Benefits and costs of halibut and halibut PSC utilization**

Underway (M)

Research the benefits and costs of halibut and halibut PSC utilization in different fishing sectors. For halibut and other PSC and bycatch species, conduct research to better identify where regulations restrict the utilization of fish from its most beneficial use and evaluate how changes in existing regulations would affect different sectors and fisheries

125 **Thresholds for ecosystem indicators**

No Action (M)

Initiate/continue research on developing and evaluating thresholds for ecosystem indicators, including ecosystem-level management strategy evaluation.

~~2012~~2013 Research Priorities - Ongoing Needs

Res.	Title
Fishery Management	
167	**Refine methods to incorporate uncertainty into harvest strategies for groundfish**

Underway (H)

Refine P* and decision theoretic methods to incorporate uncertainty into harvest strategies for groundfish for ACL estimation. Continue existing management strategy evaluations at the stock level.

168 **Conduct prospective and retrospective analyses of changes in the spatial and temporal distribution of fishing effort in response to management change**

Underway (H)

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, PSC and other bycatch restrictions, co-ops, IFQs).

169 **Develop a framework for collection of economic information**

Partially underway (H)

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

171 **Improve estimation of fishery interactions with marine mammals, seabirds, non-target groundfish, and protected species.**

No Action (L) [overlaps with protected resource priority, L for non-target, high for PR]

Improve estimation of fishery interactions (including catch) with marine mammals (e.g., state managed gillnet fisheries), seabirds, and non-target groundfish (e.g., sharks, skates), and protected species.

172 **Conduct studies documenting the subsistence harvest (patterns, norms, quantities) in communities affected by Council actions.**

No Action (L)

Conduct studies documenting the subsistence harvest patterns, norms and quantities in communities that depend upon resources that may be affected by Council action.

~~173~~ ~~**Evaluate the effectiveness of setting ABC and OFL levels for data-poor stocks**~~

~~**Partially Underway (H)**~~[covered in stock assessment]

~~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). Research is needed to refine the basis for setting gamma for Tier 4 crab stocks. (partially underway)~~

174 **Examine interactions between coastal communities and commercial fisheries**

Underway (M)

Examine interactions between coastal communities and commercial fisheries (e.g. subsistence-commercial linkages; adaptations to changes in resource use, economic opportunities for coastal communities).

175 **Retrospective analysis of the impact of Chinook salmon bycatch measures on the BSAI pollock fishery**

Partially Underway (H)

Conduct retrospective analyses to assess the impact of Chinook salmon bycatch measures on the BSAI pollock fishery. Analyses should include an evaluation of the magnitude and distribution of economic effects of salmon avoidance measures for the Bering Sea pollock fishery. In this case, it is important to understand how pollock harvesters have adapted their behavior to avoid bycatch of Chinook and "other" salmon, under various economic and environmental conditions and incentive mechanisms.

176 **Develop stock forecasting tools ~~evaluating~~ that incorporate changing climate and market ~~demands~~conditions.**

Partially Underway (M)

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. Promote the s~~S~~tandardization of "future scenarios" from different models to ~~will~~ help ~~to~~ promote comparability of model outputs.

177 **Develop an ongoing database of product inventories**

No Action (L)

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

178 **Analyze current determinants of demand for principal seafood products**

Underway (L)

Analyze current determinants of ex vessel, wholesale, international, and retail demand for principal seafood products from the GOA and BSAI.

179 **Conduct pre- and post-implementation studies of the benefits and costs, and their distribution, associated with dedicated access privileges**

Underway (H)

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, AFA pollock, and crab fisheries. "Benefits and costs" include both economic and social dimensions.

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

~~No Action~~Underway [bsierp MSE and crab]

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

Protected Species

~~**181**~~ ~~**Economic, social, and cultural valuation research on protected species**~~

~~No Action~~~~Partially underway~~ [already covered in PR]

~~Economic, social, and cultural valuation research on protected species (i.e., non-market consumptive use, passive use, non-consumptive use), particularly in the Arctic.~~

Bycatch Issues

~~188~~ ~~Evaluate interaction among Council bycatch reduction initiatives~~

~~No Action (H)~~

~~There is a need to analyze the effects of recent Council actions on bycatch, including interaction among bycatch reduction initiatives (e.g., halibut, salmon),~~

~~189~~ ~~Quantify the effects of bycatch reduction of PSC species in groundfish fisheries on target fisheries~~

~~No Action (H)~~

~~There is a need to analyze the effects of recent Council actions on bycatch, including quantifying the effects of bycatch reduction of PSC species in groundfish fisheries to the target fisheries (e.g., charter and commercial halibut fisheries, salmon fisheries)~~

~~190~~ ~~Research approaches to create bycatch and PSC reduction incentives.~~

~~No Action (H)~~

~~There is a need to analyze the effects of recent Council actions on bycatch, including research approaches to create bycatch and PSC reduction incentives.~~

188-190 Evaluate current and alternative Council PSC / bycatch reduction measures. [merged from 188-190]

Partially underway (H)

Analyze the effects of recent Council actions on bycatch, including the interaction among bycatch reduction initiatives (e.g., halibut, salmon, crab). Attention should be given to different incentives that have the potential to cost-effectively reduce PSC.

Protected Species

Protected Species

126 ~~Localized~~ **interactions between fisheries and pinnipeds (H)** ~~rotected species~~

Underway

Studies of the ~~localized~~ interactions between fisheries and protected species, such as ~~interactions between~~ Steller sea lions ~~and commercial fish species~~ in the Central and Western Aleutian Islands (~~particularly~~ areas 541, 542, 543), and northern fur seals on the eastern Bering Sea shelf are needed. These studies should be conducted at appropriate spatial and temporal scales with an emphasis on seasonal prey fields, diet, and movement of fisheries and pinnipeds~~sea lions and their prey~~.

127 ~~Age- and size-specific~~ Vital rates of Steller sea lions (H)

Underway

Assess ~~age- and size-specific~~ vital rates (i.e., reproduction and survival) of Steller sea lions in the western DPS (including Russia) ~~and central Aleutians~~ at sufficient frequency to track population dynamics ~~in the western DPS~~.

128 Indirect effects of fisheries removals on Steller sea lions (H)

Underway

Assess possible indirect effects of fisheries removals via periodic health assessments, indices of body condition, survival of pups and juveniles, and pup-non pup ratios of Steller sea lions in the ~~Eastern~~ western DPS.

129 Killer whale predation of Steller sea lions (M)

Underway

Quantify killer whale predation of Steller sea lions, particularly in the western and central Aleutian Islands.

130 Methods to estimate sea lion abundance (L)

Underway

Develop new methods to estimate sea lion abundance, such as the use of unmanned aerial vehicles, which could increase the probability of acquiring abundance estimates in remote areas.

131 Impact of the displacement of the groundfish fleet on Northern fur seals

Partially Underway (L)

Assess the impact of the displacement of the groundfish fleet due to Steller sea lions protection measures on the prey availability, foraging ecology, diet, movements, and vital rates for Northern fur seals (partially underway).

132 Impact of seabird bycatch in fisheries on bird populations, and methods to reduce (M)

Underway

Assess the extent and impact of seabird bycatch in fisheries on bird populations, and develop methods to reduce seabird bycatch, particularly protected species, such as short-tailed albatross.

133 **Impacts of fishing activities on endangered whales (M)**

No Action

Determine potential impacts of fishing activities on North Pacific right whales and the Eastern North Pacific blue whales in the GOA, particularly in identified critical (NPRW) or essential (NPBW) habitat.

Protected Species

181 **Economic, social, and cultural valuation research on protected species (H)**

Underway

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

182 **Foraging ecology ~~and vital rate~~ studies of Steller sea lions (H)**

Underway

Foraging ecology ~~and vital rate~~ studies of Steller sea lions in the Gulf of Alaska, Aleutian Islands, and Russia~~n Far East, and Commander Islands~~, including at-sea tracking of older animals, and diet composition of sea lions throughout the region. ~~Emphasis should be placed on the use of methods that allow population abundance estimates to be directly compared between Russia and Alaska.~~

~~**183**~~ ~~**Fishery-induced impacts on northern fur seals**~~

~~**No Action**~~

~~Linkages between fishery-induced disturbance or local prey depletion for northern fur seals in the Pribilof Islands region. (underway)~~

184 **Gear modifications and fishing practices to reduce bycatch[cover in bycatch issues]**

Partially Underway

Gear modifications and fishing practices to reduce bycatch, particularly of PSC species (e.g., salmon and crab). (partly underway)

185 **Studies of sperm and killer whale depredation of catch in long-line fisheries and surveys (M)**

Underway

Studies of sperm and killer whale depredation of catch in long-line fisheries and surveys to improve the quality of long-line abundance estimates.

~~186~~ ~~Monitor interactions between fishing fleet and protected seabirds~~

~~No Action~~[covered elsewhere in research priorities, need to list]

~~Monitor interactions between fishing fleet and protected seabirds, particularly in Aleutian Islands and the eastern Bering Sea shelf edge where albatross have increased.~~

~~187~~ ~~Assess the potential for increased interactions between fisheries and protected whale and seabird species and fishing efforts in essential habitats~~

[covered elsewhere in research priorities, need to list]

~~No Action~~

~~Assess the potential for increased interactions between protected species (ie, large whales and post-breeding/migrating seabirds) and fishing efforts in essential habitats, in particular throughout migratory routes, and with respect to changes in fish stock distribution and/or expansion into Arctic waters.~~

XXX

Updated sperm whale stock assessment (H)

Updated sperm whale abundance estimates are needed. Sperm whale depredation interactions with longline fisheries have increased but little is known about sperm whale populations. Updated population estimates and defined PBR's are needed to effectively respond if a take occurs in the longline fishery

Habit

~~2012~~2013 Research Priorities - Immediate Needs

Res_Title	
Evaluate habitats of particular concern	
134	**Assess whether Bering Sea canyons are habitats of particular concern(M)**
	Underway
	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 and above the canyon areas, including mid-level and apex predators to neighboring shelf/slope ecosystems. (partially underway)
Baseline Habitat Assessment	
135	**Arctic assessment of current baseline conditions (L)**

Partially underway

Dynamic ecosystem and environmental changes in the northern Bering Sea and Arctic are occurring. ~~on a pace not observed in recorded time. In response to the new Arctic FMP, a~~Assessment of the current baseline conditions and trophic interactions is ~~imperative~~important. This effort~~, while of great scientific importance,~~ should not supplant the regular surveys in the BSAI and GOA, which are of critical importance to science and management.

Fishing Effects on Habitat

136	**Effects of trawling on female red king crab and subsequent recruitment Crab PT not GPT**

Partially Underway[came from EFH review]

Research is needed on the effects of trawling on the distribution of breeding and ovigerous female red king crab and subsequent recruitment. Relevant studies include effects of potential habitat modifications on the distribution of females, particularly in nearshore areas of southwest Bristol Bay (partially underway), and environmental effects (e.g., trawling overlap in warm vs. cold years). Retrospective studies, the use of pop-up tags to identify larval release locations, and larval advection using Regional Ocean Modeling System would help address this need.

137	**Impact of bottom trawl fisheries on benthic habitat (M)**

Underway

Impact of bottom trawl fisheries on invertebrate abundance and species composition in benthic habitats, especially as might be relevant to the foraging ecology of walrus (candidate species for listing under ESA), but also bearded seals (ESA determination due in July), and gray whales.

~~2012~~2013 Research Priorities - Ongoing Needs

Res_Title	
Habitat Mapping	
191	**Improved habitat maps (H)** Underway 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 in the GOA, -BS, and Aleutian Islands ~~and Arctic~~. ~~(partially underway)~~
192	**Develop a GIS relational database for habitat, to include a historical time series of the spatial intensity of interactions between commercial fisheries and habitat. (M)** Underway 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. Such time series are needed to evaluate the impacts of changes in fishing effort and type on EFH.
193	**Assess the extent of the distribution of Primnoa corals and skate egg case concentration sites in the GOA (L)** ~~No Action~~Underway Assess the extent of the distribution of Primnoa corals and skate egg case concentration sites in the GOA, and conduct routine monitoring of these areas.
Function of Habitat	
194	**Research the role of habitat in fish population dynamics, fish production (growth, reproduction), and ecosystem processes (H)** **Partially underway** Research is needed on the role of habitat in fish population dynamics, fish production, and ecosystem processes. Specifically, studies are needed to evaluate how habitat-forming species (e.g. corals) influence life history parameters (e.g., mortality, growth, movement) of FMP species and their preferred prey. Such research will identify key habitats (including essential fish habitat and habitat areas of particular concern), improve the design and management of marine protected areas, and ultimately improve stock assessments and restoration efforts.~~Research is needed on the role of habitat in fish population dynamics, fish production (growth, r reproduction), and ecosystem processes. Such research will improve the capability to identify and protect important habitats (including essential fish habitat and habitat areas of particular concern); help design effective habitat restoration~~

~~efforts; improve the design and management of marine protected areas; improve fishery independent population surveys; and improve stock assessments. Studies are needed to evaluate relationships between, and functional importance of, habitat forming living substrates to juvenile and adult life stagesage classes of commercially FMPimportant species and their preferred prey (forage fish). (partially ongoing)~~

195 **Evaluate efficacy of habitat closure areas and habitat recovery (H)**

~~No Action~~Partially underway

Establish a scientific research and monitoring program to understand the degree to which impacts on ~~(~~habitat, benthic infauna, etc.~~,)~~ have been reduced within habitat closure areas, and to understand how benthic habitat recovery of key species is occurring. (This is ~~the~~ an objective of EFH research approach for the Council FMPs).

Ecosystem indicator development and maintenance

~~2012~~2013 Research Priorities - Immediate Needs

Res_Title

~~2012~~2013 Research Priorities - Ongoing Needs

Res_Title
Ecosystem indicator development and maintenance.

196 **Develop a multivariate index of the climate forcing of the Bering Sea shelf (M)**

Partially Underway

~~Climatic Indicators a.)~~ Develop a multivariate index of the climate forcing of the Bering Sea shelf. Three biologically significant avenues for climate index predictions include advection, setup for primary production, and partitioning of habitat with oceanographic fronts and temperature preferences.

197 **Develop bottom and water column temperature database (M)**

Partially Underway

~~Climatic Indicators b)~~ Develop bottom and water column temperature database for use in EBS, GOA, and AI stock assessments.

198 **Maintain sea ice formation and retreat index for the EBS (M)**

Underway

~~Climatic Indicators c)~~ Maintain sea ice formation and retreat index for the EBS.

199 **Collect and maintain primary production time series (M)**

No Action

~~Lower trophic level community production data a.)~~ Collect and maintain primary production time series in the EBS, AI, GOA, and Arctic; particularly in relationship to key climate and oceanographic variables.

200 **Collect and maintain zooplankton biomass and community composition time series (M)**

Partially Underway

~~Lower trophic level community production data b.)~~ Collect and maintain zooplankton biomass and community composition time series in the eastern Bering Sea. Develop, collect and maintain time series of zooplankton biomass and community composition for the GOA, AI, Arctic.

201 **Collect and maintain data on forage fish community composition and abundance (M)**

Partially Underway

~~Lower trophic level community production data c.)~~ Collect and maintain data on forage fish community composition and abundance in the Bering Sea, GOA, AI, Arctic.

202 **Collect and maintain time-series data on the community composition, production and biomass of benthic invertebrate and vertebrate fauna (M).**

Partially Underway

~~Lower trophic level community production data d.)~~ Collect and maintain time-series data on the -community composition, production and biomass of benthic invertebrate and vertebrate fauna.

203 **Maintain indicator-based ecosystem assessment for EBS and AI (H).**

Underway

~~Develop methods for incorporating ecosystem indicators into stock assessments and ecosystem assessments. a.)~~ Maintain indicator-based ecosystem assessment for EBS.

204 **Develop indicator-based ecosystem assessments for ~~AI,~~ GOA, Arctic (H).**

Underway

~~Develop methods for incorporating ecosystem indicators into stock assessments and ecosystem assessments. b.)~~ Develop indicator-based ecosystem assessments for GOA, and the Arctic.

205 **Develop stock-specific ecosystem indicators and incorporate into stock assessments (H).**

Partially Underway

~~Develop methods for incorporating ecosystem indicators into stock assessments and ecosystem assessments. c.)~~ Develop stock-specific ecosystem indicators and incorporate into stock assessments. (in progress)

206 **Develop methodologies to monitor for new/emerging diseases among exploited species and higher trophic levels (L).**

No Action

Develop methodologies to monitor for new/emerging diseases and/or parasites among exploited species and higher trophic levels.

207 **Assess the impact of increases in recovering whale populations on lower trophic level energy pathways (M).**

No Action

Assess the impact of increases in recovering whale populations (e.g. gray, humpback and fin) on lower trophic level energy pathways.

208 **Ecosystem indicator synthesis research (M).**

Partially Underway

Ecosystem indicator synthesis research.

209 **Cooperative research efforts to supplement existing at-sea surveys that provide seasonal, species-specific information on upper trophic levels (M)**

Partially Underway

Continue and expand cooperative research efforts to supplement existing at-sea surveys that provide seasonal, species-specific information on upper trophic levels (seabirds and marine mammals). Updated surveys to monitor distribution and abundance of seabirds and marine mammals are needed to assess impacts of fisheries on apex predators, improve the usefulness of apex predators as ecosystem indicators, and to improve ecosystem management.

210 **Initiate and expand non-market valuation research of habitat, ecosystem services, and passive use considerations (L).**

No Action [overlap w/ Fish Mgt group?]

Initiate and expand non-market valuation research of habitat, ecosystem services, and passive use considerations.

211 **Assess the relative importance of non-commercially exploited species to human communities (M).**

Partially Underway [commercially exploited species covered Fish Mgt]

Assess the relative importance of non-commercially exploited species (invertebrates, fish, marine mammals and seabirds) to human communities, particularly in Arctic.

Environmental Influences on Ecosystem Processes

212 **Maintain moorings. (M)**

Underway [overlap with Fish Monitoring]

Maintain moorings. 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.

213 **Monitor seasonal sea ice extent and thickness (M)**

Underway

Monitor seasonal sea ice extent and thickness: If recent changes in ice cover and temperatures in the Bering Sea persist, these may have profound effects on marine communities.

214 **Measure and monitor fish composition(H)**

Underway [overlap with Fish Monitoring]

Measure and monitor fish composition: Evaluate 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, northern Bering Sea, and areas of the Gulf of Alaska.

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

Partially Underway [overlaps with stock assessment and fish monitoring]

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

216 **Collect and maintain time series of ocean pH (M)**

Underway

Collect and maintain time series of ocean pH in the major water masses off Alaska.

217	**Assess whether changes in pH would affect managed species, upper level predators, and lower trophic levels. (M)** Partially Underway Assess whether changes in pH would affect managed species, upper level predators, and lower trophic levels.
218	**Assess the synergistic effects of ocean acidification, oil, dispersants, and changes in temperature on productivity of marine species. (H)** No Action [in planning stages] Laboratory studies are needed to assess the synergistic effects of ocean acidification, oil, dispersants, and changes in temperature on productivity of marine species.
219	**Monitor contaminant flux and loads in lower and higher trophic levels, and assess potential for impact on vital rates. (L)** No Action Monitor contaminant flux and loads in lower and higher trophic levels, and assess potential for impact on vital rates.

Ecosystem modeling

~~2012~~2013 Research Priorities - Immediate Needs

Res_Title

~~2012~~2013 Research Priorities - Ongoing Needs

Res_Title
Basic research on trophic interactions
220 **Collect, analyze, and monitor diet information (M)** Underway Collect, analyze, and monitor diet information (species, biomass, energetics), from seasons in addition to summer, 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.
221 **Ecosystem structure studies (M)**

Underway

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 differential exploitation of some components of the ecosystem (e.g., Pacific cod, pollock, and crab) relative to others (e.g., arrowtooth flounder).

~~222~~ ~~Evaluate how increases in whale increases in abundance have the potential to alter lower trophic level energy pathways~~ [move to Group 6 replacing #]

~~No Action~~

~~In the last decade, many whale populations (e.g., gray, humpback and fin) have increased dramatically after being depleted by whaling. These increases in abundance have the potential to alter lower trophic level energy pathways in the region. In addition, we should investigate potential impacts to other upper trophic level groups (ie e.g., pinnipeds, seabirds, large predatory fish).~~

Ecosystem Modeling

223 **Modeling studies of ecosystem productivity (M)**

Underway

Modeling studies of ecosystem productivity in different regions (EBS, GOA and AI). For example, evaluating the appropriateness of the 2 million t OY.

~~2012~~ 2013 Research Priorities - Scallop

Res_Title

Fish and Fisheries Monitoring

~~103~~ ~~**Methods for reliable estimation of total removals**~~

~~**No Action**~~

~~Develop methods for reliable estimation of total removals (e.g., surveys, poorly observed fisheries) to meet requirements of total removals under ACLs.~~

141 ~~**Fishery-independent surveys of scallops**~~**Estimate scallop stock abundance (H)**

No Action

Estimate scallop stock abundance in unsurveyed areas using fishery independent methods.~~There is a need for fishery-independent surveys of scallops on major fishing grounds, e.g., Yakutat, other areas.~~

NEW **Area-specific variability in population processes (H)**

Investigate area-specific variability in vital population processes including growth, recruitment,

natural mortality and movement.

Stock Assessment

106 **Improve ~~handling~~ discard mortality rate estimates for scallop (M)**

~~**No Action**~~**Partially underway**

Field studies estimating Alaskan scallop discard mortality: relationship between capture, release

condition and survival of scallops~~Improve handling mortality rate estimates for scallops. Conduct field studies to estimate scallop discard mortality (specifically the relationship between capture, release condition, and survival of scallops). (crab studies are partially underway: Chionoecetes RAMP study)~~

112 **Analyses of fishery ~~CPUE~~ effort and observer data for scallop (M)**

No Action

Assess impacts of temporal and spatial effort by a limited number of vessels on CPUE and observer data for management purposes.~~Owing to the lack of fishery-independent surveys for scallops, there is a need for analyses of fishery CPUE and observer data for use in assessing fishery performance and stock assessment. For instance, sharp declines in CPUE have occurred in some areas, such as Kayak Island and Alaska Peninsula, prompting concerns about local depletion. Additional new techniques may be desirable in regions with data-poor stocks.~~

151

~~**No Action**~~**[covered in other priorities for scallop]**

~~Acquire basic life history information needed for stock assessment and bycatch management of data-poor stocks, such as scallops, sharks, skates, sculpins, octopus, grenadiers, squid, and blue king crab (Bering Sea), golden king crabs (Aleutian Islands), and red king crab (Norton Sound). Specifically, information is needed on natural mortality, growth, size at maturity, and other basic indicators of stock production/productivity).~~

~~153~~ ~~**Acquire information on growth, movement, and abundance of scallops and golden king crab**~~

~~**No Action**~~

~~Tagging studies would provide information on growth and movement of scallops and growth and absolute abundance estimates for golden king crab.~~

154 **Conduct multivariate analysis of bycatch data from the scallop observer program** (L)

No Action

Conduct multivariate analysis of bycatch data from the scallop observer program (haul composition data) ~~to estimate abundance and trends of benthic communities on scallop beds~~and camera sled data.

NEW **Ocean Acidification: water quality (L)**

No action

Seasonal water quality monitoring in known scallop areas (Ocean Acidification)

NEW **Ocean Acidification (L)**

No action

Studies to understand the mineralization of scallop shells through life cycle and across spatial variability (Ocean Acidification)

155 ~~**Conduct computerized image processing from camera sled (CamSled) data.**~~

~~**No Action**~~

~~Conduct computerized image processing to facilitate scallop stock assessments from camera sled (CamSled) data.~~

~~160 **Develop and evaluate standard climate variability scenarios on recruitment and growth**~~

~~**No Action**~~

~~Quantify the effects of historical climate variability and climate change on recruitment and growth, and develop standard environmental scenarios for present and future variability based on observed patterns.~~

~~161 **Climate information overing a wider range of seasons is needed.**~~

~~**No Action**~~

~~There is also a clear need for climate information that covers a wider range of seasons than is presently available.~~

163 **Expanded studies to identify stock boundaries** (H)

No Action

Verify stock structure and source/sink dynamics including physical oceanographic, genetic and life-history studies ~~To identify stock boundaries, expanded studies are needed in the areas of genetics, mark-recapture, reproductive biology, larval distribution, and advection.~~

165 ~~**Genetic studies to understand the rate of larval exchange between scallop beds.**~~ **[merged with 163]**

~~**No Action**~~

~~Genetic studies to provide information on sources and sinks for scallop larvae are needed to improve our understanding of the rate of larval exchange between scallop beds.~~

166 ~~**Age-structured models for scallop assessment are needed.**~~

~~**No Action**~~ **[delete because plan underway for Central region]**

~~Also needed are age-structured models for scallop assessment.~~

Excerpt from May 2013 Crab Plan Team Report

13. Research priorities

Diana Stram presented the Team with the proposed revised process for organizing and updating research priorities. A subset of plan team members, SSC members, Council and AKFIN staff have been meeting to develop the structure for a relational database for use in organizing and evaluating annual priorities. Currently Council and AKFIN staff have created a spreadsheet (which could be turned into a database) using the SSC/Council's 2012 list of research priorities. Each of the existing 2012 research priorities has been entered into the spreadsheet. The content is unchanged. In some cases, if a 'single' 2012 research priority encompassed multiple issues, the priority was divided. For each priority in the spreadsheet, staff added multiple descriptive fields as requested by the SSC in June 2012 (related council action, species/fisheries/issues affected), as well as 'status of research' fields. In April, the SSC revised these descriptive fields, added additional fields and made other revisions to the proposed database structure. The changes will be incorporated into the current spreadsheet for the June 2013 SSC review. Once finalized, staff will develop the database and design a process to automate a web-based dashboard for revising and inputting new research priorities, and for the production of reports. This dashboard would have different tools for Plan Teams that are reviewing research priorities, and SSC members that are reviewing Plan Team comments and finalizing SSC recommendations. There would be automated reports available, e.g., for each Plan Team (including only those priorities assigned to each team); for the SSC (to review Plan Team recommended revisions and priorities); or for the Council (amalgamating the SSC's final list of recommended priorities, or perhaps reporting on research priorities that have been on the list for a long time, but remain unaddressed.)

Staff also envisions that there could potentially be multiple web-based report formats that would be publicly available, based on a user's interest. For example, a member of the public could search for all research priorities that are related to salmon, or view the status of all research priorities that are underway. These report formats would ideally also be developed and made available over the summer. The CPT was presented with the revised fields as modified by the SSC. Currently staff are proposing that the spreadsheet/database will be maintained by Pacific States Marine Fisheries Commission (AKFIN); they can prepare a web interface and standardized reports that would allow authorized users to propose and make changes to the priorities as part of the process.

The team revised the wording in the existing priorities (see attached in strike-through and bold) and then individually prioritized them using a system of numerical scores to rank each priority according to their ability to improve crab stock assessments and to monitor crab fishery impacts. The individual scores were then summed and proved (see attached table). Per team suggestion, this list also includes the standard deviation to better evaluate to what extent the numerical score is an accurate portrayal of the relative consensus on prioritization.

The CPT had the following comments on the process and prioritization of the research priorities:

- Crab research priorities as revised by the Team annually should be consistent with the ones formulated by the Team the previous year (i.e., not starting from the SSC's priorities);
- Prioritization should be done consistently and reflect relative consensus;
- Better tracking of how research priorities are used by agencies such as NPRB on an annual basis

Immediate_Flag	Y
Assigned to Plan Team	(Multiple Items)

2013 Evaluation of 2012 Research Priorities - Immediate Concerns

	Res_Title
Fish and Fisheries Monitoring	
101	**Life history research on non-recovering crab stocks** Status: No Action PlanTeam Priority: (blank) Non-recovering stocks. A pressing issue is why certain stocks have declined and failed to recover as anticipated (e.g., Pribilof Island blue king crab, Adak red king crab). Research into all life history components, including predation by groundfish on juvenile crab in nearshore areas, is needed to identify population bottlenecks, an aspect that is critically needed to develop and implement rebuilding plans.
102	**Catch accounting of crab sex and size** Status: Partially Underway PlanTeam Priority: (blank) Improvements are needed for catch accounting by sex and size for crab (~~genetic samples~~) in non-directed fisheries with high bycatch rates, particularly for blue king crab in the Pacific cod pot fishery in the Pribilof Islands. (currently under discussion)
103	~~**Methods for reliable estimation of total removals**~~ ~~Status: No Action~~ ~~PlanTeam Priority: (blank)~~ ~~Develop methods for reliable estimation of total removals (e.g., surveys, poorly observed fisheries) to meet requirements of total removals under ACLs.~~
105	**Spatial distribution of male snow crab** Status: Partially Underway PlanTeam Priority: (blank) There is a need to characterize the spatial distribution of male snow crab relative to reproductive output of females in the middle domain of the EBS shelf (partially underway)
Stock Assessment	
107	**Improve handling mortality rate estimates for crab** Status: Partially Underway (snow crab)

PlanTeam Priority: (blank)

Improve estimate of discarded crab handling mortality rate. Improved understanding on the post-release mortality rate of discarded crab from directed and non-directed crab pot fisheries and principal groundfish (trawl, pot, and hook and line) fisheries is required. The magnitude of post-release mortality is an essential parameter in the determination of the overfishing level used to evaluate overfishing in stock assessment and projection modeling. Empirical data exist for snow crab so new handling mortality data are needed for Tanner and king crab by size, sex, and fishery type with consideration of temperature..

110

Maintain the core OCEANOGRAPHIC AND ECOSYSTEM data from the eastern Bering Sea (e.g. biophysical moorings, stomach data, zooplankton, age 0 surveys)

Status: Underway

PlanTeam Priority: (blank)

Maintain the core oceanographic and ecosystem data from the eastern Bering Sea needed to support a diverse suite of models used to support the integrated ecosystem assessment program for the Bering Sea. Core data include inputs for single- or multi-species management strategy evaluations, food web, and coupled biophysical end-to-end ecosystem models (e.g. biophysical moorings, stomach data, zooplankton, age 0 surveys).

111

Biomass indices and alternate methodologies for lowest tier species

Status: ~~No Action~~ partially underway

PlanTeam Priority: (blank)

Develop biomass indices for lowest tier species including biomass indices by size, maturity and sex classes (Tier 5 for crab, Tier 6 for groundfish)~~, such as sharks, and conduct net efficiency studies for spiny dogfish.~~ Explore alternative methodologies for Tier 5 and 6 stocks such as length-based methods or biomass dynamics models.

113

~~**Research on spawner--recruit relationship**~~

~~**Status: Underway**~~

~~**PlanTeam Priority: (blank)**~~

~~New information and data are needed that would inform our understanding of the spawner-- recruit relationship for groundfish and crab with sufficient skill to project year-class strength (e.g., Tanner crab, GOA pollock, sablefish, halibut). (Underway)~~

116

Stock separation studies~~**Tagging studies of king crab**~~

Status: No Action

PlanTeam Priority: (blank)

	Conduct studies to evaluate stock boundaries (e.g. Bristol Bay red king crab, Adak red king crab, Pribilof blue king crab). ~~[a tagging studies of all red king crab in the region north of Bristol Bay to assess the movement between this region and the Bristol Bay registration area. Similar work on blue king crab in Bristol Bay relative to the Pribilof Islands is needed.]~~
Fishery Management	
125	**Thresholds for ecosystem indicators** **Status: No Action** **PlanTeam Priority: (blank)** **Initiate/continue research on developing and evaluating thresholds for ecosystem indicators, including ecosystem-level management strategy evaluation.**
Evaluate habitats of particular concern	
134	**Assess whether Bering Sea canyons are habitats of particular concern** **Status: Partially Underway** **PlanTeam Priority: (blank)** **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 and above the canyon areas, including mid-level and apex predators to neighboring shelf/slope ecosystems. (partially underway)**
Fishing Effects on Habitat	
136	**Effects of trawling on female red king crab and subsequent recruitment** **Status: Partially Underway** **PlanTeam Priority: (blank)** **Research is needed on the effects of trawling on the distribution of breeding and ovigerous female red king crab and subsequent recruitment. Relevant studies include effects of potential habitat modifications on the distribution of females, particularly in nearshore areas of southwest Bristol Bay (partially underway), and environmental effects (e.g., trawling overlap in warm vs. cold years). Retrospective studies, the use of pop-up tags to identify larval release locations, and larval advection using Regional Ocean Modeling System would help address this need.**

Ongoing_Flag	Y
Assigned to Plan Team	(Multiple Items)

2013 Evaluation of 2012 Research Priorities - Ongoing Concerns

	Res_Title
Fish and Fisheries Monitoring	
138	**Continuation of State and Federal annual and biennial surveys** Status: Underway PlanTeam Priority: (blank) 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 federal budgets in which funding may not be sufficient to conduct these surveys. Loss of funding for days at sea for NOAA ships jeopardizes these programs. 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. Although an ongoing need, these surveys are considered the highest priority research activity, contributing to assessment of commercial groundfish and crab fisheries off Alaska.
139	**Conduct routine subsistence use, fish, crab, and oceanographic surveys in the Northern Bering Sea and Arctic Ocean** Status: Partially Underway PlanTeam Priority: (blank) Conduct routine subsistence use, fish, crab, and oceanographic surveys of the northern Bering Sea and Arctic Ocean. These surveys will become increasingly important under ongoing warming ocean temperatures because range expansions of harvested fishery resources may occur. If range expansions or shifts occur, data will be needed to adjust standard survey time series for availability.
140	**Identification and integration of archived data ~~(e.g., surveys)~~** Status: ~~No Action~~ ongoing PlanTeam Priority: (blank) Identification and recovery of archived data (e.g., historical agency groundfish and shellfish surveys) should be pursued. Investigate integrating these data into stock and ecosystem assessments.
143	**Alternative approaches to acquire fishery-independent abundance data for Aleutian Islands golden king crab**

Status: No Action

PlanTeam Priority: (blank)

Explore alternative approaches to the triennial ADF&G Aleutian Islands golden king crab pot survey to acquire fishery-independent abundance data on stock distribution and recruitment, including the potential for future cooperative research efforts with Industry.

144 **~~Assess~~ Assess seasonal diets and movements of fish and shellfish**

Status: No Action

PlanTeam Priority: (blank)

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

147 **Catchability studies particularly for Tanner crab and Aleutian Islands golden king crab**

Status: No Action

PlanTeam Priority: (blank)

~~Studies are needed to evaluate effects of the environment on survey catchability.~~ For groundfish and crabs, studies are needed on catchability, as it directly bears on estimates of the stock assessment ~~size for setting of catch quotas~~. Research to refine the estimates of survey catchability, q, used to infer absolute, rather than relative, abundance would substantially improve the quality of management advice. Particular emphasis should be placed on Tanner crab because of recent trends in stock status and on fishery and fishing gear selectivity for Aleutian Island golden king crab to improve the stock assessment model.

148 **Research on survey analysis techniques for species that exhibit patchy distributions**

Status: No Action

PlanTeam Priority: (blank)

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

149 **Quantitative ~~female~~ reproductive index for the surveyed BSAI crab stocks**

Status: ~~No Action~~ Ongoing

PlanTeam Priority: (blank)

Advance research towards developing a quantitative ~~female~~ reproductive index for the surveyed BSAI crab stocks. Research on mating, fecundity, fertilization rates, and, for snow and Tanner crab, sperm reserves and biennial spawning, is needed to develop annual indices of fertilized egg production that can be incorporated into the stock assessment process and to model the effects of sex ratios, stock distribution, and environmental change on stock productivity. Priority stocks for study are eastern Being Sea snow and Tanner crab and Bristol Bay red king crab. (Ongoing for snow crab and red king crab)

Stock Assesment	
151	**Acquire basic life history information (e.g., natural mortality, growth, size at maturity) for data-poor stocks.** **Status: No Action** PlanTeam Priority: (blank) Acquire basic life history information needed for stock assessment and bycatch management of data-poor stocks, such as scallops, sharks, skates, sculpins, octopus, grenadiers, squid, and blue king crab (Bering Sea), golden king crabs (Aleutian Islands), and red king crab (Norton Sound). Specifically, information is needed on natural mortality, growth, size at maturity, and other basic indicators of stock production/productivity).
156	**Improve estimates of natural mortality (M) for Pacific cod and crab stocks.** **Status: No Action** PlanTeam Priority: (blank) Improve estimates of natural mortality (M) for several stocks, including Pacific cod and BSAI crab stocks.
157	**Develop and validate aging methods for crabs.** **Status: No Action** PlanTeam Priority: (blank) Develop and validate aging methods for crabs to improve estimates of M for stock assessments ~~including improved independent estimates of stage-specific M (e.g., large red king crab in Norton Sound).~~
159	**Evaluate hybridization of snow and Tanner crabs.** **Status: No Action** PlanTeam Priority: (blank) Evaluate the assessment and management implications of hybridization of snow and Tanner crabs.
160	**Develop and evaluate standard climate variability scenarios on recruitment and growth** **Status: No Action** PlanTeam Priority: (blank)

Quantify the effects of historical climate variability and climate change on recruitment and growth, and develop standard environmental scenarios for present and future variability based on observed patterns.

161 ~~**Climate information covering a wider range of seasons is needed.**~~

~~**Status: No Action**~~

~~**PlanTeam Priority: (blank)**~~

~~There is also a clear need for climate information that covers a wider range of seasons than is presently available.~~

Comment [DS1]: Needs specificity to be relevant

162 **Development of projection models to evaluate (a) the performance of different management strategies and (b) to forecast seasonal and climate related population shifts**

Status: Partially Underway

PlanTeam Priority: (blank)

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. (partially underway)

163 **Expanded studies to identify stock boundaries**

Comment [DS2]: Recommend combining with 116

Status: No Action

PlanTeam Priority: (blank)

To identify stock boundaries, expanded studies are needed in the areas of genetics, mark-recapture, reproductive biology, larval distribution, and advection.

164 **Develop spatially explicit stock assessment models**

Status: No Action

PlanTeam Priority: (blank)

Develop spatially explicit stock assessment models~~, where appropriate~~. High priority species for spatially explicit models include: snow crab, Tanner crab, walleye pollock, Pacific cod, sablefish, yellowfin sole, rock sole, arrowtooth flounder, Pacific ocean perch, black spotted rockfish, rougheye rockfishand Atka mackerel. (partially underway for some species)

Fishery Management

170 **Continue to evaluate the economic effects from crab rationalization programs on coastal communities.**

Status: ~~No Action~~ underway

PlanTeam Priority: (blank)

Continue to evaluate the economic effects from crab rationalization programs on coastal communities. This includes understanding economic impacts (both direct and indirect) and how the impacts are distributed among communities and economic sectors.

173 **Evaluate the effectiveness of setting ABC and OFL levels for data-poor stocks**

Status: Partially Underway

PlanTeam Priority: (blank)

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). Research is needed to refine the basis for setting gamma for Tier 4 crab stocks. (partially underway)

174 **Examine interactions between coastal communities and commercial fisheries**

Status: No Action

PlanTeam Priority: (blank)

Examine interactions between coastal communities and commercial fisheries (e.g. subsistence-commercial linkages, adaptations to changes in resource use, economic opportunities for coastal communities).

176 **Develop forecasting tools evaluating climate and market demands.**

Status: No Action

PlanTeam Priority: (blank)

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.

177 **Develop an ongoing database of product inventories**

Status: No Action

PlanTeam Priority: (blank)

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

178 **Analyze current determinants of demand for principal seafood products**

Status: ~~No Action~~ ongoing

PlanTeam Priority: (blank)

Analyze current determinants of ex vessel, wholesale, international, and retail demand for principal seafood products from the GOA and BSAI.

179 **Conduct pre- and post-implementation studies of the benefits and costs, and their distribution, associated with dedicated access privileges**

Status: No Action

PlanTeam Priority: (blank)

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, AFA pollock, and crab fisheries. "Benefits and costs" include both economic and social dimensions.

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

Comment [DS3]: Merge with 162

Status: No Action

PlanTeam Priority: (blank)

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

Bycatch Issues

189 **Quantify the effects of bycatch reduction of PSC species in groundfish fisheries on target fisheries**

Status: No Action

PlanTeam Priority: (blank)

There is a need to analyze the effects of recent Council actions on bycatch, including quantifying the effects of bycatch reduction of PSC species in groundfish fisheries to the target fisheries (e.g., charter and commercial halibut fisheries, salmon fisheries)

Habitat Mapping

191 **Improved habitat maps**

Status: No Action

PlanTeam Priority: (blank)

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 in the GOA, BS, and Arctic. (partially underway)

192 **Develop a GIS relational database for habitat, to include a historical time series of the spatial intensity of interactions between commercial fisheries and habitat.**

Status: No Action

PlanTeam Priority: (blank)

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. Such time series are needed to evaluate the impacts of changes in fishing effort and type on EFH.

Function of Habitat

194

Research the role of habitat in fish population dynamics, fish production (growth, reproduction), and ecosystem processes

Status: No Action

PlanTeam Priority: (blank)

Research is needed on the role of habitat in fish population dynamics, fish production (growth, r reproduction), and ecosystem processes. Such research will improve the capability to identify and protect important habitats (including essential fish habitat and habitat areas of particular concern); help design effective habitat restoration efforts; improve the design and management of marine protected areas; improve fishery-independent population surveys; and improve stock assessments. Studies are needed to evaluate relationships between, and functional importance of, habitat-forming living substrates to juvenile and adult age classes of commercially important species and their preferred prey (forage fish). (partially ongoing)

195

Evaluate efficacy of habitat closure areas and habitat recovery

Status: No Action

PlanTeam Priority: (blank)

Establish a scientific research and monitoring program to understand the degree to which impacts (habitat, benthic infauna, etc.) have been reduced within habitat closure areas, and to understand how benthic habitat recovery of key species is occurring. (This the objective of EFH research approach for the Council FMPs).

Ecosystem indicator development and maintenance.

196

Develop a multivariate index of the climate forcing of the Bering Sea shelf

Comment [DS4]: More of a tool than an objective. Combine or add as eg to 160

Status: No Action

PlanTeam Priority: (blank)

Climatic Indicators a.) Develop a multivariate index of the climate forcing of the Bering Sea shelf. Three biologically significant avenues for climate index predictions include advection, setup for primary production, and partitioning of habitat with oceanographic fronts and temperature preferences.

197

Develop bottom and water column temperature database

Comment [DS5]: Very specific should be added as tool to more general with 197 and 198

Status: No Action

PlanTeam Priority: (blank)

Climatic Indicators b) Develop bottom and water column temperature database for use in EBS, GOA, and AI stock assessments.

198 **Maintain sea ice formation and retreat index for the EBS**

Comment [DS6]: See above

Status: No Action

PlanTeam Priority: (blank)

Climatic Indicators c) Maintain sea ice formation and retreat index for the EBS.

208 **Ecosystem indicator synthesis research.**

Comment [DS7]: Combine with 125

Status: No Action

PlanTeam Priority: (blank)

Ecosystem indicator synthesis research.

Environmental Influences on Ecosystem Processes

212 **Maintain moorings.**

Comment [DS8]: Combine with core data objectives

Status: No Action

PlanTeam Priority: (blank)

Climate variability: monitor and understand how changes in ocean conditions influence managed species. a) Maintain moorings. 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. (underway)

213 **Monitor seasonal sea ice extent and thickness**

Comment [DS9]: Combine with 198 197

Status: No Action

PlanTeam Priority: (blank)

Climate variability: monitor and understand how changes in ocean conditions influence managed species. b) Monitor seasonal sea ice extent and thickness: If recent changes in ice cover and temperatures in the Bering Sea persist, these may have profound effects on marine communities.

214 **Measure and monitor fish composition**

Comment [DS10]: Combine with 196

Status: No Action

PlanTeam Priority: (blank)

Climate variability: monitor and understand how changes in ocean conditions influence managed species. c) Measure and monitor fish composition: Evaluate 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, northern Bering Sea, and areas of the Gulf of Alaska.

215 **Assess the movement of fish to understand the spatial importance of predator-prey interactions in response to environmental variability.**

Comment [DS11]: Combine with diet one above

Status: No Action

PlanTeam Priority: (blank)

Climate variability: monitor and understand how changes in ocean conditions influence managed species. d) Assess the movement of fish to understand the spatial importance of predator-prey interactions in response to environmental variability.

216 **Collect and maintain time series of ocean pH**

Comment [DS12]: Combine with climate 216, 217, 218

Status: No Action

PlanTeam Priority: (blank)

Improve understanding of ocean acidification and its effects on managed species. a) Collect and maintain time series of ocean pH in the major water masses off Alaska. (partially underway)

217 **Assess whether changes in pH would affect managed species, upper level predators, and lower trophic levels.**

Status: No Action

PlanTeam Priority: (blank)

Improve understanding of ocean acidification and its effects on managed species. b) Assess whether changes in pH would affect managed species, upper level predators, and lower trophic levels. (partially underway for some species)

218 **Assess the synergistic effects of ocean acidification, oil, dispersants, and changes in temperature on productivity of marine species.**

Comment [DS13]: Combine 218 and 219 with more general contaminants priority

Status: No Action

PlanTeam Priority: (blank)

Species' responses to multiple environmental stressors. a) Laboratory studies are needed to assess the synergistic effects of ocean acidification, oil, dispersants, and changes in temperature on productivity of marine species.

219 **Monitor contaminant flux and loads in lower and higher trophic levels, and assess potential for impact on vital rates.**

Comment [DS14]: More information needed to address relevancy

Status: No Action

PlanTeam Priority: (blank)

Species' responses to multiple environmental stressors. ~~b)~~ Monitor contaminant flux and loads in lower and higher trophic levels, and assess potential for impact on vital rates.

Basic research on trophic interactions

220 **Collect, analyze, and monitor diet information**

Status: ~~No Action~~ underway

PlanTeam Priority: (blank)

Collect, analyze, and monitor diet information (species, biomass, energetics), from seasons in addition to summer, 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.

Comment [DS15]: Combine with general diet objectives

221 **Ecosystem structure studies**

Status: ~~No Action~~ underway

PlanTeam Priority: (blank)

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 differential exploitation of some components of the ecosystem (e.g., Pacific cod, pollock, and crab) relative to others (e.g., arrowtooth flounder).

Fishery Management

~~2012~~2013 Research Priorities - Immediate Needs

	Res_Title
Fishery Management	
121	**Investigate factors affecting the guided angler sector of the halibut fishery** Underway (M) ~~Develop improved catch monitoring methods of fishery interactions including direct and alternative options (e.g., electronic logbooks, video monitoring), particularly on smaller groundfish, halibut, and commercially guided recreational fishing vessels, including an assessment of feasibility for small vessels.~~ ~~Continue to~~ ~~I~~Investigate factors that affect angler demand in the guided angler sector of the halibut fishery resulting from regulatory changes under consideration by the North Pacific Fishery Management Council or general economic conditions.~~(Underway)~~
122	**Improve methods of monitoring fishery interactions** Underway (H) Develop improved catch monitoring methods of fishery interactions including direct and alternative options (e.g., electronic logbooks, video monitoring), particularly on smaller groundfish, halibut, and commercially guided recreational fishing vessels, including an assessment of feasibility for small vessels.
124	**Benefits and costs of halibut and halibut PSC utilization** Underway (M) Research the benefits and costs of halibut and halibut PSC utilization in different fishing sectors. For halibut and other PSC and bycatch species, conduct research to better identify where regulations restrict the utilization of fish from its most beneficial use and evaluate how changes in existing regulations would affect different sectors and fisheries
172	**~~Conduct~~ Continue studies documenting the subsistence halibut? harvest (patterns, norms, quantities) in communities affected by Council actions.** ~~No Action~~Underway (~~L~~M) ~~Conduct~~ Continue studies documenting the subsistence harvest patterns, norms and quantities in communities that depend upon resources that may be affected by Council action.
177	**Develop an ongoing database of product inventories** No Action (L)

Comment [JDC1]: AFSC surveys have not reflected management measures under consideration by the Council

Comment [JDC2]: ADF&G has been contracted by NMFS to provide annual documentation of subsistence halibut harvest patterns, norms and quantities but due to budget constraints these annual surveys may be reduced to every 2 or 3 years. The Council and IPHC send annual letters of support for continued annual funding of these surveys.

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

Bycatch Issues

~~188~~ ~~**Evaluate interaction among Council bycatch reduction initiatives**~~

~~**No Action (H)**~~

~~There is a need to analyze the effects of recent Council actions on bycatch, including interaction among bycatch reduction initiatives (e.g., halibut, salmon),~~

~~189~~ ~~**Quantify the effects of bycatch reduction of PSC species in groundfish fisheries on target fisheries**~~

~~**No Action (H)**~~

~~There is a need to analyze the effects of recent Council actions on bycatch, including quantifying the effects of bycatch reduction of PSC species in groundfish fisheries to the target fisheries (e.g., charter and commercial halibut fisheries, salmon fisheries)~~

188-190 Evaluate current and alternative Council PSC / bycatch reduction measures. [merged from 188-190]

Partially underway (H)

Analyze the effects of recent Council actions on bycatch, including the interaction among bycatch reduction initiatives (e.g., halibut, salmon, crab). Attention should be given to different incentives that have the potential to cost-effectively reduce PSC.

Comment [JDC3]: In addition to Council analyses, the IPHC's Halibut Bycatch Panel will report to the IPHC on halibut bycatch reduction in 2013.

Ecosystem effects and inter-species interactions

Underway (H)

Investigate potential ecosystem effects and inter-species interactions on Pacific halibut recruitment and size-at-age. Includes integration of existing IPHC and NOAA trawl survey observations of size-at-age, diet, and population distribution and trends for multiple species in the GOA and BS.

Comment [JDC4]: The following are condensed from Appendix 3 – halibut research recommendations from the halibut bycatch work shop panel.

Comment [JDC5]: -IPHC/UAF/NOAA-AFSC

Temporal and spatial patterns in size-at-age

Underway (H)

Reanalyze historical records of Pacific halibut size-at-age. Requires identifying samples from consistent spatial areas as well as re-ageing of older samples that utilized differing methods for age determination. Relate observed patterns to somatic growth via otolith increment analysis and development of bioenergetics

Comment [JDC6]: -IPHC/UAF/NOAA-AFSC

model relating long-term environmental and ecological drivers to halibut size-at-age.

Effects of migration on population and management

Underway (L)

Comment [JDC7]: IPHC

Extend existing analyses of tagging studies to include age-specific components. Continue to evaluate the role of migration in contributing to population dynamics and trends associated with area-specific catch, bycatch levels, and downstream effects.

Environmental influences

Underway (L)

Comment [JDC8]: IPHC

Extend historical analyses of climatic (PDO, climate change) effects on size-at-age and recruitment. Continue to evaluate the role of migration in contributing to population dynamics and trends associated with area-specific catch and bycatch levels.

Long term effects of fishing

Underway (L)

Comment [JDC9]: IPHC

Continue to explore the potential role of fishing in observed size-at-age trends via direct or evolutionary pathways and the interaction with fishery size-limits, include these analyses in harvest policy analyses. Collect genetic samples for future comparison.

Bycatch and discard behavior

Underway (H)

Comment [JDC10]: NPFMC, IPHC

Continue to explore management actions that reduce the incentives for bycatch- and discard-related mortality of Pacific halibut. Evaluation of observer coverage, accuracy, and representativeness of bycatch estimates should be included.

Improve utilization of NMFS Trawl survey data

Underway (M)

Comment [JDC11]: IPHC

Re-investigate the use of trawl survey data for constructing indices of Pacific halibut abundance, particularly for recruitment trends, and the areas of the BS that are not covered by standard IPHC setline surveys

Stock assessment model development

Underway (H)

Comment [JDC12]: PHG

Continue recent work to improve the annual stock assessment model, including treatment of input data, model performance (retrospective patterns) and alternative approaches to selectivity, and spatial processes. Also improve integrated use of historical data.

AGENDA D-1(d)
JUNE 2013

MEMORANDUM

TO: SSC Members

FROM: Chris Oliver
Executive Director

ESTIMATED TIME
4 HOURS
All D-1 items

DATE: May 21, 2013

SUBJECT: Groundfish Issues

ACTION: Review Pacific cod assessment models. (SSC only)

BACKGROUND

The BSAI Groundfish Plan Team and GOA Groundfish Plan Team participated in a joint meeting via teleconference and WEBEX on May 13, 2013. The objective of the meeting was to review proposals for Eastern Bering Sea (EBS), Aleutian Islands (AI), and Gulf of Alaska (GOA) Pacific cod stock assessment models and recommend models assessments. The joint plan team report and background documents are attached as Item D-1(d). Additional recommendations to the authors are contained in the minutes. The SSC will review the Plan Teams' recommendations and provide comment.

For the **preliminary EBS assessment**, the Teams recommend that the following models be included:

1. Last year's final model (Model 1), which is the same as the 2011 final model
2. Last year's "exploratory" model (Model 4), but with the logarithm of survey catchability estimated internally, using a non-constraining uniform prior
3. Last year's "exploratory" model (Model 4), but with the logarithm of survey catchability estimated internally, using a normal prior derived from the archival tagging data used by Nichol et al. (2007), and with asymptotic trawl survey selectivity

For the **preliminary AI assessment**, the Teams recommend that the author have discretion over any and all models to be included. The Teams noted that no model for this stock has been accepted by the SSC and that a significant amount of development and analysis still needs to occur before a model for this stock can be recommended with confidence. The Teams understand that the SSC will recommend separate EBS and AI harvest specifications for 2014 regardless of whether a model is accepted this year.

For the **preliminary GOA assessment**, the Teams recommend that the following models be included:

1. The 2011 final model
2. Last year's final model (Model 2)
3. Last year's Model 4, but with all selectivities forced to equal zero at age zero, growth parameters fixed at the values from Model 2, and time-invariant selectivity for the 27-plus survey

Table 1. List of paraphrased model proposals (see Attachment 1) and assignment thereof to candidate models, as recommended by the Teams. Column "D": Proposals to be included at the author's discretion. Column "T": Proposals to be tabled until after the September meeting. Legend for other symbols: A = age, G = growth, L = length, M = natural mortality, Q = catchability, R = recruitment, S = selectivity, W = weight.

				September model					
Region	Type	Number(s)	Proposal (model numbers are those from last year's respective final assessment)	0	1	2	3	D	T
AI	base	n/a	Model 3? (used to illustrate results, but not accepted for use in management)					X	
AI	data	WGC1	Start the model in 1991					X	
BS	base	SSC1	Retain final 2011 model for several assessment cycles		X				
BS	base	n/a	Last year's final model (Model 1)		X				
BS	data	RRL1	Adjust survey variance estimators to account for spatial autocorrelation						X
BS	data	RRL2	Adjust survey variance estimators to account for temporal sequence of stations						X
BS	data	BPT2,FLC1	Model 3 (like Model 1, but with ageing bias and agecomp fit both turned off)					X	
BS	biology	FLC2	Like Model 1, but with time-varying G					X	
BS	biology	GGT1	Allow increasing M with age					X	
BS	capture	BPT1	Like Model 4, but with gear-and-block-specific S					X	
BS	capture	SSC2	Like Model 4, but with gear-and-block-specific S and time-varying Q					X	
BS	capture	new	Like Model 4, but with non-constraining uniform prior on ln(Q)			X			
BS	capture	new	Like Model 4, but with normal prior on ln(Q) based on tagging data, and asymptotic survey S				X		
BS	capture	BPT2	Model 2 (like Model 1, but with free Q)					X	
BS	capture	SSC3	Like Model 1, but with Q adjusted to reflect results of 2012 field study					X	
BS	capture	GGT2	Include annually varying S					X	
BS	various	SSC4	Like Model 4, including Richards G, new W-at-L, length-based S, internal estimation of σ_R					X	
GOA	base	SSC1	Retain final 2011 model for several assessment cycles	X					
GOA	base	n/a	Last year's final model (Model 2)		X				
GOA	data	GPT4	Turn off age zeros whenever sub-27 age data are included			X			
GOA	data	GPT1	Evaluate implications of weighting L-at-A data spatially					X	
GOA	data	SSC7	Further explore omitting or downweighting L-at-A data for the 27-plus survey					X	
GOA	data	SSC8	Downweight, rather than omit, the L-at-A data					X	
GOA	biology	SSC12	Use Richards G					X	
GOA	biology	SSC5,JPT2	Use an explicit phenological model to estimate seasonal W-at-L					X	
GOA	biology	SSC6,JPT3	Evaluate implications of using ageing bias parameters as estimated in Bering Sea model					X	
GOA	capture	JPT1	Integrate out random effects before estimating σ parameters for Q and S devs					X	
GOA	capture	GPT3	Use age-based cubic splines for S					X	
GOA	capture	SSC10	Use length-based survey S					X	
GOA	capture	SSC11	Do not use time-varying S for an index that primarily reflects variability due to incoming R					X	
GOA	various	SSC9	Evaluate impacts of S form and interactions between S, G, and L-at-A data					X	
GOA	various	GPT2	Like Model 4, but with G fixed at Model 2 values and constant 27-plus S			X			

Minutes of the Joint Plan Teams for the Groundfish Fisheries of the Gulf of Alaska (GOA) and Bering Sea and Aleutian Islands (BSAI)

May 13, 2013

North Pacific Fishery Management Council
605 W 4th Avenue, Suite 306
Anchorage, AK 99501

BSAI Team		GOA Team	
Mike Sigler	**AFSC (co-chair)**	**Jim Ianelli**	**AFSC REFM (co-chair)**
Grant Thompson	**AFSC REFM (co-chair)**	**Diana Stram**	**NPFMC (co-chair)**
Jane DiCosimo	**NPFMC (coordinator)**	Mike Dalton	AFSC REFM
Kerim Aydin	**AFSC REFM**	Craig Faunce	AFSC FMA
David Barnard	**ADF&G**	Nancy Friday	AFSC NMML
Bill Clark	**IPHC**	Kristen Green	ADF&G
Lowell Fritz	**AFSC NMML**	**Jon Heifetz**	**AFSC ABL**
Mary Furuness	**NMFS AKRO**	Sandra Lowe	AFSC REFM
Dana Hanselman	**AFSC ABL**	Chris Lunsford	AFSC ABL
Alan Haynie	**AFSC REFM**	Tom Pearson	NMFS AKRO
Brenda Norcross	UAF	Elisa Russ	ADF&G
Chris Siddon	ADF&G	Leslie Slater	USFWS
Leslie Slater	USFWS	**Paul Spencer**	**AFSC REFM**
		Ian Stewart	IPHC
		Mark Stichert	**ADF&G**

Introduction

Ten members of the BSAI Groundfish Plan Team and five members of the GOA Groundfish Plan Team participated in this WebEx meeting (names in bold above). Others in attendance included: Teresa A'mar, Alison Dauble, Bob Lauth, Krista Milani, Steve Minor, Jan Rumble, Chad See, Janet Smoker, Dave Somerton, Anne Vanderhoeven, and Ernie Weiss. The purpose of the meeting was to recommend models for inclusion in this year's preliminary assessments of Pacific cod in the (Eastern) Bering Sea, Aleutian Islands, and Gulf of Alaska.

Plan Team members were provided with several background documents two weeks prior to the meeting. The background documents are provided as attachments to these minutes, numbered as follows:

1. Comments and proposals related to the 2013 Pacific cod assessments.
2. Full text of relevant Team (November, 2012) and SSC (December, 2012) minutes.
3. Models analyzed in the 2012 Bering Sea Pacific cod assessment.
4. Models analyzed in the 2012 Aleutian Islands Pacific cod assessment.
5. Models analyzed in the 2012 Gulf of Alaska Pacific cod assessment.
6. Comparing Pacific cod catches from survey bottom trawls with a low and a high vertical opening (summary of 2012 pilot field study, by Robert Lauth and Cynthia Yeung).

Grant Thompson, senior author of the EBS and AI Pacific cod assessments, opened the meeting with a brief overview of last year's models and this year's comments and proposals. Grant also described the

individual EBS and AI proposals during the discussion. Teresa A'mar, senior author of the GOA Pacific cod assessment, did the same for the individual GOA proposals. Mike Sigler moderated the discussion.

Trawl survey escapement study

For the last few years, the EBS and GOA models have used the results of the archival tagging study by Nichol et al. (2007, *Fisheries Research* 86:129-135) to constrain their respective estimates of survey catchability. Specifically, the average of the product of catchability and selectivity across the 60-81 cm size range has been constrained to a value of 0.47 in the EBS and 0.92 in the GOA. The underlying assumption is that more fish escape over the headrope in the EBS survey than in the GOA survey, because the former has a lower headrope. The Teams received a presentation from Bob Lauth, who led a 2012 pilot field study that compared the Pacific cod CPUE from the two nets by deploying both in the same location (see Attachment 6). The results from this study failed to reject the null hypothesis that the nets used in the EBS and GOA surveys have the same catchability for Pacific cod in the 60-81 cm size range. Because this was just a small pilot study, Dave Somerton, the Program Manager for the Groundfish Assessment Program, felt that the results were inconclusive, and the Teams agreed. Dave Somerton noted that the archival tags used in the paper by Nichol et al. measure depth, not distance off bottom, which is why the number of tags used in the paper (11) was much smaller than the total number of tags returned (286), as it was necessary to exclude all tags not recovered over flat bathymetry (defined in the paper as slope<0.05%). However, a new tag design has recently come on the market which may give more direct information about distance off bottom. Dave has applied for funding to obtain a supply of the new tags. There was some discussion about the possibility of repeating the 2012 field study in deeper water. It was noted that the co-occurrence of pollock in deeper water would complicate the study and that it would require more funding and survey time than was currently available in the survey budget. On a related issue, this summer the EBS trawl survey group will be conducting a small pilot study to examine survey selectivity for larger Pacific cod that may out-swim the survey net. **The Teams commend Bob Lauth, Dave Somerton, and the other RACE Division scientists for their efforts to estimate the catchability and selectivity of the EBS shelf bottom trawl survey gear with respect to Pacific cod, and recommend that such efforts continue to receive high priority.**

Recommended models for this year's preliminary assessments

A total of 45 comments relevant to this year's Pacific cod assessments were received prior to the meeting from the Teams, the SSC, the Freezer Longline Coalition (the two FLC's proposals were identical to their 2012 proposals), and individuals. These were divided into two groups: 28 were classified as "model proposals," which pertained to structural features suggested for this year's models or data; and 17 were classified as "non-model comments," which pertained to other things such as requests for inclusion of additional graphs or analyses based on model results. Of the 28 model proposals, 12 pertained to the EBS assessment, 1 to the AI assessment, and 15 to the GOA assessment. In addition to the 28 model proposals received prior to the meeting, two proposals were developed during the meeting itself, giving a total of 30. The non-model comments were not discussed during the meeting, but will be addressed by the authors in their respective assessments as appropriate, either in the preliminary or final drafts.

The Teams dealt with the 30 model proposals in three ways (Table 1): Some were recommended for inclusion in a set of candidate models, some were recommended to be left up to the authors to investigate at their discretion, and two were recommended to be tabled until after the September meeting. These last two (tabled) proposals pertained to alternative variance estimators for abundance and biomass in the EBS bottom trawl survey. **The Teams recommend that the RACE survey scientists apply the alternative variance estimators to the EBS survey time series for Pacific cod and present the results at the September meeting, after which the BSAI Team will determine whether to recommend their use in the final EBS assessment.**

Jim Ianelli offered to assist the authors with prioritizing the "discretionary" proposals.

For the preliminary AI assessment, the Teams recommend that the author have discretion over any and all models to be included. The Teams noted that no model for this stock has been accepted by the SSC and that a significant amount of development and analysis still needs to occur before a model for this stock can be recommended with confidence. The Teams understand that the SSC will recommend separate EBS and AI harvest specifications for 2014 regardless of whether a model is accepted this year. Although the Teams are not recommending any specific models for the AI stock, one member suggested that the author might consider starting the model in 1977 but omitting survey data prior to 1991, as was done in last year's AI Model 4.

For the preliminary EBS assessment, the Teams recommend that the following models be included:

1. Last year's final model (Model 1), which is the same as the 2011 final model
2. Last year's "exploratory" model (Model 4), but with the logarithm of survey catchability estimated internally, using a non-constraining uniform prior
3. Last year's "exploratory" model (Model 4), but with the logarithm of survey catchability estimated internally, using a normal prior derived from the archival tagging data used by Nichol et al. (2007), and with asymptotic trawl survey selectivity

Grant reported that he will likely bring forward an EBS model similar to last year's Model 4 on his own.

Regarding the two proposals that requested inclusion of an EBS model with the age data turned off (BPT2 and FLC1), the Teams noted that models like this have been included in the past, but primarily just as a sensitivity test. In last year's EBS assessment, the final model (Model 1), which had the age data turned on, gave results very similar to those of the same model with the age data turned off (Model 3), suggesting that there may not be much value in repeating this comparison.

For the preliminary GOA assessment, the Teams recommend that the following models be included:

0. The 2011 final model
1. Last year's final model (Model 2)
2. Last year's Model 4, but with all selectivities forced to equal zero at age zero, growth parameters fixed at the values from Model 2, and time-invariant selectivity for the 27-plus survey

The Teams also recommend that catchability for the 27-plus survey in the GOA models not be retuned unless the average of the product of catchability and selectivity across the 60-81 cm size range departs appreciably from the value of 0.92 estimated by Nichol et al. (2007).

Other business

For the last two years, the Teams have reserved the right to request that the author's preferred model be excluded from the final assessment. Upon further reflection and consideration of the SSC's June, 2012 minute stating that authors are free to include their own models in both the preliminary and final assessments, the Teams decided to abandon their previous policy. **The Teams recommend that authors feel free to include their own models in both the preliminary and final assessments.**

The Teams also discussed whether they should plan to hold a similar meeting next year. Some of the controversy over the Pacific cod assessments seems to have diminished, and some of the remaining issues are highly technical in nature and so do not lend themselves to discussion by a large group. The authors feel that the meetings have been helpful, given the large number of proposals that continue to be made; however, the meetings are time consuming for those who have to read the background documents and participate. **The Teams recommend that the following alternatives be considered next year:**

1. Perhaps the authors' introductory remarks at the beginning of the meeting could be expanded, so as to bring participants up to speed regarding what was done in the previous year's assessments and what the proposals for the current year's assessments entail, recognizing that some proposals may be ambiguous and require clarification from the proposer(s). (In the past, the Teams have asked the authors to keep their introductory remarks very brief, to maximize the amount of time available for Team discussion. However, as the proposals have become increasingly technical, some Team members have found it difficult to keep track of how everything fits together.)
2. Perhaps the task of prioritizing proposals and developing candidate models could be delegated to a subcommittee comprised of Team members who are especially interested in assessment methodology. This might have the benefit of keeping the discussion more focused, and would free other Team members from having to participate in yet another meeting (note that nearly half of all Team members were absent from this year's meeting).

Table 1. List of paraphrased model proposals (see Attachment 1) and assignment thereof to candidate models, as recommended by the Teams. Column "D": Proposals to be included at the author's discretion. Column "T": Proposals to be tabled until after the September meeting. Legend for other symbols: A = age, G = growth, L = length, M = natural mortality, Q = catchability, R = recruitment, S = selectivity, W = weight.

				September model					
Region	Type	Number(s)	Proposal (model numbers are those from last year's respective final assessment)	0	1	2	3	D	T
AI	base	n/a	Model 3? (used to illustrate results, but not accepted for use in management)					x	
AI	data	WGC1	Start the model in 1991					x	
BS	base	SSC1	Retain final 2011 model for several assessment cycles		x				
BS	base	n/a	Last year's final model (Model 1)		x				
BS	data	RRL1	Adjust survey variance estimators to account for spatial autocorrelation						x
BS	data	RRL2	Adjust survey variance estimators to account for temporal sequence of stations						x
BS	data	BPT2,FLC1	Model 3 (like Model 1, but with ageing bias and agecomp fit both turned off)					x	
BS	biology	FLC2	Like Model 1, but with time-varying G					x	
BS	biology	GGT1	Allow increasing M with age					x	
BS	capture	BPT1	Like Model 4, but with gear-and-block-specific S					x	
BS	capture	SSC2	Like Model 4, but with gear-and-block-specific S and time-varying Q					x	
BS	capture	new	Like Model 4, but with non-constraining uniform prior on ln(Q)			x			
BS	capture	new	Like Model 4, but with normal prior on ln(Q) based on tagging data, and asymptotic survey S				x		
BS	capture	BPT2	Model 2 (like Model 1, but with free Q)					x	
BS	capture	SSC3	Like Model 1, but with Q adjusted to reflect results of 2012 field study					x	
BS	capture	GGT2	Include annually varying S					x	
BS	various	SSC4	Like Model 4, including Richards G, new W-at-L, length-based S, internal estimation of σ_R					x	
GOA	base	SSC1	Retain final 2011 model for several assessment cycles	x					
GOA	base	n/a	Last year's final model (Model 2)		x				
GOA	data	GPT4	Turn off age zeros whenever sub-27 age data are included			x			
GOA	data	GPT1	Evaluate implications of weighting L-at-A data spatially					x	
GOA	data	SSC7	Further explore omitting or downweighting L-at-A data for the 27-plus survey					x	
GOA	data	SSC8	Downweight, rather than omit, the L-at-A data					x	
GOA	biology	SSC12	Use Richards G					x	
GOA	biology	SSC5,JPT2	Use an explicit phenological model to estimate seasonal W-at-L					x	
GOA	biology	SSC6,JPT3	Evaluate implications of using ageing bias parameters as estimated in Bering Sea model					x	
GOA	capture	JPT1	Integrate out random effects before estimating σ parameters for Q and S devs					x	
GOA	capture	GPT3	Use age-based cubic splines for S					x	
GOA	capture	SSC10	Use length-based survey S					x	
GOA	capture	SSC11	Do not use time-varying S for an index that primarily reflects variability due to incoming R					x	
GOA	various	SSC9	Evaluate impacts of S form and interactions between S, G, and L-at-A data					x	
GOA	various	GPT2	Like Model 4, but with G fixed at Model 2 values and constant 27-plus S			x			

1 Comments and proposals related to the 2013 Pacific cod assessments

Comments and proposals are listed in order of assessment, and chronologically within assessment. Comments that do not pertain to a structural feature of an assessment model (e.g., requests for inclusion of additional graphs or analyses based on model results) are not numbered but are instead labeled "non-model comment."

Assessments in general

Please note: This section contains only those comments on assessments in general that have arisen since last year's assessments. Any previous comments on assessments in general that were not addressed fully in last year's assessments are listed in the appropriate assessment-specific section below.

SSC minutes (June, 2012)

Non-model comment: "We note that stock assessment authors are free to develop and bring forward an alternative model or models in both the preliminary and final assessment."

GOA Team minutes (November, 2012)

Non-model comment: "The Team discussed a pollock CIE review comment that the assessment be risk neutral. This comment is relevant to all stock assessments, and led to the specific question of 'at what biomass is there no longer a need for the author's recommended ABC lower than the maximum permissible ABC?'"

Non-model comment: "The Team noted that in general for all stocks where a projection is employed, the catch projection for the current year should be the current ABC or the current technique for estimating in year catches whichever is less."

SSC minutes (December, 2012)

Non-model comment: "The SSC recommends that the authors consider whether it is possible to estimate M with at least two significant digits in all future stock assessments to increase validity of the estimated OFL."

Non-model comment: "The SSC requests that all assessment authors of AI species evaluate AI survey information to ensure that the same standardized survey time series is used." (Please note: In a 4/4/2013 e-mail, SSC chair Pat Livingston offered the following clarification of this comment: "I brought this up to the SSC and we are definitely open any time to what the analysts deem to be the best time series to use - it would be particularly important to hear the rationale from each analyst as to why they feel a particular time series is best for their species.")

Bering Sea Pacific cod assessment

Please note:

- This section lists only those comments that have arisen since last year's assessment and any previous comments that were not addressed fully in last year's assessment. See last year's SAFE report for other comments.
- Although no proposals were received regarding use of last year's final model as this year's base model, tradition indicates that this will be the case.

SSC minutes (December, 2011)

SSC1: "Allow for a thorough evaluation of the performance of the current model over several assessment cycles."

BSAI Plan Team minutes (September, 2012)

BPT1: "There was also a lot of interest in a model intermediate between Model 1 and Model 5, such as a version of Model 5 in which the commercial fishery data are still broken out by gear and season, with selectivity parameters estimated by time block. The Team recommends that the author investigate a model like that and bring it forward on his own if it looks worthwhile." (Please note: Model 5 from last year's preliminary assessment was relabeled Model 4 in the final assessment.)

BPT2: "While they are not candidates for the specifications, we think that Models 1.1 and 4 provide a useful check on the candidate models and recommend that they be reported in November (and next September)." (Please note: Models 1.1 and 4 from last year's preliminary assessment were relabeled Models 2 and 3 in the final assessment, respectively.)

SSC minutes (October, 2012)

SSC2: "The Plan Team recommended the author bring forward a version of Model 5 that incorporates time varying selectivity for the fishery, if time permits and is worthwhile. The SSC supports Plan Team recommendations and encourages the author - if time permits - to bring forward a model that considers time varying survey Q to see if that produces better fit to the survey data." (Please note: Model 5 from last year's preliminary assessment was relabeled Model 4 in the final assessment.)

BSAI Plan Team minutes (November, 2012)

Non-model comment: "The Team recommends that jitter tests continue to be conducted, but statistics related to jitter tests do not need to be reported in future assessments."

Non-model comment: "The Team commends the authors for responding to every single Team request, of which (as is customary for Pacific cod) there were a large number during the past year."

SSC minutes (December, 2012)

SSC3: "The SSC re-iterates continuing concerns over the best value for the catchability coefficient, which by long-standing practice is either tuned to experimental results or fixed at a previously tuned value to keep it close to the experimental results (currently fixed at 0.77 in Model 1). Based on exploratory models estimating Q, catchability may be much higher. The SSC expects to receive a report prior to next year's assessment about a comparison of the standard EBS trawl with a high-opening trawl conducted during the 2012 field season."

SSC4: "The results for Model 4 suggest that several of the new features represent an improvement over the current base model and the SSC recommends bringing forward a similar model next year that retains at least some of these promising features such as the Richards growth curve, newly parameterized seasonal changes in weight-at-length, selectivity modeled as a function of length, and estimating log-scale standard deviations for recruitment internally rather than fixing them."

Non-model comment: "The SSC would like to see [an] ... analysis of retrospective patterns for a model with an alternative estimate for Q (internally estimated or updated value from field experiment) in next year's assessment."

Freezer Longline Coalition (April, 2013)

The following two proposals were originally made in April, 2012, but the FLC has asked that they be resubmitted for this year's assessment cycle.

FLC1: "Last year's final model and/or this year's preferred model with age data excluded."

FLC2: "Last year's final model with temporal variation in growth. We will leave it to the assessment author to decide which growth parameters should vary or if cohort specific growth should be used."

Bob Lauth (April, 2013)

RRL1: "Use the variance estimation method of D'Orazio (2003, *J. Agric. Biol. Environ. Stat.* 3:280-295) to account for spatial autocorrelation in the systematic design of the EBS shelf trawl survey."

RRL2: "Use a variance estimation method suggested during the CIE review of the survey programs to account for the temporal sequence of stations in the systematic design of the EBS shelf trawl survey."

Grant Thompson (April, 2013)

The following two proposals were conveyed to the assessment author informally, but emphatically enough that the assessment author felt that it was appropriate to bring them forward on his own. Except for the following, the assessment author has no new proposals to bring forward at present. However, consistent with SSC policy, he reserves the right to bring forward additional models at any time.

GGT1: Allow increasing natural mortality with age.

GGT2: Include annually varying selectivity.

Aleutian Island Pacific cod assessment

Please note:

- This section lists only those comments that have arisen since last year's assessment and any previous comments that were not addressed fully in last year's assessment. See last year's SAFE report for other comments.
- Identification of a base model for this year's assessment is problematic due to the fact that no model was accepted by the SSC last year. One possibility might be to use last year's Model 3 as the base model, as this was the model that was used to illustrate results and possible harvest projections in last year's assessment.
- The assessment author has no new proposals to bring forward at present. However, consistent with SSC policy, he reserves the right to bring forward additional models at any time.

BSAI Plan Team minutes (November, 2012)

Non-model comment: "The Team commends the authors for responding to the Team's request for inclusion of specific alternative models in this exploratory assessment."

Bill Clark (November, 2012)

WGC1: "The fishery size comps from the 1980s ... are ... strange, with more small fish and fewer big fish than the model can predict.... One course of action therefore would be to leave out all of the early years (not just the ... survey data) when fitting the model."

SSC minutes (December, 2012)

Non-model comment: "The SSC encourages further model development but had no specific suggestions beyond those identified in plan team discussions and the possibility of obtaining additional age composition data from archived otoliths."

Gulf of Alaska Pacific cod assessment

Please note:

- This section lists only those comments that have arisen since last year's assessment and any previous comments that were not addressed fully in last year's assessment. See last year's SAFE report for other comments.
- Although no proposals were received regarding use of last year's final model as this year's base model, tradition indicates that this will be the case.
- The assessment author has no new proposals to bring forward at present. However, consistent with SSC policy, she reserves the right to bring forward additional models at any time.

Joint Plan Team (September, 2011)

JPT1: "In Model A ..., the catchability and selectivity deviations are treated as random effects but they are not properly integrated out. The MLEs are therefore suspect, and the iterative tuning may produce pathological results." (Please note: The BSAI Plan Team has since retracted this criticism (September, 2012), but the GOA Plan Team has not.)

SSC minutes (December, 2011)

(See comment SSC1 under "Bering Sea Pacific cod assessment" above, as this comment pertained to the GOA assessment also.)

SSC5: "The SSC notes that weight-at-age in both regions was lowest in May-Aug. or Sept.-Oct. and highest in Jan.-Feb. These patterns seem somewhat counter-intuitive and we encourage the authors to evaluate the biological basis for these patterns."

SSC6: "The recommended models for both regions estimate ageing bias as a linear function of age, but the estimated patterns in bias by age differs by region increasing from approximately 0.34 at the youngest age to 0.85 at the oldest age in the BSAI assessment (Model 3b), but decreases from 0.36 to 0 at the oldest age in the GOA assessment (Model 3)."

Non-model comment: "The SSC is pleased to see that many assessment authors have examined retrospective bias in the assessment and encourages the authors and Plan Teams to determine guidelines for how to best evaluate and present retrospective patterns associated with estimates of biomass and recruitment. We recommend that all assessment authors (Tier 3 and higher) bring retrospective analyses forward in next year's assessments."

Joint Plan Team minutes (May, 2012)

JPT2: "For both the EBS and GOA, the Teams recommend that the authors attempt to evaluate the biological basis for estimated patterns of seasonal weight at length."

JPT3: "For both the EBS and GOA, the Teams recommend that the authors attempt to explore the divergent ageing bias trends in the two regions and the impacts thereof."

GOA Plan Team minutes (September, 2012)

Non-model comment: "The Teams recommend that authors conduct a retrospective analysis back 10 years (thus, back to 2002 for the 2012 assessments), and show the patterns for spawning biomass (both the time series of estimates and the time series of proportional changes relative to the 2012 run). This is consistent with a December 2011 NPFMC SSC request for stock assessment authors to conduct a retrospective analysis. The base model used for the retrospective analysis should be the author's recommended model, even if it differs from the accepted model from the previous year."

Non-model comment: "The Teams recommend that authors continue to include other removals in an appendix for 2012. Authors may apply those removals in estimating ABC and OFL; however, if this is done, results based on the approach used in the previous assessment much also be presented."

GOA Plan Team minutes (November, 2012)

GPT1: "The Team suggested that the spatial aspect of available length-at-age data be evaluated, particularly between years for the older/larger Pacific cod since in some years most of the apparent 'lack-of-fit' arose from the larger fish samples."

GPT2: "The Team suggested considering a model that had the features of Model 4 but with fixed growth (e.g., at Model 2 values), then look at constant selectivity for main survey data."

GPT3: "Examination of the possibility of using cubic splines over age, smoother shape and fewer parameters (in general) was recommended."

GPT4: "The Team suggested that the stock synthesis feature to turn off age zeros whenever sub-27 age data were included should be activated."

Non-model comment: "Retrospective patterns should be evaluated as an additional diagnostic for alternative models (e.g., Model 4 may show an improved retrospective pattern)."

Non-model comment: "For communication purposes, when stock sizes change for the same year from one assessment to the next, it would be useful to evaluate the changes graphically (e.g., biomass at age for last year's model with the accepted model this year)."

Non-model comment: "Since the fishery is comprised of many components, the Team suggested using a general exploitation matrix such as 1-SPR for F implied over time."

SSC minutes (December, 2012)

SSC7: "The Plan Team noted, and the SSC concurs, that Model 4 had much better fits to other data components and encourages the authors to further explore a model that omits or down-weights the mean-length at age data for the 27cm-plus group."

SSC8: "The Plan Team recommended, and the SSC concurs, to consider down-weighting rather than omitting the mean size-at-age data to more appropriately reflect the effective sample sizes associated with the data."

SSC9: "We encourage the authors to carefully evaluate the impact of the chosen form for selectivity curves on model results and to examine how changes in selectivity interact with the treatment of growth and inclusion of mean size-at-age data."

SSC10: "The SSC encourages the author to develop a model with length-based survey selectivity to take advantage of available length data from all survey years."

SSC11: "While there are legitimate concerns about the high variability of the sub-27 group, omitting the data may not be consistent with using the best available information. However, using time varying catchability with an index that primarily reflects variability due to incoming year classes is clearly not appropriate."

SSC12: "To improve fits to the size data, the author may also want to consider using the Richards growth curve to parameterize growth as in Model 4 in the EBS Pcod assessment."

Non-model comment: "It would also be informative to explore how the exclusion of the size-at-age data in models 3 & 4 interacts with other features of the model to result in these apparently inflated biomass estimates."

2 Full text of relevant Team (November, 2012) and SSC (December, 2012) minutes

BSAI Plan Team minutes (November, 2012)

BS/AI Pacific cod

Grant Thompson presented the assessment. Following suggestions from Team/SSC meetings in May/June and September/October, he had fitted four models. The base model, used for making specifications in 2011 and designated Model 1, had the following features, many of long standing:

- M = 0.34
- Length-specific commercial selectivities for all fisheries, some forced to be asymptotic, estimated for blocks of years (as before).
- Age-specific survey selectivity with annually varying left limb.
- Survey catchability fixed at the value obtained in the 2009 assessment (0.77), where it resulted in the product of catchability and selectivity at 60-81 cm equal (on average) to the desired value of 0.47 in the EBS. The desired value was based on a small number (11) of archival tags.
- A single growth schedule for all years.
- Intercept and slope of age reading bias estimated internally.
- Standard deviation of length at age estimated internally.
- Mean length at age data left out of the fit.
- All length composition data included in fit.

Model 2 was the same as Model 1 but with survey catchability estimated freely. Model 3 was the same as Model 1 except that the age composition data were not used (i.e., left out of the log likelihood). Models 2 and 3 had been requested by the Team as checks on Model 1, not as candidates for setting specifications.

Model 4 was a simplification of the "author's preferred model" from 2011. It has many fewer parameters than the other models and it differs from Model 1 in many ways, among them:

- Improved modeling of weight at length.
- Initial numbers estimated at 10 ages rather than 3.
- The full Richards growth equation used rather than the von Bertalanffy.
- Survey selectivity estimated as a function of length rather than age.
- Fisheries defined (and selectivities estimated) for each of five seasons with gears combined.
- Age composition sample size multipliers tuned iteratively to make the standard deviation of the normalized residuals equal 1.

The fits of the four models were similar in most respects, including selectivity estimates, fit to age and size compositions, agreement with survey length frequency modes, agreement with survey abundance data, and (except for Model 2) estimates of present abundance. The dissimilarities were:

- Model 2 estimates survey catchability (freely) at about 1 and therefore estimates present abundance to be much less than the other models, where catchability is fixed at 0.77. Model 2 also fits the survey abundance data much better, with RMSE=0.16 compared with around 1 for the other models.
- Model 3 fits the age composition data poorly. (It doesn't try.)
- Model 4 fits the survey size composition data much better than the others, an indication that length-based survey selectivity (rather than age-based) is appropriate.

Grant reported jitter tests in which a (presumably) global minimum was first located by an exhaustive procedure of perturbing the minimizing parameter vector at a succession of local minima until no further improvement was possible. The final parameter vector was then perturbed and the model refitted to see how often each model fit could relocate the global minimum. All of the models performed more or less poorly, relocating the global minimum only around half the time. On the other hand, all of them except Model 2 produced a present biomass estimate very close to the correct number in almost every trial. The Team had some discussion of the relevance of jitter tests to model selection and eventually concluded that they were not relevant, so long as the author followed a procedure akin to Grant's for locating the global minimum.

The Team recommends that jitter tests continue to be conducted, but statistics related to jitter tests do not need to be reported in future assessments.

Grant stated that he wanted to do more work on Model 4 before proposing its use for setting ABC and OFL. The Team agreed to that, so Model 1 was left as the sole candidate and a solid performer in most ways but not in retrospective performance. In retrospective runs, successive estimates of abundance in a given year have been steadily revised downward as each new year of data is added. At the extreme, the estimate of 2008 spawning biomass from a fit to data through 2007 was 70% higher than the estimate of 2008 spawning biomass from a fit to data through 2012. The Team had a brief discussion of the implications of poor retrospective performance for setting ABC and OFL. Clearly the retrospective differences add to the uncertainty of the biomass estimates, but for the time being we continue to believe that the best estimate of present abundance is the one from the most recent assessment. (The Joint Teams have appointed a retrospective working group that is examining the retrospective behavior of all groundfish assessments.)

Having accepted Model 1, the Team had a lengthy discussion of whether the ABC/OFL recommendation should be lower than the standard Tier 3a value. The main issue was the survey catchability coefficient and whether it was prudent to discount the high catchability (and low biomass) estimated by Model 2. The low fixed value in the other models is based on data on the vertical distribution of 11 fish obtained from archival tags, which suggests that they were above the survey trawl headrope a good deal of the time. However other studies suggest that cod (and other species) tend to dive to the bottom when a trawl approaches. Bob Lauth reported (as he had in September) that comparative tows made with the low-opening Bering Sea survey trawl and the high-opening GOA survey trawl appeared to catch about the same quantity of cod. (A full report will be available next year.) He also related that the echo sounder showed few fish in midwater during the comparative tows when cod were plentiful on the bottom, and that midwater trawling during acoustic surveys for pollock in the summer encountered few cod. On the other hand, he reported that at least one exploratory tow in shallow water, inshore of the survey area, had brought up a very large catch of cod, so it may be true that in summer a sizable proportion of the stock is near shore and unavailable to the survey. In the end the Team decided to continue to rely on the lower fixed survey catchability both for fitting the model and setting ABC. The Team therefore agreed with the authors' recommended ABC/OFL.

The Team commends the authors for responding to every single Team request, of which (as is customary for Pacific cod) there were a large number during the past year.

GOA Plan Team minutes (November, 2012)

Pollock

Assessment CIE

Assessment authors will continue to improve on methods following CIE review recommendations. This year the author implemented recommendations which could be quickly accomplished without major changes to the model structure (e.g., the age range of the assessment was expanded to ages 1-10 from 2-10). Future assessments will explore CIE recommendations that require methodological development and substantial analysis (e.g., including predation mortality in the assessment). The Team briefly discussed a CIE review comment that the assessment be risk neutral. This comment is relevant to all stock assessments, and led to the specific question of "at what biomass is there no longer a need for the author's recommended ABC lower than the maximum permissible ABC?" The author will examine this issue, but noted that given recent positive trends in the spawning stock biomass this appears to be less of a concern than past years.

Pacific cod

Teresa Amar presented the assessment of GOA Pacific cod. As in past years she refined models based on detailed discussion and presentations given at the September 2012 meeting. At the September meeting the Team requested analysis where q is fixed at 1.0 rather than tuning to a specific size range (there was little difference between these model runs and the extra work required seemed unjustified). They also requested models which dropped the heavily influential growth data components and the "sub-27cm" survey data. The Team discussed that the statistical weights from these likelihood components may be too high given the input sample size for the length-at-age data from NMFS surveys. It may be more appropriate to use the number of hauls instead of the raw numbers of fish. The Team suggested that the spatial aspect of available length-at-age data be evaluated, particular between years for the older/larger Pacific cod since in some years most of the apparent 'lack-of-fit' arose from the larger fish samples.

The Team suggested considering a model that had the features of Model 4 but with fixed growth (e.g., at Model 2 values), then look at constant selectivity for main survey data. Also examination of the possibility of using cubic splines over age, smoother shape and fewer parameters (in general) was recommended. Retrospective patterns should be evaluated as an additional diagnostic for alternative models (e.g., Model 4 may show an improved retrospective pattern. For communication purposes, when stock sizes change for the same year from one assessment to the next, it would be useful to evaluate the changes graphically (e.g., biomass at age for last year's model with the accepted model this year). Since the fishery is comprised of many components, the Team suggested using a general exploitation matrix such as 1-SPR for F implied over time. This provides an indication of the effective exploitation rate relative to the reproductive potential of recruits entering the population.

The quota allocations between GOA regions are provided following two methods: a new approach (Kalman filter) vs status quo (weighted survey average). The Plan Team recommended going forward with the Kalman filter approach since the survey averaging work-group notes that this method is robust. The Team suggested that the stock synthesis feature to turn off age zeros whenever sub-27 age data were included should be activated.

Northern rockfish

Chris Lunsford provided a summary of the northern rockfish executive summary for lead author Pete Hulson. This assessment was updated with catch data in 2012 for projecting 2013 and 2014 ABC. The Team noted that in general for all stocks where a projection is employed, the catch projection for the

current year should be the current ABC or the current technique for estimating in year catches whichever is less. The Team approved the recommended ABCs and OFLs for 2013 and 2014.

SSC minutes (December, 2012)

General SAFE Comments

The SSC reviewed the SAFE chapters and 2011 OFLs with respect to status determinations for BSAI and GOA groundfish. The SSC accepts the status determination therein, which indicated that, with the exception of BSAI Octopus, no stocks were subject to overfishing in 2011. Also, in reviewing the status of stocks with reliable biomass reference points (all Tier 3 and above stocks and rex sole), the SSC concurs that these stocks are not overfished or approaching an overfished condition.

The SSC recommends that the authors consider whether it is possible to estimate M with at least two significant digits in all future stock assessments to increase validity of the estimated OFL. The SSC encourages assessment authors of stocks managed in Tier 5 to consider the recommendations found in the draft survey averaging workgroup report.

Bering Sea assessment

Public testimony was provided by Dave Fraser on behalf of Adak Development Corporation. He reiterated their long-standing support for an area split for Pacific cod, but questioned model assumptions with respect to survey catchability in the Aleutians. Based on his fishing experience there are times (particularly under low-density conditions) when a low-opening net is most efficient, while at other times, a high-opening trawl is more efficient to target off-bottom concentrations. He recommended that the effectiveness of the survey trawl in the Aleutians under different conditions be closely examined.

Following review of the preliminary assessment by the Plan Team in September and SSC in October, four models were selected for this year's final assessment. Model 1 is last year's accepted model, updated with new information (catch data, fishery and survey size compositions, survey abundances, survey age compositions, and fishery CPUE data); Model 2 is identical to model 1 but estimates the survey catchability coefficient as a free parameter; Model 3 is identical to model 1, but does not include age composition data in the likelihood function; Model 4 is an exploratory model that incorporates a number of author-suggested changes.

The authors, as always, have been very responsive to Plan Team and SSC recommendations and the models brought forward in the final assessment were selected based on Plan Team and SSC recommendations. There was insufficient time to consider some other recommended modifications such as time varying survey catchability (SSC, Oct-12) or selectivity parameters estimated by time block, gear, and season (Plan Team, Sep-12). A retrospective analysis was included as requested by the Plan Team and SSC and 'other' removals were included in an appendix but not incorporated in the assessment.

The authors and Plan Team recommend Model 1, which is last year's accepted model. The SSC concurs with the choice of Model 1 for stock status determinations in 2013 in spite of a good fit for Model 4, which incorporates some desirable features but has not been fully vetted. The data and models suggest a relatively high and increasing biomass in recent years, putting the stock in Tier 3a. The SSC agrees with the current expansion of the biomass estimated for the EBS to the BSAI area based on the updated Kalman filter estimates for biomass distribution between the two areas (93% EBS and 7% AI). In spite of concerns over the status of the stock in the Aleutians as noted below, the SSC agrees with the Plan Team that there is no compelling reason to reduce the ABC from the maximum permissible value under Tier 3a as summarized below in metric tons. The SSC supports the following ABCs and OFLs for 2013 and 2014 (in metric tons):

The SSC re-iterates continuing concerns over the best value for the catchability coefficient, which by long-standing practice is either tuned to experimental results or fixed at a previously tuned value to keep it close to the experimental results (currently fixed at 0.77 in Model 1). Based on exploratory models estimating q, catchability may be much higher. The SSC expects to receive a report prior to next year's assessment about a comparison of the standard EBS trawl with a high-opening trawl conducted during the 2012 field season. Very preliminary results suggest that catchability is higher than the currently used value because catch rates in both trawls were not substantially different.

A second concern is the strong retrospective pattern that suggests consistent over-estimation of biomass in the most-recent year, relative to the current assessment. The SSC would like to see a similar analysis of retrospective patterns for a model with an alternative estimate for q (internally estimated or updated value from field experiment) in next year's assessment.

In combination, the above concerns suggest the possibility that biomass may be substantially lower than the current model suggests. However, biomass has increased in recent years in large part to above-average year classes in 2006, 2008, and 2010 and the possibility of another strong year class in 2011 (based on limited 2012 survey data).

The results for Model 4 suggest that several of the new features represent an improvement over the current base model and the SSC recommends bringing forward a similar model next year that retains at least some of these promising features such as the Richards growth curve, newly parameterized seasonal changes in weight-at-length, selectivity modeled as a function of length, and estimating log-scale standard deviations for recruitment internally rather than fixing them. The appropriate treatment of selectivity remains to be determined but the simplifications introduced in Model 4 (i.e. combining gear types), in combination with the other changes, appears to provide a very reasonable fit to the age composition data and other data components.

Aleutian Islands assessment

The author continued to explore an age-structured model for the Aleutian Islands but did not bring forward a full assessment. Model 1 for the AI is similar to Model 1 for EBS Pacific cod, except that it assumes a single season and fishery per year, does not include age data, and the catchability coefficient is tuned to a higher value (because of the difference in survey net configurations between the two areas, Nichol et al. 2007). Model 2 is similar to Model 1, except that it allows temporal variability in two of the growth parameters. Model 3 is identical to Model 1, except that all input sample sizes for length composition data are multiplied by 1/3 in response to a Plan Team request to use a smaller average sample size. Model 4 differs from Model 1 in that it: 1) excludes US-Japanese joint survey data from before 1990 because of concerns over their reliability, 2) allows survey catchability to vary randomly among surveys, 3) forces selectivity to be asymptotic for the survey but not for the fishery, 4) estimates input sample sizes for length composition data iteratively, 5) allows several selectivity parameters to vary randomly, and 6) estimates the standard deviation for log-recruitment internally.

All models except Model 4 overestimate survey abundances substantially and result in relatively poor fits to the fishery size composition data, particularly in early years when sample sizes were low. All of the models achieved a reasonable fit to the survey size composition data. Recruitment deviations differed considerably for Model 4 and, as the authors noted, the recruitment deviations are very different from those in the eastern Bering Sea and Gulf of Alaska models, while recruitment in the latter two regions is highly synchronous. It is unclear whether that reflects a true difference in recruitment dynamics or suggests a problem with the exploratory AI assessment models.

A number of issues and data gaps were identified by the author that may need to be resolved before the present model can be adopted for stock status determinations for AI Pacific cod. In particular, the authors question whether the data to support an age-structured assessment for AI Pacific cod are adequate given large survey CVs and small sample sizes for length composition data. The SSC encourages further model development but had no specific suggestions beyond those identified in plan team discussions and the possibility of obtaining additional age composition data from archived otoliths.

While these models are still exploratory, the range of models examined appears to provide strong evidence for a substantial decline in biomass in the Aleutian Islands since the early 1990s. This decline, unlike in the Eastern Bering Sea, has continued in recent years and is consistent with observed declines in fishery CPUE in the AI for both longline and trawl fisheries (Fig. 2.3b of the assessment). The model estimates of maxABC ranged from 2,990 to 8,690 for the four exploratory models fit to the AI data and were substantially below the actual catches taken in recent years (29,000 t in 2010, 10,862 t in 2011, and 12,991 t through Nov 3). Therefore the current approach of setting a single ABC for the entire BSAI area raises potentially serious conservation concerns for Pacific cod in the AI. As noted in the SAFE introduction, the SSC has put the Council on notice for some time that it expects to adopt an area-specific ABC and OFL for the Aleutians. Given the heightened conservation concern, the SSC intends to set separate ABC/OFL for EBS Pacific cod and AI Pacific cod for the 2014 fishing season based on the best available information at that time, regardless of whether the age-structured model is adequate for stock status determinations. Therefore, the Council should initiate preparation of any background supporting documents such as a supplemental NEPA document that may be required for specification of separate ABCs/OFLs in 2014.

GOA assessment

Public testimony was provided by Julie Bonney (Alaska Groundfish Data Bank) expressing concerns about the significant drop in ABC/OFL due to model changes and about implementing a change in area apportionments prior to adopting the new Kalman filter approach across stocks.

For this assessment cycle the 2011 model (with and without "tail compression") was updated with new data, including catch for 2011, preliminary catch for 2012, catch-at-length for 2011, seasonal and gearspecific catch for 1991-2012, and age composition and mean size-at-age for the 2011 NMFS bottom trawl survey data. In addition, five new models (Models 1-5) were explored to examine the effects of different combinations of the survey '27 cm – plus' and 'sub-27 cm' length groups on model fit. The sub-27 survey data are highly variable and there is considerable uncertainty in the catchability and selectivity of sub-27 cm fish in the trawl survey. In addition, variants of three of the models fixed catchability at 1.04 (2011 value) instead of 1.00.

The SSC agrees with the author's and Plan Team recommendation to use Model 2 for the purposes of specification. This model excludes all of the sub-27cm data, yet estimated a length at age-1 that was more consistent with the observed value than estimates from other models. The biomass estimates were similar to other model configurations. The plan team noted, and the SSC concurs, that Model 4 had much better fits to other data components and encourages the authors to further explore a model that omits or down-weights the mean-length at age data for the 27cm-plus group.

The Pacific cod stock in the Gulf of Alaska has benefitted from relatively strong recruitment from 2005 to 2009, hence stock abundance is expected to be stable or increase in the short term. The projected spawning stock biomass based on Model 2 is 110,000 t in 2013, which is well above the B40% reference point of 93,900 t and puts the stock in Tier 3a. The SSC agrees with the Plan Team that there is no reason to reduce the ABC from maximum permissible and the standard control rule results in the OFL and ABC estimates for the total GOA shown in the table below.

The Plan Team discussed two options for area apportionments using either the established approach or a new Kalman filter approach that has been recommended by a recent working group on the issue. The SSC agrees with using the recommended new approach, resulting in apportionments of 35% in the Western GOA, 61% in the Central GOA, and 4% in the Eastern GOA and the ABC splits shown below (in metric tons):

With respect to further development of the model, the SSC has the following concerns and recommendations:

- Omitting mean size-at-age data for the 27+ group (Models 3 & 4) had a large effect on biomass estimates (estimating substantially higher biomass levels in the 1980s) and a strong impact on model fits. The Plan Team recommended, and the SSC concurs, to consider down-weighting rather than omitting the mean size-at-age data to more appropriately reflect the effective sample sizes associated with the data. It would also be informative to explore how the exclusion of the size-at-age data in models 3 & 4 interacts with other features of the model to result in these apparently inflated biomass estimates.
- The estimated fishery selectivities-at-length are extremely peaked for most fisheries and the resulting low selectivities for larger size classes imply high abundances of "cryptic" large Pacific cod. While similar patterns are seen in the EBS and Aleutians there is continuing large uncertainty about how to appropriately parameterize selectivity. We encourage the authors to carefully evaluate the impact of the chosen form for selectivity curves on model results and to examine how changes in selectivity interact with the treatment of growth and inclusion of mean size-at-age data.
- Of particular concern is the time varying pattern of dome-shaped selectivity with age in the survey based on very little data prior to the 1990s (Fig. 2.11). It is doubtful that age-based selectivity for the early time period can be reliably estimated if only age data from 1990-2011 was used in the model (as indicated in Table 2.7, where data from 1987 were omitted). It was not clear from the documentation if there were any composition data to inform the first time-block of selectivity for the trawl survey. The SSC encourages the author to develop a model with lengthbased survey selectivity to take advantage of available length data from all survey years.
- While there are legitimate concerns about the high variability of the sub-27 group, omitting the data may not be consistent with using the best available information. However, using time varying catchability with an index that primarily reflects variability due to incoming year classes is clearly not appropriate.
- To improve fits to the size data, the author may also want to consider using the Richards growth curve to parameterize growth as in Model 4 in the EBS Pcod assessment.

3 Models analyzed in the 2012 Bering Sea Pacific cod assessment

Models analyzed in the preliminary assessment

Four primary models (1-4 below) and three secondary models (1.1-1.3 below) were requested by the Plan Team and SSC for inclusion in the preliminary 2012 assessment. A fifth primary model and six more secondary models were added by the assessment author. A brief description of each model is shown below:

Model	Description
1	Last year's accepted model (same as last year's Model 3b)
1.1	Same as Model 1, except survey catchability estimated internally
1.2	Same as Model 1, except ageing bias parameters fixed at GOA values
1.3	Same as Model 1, except with revised weight-length representation
2	Same as Model 1, except survey catchability re-tuned to match Nichol et al. (2007)
3	Same as Model 1, except new fishery selectivity period beginning in 2008
4	Same as Model 1, except no age data used (same as last year's Model 4)
Pre5.1	Same as Model 1.3, except for three minor changes to the data file
Pre5.2	Same as Model Pre5.1, except ages 1-10 in the initial vector estimated individually
Pre5.3	Same as Model Pre5.2, except Richards growth curve used
Pre5.4	Same as Model Pre5.3, except σ for recruitment *devs* estimated internally as a free parameter
Pre5.5	Same as Model Pre5.4, except survey selectivity modeled as a function of length
Pre5.6	Same as Model Pre5.5, except fisheries defined by season only (not season-and-gear)
5	Same as Model Pre5.6, except four quantities estimated iteratively

The purpose of including Models Pre5.1-Pre5.6 was to provide a reasonably smooth transition between Model 1.3 and Model 5. The main differences between primary and secondary models were: 1) full results were presented for primary models, but only a small subset of results were presented for secondary models, and 2) some of the secondary models (specifically, Models Pre5.1-Pre5.6) were subjected to less rigorous tests for convergence than the other models.

Models analyzed in the preliminary assessment

Following review in September and October, four of the models from the preliminary 2012 assessment were requested by the Plan Teams or SSC to be included in the final 2012 assessment:

Model 1 was identical to the model accepted for use by the BSAI Plan Team and SSC last year, except for inclusion of new data.

Model 2 was identical to Model 1, except that the survey catchability coefficient was estimated as a free parameter.

Model 3 was also identical to Model 1, except that ageing bias was not estimated internally and the fit to the age composition data was not included in the log-likelihood function.

Model 4 was an exploratory model that differed from Model 1 in several respects:

1. A new, inter- and intra-annually varying weight-length representation developed in the preliminary assessment was used.

2. "Tail compression" was turned off. This feature aggregates size composition bins with few or zero data on a record-by-record basis, which improves computational speed, but which also makes some of the graphs in the R4SS package difficult to interpret. In Models 1-3, tail compression was turned on.
3. Fishery CPUE data were omitted. In Models 1-3, fishery CPUE data were included for purposes of comparison, but are not used in estimation.
4. A new population length bin was added for fish in the 0-0.5 cm range, which was used for extrapolating the length-at age curve below the first reference age. In Models 1-3, the lower bound of the first population length bin is 0.5 cm.
5. Mean-size-at-age data were eliminated. In Models 1-3, mean-size-at-age data are included, but not used in estimation.
6. The number of estimated year class strengths in the initial numbers-at-age vector was set at 10. In Models 1-3, only 3 elements of the initial numbers-at-age vector were estimated, which causes an automatic warning in SS.
7. The Richards growth equation (Richards 1959, Schnute 1981, Schnute and Richards 1990) was used, which adds one more parameter. In Models 1-3, the von Bertalanffy equation—a special case of the Richards equation—was used.
8. The log-scale standard deviation of recruitment was estimated internally (i.e., as a free parameter estimated by ADMB). In Models 1-3, this parameter was held constant at the value of 0.57 that was estimated in the final 2009 assessment by matching the standard deviation of the recruitment *devs*, per Plan Team request.
9. Survey selectivity was modeled as a function of length. In Models 1-3, survey selectivity was modeled as a function of age.
10. Fisheries were defined with respect to each of the five seasons, but not with respect to gear. In Models 1-3, fisheries were defined with respect to both season and gear.
11. Fishery selectivity curves were defined for each of the five seasons, but were not stratified by gear type. In Models 1-3, seasons 1-2 and 4-5 were lumped into a pair of "super" seasons for the purpose of defining fishery selectivity curves, and fishery selectivities were also *gear*-specific (3 super-seasons × 3 gears = 9 selectivity curves).
12. The selectivity curve for the fishery that came closest to being asymptotic on its own (in this case, the season 3 fishery) was forced to be asymptotic by fixing both *width_of_peak_region* and *final_selectivity* at a value of 10.0 and *descending_width* at a value of 0.0. In Models 1-3, six of the nine super-season × gear fisheries were forced to exhibit asymptotic selectivity.
13. Survey catchability was tuned iteratively to set the average of the product of catchability and survey selectivity across the 60-81 cm range equal to 0.47, corresponding to the Nichol et al. (2007) estimate. In Models 1-3, Q was left at the value of 0.77 estimated by a similar procedure in the final 2009 assessment, per Plan Team request.
14. The age composition sample size multiplier was tuned iteratively to set the mean of the ratio of effective sample size to input sample size equal to 1.0. In Models 1-3, the variance adjustment was fixed at 1.0.
15. The two parameters governing the ascending limb of the survey selectivity schedule were given annual additive *devs* with each σ_{dev} tuned to match the estimate that would be appropriate for a univariate linear-normal model with random effects integrated out. In Models 1-3, no *dev* vector corresponding to the *initial_selectivity* parameter was used, because it was "tuned out" in the 2009 final assessment; and σ_{dev} for the *ascending_width* parameter was left at the value of 0.07 estimated iteratively in the final 2009 assessment, per Plan Team request.

4 Models analyzed in the 2012 Aleutian Islands Pacific cod assessment

Models analyzed in the preliminary assessment

Two models (labeled Model 1 and Model 2) were presented in the preliminary 2012 assessment, both based largely on the 2011 final model for Pacific cod in the EBS. The natural mortality rate was fixed at 0.34 in both models, borrowing the accepted value in the EBS.

In both models, weight (kg) at length (cm) was assumed to follow the usual form weight=$\alpha \times \text{length}^{\beta}$ and to be constant across the time series, with α and β estimated at 5.68×10^{-6} and 3.18, respectively, based on 8,126 samples collected between 1974 and 2011.

In both models, length bins (1 cm each) were extended out to 150 cm instead of the limit of 120 cm that is used in the EBS assessment, because of the higher proportion of large fish observed in the AI.

In addition to differences in the data between the AI and EBS, Model 1 differed from the 2011 final EBS model in the following respects:

- Each year consisted of a single season instead of five.
- A single fishery was defined (with forced asymptotic selectivity) instead of nine season-and-gear-specific fisheries (with forced asymptotic selectivity for six of them).
- Fishery selectivity was constant over time instead of variable in multiple time blocks.
- The survey was assumed to sample age 1 fish at true age 1.5 instead of 1.41667.
- Ageing bias was not estimated (no age data) instead of estimated.
- Survey catchability Q was tuned to match the value of 0.92 estimated by Nichol et al. (2007) for the AI survey net instead of the value of 0.47 estimated for the EBS survey net.

Model 2 was chosen from a set of seven candidate models, all of which were identical to Model 1 except that they each allowed at least one of the three length-at-age parameters (length at age 1, *L1*; asymptotic length, *Linf*; and Brody's growth coefficient, *K*) to vary annually from 1977-2010, using multiplicative *dev*s with $\sigma = 0.1$. The candidate models were structured as follows:

Model	*L1 devs*	*Linf devs*	*K devs*
A	yes	yes	yes
B	yes	yes	no
C	yes	no	yes
D	no	yes	yes
E	yes	no	no
F	no	yes	no
G	no	no	yes

The candidate model with the lowest AIC value was chosen as Model 2.

Models analyzed in the final assessment

Four models were presented in the final 2012 assessment, three of which were based largely on last year's accepted model for Pacific cod in the EBS.

Models 1 and 2 were identical to Models 1 and 2 from the preliminary assessment, with one exception: An additional year of catch data (1976) was included in the data file for Model 2. This change was necessitated when it was discovered that SS was estimating $B_{100\%}$ from the length-at-age parameters corresponding to the first year in the catch data, which would normally be 1977. However, it turned out that 1977 had one of the largest estimated growth *devs* in the time series. The available options were either to turn off the growth *devs* for 1977 or to add another year to the start of the time series. Given that 1977 appeared to exhibit one of the most non-typical growth patterns in the time series, the latter option seemed preferable.

Model 3 was the same as Model 1, except that all input sample sizes for length composition data were multiplied by 1/3, in response to a request from the BSAI Groundfish Plan Team.

Model 4 differed from Model 1 in several respects:

1. Survey data from the pre-1991 years (i.e., the years of the U.S.-Japan cooperative survey) were removed from the data file.
2. Survey catchability was allowed to vary randomly around a base value (estimated iteratively, using the same approach as the other three models), with the input standard deviation estimated iteratively by matching the standard deviation of the estimated *devs*.
3. Survey selectivity was forced to be asymptotic.
4. Fishery selectivity was not forced to be asymptotic.
5. Input sample sizes for length composition data were estimated iteratively by setting the root-mean-squared-standardized-residual of the survey abundance time series equal to unity.
6. All fishery selectivity parameters except *initial_selectivity* and the *ascending_width* survey selectivity were allowed (initially) to vary randomly, with the input standard deviations estimated iteratively by matching the respective standard deviations of the estimated *devs*.
7. The input standard deviation for log-scale recruitment *devs* was estimated internally (i.e., as a free parameter).

5 Models analyzed in the 2012 GOA Pacific cod stock assessment

Models analyzed in the preliminary assessment

Model	Description
1	The base model: Model 3 from the 2011 stock assessment
1Q	Model 1 tuned iteratively so that the mean catchability for the 27plus survey is 0.916
A	Model 1 with tail compression turned off
AQ	Model A tuned iteratively so that the mean catchability for the 27plus survey is 0.916
B	Model A with changes to the sub27 survey: changed from 12 to 2 periods for catchability, changed from 1 to 2 periods for selectivity, initial values for some devs changed to 0.0
BQ	Model B tuned iteratively so that the mean catchability for the 27plus survey is 0.916
C	Model B with the initial value for the pre-1977 R0 dev (SR_R1_offset) changed from -0.391537 to 0.0 and the upper bound changed from 0.0 to 5.0
CQ	Model C tuned iteratively so that the mean catchability for the 27plus survey is 0.916
D	Model C with changes to the 27plus survey: changed from 11 to 2 periods for selectivity
E	Model A with q for the 27plus survey estimated (requested by the Plan Team)
1B	Model B with the tail compression value set to the same value as in Model 1 (turned on)
1C	Model C with the tail compression value set to the same value as in Model 1 (turned on)

Models analyzed in the final assessment

Model	Description
2011 model	Model 3 from the 2011 stock assessment with 2012 data
2011 model no tc	Model 3 from the 2011 stock assessment with 2012 data and tail compression turned off
1	q set to 1.0, 2 periods of catchability and selectivity for the sub27 survey, tc off
1Q	Model 1 with q set to 1.04 (the value used in 2011)
2	q set to 1.0, all sub27 survey data is omitted, tc off
2Q	Model 2 with q set to 1.04 (the value used in 2011)
3	q set to 1.0, 2 periods of catchability and selectivity for the sub27 survey, all sub27 and 27plus survey mean length-at-age omitted, tc off
3Q	Model 3 with q set to 1.04 (the value used in 2011)
4	Model 2 with the 27plus mean length-at-age data omitted
5	Model 1 with the sub27 mean length-at-age data omitted

Several additional models were run with weights on the 27plus mean length-at-age data ranging from 0.1 to 0.5; Models 2 and 5 had the value of this weight of 1.0, and Models 3 and 4 had the value of this weight of 0.0.

6 Comparing Pacific cod catches from survey bottom trawl with a low and a high vertical opening

Robert Lauth and Cynthia Yeung

Introduction

A field experiment was conducted from 17-18 June 2012 aboard the AFSC chartered fishing vessels *Aldebaran* (vessel code=89) and *Alaska Knight* (vessel code=162) comparing catch rates of Pacific cod between the low-opening (~2.5 m) eastern Bering Sea (EBS) shelf standard 83-112 Eastern survey trawl and the high-opening (~7 m) Gulf of Alaska (GOA) standard Poly Nor'eastern survey trawl (Stauffer 2004). Nichol et al. (2007) used archival tag data from Pacific cod to investigate distance off bottom and determined that about 47% of Pacific cod are available to the low-opening EBS 83-112 Eastern survey trawl and that 92% are available to the high-opening GOA Poly Nor'eastern survey trawl. The BSAI assessment model uses the point estimate 0.47 (Thompson and Lauth 2012) and the GOA assessment model uses the point estimate 0.92 (A'Mar et al. 2012) from Nichol et al. (2007) to constrain the product of catchability and selectivity for the 60-81 cm size range of Pacific cod. The objective of the gear comparison experiment was to test the validity of the 0.47 and 0.92 point estimates by determining if there was a difference in catch rates of Pacific cod in the 60-81 cm size range between the low- and high-opening survey trawls used in standard Alaska Fisheries Science Center (AFSC) bottom trawl surveys in the EBS and GOA.

Seventeen side-by-side trawl tows were successfully completed in the vicinity of the EBS shelf survey stations L-07 and L-09 (Fig. 1). The location was chosen during the first leg of the annual EBS shelf survey in an area where there was a relatively high density of Pacific cod over a large area (Fig. 2). The experiment was conducted with the AFSC chartered survey vessels one week after survey sampling was completed in the area. Samples aboard the *Aldebaran* were taken using the standard 83-112 Eastern survey trawl net and samples aboard the *Alaska Knight* were taken using the standard Poly Nor'eastern survey trawl net. Trawl tows were 30 minutes in duration and vessels maintained a minimum distance of 0.1 nm during each tow. Average bottom depths for the comparison tows ranged from 25 to 38 m, and average bottom temperatures from 3.4°C to 5.9°C. Pacific cod were sorted from each trawl catch sample and weighed in aggregate. In trawl catches with ≤ 400 Pacific cod, fork length measurements were taken on all specimens to the nearest centimeter, and in trawl catches with >400 specimens, fork length measurements were taken on a representative sample of about 400 Pacific cod. Mean catch per unit effort (CPUE) values for each haul and gear type were calculated by dividing the catch weight or number by the trawl area swept, which was calculated by multiplying the horizontal distance the trawl was towed by the mean horizontal trawl spread during the time period when the trawl first touched bottom until it lifted off the bottom.

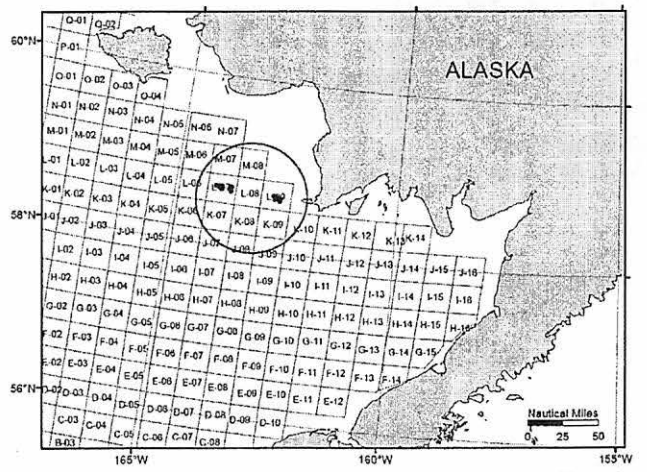

Figure 1. -- Red dots show area where side-by-side comparison tows were made to compare catch rates between the two different trawls.

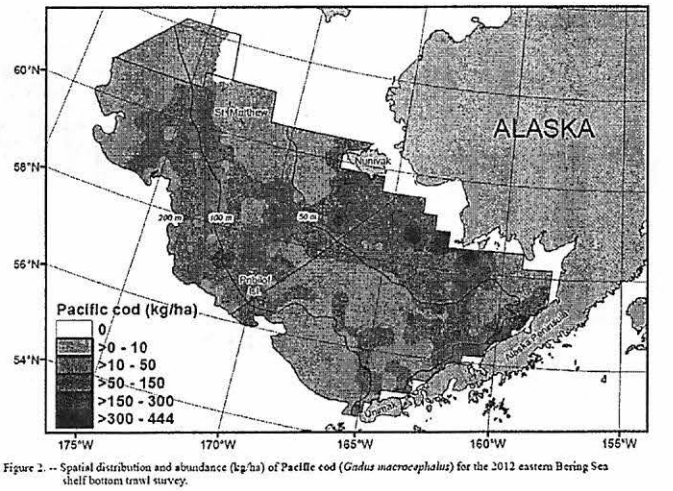

Figure 2. -- Spatial distribution and abundance (kg/ha) of Pacific cod (*Gadus macrocephalus*) for the 2012 eastern Bering Sea shelf bottom trawl survey.

CONCLUSIONS

- **Cannot reject H_0: Total cpue of pcod 60-81 cm length class EBS trawl = GOA trawl**
- **Cannot reject H_0: No difference in mean CPUE of pcod 60-81 cm between nets (normal distribution or non-parametric)**
- **Cannot reject H_0: Equal variance/median in cpue of pcod 60-81 cm between nets = 1 (normal distribution or non-parametric)**
- **Proportional catch of 60-81 cm pcod EBS trawl/GOA trawl > 1 – EBS trawl catches more 60-81 cm pcod than GOA trawl**
- **Proportional catch of 60-81 cm pcod is different - EBS trawl/GOA trawl can be 1.27±0.18 x, ~ 9-45% more**
- **Almost no chance with this sampling distribution that EBS trawl catches any less or 0.5 x less than GOA trawl**
- **Catch of 60-81 cm pcod, at best EBS trawl = GOA trawl, at worse EBS trawl ~1.25x > GOA trawl**

ANALYSIS

TOTAL CPUE (number per km^2) PCOD length class 60-81 cm

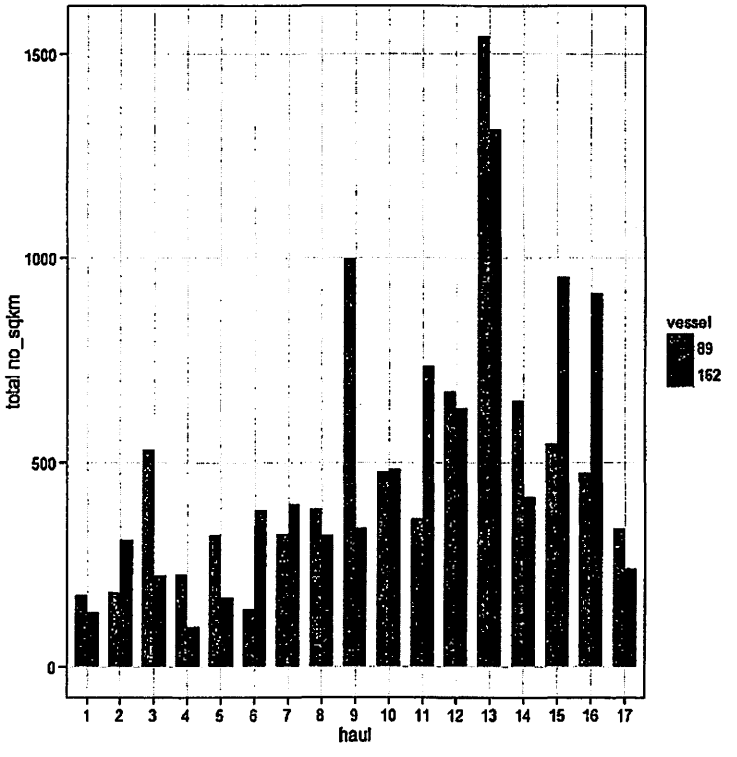

Figure 1. Comparison of paired trawl haul CPUE (no/km^2) for Pcod within the 60-81 cm size class (vessel 89 = EBS trawl, vessel 162 = GOA trawl).

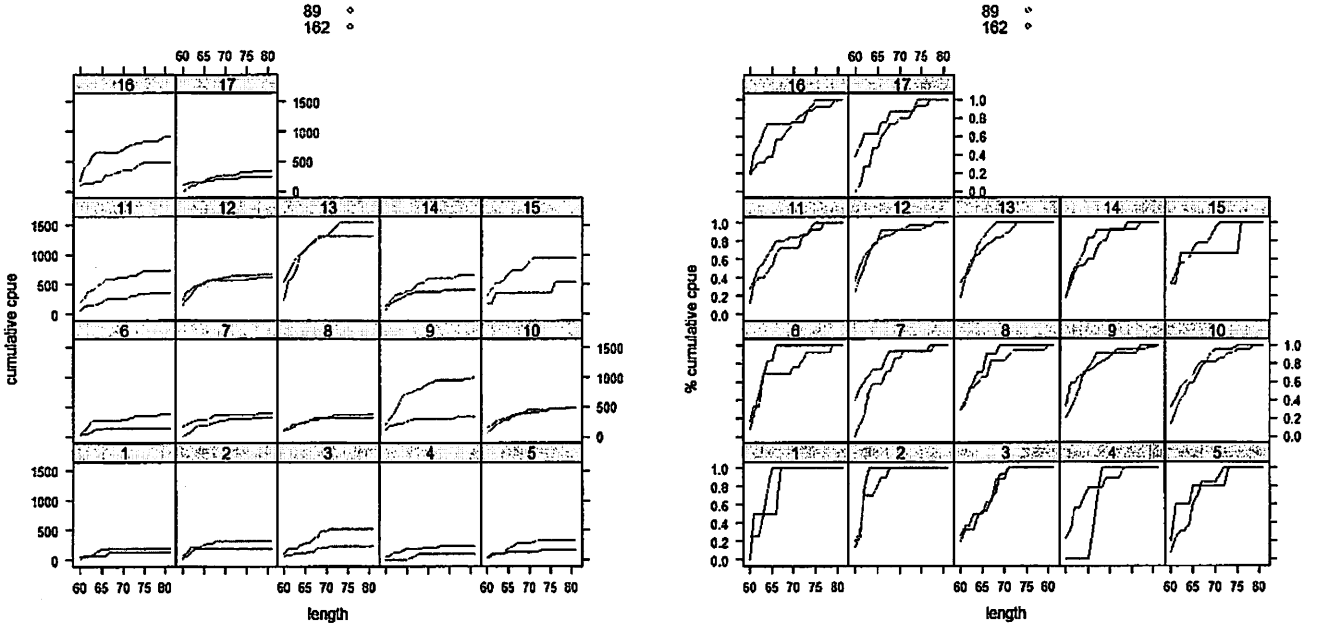

Figure 4. Comparison of length selection (within 60-81 cm, 5 cm bin intervals) of pcod between paired hauls (vessel 89 = EBS trawl, vessel 162 = GOA trawl).

H_0: Total cpue of pcod 60-81 cm length class, EBS = GOA (i.e. Pr(EBS > GOA) = 0.5) √
Two-tailed probability of exact binomial p-value = 0.3036 – cannot reject H_0.

H_1: Ratio of catchability of EBS:GOA is 0.47:0.92, or catch proportion is ~0.5
Compare only retained population; true population availability and avoidance unknown; trawl selectivity unknown.
Catch of cod >81 cm ~ 0; few >70 cm

Define: Total cpues in the 60-81 cm length group are different between nets if GOA > EBS by ±10% (89 = EBS and 162 = GOA).

Total cpue: 60-81 cm length class

	haul.no																
vessel	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
EBS	174	183	529	224	320	141	325	385	996	478	362	670	1541	648	545	475	339
GOA	130	310	223	97	168	382	398	321	337	483	732	628	1311	414	952	912	240
%diff	-25	70	-58	-57	-48	171	23	-17	-66	1	102	-6	-15	-36	75	92	-29

Difference range between -66% to +171%

15/17 hauls with difference of ±10%

H_0: Total cpue of EBS > GOA (-ve difference) in s = 9 of n = 15 paired hauls (haul#1,3,4,5,8,9,13,14,17)√

Two-tailed probability of exact binomial p-value = 0.3036 – cannot reject H_0.
Sample estimate: Pr(EBS > GOA) = 0.6
or
H_0: Total cpue of EBS > GOA in s = 10 of n = 17 paired hauls (haul#1,3,4,5,8,9,12,13,14,17) √
Two-tailed probability of exact binomial p-value = 0.3145 – cannot reject H_0.
Sample estimate: Pr(EBS > GOA) = 0.58

For n = 17 and a chosen significance level of $\alpha = 0.05$, the threshold for rejecting H_0 is $s \leq 3$ or $s \geq 13$.

Descriptive Statistics, total pcod 60-81 cm cpue

vessel	n	mean	sd	median	trimmed	mad	min	max	range	skew	kurtosis	se
EBS	17	490	346	385	444	237	141	1541	1400	1.65	2.44	84
GOA	17	473	333	382	442	235	97	1311	1214	1.03	0.07	81

H_0: Total cpue difference in means between nets = 0 (assume normal distribution) √
Paired t-test t = 0.257, df = 16, p-value = 0.8 – cannot reject H_0.
95% confidence interval -127, 162
Sample estimates: mean of the differences 17.5

H_0: Ratio of variance in cpue between nets = 1 (equal variance; assume normal distribution) √
F-test F = 1.083, num df = 16, denom df = 16, p-value = 0.8753 - cannot reject H_0
95% confidence interval: 0.39, 2.99
sample estimates: ratio of variances 1.083

H_0: Total cpue, difference in location parameter (median) between nets = 0 (non-parametric t-test)
Wilcoxon signed rank test V = 82, p-value = 0.8176 – cannot reject H_0.

Proportional catch of 60-81 cm pcod, EBS/GOA > 1 – EBS trawl catches more 60-81 cm pcod than GOA trawl

haul.no

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1.3	0.59	2.4	2.3	1.9	0.4	0.8	1.2	3	1	0.5	1.07	1.18	1.6	0.6	0.5	1.4

Descriptive statistics, catch proportion EBS/GOA

n	mean	sd	median	trimmed	mad	min	max	range	skew	kurtosis	se
17	1.27	0.75	1.18	1.22	0.87	0.37	2.96	2.59	0.71	-0.6	0.18

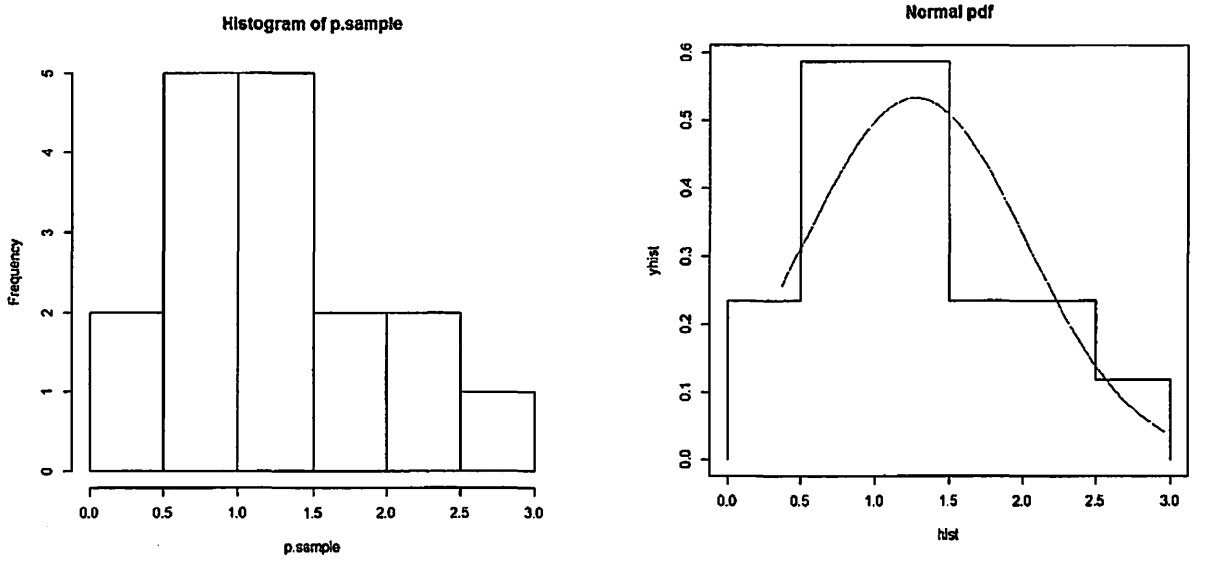

Figure 2 Sampling distribution of the catch proportion (EBS/GOA) of 60-81 cm pcod (left) and a PDF curve fitting for the sampling distribution of catch proportions (right)

Problem: Small sample size (n<40, with <10 failures and <10 success); too? small for χ^2 approximation
normal: mean = 1.27, sd = 0.72
χ^2_{6-2-1}, p = 0.506
df = k bins – p parameters - 1
cannot reject H_0, that sampling distribution is normal

Assume: Normal distribution
mean of sample catch proportions $\bar{x}$ = 1.27
std error of the mean $s_{\bar{x}}$= 0.18
H_0 True population proportion $X = \bar{x}$ V i.e. EBS > GOA catch in 60-81 cm pcod, EBS/GOA = 1.27, ~ 25% more
H_1 True population proportion $X \leq 1$ (no difference in catch of target length class between nets) X
$Pr(H_1) = 0.07$
H_2 True population proportion $X \leq 0.5$ (EBS catch is ≤0.5 of GOA) X
$Pr(H_2) \approx 0$ i.e. no chance with this sampling distribution that EBS catches less than GOA

<u>Z score 1 sample test of proportions</u>
H_0 True population proportion $X \leq 0.5$ (1-tail)

$$\sigma \approx \sqrt{\frac{X(1-X)}{n}} = 0.12$$

$$z = \frac{\bar{x}-X}{\sigma} = 6.42$$

Pr(z > 6.42) ≈ 0 => reject H_0