North Pacific Fishery Management Council

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The North Pacific Fishery Management Council has identified priorities for research, over 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 funding agencies. Research priorities are organized into four categories (critical, high, medium, and low), but within each category, are in no particular order of importance.

The Council would also like to highlight several current Council initiatives that are of high priority, and notes the research priorities that specifically relate to these initiatives:

1) Build Integrated Ecosystem Management capabilities
   Related research priorities: 110, 125, 142, 194, 198, 200, 203, 204, 205, 216, and 217.

2) Facilitate Council efforts to reduce impacts to chinook salmon
   Related research priorities: 119, 120, 184 and 188.

3) Increase knowledge of SSL fishery interactions and population dynamics
   Related research priorities: 126, 127, 128, 129, 130, 182 and 310.

Council's Five-Year Research Priorities: 2013 through 2017
(as adopted in June 2013)

2013 Research Priorities - Critical Priorities

115 **District-wide survey for demersal shelf rockfish in Southeast Alaska**

Status: No Action

Conduct a district-wide survey for demersal shelf rockfish in Southeast Alaska on a biennial or triennial basis. Survey information is becoming extremely dated.

138 **Continuation of State and Federal annual and biennial surveys**

Status: 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. Budgetary concerns have resulted in cuts to not only days at sea, which increases uncertainty, but also sampling the deepest strata, which threatens the value of trawl surveys as a synoptic ecological survey. 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.

146 **Improve surveys in untrawlable habitat, particularly for rockfish, Atka mackerel, and sculpins**

Status: Partially Underway

For groundfish in general, and rockfish and Atka mackerel 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.

2013 Research Priorities - High Priorities

101   **Life history research on non-recovering crab stocks**

Status: No Action

Why certain stocks have declined and failed to recover as anticipated is a pressing issue (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.

105   **Spatial distribution of male snow crab**

Status: Partially Underway

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.

107   **Improve handling mortality rate estimates for crab**

Status: Partially Underway

Improve estimate of discarded crab handling mortality rate. This will require improving understanding of 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. 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 biological and oceanographic data (e.g., biophysical moorings, stomach data, zooplankton, age 0 surveys) necessary to support integrated ecosystem assessment**

Status: Underway

Maintain the core data needed to support integrated ecosystem assessments. 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).

114   **Develop a spatially-explicit model for BSAI pollock**

Status: Underway

Conduct studies to determine stock structure and potential spatial management for BSAI pollock (e.g., movement). Evaluate interactions of BSAI pollock with those in Russian waters. These studies should lead to a detailed spatial age-structured stock assessment model with at least 3 regions (Russia, NW EBS, SE EBS].

116   **Studies to identify crab stock boundaries**

Status: No Action

Conduct studies to evaluate stock boundaries (e.g, Bristol Bay red king crab, Adak red king crab, Pribilof blue king crab). Studies are needed in the areas of genetics, reproductive biology, larval distribution, and advection. Mark-recapture studies are needed as well.

117 **Study vertical distribution of Pacific cod to better understand catchability**

Status: Underway

Research is needed on the vertical distribution of Pacific cod relative to the EBS bottom trawl and comparisons of gear between the EBS and GOA trawl gear. This is because there is controversy about fishery and survey catchability.

118 **Pacific cod stock assessment for the Aleutian Islands**

Status: Underway

Develop Pacific cod stock assessment for the Aleutian Islands region. The Aleutian Islands and eastern Bering Sea regions will soon be split and get their own ABC's and OFL's. Therefore there is need to develop an assessment model for cod in the Aleutians.

119 **Evaluation of salmon PSC mitigation measures**

Status: Underway

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.

120 **Improve knowledge for salmon PSC impact assessment**

Status: Underway

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, but more work on Cook Inlet chum is needed.

122 **Improve methods of monitoring fishery interactions**

Status: Underway

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.

125 **Research ecosystem indicators and their thresholds for inclusion in ecosystem-level management strategy evaluation.**

Status: Underway

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

126 **Evaluate interactions between fisheries and pinnipeds**

Status: Underway

Studies of the interactions between fisheries and protected species, such as Steller sea lions in the Central and Western Aleutian Islands (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.

127   Assess vital rates of Steller sea lions

Status: Underway

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

128   Assess the health of Stellar sea lions

Status: Underway

Assess possible indirect effects of fisheries removals via periodic health assessments, indices of body condition, survival of pups and juveniles, and natality of Steller sea lions in the western DPS.

129   Quantify killer whale predation of Steller sea lions (M)

Status: Underway

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

135   Conduct routine fish, crab, and oceanographic surveys in the northern Bering Sea and Arctic Ocean

Status: Partially Underway

Dynamic ecosystem and environmental changes in the northern Bering Sea and Arctic are occurring. Assessment of the current baseline conditions and trophic interactions is important. This effort should not supplant the regular surveys in the BSAI and GOA, which are of critical importance to science and management.

136   Effects of trawling on female red king crab and subsequent recruitment

Status: Partially Underway

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.

139   Conduct routine surveys of subsistence in the northern Bering Sea and Arctic Ocean

Status: Partially Underway

Conduct routine surveys of subsistence use of marine resources in 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.

141   Estimate scallop stock abundance

Status: No Action

Estimate scallop stock abundance in unsurveyed areas using fishery independent methods.

143   Alternative approaches to acquire fishery-independent abundance data for Aleutian Islands golden king crab

Status: No Action

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 of Aleutian Islands golden king crab, including the potential for future cooperative research efforts with Industry.

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

Status: No Action

Assess seasonal or species-specific information for use in improved assessment and management (e.g., expand or continue cooperative research). The data would be useful in studies of species interactions in spatially explicit stock assessments.

147 **Studies on factors that affect catchability particularly for Tanner crab and Aleutian Islands golden king crab**

Status: Partially Underway

For groundfish and crabs, studies are needed on factors that affect catchability, as they directly bear on estimates of the stock assessment. 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.

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

Status: Underway

Advance research towards developing a quantitative 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.

151 **Acquire basic life history information (e.g., natural mortality, growth, size at maturity) for data-poor stocks.**

Status: Partially Underway

Acquire basic life history information needed for stock assessment, PSC, 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).

157 **Develop and validate aging methods for crabs.**

Status: No Action

Develop and validate aging methods for crabs to improve estimates of M for stock assessments.

163 **Expanded studies to identify stock and management boundaries**

Status: 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. Verify stock structure and source/sink dynamics including physical oceanographic, genetic and life-history studies.

164 **Develop spatially explicit stock assessment models**

Status: Partially Underway

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

166   **Develop age-structured models for scallop assessment**

Status: Partially Underway

Age structured models for scallop are needed to increase understanding of population dynamics and harvestable surpluses.

167   **Refine methods to incorporate uncertainty into harvest strategies for groundfish**

Status: Underway

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**

Status: Underway

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**

Status: Partially Underway

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.

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

Status: Partially Underway

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.

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

Status: Underway

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

182   **Foraging ecology studies of Steller sea lions**

Status: Underway

Foraging ecology studies of Steller sea lions in the Gulf of Alaska, Aleutian Islands, and Russia are needed, including at-sea tracking of older animals, and diet composition of sea lions throughout the region.

188   **Evaluate current and alternative Council PSC/bycatch reduction initiatives**

Status: Partially Underway

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

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

Status: 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.

195 **Evaluate efficacy of habitat closure areas and habitat recovery**

Status: 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 an objective of EFH research approach for the Council FMPs).

198 **Maintain moorings and develop/maintain a sea ice formation, sea ice retreat, and spring bloom indices for the EBS**

Status: Partially Underway

Develop and maintain indices of sea ice formation, sea ice retreat, and timing/extent of the spring bloom for the EBS. For this, maintenance of moorings, especially M-2, is essential. If recent changes in ice cover and temperatures in the Bering Sea persist, these may have profound effects on marine communities.

200 **Collect and maintain zooplankton biomass and community composition time series**

Status: Partially Underway

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.

203 **Maintain indicator-based ecosystem assessment for EBS.**

Status: Underway

Maintain indicator-based ecosystem assessment for EBS.

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

Status: Partially Underway

Develop indicator-based ecosystem assessments for AI (in progress), GOA, and the Arctic.

205 **Develop stock-specific ecosystem indicators and incorporate into stock assessments**

Status: Partially Underway

Develop stock-specific ecosystem indicators and incorporate into stock assessments. (in progress)

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

Status: Partially Underway

Collect and maintain time series of ocean pH in the major water masses off Alaska to improve understanding of ocean acidification and its effects on managed species, upper level predators and lower trophic levels

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

Status: Partially Underway

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

220 Collect, analyze, and monitor diet information

Status: 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.

301 Investigate ecosystem effects and inter-species interactions of halibut

Status: Underway

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.

302 Study temporal and spatial patterns in size-at-age of Pacific halibut

Status: Underway

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 model relating long-term environmental and ecological drivers to halibut size-at-age. Continue to explore the potential role of fishing in observed size-at-age trends via direct or evolutionary pathways and the interaction with size-selective fishing, include these analyses in harvest policy analyses.

305 Study Pacific halibut PSC, bycatch, and discard behavior in fisheries

Status: Underway

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

306 Effects of changes to the observer program

Status: Partially Underway

Evaluate the effects on biological parameter estimates and on estimated catch, bycatch, and PSC from 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 so that time series remain intact. Improve biological data collection including representative length and age samples from all sectors of the fleet. Attempt to separate temporal changes from sampling design effects.

310 Develop a simulation model of Steller sea lion fishery interactions

Status: No Action

Management strategy evaluation tools based on coupled bio-physical models with fishing and top trophic level foragers (e.g., Steller sea lions) should be developed to evaluate the performance of different harvest strategies, to inform future management decisions, and to prioritize field studies.

311 **Continue to improve stock assessment methodology with respect to uncertainty**
Status: Underway

Recent studies have made advances in determining effective sample size, effective number of parameters, Bayesian paramerizations, and how to weight datasets in assessments with multiple datasets. However, results appear to vary from paper to paper, and no general rules have emerged. Thus, our ability to characterize uncertainty remains elusive.

312 **Continue to investigate time variation and the shape of fishery and survey selectivity models**
Status: Underway

There is considerable controversy about (1) whether selectivity should be dome-shaped or asymptotic, and (2) whether selectivity should be time-varying by default. Using a dome-shaped curve can create a large increase in biomass which may not be real. Treating selectivity as time-varying increases the number of model parameters greatly, which may lead to confounding among parameters. Better scientific guidance through research studies is needed to address these two problems.

314 **Updated sperm whale stock assessment**
Status: No Action

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

318 **Verify coral and sponge distribution model projections in the Bering Sea**
Status: No Action

Verify AFSC model projections of coral and sponge distribution throughout the Bering Sea slope and canyons

2013 Research Priorities - Medium Priorities

102 **Catch accounting of crab sex and size**

Status: Partially Underway

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

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

Status: 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.

106 **Improve discard mortality rate estimates for scallop**

Status: Partially Underway

Field studies estimating Alaskan scallop discard mortality: relationship between capture, release condition and survival of scallops

108 **Tagging studies of Aleutian Islands Pacific cod and Atka mackerel**

Status: Partially Underway

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

109 **Age determination methods for Pacific cod, Pacific sleeper sharks, and spiny dogfish**

Status: 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).

111 **Biomass indices and alternate methodologies for lowest tier species**

Status: Partially Underway

Develop biomass indices for lowest tier species (Tier 5 for crab, Tier 6 for groundfish), such as sharks and octopus . Explore alternative methodologies for Tier 5 and 6 stocks such as length-based methods, catchability experiments (e.g., net selectivity), or biomass dynamics models.

112 **Analyses of fishery effort and observer data for scallop**

Status: No Action

Assess impacts of temporal and spatial effort by a limited number of vessels on CPUE and observer data for management purposes.

113 **Research on stock- recruit relationships**

Status: Underway

New information and data are needed that would inform our understanding of the stock- recruit relationship for groundfish, Pacific halibut, and crab to project year-class strength.

121   **Investigate factors affecting the guided angler sector of the halibut fishery**

Status: Underway

Continue to 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 Management Council or general economic conditions.

123   **Develop bioeconomic models**

Status: Partially Underway

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 directed halibut catch and halibut PSC utilization**

Status: Underway

Research the benefits and costs of directed halibut catch 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

130   **Develop methods to estimate sea lion abundance**

Status: 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   **Assess the impact of the displacement of the groundfish fleet on Northern fur seals**

Status: Partially Underway

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

132   **Evaluate the impact of seabird bycatch in fisheries on bird populations, and methods to reduce**

Status: 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   **Determine potential impacts of fishing activities on marine mammals**

Status: No Action

Determine potential impacts of fishing activities on marine mammals (e.g., state managed gillnet fisheries), and in particular on North Pacific right whales and the Eastern North Pacific blue whales, particularly in identified critical (NPRW) or essential (NPBW) habitat.

134   **Assess whether Bering Sea canyons are habitats of particular concern**

Status: Partially 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 a comparison of mid-level and apex predators to neighboring shelf/slope ecosystems.

137   **Impact of fisheries on benthic habitat and trophic interactions**

Status: Underway

Impact of bottom trawl fisheries on invertebrate abundance and species composition in benthic habitats. This isespecially relevant to the foraging ecology of walrus (candidate species for listing under ESA), but also bearded seals, and gray whales.

142   **Survey capability for forage fish**

Status: Partially Underway

Develop a long-term survey capability for forage fish (partially underway). The NPRB funded GOA and Bering Sea projects are currently describing the 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.

145   **Monitor skate egg case concentration sites**

Status: 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.

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

Status: No Action

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.

150   **Collect maturity scans during fisheries that target spawning fish**

Status: Underway

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 pollock and Pacific cod is collected by observers and should be analyzed. Maturity information for rockfish species near Kodiak has been collected recently, both during the fishery and dedicated scientific cruises, and should be analyzed. A dedicated survey to examine spawning sablefish has also been conducted. Efforts to collect maturity data, and then analyze for rockfish and other species should continue. In particular, retrospective studies to identify factors (e.g., fishing, climate, prey quality and quantity) influencing the maturity schedule should be conducted.

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

Status: Partially Underway

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

160   **Develop and evaluate global climate change models (GCM) or downscaled climate variability scenarios on recruitment, growth, spatial distribution**

Status: Underway

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

161   **Climate and oceanographic information covering a wider range of seasons is needed**

Status: Partially Underway

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

162   **Development of projection models to evaluate (a) the robustness and resilience of different management strategies under varying environmental and ecological conditions and (b) to forecast seasonal and climate related population shifts**

Status: Partially Underway

There is a need for the development of projection models to evaluate the robustness and resilience of different management strategies under varying environmental and ecological conditions. Projection models are also needed to forecast seasonal and climate related shifts in the spatial distribution and abundance of commercial fish and shellfish.

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

Status: Underway

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.

171   **Improve estimation of fishery interactions with non-target groundfish, and prohibited species.**

Status: No Action

Improve estimation of fishery interactions (including catch) and non-target groundfish (e.g., sharks, skates), and prohibited species.

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

Status: Partially Underway

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**

Status: Partially Underway

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.

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

Status: Underway

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 PSC avoidance measures on the BSAI pollock fishery**

Status: Partially Underway

Conduct retrospective analyses to assess the impact of Chinook salmon PSC avoidance 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 management strategy evaluations that incorporate changing climate and market economic conditions.**

Status: Partially Underway

Develop management strategy evaluations under differing assumptions regarding climate and economic conditions. Promote the standardization of "future scenarios" from different models to promote comparability of model outputs.

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

Status: No Action

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: Partially Underway

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

184   **Investigate gear modifications and changes in fishing practices to reduce bycatch and PSC**

Status: Partially Underway

Gear modifications and changes in fishing practices to reduce bycatch and PSC are needed.

185   **Conduct studies of sperm whale and killer whale depredation of catch in long-line fisheries and surveys**

Status: Underway

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

191   **Improved habitat maps**

Status: Partially 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.

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: Partially 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 corals**

Status: Partially Underway

Assess the extent of the spatial distribution of corals and conduct routine monitoring of these areas.

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

Status: Partially Underway

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 and indices

Status: Partially Underway

Develop bottom and water column temperature database and indices for use in EBS, GOA, and AI stock assessments.

199   Collect and maintain primary production time series

Status: No Action

Collect and maintain primary production time series in the EBS, AI, GOA, and Arctic; particularly in relationship to key climate and oceanographic variables.

201   Collect and maintain data on forage fish community composition and abundance

Status: Partially Underway

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

Status: Partially Underway

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

207   Assess the impact of increases in recovering whale populations on lower trophic level energy pathways

Status: No Action

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

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

Status: 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.

211   Assess the relative importance of non-commercially exploited species to human communities

Status: Partially Underway

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

214   Measure and monitor fish composition

Status: No Action

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, monitor changes in the distribution of assemblages, and understand the spatial importance of predator-prey interactions in response to environmental variability. 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**

   Status: Partially Underway

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

221   **Conduct ecosystem structure studies**

   Status: Underway

   Studies are needed to evaluate the effects of global warming, ocean acidification, and selective fishing on food webs. 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).

223   **Modeling studies of ecosystem productivity**

   Status: Underway

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

300   **Assess the population status of harbor seals in the Aleutian Islands and determine factors affecting their population trajectories**

   Status: No Action

   Assess the population status of harbor seals in the Aleutian Islands and determine factors affecting their population trajectories

307   **Determine quantitative indicators of spatial structure, particular for walleye pollock and Pacific cod**

   Status: No Action

   The next generation of stock assessment models will be spatial age- and length-structured assessment models, in line with the goal of ecosystem-based fishery management. Current distributions of spatial location have been empirically summarized, but methods should be explored to convert these to movement patterns for biological and/or management regions.

308   **Investigate in situ methods of tagging species that experience barotrauma**

   Status: No Action

   Species with swim bladders experience barotrauma, so that tagging studies result in high mortality and little information. Icelandic and Norwegian scientists have developed in situ methods for tagging, so that these fish never change depth. This could provide precise estimates of movement rates from tagging studies needed for spatial stock assessments. Such a recommendation for walleye pollock is found in a 2011 Report of a Workshop on Spatial Structure and Dynamics of Walleye pollock (AFSC Processed Report 2011-04).

309   **Effects of changes to the observer program**

   Status: No Action

   Evaluate the effects of changes to data collection protocols that occur because of observer restructuring. Ensure that data can be compared easily to the previous data collection methods and time series remain intact.

313   Retrospective analysis of the impact of Chinook PSC avoidance measures on communities of western Alaska

Status: No Action

Conduct retrospective analysis using qualitative and quantitative methods on salmon dependent communities of western Alaska that may be affected by Chinook salmon PSC avoidance measures in the BSAI. Analysis should evaluate long-term changes in local Chinook abundance and uses, and provide detailed ethnographic work exploring the meaning of salmon to these communities in the context of industrialized offshore fisheries.

315   Area-specific variability in scallop population processes

Status: No Action

Investigate area-specific variability in vital population processes including growth, recruitment, natural mortality and movement.

2013 Research Priorities - Low Priorities

104 **Improve species identification**

Status: Partially Underway

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.

140 **Identification and integration of archived data**

Status: 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 have been cataloged, and most trawl surveys have been included in databases. Some one-time research surveys remain neglected.

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

Status: Underway

Conduct multivariate analysis of bycatch data from the scallop observer program (haul composition data) and camera sled data. The analysis should include an investigation of localized depletion of scallops relative to fishing effort.

159 **Evaluate hybridization of snow and Tanner crabs.**

Status: No Action

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

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

Status: No Action

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

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

Status: No Action

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

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

Status: No Action

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.**

Status: No Action

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

303 **Determine effects of migration on the Pacific halibut population and management**

Status: Underway

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, PSC levels, and downstream effects.

304 **Investigate long term effects of fishing on Pacific halibut**

Status: Underway

Collect genetic samples for future comparison.

316 **Ocean Acidification and Scallops: monitoring water quality**

Status: No Action

Seasonal water quality monitoring in known scallop areas

317 **Effects of Ocean Acidification on Scallops**

Status: No Action

Studies to understand the mineralization of scallop shells through life cycle and across spatial variability