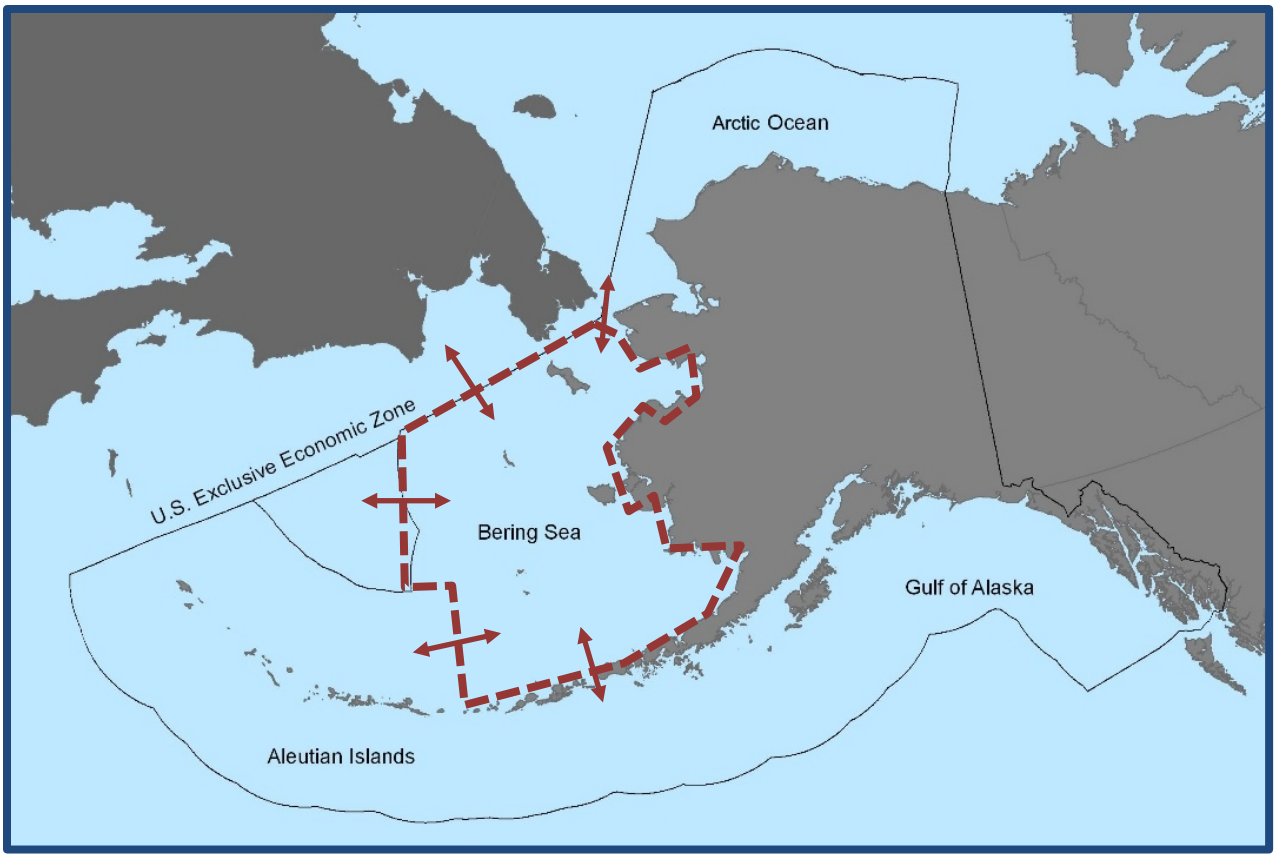

PRE-DRAFT FOR NPFMC ECOSYSTEM COMMITTEE

Bering Sea Fishery Ecosystem Plan

Prepared by the Bering Sea Fishery Ecosystem Plan Team
February 2, 2018

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Table of Contents

1 Introduction

Fisheries management in Alaska has long been recognized as being particularly responsive to ecosystem concerns. The Council has practiced an ecosystem approach for many years. The Alaska Fisheries Science Center (AFSC) has worked continually and closely with the management process (i.e., stock assessment authors, Plan Teams, SSC and Council members) since the early 1980s to incorporate ecosystem science into decision-making. The Council has adopted harvest conservation measures, protection measures for ecosystem resources, and has adopted ecosystem-based policy goals for its groundfish FMPs. Nonetheless, while there are strong relationships between management and ecosystem science in Alaska, which are recognized worldwide as exemplary, they often remain informal.

Accordingly, the Council is currently taking steps to formalize its ecosystem approach as ecosystem-based fisheries management (EBFM). The Council has acknowledged that moving toward EBFM is a process, and as new information or tools become available, the Council has responded by improving the fishery management program. One tool that may help to guide a shift towards EBFM is a Fishery Ecosystem Plan (FEP). FEPs are a tool that can serve as a framework for continued incorporation of ecosystem goals and actions in regional management. In December 2015, the Council initiated development of an FEP for the Bering Sea region. An FEP for the Bering Sea will be used to guide policy options and associated opportunities, risks, and tradeoffs affecting FMP species and the broader Bering Sea ecosystem in a systematic manner. The Bering Sea FEP will document current procedures and best practices for EBFM in the region, provide brief, targeted, and evolving descriptions of the interconnected physical, biological, and human/institutional Bering Sea ecosystem, and, through ecosystem thresholds and targets, direct how that information can be used to guide fishery management options. The Council underscored its commitment to EBFM with the adoption of an ecosystem approach policy statement in 2014 (Section 2.1). With the development of a Bering Sea FEP, the Council has another opportunity to progress on the continuum of EBFM, allowing Alaska to lead the world in fishery management, and provide a clear record of the Council's ecosystem-based policy decision making, while still applying policies that are suited to Alaskan circumstances.

The Council's intent has been to develop an FEP that:

1. provides added value to existing Council documents, processes, and decision-making;
2. delivers targeted, evolving ecosystem evaluations but does not overwhelm the audience with a compilation of ecosystem information; and
3. results in measurable improvements to Bering Sea fishery management, but does not directly authorize management actions (action-informing rather than action-forcing).

1.1 Purpose of the FEP

The Council has identified the following potential benefits from developing an FEP for the Bering Sea, in the short term and long term:

- Create a transparent public process for the Council to identify ecosystem goals and management responses.
- Serve as a communication tool for ecosystem science and Council policy.
- Provide a framework for strategic planning that would guide and prioritize fishery, habitat, and ecosystem research, modeling, and survey needs.
- Identify connected Bering Sea ecosystem components, and their importance for specific management questions.
- Assess Council management with respect to ecosystem-based fishery management best practices, and identify areas of success and gaps indicating areas for improvement on a regular basis.

- Provide a framework for considering policy options and associated opportunities, risks, and tradeoffs affecting FMP species and the broader Bering Sea ecosystem (e.g., evaluation of management tradeoffs among FMPs, fisheries, or with other activities).
- Build resiliency of Council management strategies, and options for responding to changing circumstances (e.g., climate change-driven changes to fish distribution and abundance, changes in shipping patterns, etc.).

The FEP provides value by facilitating dialogue and information exchange among stakeholders, scientists, and fishery managers. In the 2014 ecosystem approach statement (Section 2.1), the Council set out a commitment to managing fisheries through a precautionary, transparent, and inclusive process. Public outreach and stakeholder involvement throughout the process helps develop a common understanding of the Bering Sea ecosystem by managers, scientists, and user groups. As such, the Bering Sea FEP includes methods for the Council to bring information into management from those people closest to the resource, for example through local and traditional knowledge (LTK).[1] Expanded understandings of existing best available science and best available social science are outlined as well, including best practices for continuing to build strong understandings and incorporation of LTK in the Council process. Although all of this might also be achieved outside of an FEP, a formal FEP will coordinate and direct research and outreach resulting in a transparent and efficient mechanism to integrate best available science and best available social science into management decisions, while maintaining strong communication with stakeholders that are affected by management policies.

While the intention of the FEP is to focus on actions within the Council's authority, the Council will also use the FEP to promote dialogue with non-fishery authorities about activities affecting fishery resources. The FEP framework can also be used to inform new lines of research relevant to management. The value of including individuals who cannot attend Council meetings for various reasons is significant, and by increasing transparency, the FEP process will make the decision-making process more accessible.

The FEP presents a step in the process of EBFM, by allowing the Council to define its information needs with respect to ecosystem considerations in stock assessments and management. The NOAA Integrated Ecosystem Assessment (IEA) program emphasizes that best practices for EBFM include developing a shared vision for ecosystem-based management between stakeholders and scientists. Researchers need to develop science that is timely and actionable for managers, while managers need to be prepared and expect to receive and (as relevant) act on results. The proposed structure of this FEP ensures that this "handshake" takes place early in the process, thus setting clear expectations on both sides for any given analysis or piece of research. Currently, there is a strong atmosphere of collaboration at the AFSC between ecosystem scientists and the management process. A visible product of that collaboration is the Ecosystem Considerations report of the groundfish SAFE, presented annually to the SSC and the Council as an immediate prelude to setting quotas on groundfish. Similarly, some stock assessments also directly incorporate ecosystem and climate variables. While this collaboration would continue regardless, the Bering Sea FEP provides the Council with greater control over the ongoing transition to EBFM, and helps to formalize current ad hoc practices.

The FEP provides specific advantages for both the Council and the AFSC by improving communication about management needs and the relationship to research. The FEP process coincides well with the process of Activity Planning that is currently used to prioritize research in the AFSC. While multiple methods of prioritization exist (e.g., the Council's annual Research Priorities), the combination of the

[1] Traditional knowledge is defined as traditional indigenous knowledge that is acquired through long-term resource use and environmental observation, and is transmitted intergenerationally, while LTK more broadly includes the observation and experience of local participants that may be, but are not necessarily, indigenous. A detailed definition of TK can be found in Raymond-Yakoubian and Raymond-Yakoubian 2015, p.8.

FEP planning and activity plans will aid in prioritizing (and allocating) current funds and when seeking future growth.

The Council also believes it is valuable to synthesize our scientific understanding of the Bering Sea ecosystem specifically from a fishery management perspective. The Bering Sea is well-studied, and the Council is not interested in creating a redundant compilation of information that is available elsewhere. Rather, it is useful to develop our understanding of ecosystem connectivity as it may relate to specific fishery management concerns (e.g., the halibut stock, Norton Sound communities, or red king crab spawning habitat in Bristol Bay). The FEP builds off the existing Eastern Bering Sea Ecosystem Assessment, which is produced in conjunction with the annual groundfish Stock Assessment and Fishery Evaluation (SAFE) report, and which already synthesizes ecosystem information on an annual basis. FEP-relevant findings will be readily incorporated into the existing process.

Another purpose of the FEP is to document our current procedures and best practices for EBFM. While the Council believes that our current approach is precautionary and effective, documentation is helpful to demonstrate this to the broader public. The FEP describes methods for the Council to utilize and adapt existing scientific tools and policy instruments for achieving EBFM. Additionally, this documentation will allow the Council to conduct a gap analysis in order to have a more informed understanding of the strengths and areas of improvement of its EBFM approach. This gap analysis is currently envisioned as an action module under the FEP framework (Section 7.1).

Finally, the FEP provides a framework to address tradeoff issues that arise, and supplement existing decision-making processes to respond to a range of issues, such as changing environmental conditions, or potential conflicts with other sectors (e.g., shipping or oil extraction). In working with other agencies or stakeholders in other industries, it is extremely valuable to have a clear statement of the ecosystem goals and concerns of the fishing sector. Under the FEP framework, decision tools are developed that allow the Council to evaluate tradeoffs and alternative management policies and tools (e.g., harvest limits, time/area closures) for their performance and effectiveness (especially stationary and static management tools). Thus, the FEP helps ensure that management is flexible, responsive, and resilient to ecosystem shifts and changing pressures, and able to continue to support long-term sustainable fisheries harvest in the Bering Sea.

1.2 Background / EBFM theory

NMFS recognizes the importance of considering ecological and human components of any ecosystem during the management process. NMFS defines EBFM as:

> *a systematic approach to fisheries management in a geographically specified area that contributes to the resilience and sustainability of the ecosystem; recognizes the physical, biological, economic, and social interactions among the affected fishery-related components of the ecosystem, including humans; and seeks to optimize benefits among a diverse set of societal goals."* (NMFSPD 01-120, 23 May 2016)[2]

In their paper, Link and Brownman (2014) describe EBFM on the spectrum of management philosophies between EBM and single species management (Figure 4). EBM, which may be considered place-based management, necessarily considers and tries to balance trade-offs in multisectoral (sometimes conflicting) mandates that may be acting on system of interest (e.g., between tourism, extraction, shipping, fisheries, land use, and conservation). In contrast, single species management (SSM) is focused on a species of

[2] It is noted that 'Societal goals' should "consider and include any relevant economic, social, and ecological factors in the context of relating to fisheries and fishery resources."

interest but does not specifically consider the species in the context of the broader ecosystem or food-web, or effects of the species-specific managed activities on non-target species per se (usually due to a lack of sufficient data). An Ecosystem Approach to Fisheries management (EAFM), is on the EBM – SSM spectrum, where fisheries management considers the ecological and ecosystem context of the focal species in that habitat, environmental, and trophic considerations are included in the management process. EBFM builds upon EAM while still primarily focused on the fisheries sector. In EBFM, trophic and environmental interactions and cumulative impacts are specifically accounted for in the management process (e.g., using multi-species or environmentally enhanced singles species models, food web-models, coupled physical-fishery-socioeconomic models).

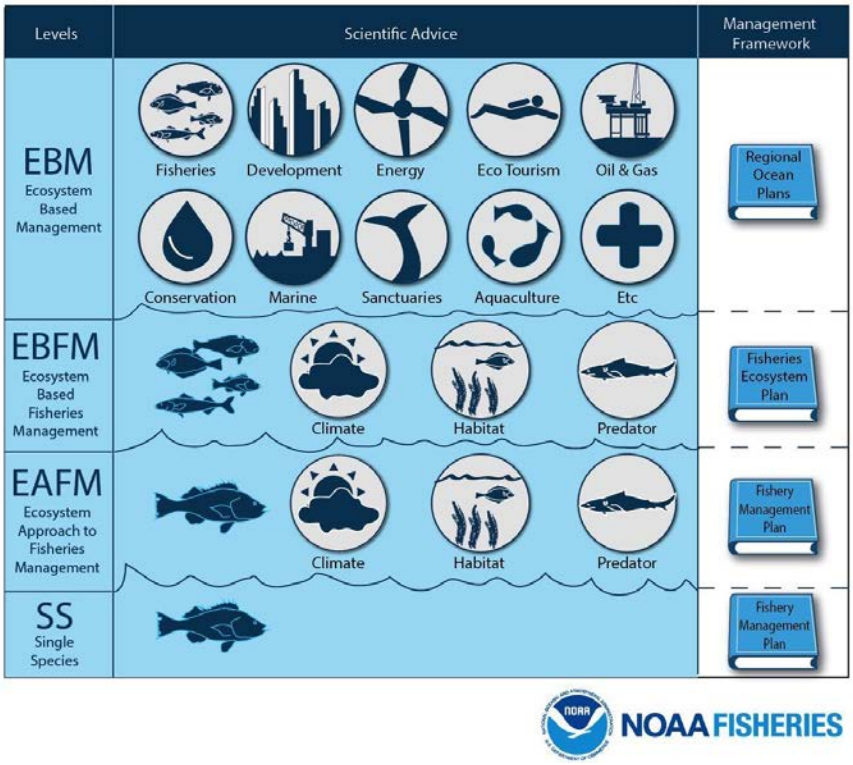
Both EBFM and EBM are expected to result in more holistic management recommendations that are robust to the nonstationarity characteristic of ecosystem dynamics, which can confound single species management. EBFM has the particular advantage of quantifying the value of marine resources beyond fisheries extraction and provides the management framework for optimizing fisheries productivity and meeting ecosystem-level goals (Fogarty, 2014; Large et al., 2013; Link, 2010; Samhouri et al., 2010). Specifically in the context of fisheries management, implementing ecosystem-based fisheries management requires: recognition that no fish population is independent of other species in the ecosystem; acknowledgement of interdependent biological and human systems; and, use of the best available models of interactions among interdependent ecosystem components to sustain fisheries and conserve all valued components of marine ecosystems. EBFM does not require the development of new methods or even necessitate the collection of new data. Instead, it is centered around considering the most comprehensive range of factors possible, to capture the tradeoffs involved in management decisions (Patrick and Link, 2015).

"Implementation of EBFM is not a single large action but rather a series of ongoing and cumulative actions leading to comprehensive management..." (NMFSPD 01-120).

Globally, EBFM of living resources of the oceans has made substantial progress over the past decade in balancing tradeoffs and meeting multiple, sometimes conflicting management objectives for a region (Link 2010; Belgrano and Fowler 2011). Examples include establishing and showing the effectiveness of marine protected areas (e.g., Halpern 2003), building ecosystem resilience and resource sustainability (e.g., Levin and Lubchenco 2008, Link 2010) though anticipating and avoiding tipping points and ecosystem state changes (e.g., Scheffer et al. 2009, Travis et al. 2014), and adapting management to test and monitor impacts of management actions (e.g., Pauly et al. 2000).

Figure 4 The spectrum of ecosystem based fisheries management

The FEP operates at this level



Source: http://www.st.nmfs.noaa.gov/ecosystems/ebfm/ebfm-myths#

Regionally, significant progress has been made at the Regional Fishery Management Council-level toward implementing EBFM and EAFM. The North Pacific Fishery Management Council (NPFMC) has been a leader in implementing these approaches including developing a fishery ecosystem plan, protecting forage species, basing management choices on reliable science and modeling, and implementing precautionary protection measures. These steps and others are of great benefit to the conservation and management of fishery resources. Particularly in light of changing conditions in the ocean, continuing the momentum and progress toward ecosystem-based management approaches is a key to ensuring the long-term sustainability of the nation's fisheries.

FEPs are a tool to assist in the process of operationalizing EBFM approaches (Lenfest 2016). FEPs can outline a process to consolidate information in order to better understand linkages and tradeoffs between environmental, economic, and social aspects of fisheries ecosystems in the long term (Marshall et al. 2017). This FEP is part of an ongoing process to manage the Bering Sea ecosystem using a comprehensive EBFM framework.

Operationalizing EBFM for the Bering Sea FEP includes (but is not limited to):

- Regular incorporation of emergent science and tools to address novel challenges and changing conditions.
- Models that are maintained with current and up-to-date information and are set up to deliver results in a timely manner so that outputs can feed directly into the management cycle.
- Regular evaluation of management tools, in particular stationary and static management limits, in order to ensure that they are effective under changing environmental conditions.
- Regular collaboration between stock assessment, physical, ecosystem, and socio-economic research scientists through action modules, and periodic ecosystem workshops reviewing new and existing science (assessment).

- Regular review and evaluation of ecosystem-level science as part of the ongoing stock assessment (in order to evaluate the integration of new science into management).
- Regular (e.g., annual) quantification of the effects of harvest on both target and non-target marine species and habitats (and interactions) as well as the effects of trophic and environmental processes on target fisheries.
- Consideration/evaluation of the aforementioned direct and indirect effects on management limits and recommendations (e.g., recommended harvest rates, fishing season, lower and upper harvested biomass limits, and/or exclusion zones of fisheries in the EBS).
- Expanding understandings of existing best available science and best available social science, including continuing to build strong understandings and incorporation of LTK in the Council process.

2 Goals and objectives

2.1 Council's ecosystem vision statement

In February 2014, the Council adopted an ecosystem policy that expressed the Council's intent to continue moving towards EBFM:

> **Ecosystem Approach for the North Pacific Fishery Management Council**
>
> ***Value Statement***
>
> The Gulf of Alaska, Bering Sea, and Aleutian Islands are some of the most biologically productive and unique marine ecosystems in the world, supporting globally significant populations of marine mammals, seabirds, fish, and shellfish. This region produces over half the nation's seafood and supports robust fishing communities, recreational fisheries, and a subsistence way of life. The Arctic ecosystem is a dynamic environment that is experiencing an unprecedented rate of loss of sea ice and other effects of climate change, resulting in elevated levels of risk and uncertainty. The North Pacific Fishery Management Council has an important stewardship responsibility for these resources, their productivity, and their sustainability for future generations.
>
> ***Vision Statement***
>
> The Council envisions sustainable fisheries that provide benefits for harvesters, processors, recreational and subsistence users, and fishing communities, which (1) are maintained by healthy, productive, biodiverse, resilient marine ecosystems that support a range of services; (2) support robust populations of marine species at all trophic levels, including marine mammals and seabirds; and (3) are managed using a precautionary, transparent, and inclusive process that allows for analyses of tradeoffs, accounts for changing conditions, and mitigates threats.
>
> ***Implementation Strategy***
>
> The Council intends that fishery management explicitly take into account environmental variability and uncertainty, changes and trends in climate and oceanographic conditions, fluctuations in productivity for managed species and associated ecosystem components, such as habitats and non-managed species, and relationships between marine species. Implementation will be responsive to changes in the ecosystem and our understanding of those dynamics, incorporate the best available science (including local and traditional knowledge), and engage scientists, managers, and the public.
>
> The vision statement shall be given effect through all of the Council's work, including long-term planning initiatives, fishery management actions, and science planning to support ecosystem-based fishery management.

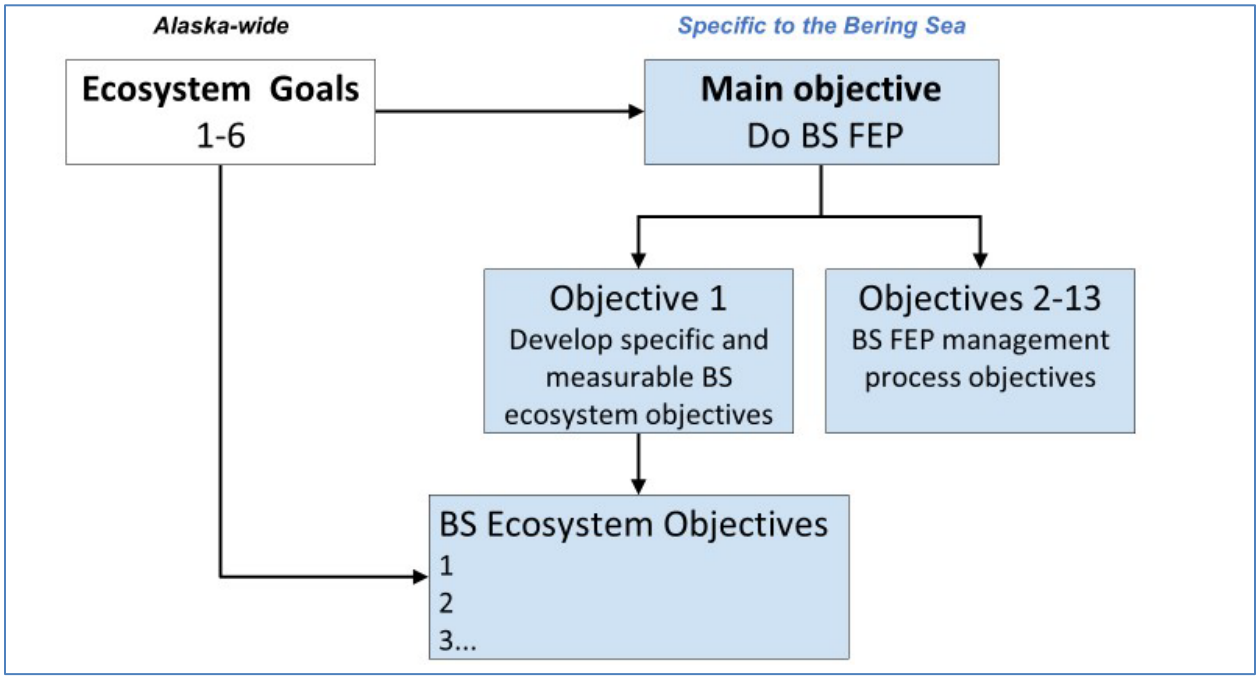
2.2 Ecosystem Goals

The FEP, though not legally binding, incorporates explicit principles, policies, and guidelines for ecosystem-based management to be implemented in Fishery Management Plans, including measures designed to meet the mandates of the Magnuson-Stevens Fishery Conservation and Management Act, other applicable law, and six established Ecosystem Goals (Figure 2-1):

1. Protect, restore, and maintain the ecological processes, trophic levels, diversity, and overall productive capacity of the system;

2. Rebuild, restore, and maintain fish stocks at levels sufficient to protect, maintain, and restore food web structure and function;
3. Conserve habitats for fish and other wildlife;
4. Provide for subsistence, commercial, recreational, and non-consumptive uses of the marine environment;
5. Avoid irreversible or long-term adverse effects on fishery resources and the marine environment;
6. Provide a legacy of healthy ecosystems for future generations.

Figure 2-1 Schematic of the relationship between the Council's ecosystem goals and the Bering Sea FEP objectives.



2.3 Objectives

Main Objective: Put in place a Bering Sea FEP

The Council's main objective is to use the FEP to enable the Council to move toward achieving the six Alaska-wide overarching Ecosystem Goals within the Bering Sea ecosystem area (Figure 2-1).

2.3.1 Process objectives

Once the FEP is in place, the Council has identified a series of management process objectives that can be accomplished through the FEP.

1. Translate the overarching ecosystem goals into achievable, measurable ecosystem objectives.
2. Create a transparent public process for the Council to identify ecosystem goals and management responses
    - Develop a public and open process, including a deliberate effort to document and publicize FEP-related activity that allows for public involvement.
3. Communicate ecosystem science and Council policy
    - Develop Core FEP document
    - Develop Outreach program
    - Develop schedule and process for presenting Action Module updates and results

4. Provide a framework for strategic planning that would guide and prioritize fishery, habitat, and ecosystem research, modeling, and survey needs
5. Identify connected Bering Sea ecosystem components, and their importance for specific management questions, to include:
    - Develop a conceptual model(s)
6. Assess Council management with respect to ecosystem-based fishery management best practices, and identify areas of success and gaps indicating areas for improvement on a regular basis. [Some of these benefits are likely to be realized through action modules under the FEP framework.]
    - Compile a review of existing Council EBFM practices against EBFM best practices
7. Provide a framework for considering policy options and associated opportunities, risks, and tradeoffs affecting FMP species and the broader Bering Sea ecosystem (e.g., evaluation of management tradeoffs among FMPs, fisheries, or with other activities), may include:
    - Develop analytical method to conduct consistent, explicit, systematic tradeoff analyses during public review of NEPA/RIR analyses
8. Build resiliency of Council management strategies, and options for responding to changing circumstances (e.g., climate change-driven changes to fish distribution and abundance, changes in shipping patterns, etc.)
    - Complete an action module to document best practices for proactive, adaptive fishery management under changing climate conditions and to determine next steps
9. Synthesize and update current scientific understanding and ongoing monitoring of Bering Sea ecosystem processes and status, including fisheries and subsistence use, to inform fishery management and identify areas that need further work for our understanding of ecosystem processes.
10. Incorporate/improve Alaska Native, local community, external stakeholder/agency involvement, Local and Traditional Knowledge, access in process
11. Create and implement a cohesive process for Bering Sea EBFM, including developing an operational definition of EBFM, providing a mechanism for incorporating new sources of ecosystem information into Council processes, and defining the Council's management process to improve understanding by the broader public.
12. Establish a process to use ecosystem information to inform decisions for adaptive management, to:
    - address change under novel or intensified stressors,
    - understand and consider tradeoffs among ecological, social, and economic factors of fishery harvest, and
    - to consider subsistence needs and traditional knowledge.
13. Review and evaluate the direct, indirect and cumulative effects of fishery management actions on the Bering Sea ecosystem to provide a baseline for evaluation of future council actions.

2.3.2 Bering Sea FEP Ecosystem Objectives

In addition, there are a number of ecosystem objectives for the FEP that relate to the overarching ecosystem goals of the Council. Developing these specific, measurable ecosystem objectives is itself the first process-related objective for the FEP (Figure 2-1). Every ecosystem objective should be related to at least one of the overarching ecosystem goals. The action modules are structured with ecosystem objectives that link to the overarching ecosystem goals.

Below are working examples of ecosystem objectives.

1. Develop indicators and monitor **subsistence activity** in the EBS. *Related to Goals 4, 5*
    - Ecosystem Status Report indicator. Subsistence annual trends for ~3 indicator species, across >=1 community: e.g., Pribilofs fur seals, halibut, salmon, other marine mammals. Status: new indicator developed in 2017 to be further developed in 2018.
2. Develop indicators and monitor **biomass abundance** in the EBS. *Related to Goals 1, 2*
    - Ecosystem Status Report indicators, including:
        i. Foraging guild biomass trends from annual bottom trawl surveys
        ii. Acoustically-determined abundance of euphausiids, updated biennially in even-numbered years.
        iii. ...
3. Conduct risk or trade-off analyses (link this to the climate action module?)
    - *to be determined*
4. Identify targets, reference points, and/or thresholds
    - *to be determined*
5. Identify appropriate response
    - *to be determined*

3 Assessment of EBFM in current Bering Sea fishery management

NMFS defines EBFM as "a systematic approach to fisheries management in a geographically specified area that contributes to the resilience and sustainability of the ecosystem, recognizes the physical, biological, economic and social interactions among the affected fishery-related components of the ecosystem, including humans; and seeks to optimize benefits among a diverse set of societal goals." This section documents how the Council's existing procedures and policies for managing fisheries in the Bering Sea EEZ account for interactions among Bering Sea fisheries, ecosystems, and human activities to optimize food production and protect the marine ecosystem.

3.1 Council process and public involvement

The North Pacific Fishery Management Council (the Council) is one of the eight regional councils established by the Magnuson-Stevens Fishery Conservation and Management Act in 1976 to manage fisheries in the U.S. 200-mile Exclusive Economic Zone. The Council's jurisdiction includes all of the federally managed fisheries off Alaska, with a focus on groundfish species (including cod, pollock, flatfish, mackerel sablefish, and rockfish), harvested by trawl, longline, jig, and pot gear. The primary purpose of the Council is to develop fishery management plans to provide sustainable fisheries, through a partnership of the Council and National Marine Fisheries Service, with input from the Alaska Department of Fish and Game, other state and federal agencies, and the affected public.

The guiding law for federal marine fisheries in the U.S. is the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act). Adopted in 1976, the Act established:

- federal jurisdiction in the form of the 3-200 nm exclusive economic zone (EEZ) [200-mile limit];
- national standards and other requirements for conservation and management of resources; and,
- a system of 8 regional councils (composed of fishermen and government agency representatives) to develop fishery management plans (FMPs) and other regulations for their specific area, subject to approval and implementation by the federal government (i.e., the National Marine Fisheries Service).

It is important to note that in Alaska:

- federal jurisdiction generally does not extend into State of Alaska waters (within 3 nm from shore) nor beyond the EEZ (200 nm from shore);
- federal requirements outside the EEZ can be extended to vessels operating with a federal fisheries permit (e.g., VMS and other monitoring requirements);
- federal management of the Pacific halibut fishery is extended throughout US waters; and,
- coordination between state, federal, and international[3] management organizations is critical.

The Magnuson-Stevens Act encourages integrated management of fish stocks via FMPs, and stipulates that FMPs must prevent overfishing; rebuild overfished stocks; and, protect, restore, and promote the sustainability of fish stocks. In addition to the Magnuson-Stevens Act, U.S. FMPs be consistent with the requirements of other regulations including the Marine Mammal Protection Act (MMPA), the Endangered Species Act (ESA), the Migratory Bird Treaty Act, the National Environmental Policy Act (NEPA), the Regulatory Flexibility Act, as well as other applicable law and executive orders.

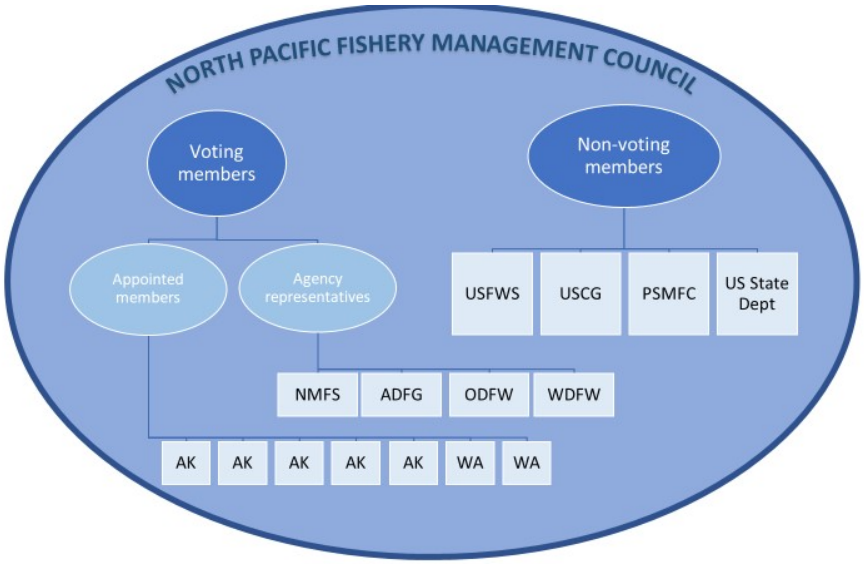
To maintain its commitment to responsible fisheries management, the Council adjusts harvest specifications, gear requirements, and closure areas as necessary. FMPs may also include limited access

[3] Especially for halibut (through the International Pacific Halibut Commission) and salmon (under the Pacific Salmon Treaty).

regimes, harvest incentives for reduced bycatch, requirements for fishery observers, and conservation of target and nontarget species and habitats (Lenfest 2016). The Council can also affect the policy process, by writing letters of support to representatives, providing guidance to NMFS, and hold consultations regarding important conservation topics such as essential fish habitat. The FMPs and fishery regulations are dynamic and continuously changing as new information or issues arise.

The Council is made up of 11 voting members—five appointees from Alaska, two appointees from Washington, and four agency representatives from: NMFS, Alaska, Oregon, and Washington (Figure 3-1). Additionally, there are four non-voting members representing the U.S. Fish and Wildlife Service, the U.S. Coast Guard, the Pacific States Marine Fisheries Commission (PSMFC), and the U.S. State Department.

Figure 3-1 Council membership



When reviewing potential rule changes, the Council draws upon the services and recommendations of knowledgeable people from State and Federal agencies, universities, and the public, who serve on advisory bodies. These experts provide written and oral comments on relevant issues being considered by the Council. Advisory bodies include the Advisory Panel (AP), the Scientific and Statistical Committee (SSC), Plan Teams, and Committees.

- **Advisory Panel** members represent experts from the fishing industry and several related fields, representing a variety of gear types, industry, and related interests as well as a spread of geographic regions of Alaska and the Pacific Northwest having major interest in the fisheries off Alaska. The Council relies on the AP for comprehensive advice on how various fishery management alternatives will affect the industry and local economies, on potential conflicts between user groups of a given fishery resource or area, and on the extent to which the United States will utilize resources management by the Council's FMPs.
- **SSC** members include Federal and State agency personnel, academics, and independent experts[4] that have strong scientific or technical credentials and experience relevant to Alaska fisheries. The SSC is composed of experts in biology, statistics, economics, sociology, and other relevant disciplines. The SSC provides ongoing scientific and technical advice for management decisions; assists in the identification, development, collection, and evaluation of scientific information

[4] Independent experts on the SSC cannot be employed by an interest group or advocacy group.

relevant to fishery management planning, particularly with regard to determining the best scientific data available; and serves as the Council's peer review body.

- **Plan Team** members are appointed by the Council from government agencies and academic institutions having expertise relating to the subject of the plan in question. The Council has Plan Teams for each of its FMPs with active fisheries (BSAI and GOA groundfish, BSAI crab, and Alaska scallop). The purpose of the Plan Teams is to provide the Council with advice in the areas of regulatory management, natural and social science, mathematics, and statistics as they relate to the Council's fisheries. In practice, the primary function of these teams is as a stock assessment review body for fishery species. The Council has also established Plan Teams for each of its Fishery Ecosystem Plans, including this Bering Sea FEP, although the Aleutian Islands FEP team is currently inactive. The FEP teams' purpose is develop the FEPs, and update and maintain information on ecosystem interactions as they relate to each ecosystem. The Council also established a Social Science Planning Team, whose advice is not focused on a plan per se, but rather was formed to facilitate and enhance the use of social science data in the management process.
- **Committees** are convened by the Council to address specific, timely topics and are appointed to advise the Council on a particular issue. The Council has standing committees that have been in existence for many years and meet periodicially, for topics such as enforcement, observer issues, of IFQ implementation. For example, the Ecosystem Committee has been active since 1996 and among other things, has played an integral role in the development and implementation of the Council's FEPs. There are also Committees that are formed to complete a specific task and then disbanded, such as to provide advice on contentious management measures such as a salmon bycatch amendment, the development of a binding arbitration clause, or the implementation of an electronic monitoring program.

The Council meets five times each year, with each meeting lasting about seven days. The SSC and AP usually meet around the same times as the Council, following the same agenda, but beginning their meetings two days earlier. As needed, Committee meetings are held either in conjunction with the Council meeting or preceding it. Three of the annual Council meetings are held in Anchorage, one (usually in June) is held in a fishing community in Alaska, and the other (usually in February) is held in either Seattle or Portland. The SSC and AP provide input to the Council at each meeting, and public testimony is taken on each agenda item.

All Council-related meetings are open to the public, except for an occasional executive session in which the Council deals with personnel, administrative, or litigation issues. Anyone may attend meetings of the SSC, AP, the Council, or other advisory bodies, and provide written and/or oral comments for the public record. Minutes are taken for each Council meeting and are available to the public. Additionally, the Council broadcasts meetings online, with links and details posted on the website. Archived digital audio files of the Council meetings are available on the internet.

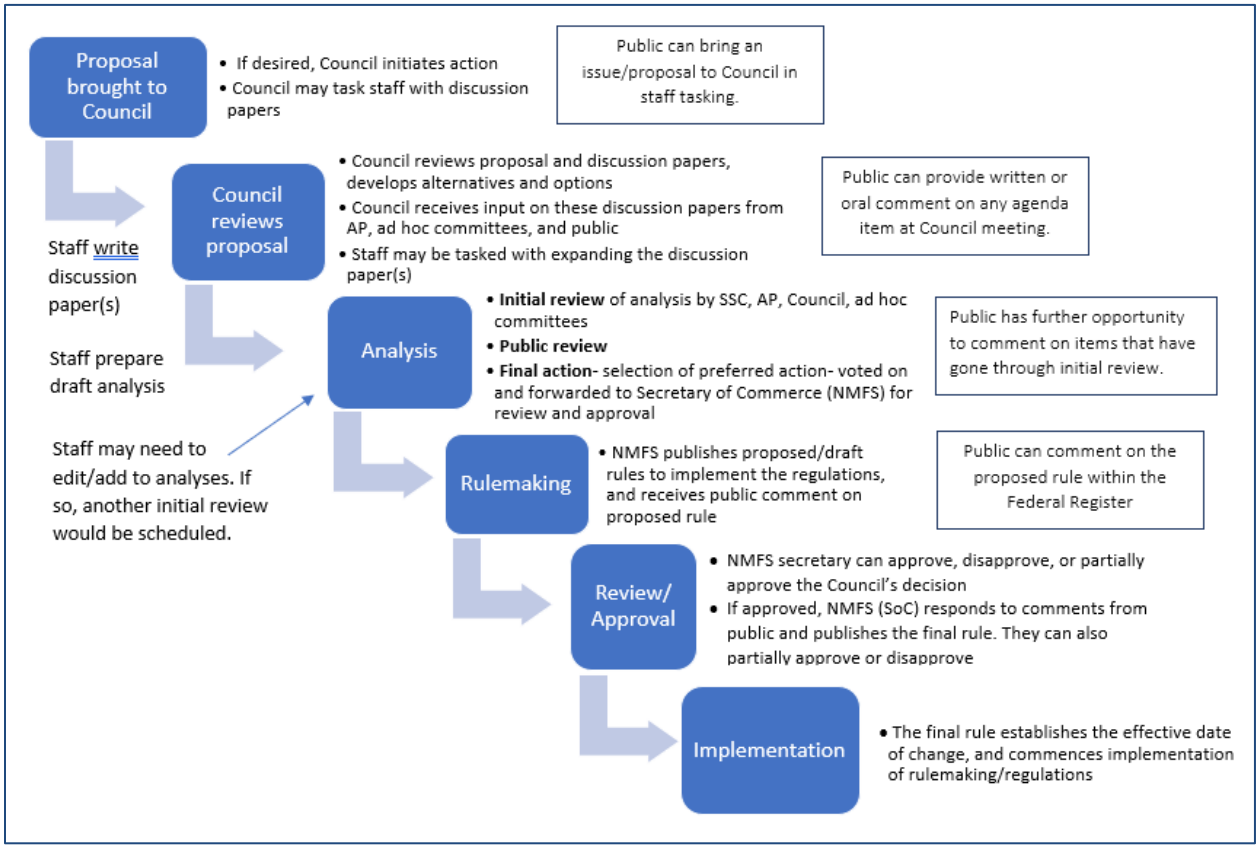
Concerns and proposals for change are brought to the Council's attention by the public through the AP or another advisory body, or directly to the Council via written or oral comment from the public or a stakeholder group during the 'Staff Tasking' agenda item at each Council meeting (Figure 3-2). The Council reviews each proposal and decides whether to initiate analysis of alternatives and options. Oftentimes, the Council directs staff to prepare a discussion paper to fully flesh out the scope of an issue that has been identified. For relatively simple changes to a FMP, a discussion paper may not be necessary. In contrast, very complex issues may require several discussion papers before reasonable alternatives can be developed.

When discussion papers are warranted, the Council reviews each proposal and completed discussion papers, provides recommendations, and identifies and develops options and alternatives. After discussion

papers are reviewed, the Council normally adopts a problem statement and tasks Council staff with draft analyses. These draft analyses are reviewed by the SSC and the AP during the initial review, and the action may either go through public review or be required to undergo further analysis and another initial review before going to final review. If the analysis is deemed ready, the Council votes on a preferred alternative which is then forwarded to the Secretary of Commerce for review and approval.

NMFS then prepares draft regulations, and once cleared by the OMB, the proposed rule is published in the Federal Register. The public is provided with time to comment on the proposed rule. NMFS region staff may adjust the rule based on these comments, and publish the final rule. They can also partially approve or disapprove the action. The final rule establishes the effective date of change, and commences implementation of rulemaking/regulations.

Figure 3-2 Council process and opportunities for public input



The Council's policy is to proactively apply judicious and responsible fisheries management practices, based on sound scientific research and analysis, to ensure the sustainability of fishery resources and associated ecosystems for the benefit of future, as well as current generations. The Council utilizes a precautionary approach to management that incorporates forward-looking conservation measures that address differing levels of uncertainty. Recognizing that potential changes in productivity may be caused by fluctuations in natural oceanographic conditions, fisheries, and other non-fishing activities, the Council intends to continue to take appropriate measures to insure the continued sustainability of managed species. This precautionary approach to management recognizes the need to balance many competing uses of marine resources and different social and economic goals for sustainable fishery management, including protection of the long-term health of the resource and the optimization of yield.

3.2 Other EBFM Measures Embedded in Magnuson-Stevens Act Legal Framework

In addition to establishing a regional public process for fishery management in the United States, the Magnuson-Stevens Act embodies other ecosystem-based principles. Specifically, the Magnuson-Stevens Act provides for the development of FMPs which achieve and maintain, the optimum yield from each fishery and promotes the protection of essential fish habitat (EFH) in the review of Federal permits, licenses, or projects of any nature. The Magnuson-Stevens Act requires that fishery conservation and management measures be designed to ensure that irreversible or long-term adverse effects on the fishery resources and environment are avoided and that there are a multiplicity of options available with respect to future uses of these resources.

The Magnuson-Stevens Act established 10 national standards for fishery conservation and management and requires that all FMPs and all regulations implementing the FMPs, be consistent with these standards. Several of these standards compel the Council to take non-fishery aspects of the ecosystem into account when making fishery policy and setting fishery total allowable catch. For example, National Standard 1 compels the Council to take the protection of marine ecosystems into account and to consider relevant social, economic and ecological factors when setting the fishery OY. National Standard 8 compels the Council to take the importance of fishery resources to fishing communities into account when establishing conservation and management measures and National Standard 9 requires management measures to minimize bycatch and bycatch mortality in the fisheries to the extent practicable[5].

By design of the Magnuson-Stevens Act, all FMPs center on preventing overfishing and protecting the long-term productivity of the fishery resource to allow for the achievement of OY on a continuing basis. Magnuson-Stevens Act section 3(33) further defines the term "optimum" with respect to the yield from a fishery to mean, “the amount of fish which -- (A) will provide the greatest overall benefit to the Nation, particularly with respect to food production and recreational opportunities, and taking into account the protection of marine ecosystems; (B) is prescribed on the basis of the maximum sustainable yield from the fishery, as reduced by any relevant social, economic, or ecological factor; and (C) in the case of an overfished fishery, provides for rebuilding to a level consistent with producing the maximum sustainable yield in such fishery.”

The Magnuson-Stevens Act requires each FMP to describe and identify EFH for the fishery, minimize to the extent practicable, the adverse effects of fishing on EFH, describe non-fishing effects on EFH and identify other actions to encourage the conservation and enhancement of EFH. All of the Council’s FMPs identify and describe EFH. To date, all fishery impacts on EFH have been found to be minimal in nature, however, the Council has adopted precautionary conservation and management measures to conserve EFH. Such measures adopted by the Council in the Bering Sea are described in Section 3.5.

EFH implementing regulations provide a means for the Council to identify HAPCs [50 CFR 600.815(a)(8)] within FMPs. Specific to fishery actions, HAPCs are areas within EFH that are ecologically important, sensitive to disturbance, or rare. In 2010, the Council revised the process by which it solicits nominations for HAPC designations to align the nomination process with the EFH 5-year review. During each EFH 5-year review, the Council decides whether to initiate a call for HAPC proposals focused on specific sites consistent with HAPC priorities identified by the Council.

The Council may designate HAPCs as habitat sites and consider management measures, if needed, to be applied to a habitat feature or features in a specific geographic location. The feature(s), as identified on a map or chart, must meet the considerations established in the Federal regulations, and address identified

[5] A complete explanation of the National Standards is provided online at: http://www.fisheries.noaa.gov/sfa/laws_policies/national_standards/

problems for an FMP species. Proposals must provide clear, specific, and adaptive management objectives. HAPC designations in the Bering Sea are described below.

3.3 EBFM requirements of applicable Federal Law

The Council must comply with all applicable Federal law when establishing fishery conservation and management measures. NMFS must comply with all applicable law when authorizing fisheries per the Council's FMPS in the Bering Sea. Many of these laws require consideration of, and in some cases, minimization of, effects of the fisheries on components of the ecosystem. Such applicable laws and policy related to EBFM include the National Environmental Policy Act (NEPA), the Regulatory Flexibility Act (RFA), the Endangered Species Act (ESA), the Marine Mammal Protection Act (MMPA), and Executive Order 12866 (EO 12866).

NEPA

The chief purpose of NEPA is to declare a national environmental policy, which directs Federal agencies to use all practicable means to maintain conditions in which man and nature can live in productive harmony (i.e., fulfilling the social, economic, and other requirements of present and future generations of Americans). NEPA includes requirements for Federal agencies to consider the effects of their actions on the environment, to consider alternatives during the decision-making process, and to provide opportunities for public involvement.

Environmental review under NEPA is required whenever the Council proposes to take an action. The environmental review under NEPA can involve three different levels of analysis: categorical exclusion determination (CATEX), environmental assessment/finding of no significant impact (EA/FONSI), and an environmental impact statement (EIS). An action may be categorically excluded from the requirement to prepare a detailed environmental analysis under NEPA if the action does not individually or cumulatively have a significant effect on the human environment. Each Federal agency has a set of procedures detailing the categories of actions eligible to be categorically excluded from environmental review under NEPA. If an action does not meet the CATEX criteria, then Council staff prepare an EA which determines whether or not the action has the potential to cause significant environmental effects.

In essence, the EA and EIS analytical documents compare and contrast the effects of the various alternatives on the affected environment so that decision-makers, and the public, are informed of the tradeoffs associated with the policy choices. For example, the NEPA analysis examines the effects of the fishery management alternatives on the target species, non-target species, marine mammals, seabirds, habitat, and the marine ecosystem.

RFA

The RFA (5 USC 601, et seq.) requires Federal agencies to assess the impacts of their proposed regulations on small entities and to seek ways to minimize economic effects on small entities that would be disproportionately or unnecessarily adverse. Under the RFA, a business primarily engaged in commercial fishing is classified as a small business if it is independently owned and operated, is not dominant in its field of operation (including its affiliates), and has combined annual receipts not in excess of $11 million for all its affiliated operations worldwide. For Alaska fisheries, these criteria include most fishing firms except for the large catcher processor vessels and most coastal communities except for Anchorage. Although the RFA allows agencies to certify that a proposed rule will not have significant impacts on a substantial number of small entities, an initial regulatory flexibility analysis (IRFA) is routinely prepared for most proposed Alaska fishery management measures. The IRFA is usually combined with the EA or EIS document required by NEPA. If, following public comments on the proposed rule, the action is still considered to meet the criteria for requiring RFA analysis, then a final regulatory flexibility analysis (FRFA) must be prepared. The FRFA contains most of the same

information presented in the IRFA, but also must include (1) a summary of significant issues raised in public comment on the IRFA and the agency's response to those comments, and (2) a description of the steps the agency has taken to minimize the significant economic impacts on small entities, including a statement of factual, policy, and legal reasons for selecting the alternative adopted in the final rule and why all other alternatives considered were rejected. Finally, the FRFA or a summary of it must be published in the Federal Register with the final rule.

EO 12866

Regulatory Planning and Review EO 12866 requires agencies to take a deliberative, analytical approach to rulemaking, including assessment of costs and benefits of the intended regulations. For fisheries management purposes, it requires NOAA Fisheries (1) to prepare a regulatory impact review (RIR) for all regulatory actions, (2) to prepare a unified regulatory agenda twice a year to inform the public of the agency's expected regulatory actions, and (3) to conduct a periodic review of existing regulations. The purpose of an RIR is to assess the potential economic impacts of a proposed regulatory action. As such, it can be used to satisfy NEPA requirements and to serve as a basis for determining whether a proposed rule will have a significant impact on a substantial number of small entities which would trigger the completion of an IRFA under the RFA. For this reason, the RIR is frequently combined with an EA and an IRFA in a single EA/RIR/IRFA document that satisfies the analytical requirements of NEPA, RFA, and EO 12866. Criteria for determining "significance" for EO 12866 purposes, however, are different than those for determining significance for RFA purposes. A significant rule under EO 12866 is one that is likely to (1) have an annual effect on the economy (of the nation) of $100 million or more; (2) create serious inconsistency or otherwise interfere with an action taken or planned by another agency; (3) materially alter the budgetary impact of entitlements, grants, user fees, or loan programs or the rights and obligations of recipients thereof; or (4) raise novel legal or policy issues.

Although fisheries management actions rarely have an annual effect on the national economy of $100 million or more or trigger any of the other criteria, OMB makes the ultimate determination of significance under this EO, based in large measure on the analysis in the RIR.

EA/RIR/IRFA

In sum, an EA/RIR/IRFA provides assessments of the environmental impacts of an action and its reasonable alternatives (the EA), the economic benefits and costs of the action alternatives, as well as their distribution (the RIR), and the impacts of the action on directly regulated small entities (the IRFA). An EA/RIR/IRFA is a standard document produced by the Council and NOAA Fisheries Alaska Region to provide the analytical background for decision-making.

ESA

The ESA (16 USC 1531 et seq.) provides a means for the conservation of threatened and endangered species and the ecosystems upon which they depend. Section 7 of the ESA requires Federal agencies to use their authorities to advance conservation for threatened and endangered species and to ensure that any action authorized, funded, or conducted by a Federal agency is not likely to jeopardize the continued existence of a listed species or destroy or adversely modify designated critical habitat.

NOAA Fisheries conducts consultations under the ESA on any proposed action that may affect a listed species or its designated critical habitat. If a proposed action has the potential to adversely affect a listed species or critical habitat, NOAA Fisheries or the USFWS (depending on the affected species) conducts an analysis of the expected effects to determine whether the effects of the action, when added to the baseline, would be expected to reduce a species survival or recovery. If the proposed action may reduce a species survival or recovery, or adversely modify critical habitat, the Federal agency must include reasonable and prudent alternatives with the implementation of the action, developed in consultation with

NOAA Fisheries or the USFWS, to ensure that the action is not likely to jeopardize the continued existence of the species or destroy or adversely modify critical habitat. As discussed below, many conservation and management measures have been implemented in the Bering Sea fisheries to conserve threatened and endangered species and their critical habitat.

MMPA

The MMPA (16 USC 1361, et seq.) establishes a Federal responsibility to conserve marine mammals. Congress declared that marine mammals are resources of great international significance and that they should be protected and their development promoted to the greatest extent feasible, commensurate with sound resource management policies. Finding that certain species and populations of marine mammals are or may be in danger of extinction or depletion due to human activities, Congress vested NOAA Fisheries with management responsibility for cetaceans (whales) and pinnipeds (seals and sea lions) other than walrus. All other marine mammals found in Alaska, such as the sea otter, walrus, and polar bear, fall under the auspices of the USFWS.

The MMPA's primary management objective is to maintain the health and stability of the marine ecosystem, with a goal of obtaining an optimum sustainable population of marine mammals within the carrying capacity of the habitat. The MMPA is intended to work in concert with the provisions of the ESA. The MMPA prohibits take of marine mammals where "take" is broadly defined to mean "to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal." If a fishery affects a marine mammal population, then the potential impacts of the fishery must be analyzed in the appropriate EA or EIS, and the Council may be requested by NOAA Fisheries or the USFWS to consider regulations to mitigate adverse impacts. As discussed below, conservation and management measures have been implemented in the Bering Sea fisheries to mitigate incidental take of marine mammals.

EO 13175: Consultation and Coordination with Indian Tribal Governments

EO 13175, signed by the President on November 6, 2000, and published November 9, 2000 (65 FR 67249), is intended to establish regular and meaningful consultation and collaboration between federal agencies and Native tribal governments in the development of federal regulatory practices that significantly or uniquely affect their communities. EO 13175 prohibits regulations that impose substantial direct compliance costs on Native tribal communities.

The Council's Rural Outreach Committee advises the Council on how to provide opportunities for better understanding of fishery management issues and participation from Alaska Native and rural communities; provides feedback on community impacts sections of specific analyses; and provides recommendations to the Council about which proposed actions need a specific outreach plan.

EO 13186

Signed by the President on January 10, 2001, this EO directs executive departments and agencies to take action to further implement the Migratory Bird Treaty Act (16 U.S.C. 703-711). EO 13186 directed each Federal agency taking actions that have, or are likely to have, a measurable negative effect on a migratory bird population to develop and implement a Memorandum of Understanding (MOU) with the USFWS to promote the conservation of migratory birds.

Summary

Many Federal laws and policies require the Council and NOAA Fisheries to consider effects of the fisheries on the ecosystem when choosing and implementing conservation and management measures. The Council considers tradeoffs among ecosystem components and cumulative impacts of fishery management decisions through analyses presented in the EA/RIR/IRFA (or EIS/RIR/IRFA) prepared for

each action it proposes. The Council adopts measures to ensure compliance with the ESA, MMPA and relevant EOs to minimize effects of the fisheries on other components of the ecosystem.

3.4 Ecosystem-considerations in Council management policies

3.4.1 Council's Overarching Ecosystem Approach to Management

In 2014, the Council underscored its commitment to EBFM by formally adopting an ecosystem approach for fisheries in the EEZ off Alaska. The Council's ecosystem approach includes a vision statement that applies to all of the Council's work, including long-term planning initiatives, fishery management actions, and science planning to support ecosystem-based fishery management, and is included in full in Section 2.12.1. The Council's 2014 overarching ecosystem approach statements and strategy extend the broad EBFM principles, similar to those in the groundfish FMP, to all fisheries in the Council's jurisdiction.

3.4.2 Council Management Plans in the Bering Sea

The Council's fishery management policy in the Bering Sea EEZ recognizes the dynamics of the Bering Sea ecosystem and the need for a flexible management regime to accommodate new information as more is learned about the ecosystem. This section describes the extent to which ecosystem considerations are incorporated into the overarching management approach in each Bering Sea FMP.

Groundfish FMP

The BSAI groundfish FMP, implemented in 1981, is based on ecosystem principles reflected in policy goals and objectives. These policy goals and objectives were unchanged from 1981 through 2004. In 2005, through the 2004 Alaska Groundfish PSEIS, the Council updated its management approach and objectives for BSAI groundfish fisheries and formalized its intention to consider and adopt measures that accelerate the Council's precautionary, adaptive management approach through community-based or rights-based management, ecosystem-based management principles that protect managed species from overfishing, and where appropriate and practicable, increase habitat protection and bycatch constraints. The Council uses the management objectives in the 2004 Alaska Groundfish PSEIS as guideposts when considering amendments to the BSAI groundfish FMP. Forty-five management objectives are organized into the following nine categories: prevent overfishing, promote sustainable fisheries and communities; preserve the 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; and improve data quality, monitoring and enforcement. The Council's BSAI groundfish policy goals and objectives include a broad ecosystem view of the fisheries.

The Council's stated management approach for Bering Sea[6] groundfish is multifaceted and in aggregate comprises a precautionary, ecosystem-based approach. The Council's groundfish management approach incorporates forward looking conservation measures that address differing levels of uncertainty. All management decisions are based on the best scientific information available to achieve the fishery management goal to provide sound conservation of the living marine resources; provide socially and economically viable fisheries for the wellbeing of fishing communities; minimize human-caused threats to protected species; maintain a healthy marine resource habitat; and incorporate ecosystem-based considerations into management decisions.

[6] Applies to Bering Sea/Aleutian Islands and Gulf of Alaska groundfish management

Crab FMP

The goals and objectives of the crab FMP have not been updated since the FMP was implemented in 1989. However, an ecosystem focus was added to the crab FMP through the requirement in the 1996 Magnuson-Stevens Act reauthorization to identify essential fish habitat (EFH) in every FMP. The policy objectives of the crab FMP are to: ensure the long term viability of king and Tanner crab populations; maximize the social and economic benefits to nation over time; and protect, conserve, and enhance adequate quantities of EFH to support king and Tanner crab populations and maintain a healthy ecosystem. The FMP also notes the importance of considering the potential impact of king and Tanner crab fisheries on other fish and shellfish populations.

Scallop FMP

The management goals and objectives of the scallop FMP were established in 1998 and centered on operational, biological, and socio-economic aspects of the scallop fishery. In 1999, the scallop FMP was amended to add a habitat objective: to protect, conserve, and enhance adequate quantities of EFH to support scallop populations and maintain a healthy ecosystem.

Salmon FMP

The Council's existing salmon management policy is the application of judicious and responsible fisheries management practices, based on sound scientific research and analysis, proactively rather than reactively, to ensure the sustainability of fishery resources and associated ecosystems for the benefit of future, as well as current generations. The management policy recognizes the need to balance many competing uses of marine resources and different social and economic objectives for sustainable fishery management, including protection of the long-term health of the resource and the optimization of yield. The management objectives of the FMP center on conserving the fishery resource, maximizing economic and social benefits of the fishery, and promoting crew safety at sea. As with all FMPs, the salmon FMP identifies EFH needed to support targeted populations and maintain a healthy ecosystem.[7]

Halibut Fisheries

Pacific halibut fisheries are governed under the authority of the Northern Pacific Halibut Act of 1982. For the United States, the Halibut Act gives effect to the Convention between the United States and Canada for the Preservation of the Halibut Fishery of the North Pacific Ocean and Bering Sea (Convention). The Convention requires that all fishing for Pacific halibut within Convention waters comply with the Convention and regulations of the International Pacific Halibut Commission (IPHC). The Convention gives the IPHC broad authority to adopt regulations to maintain halibut abundance.

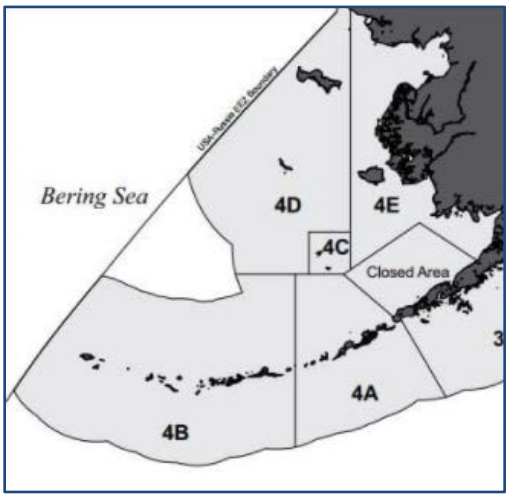
The Halibut Act provides the Secretary of Commerce with the authority and general responsibility to carry out the requirements of the Convention and the Halibut Act. The regional fishery management councils may develop, and the Secretary of Commerce may implement, regulations governing harvesting privileges among U.S. fishermen in U.S. waters that are in addition to, and not in conflict with, approved IPHC regulations. The Council has exercised this authority most notably in developing halibut management programs for three fisheries that harvest halibut in Alaska: the subsistence, sport, and commercial fisheries.

The subsistence, sport, and commercial fisheries are three separate fisheries for halibut that are governed by separate regulations. Subsistence and sport halibut fishery regulations for Alaska are codified at 50

[7] Ninth Circuit Court of Appeals (Court) remanded to NMFS, Amendment 12 to the salmon FMP on February 21, 2016. Amendment 12 removed the historic net-fishing area of Cook Inlet from the salmon FMP and delegated management authority to the State of Alaska. The Council is developing an analysis to amend the salmon FMP in response to the Court's remand. However, the overarching management objectives of the existing salmon FMP are not affected by the February, 2016 ruling.

CFR part 300. Commercial halibut fisheries in Alaska are subject to the Halibut and Sablefish Individual Fishing Quota (IFQ) Program and the Western Alaska Community Development Quota (CDQ) Program (50 CFR part 679) regulations, and the area-specific catch sharing plans. The IPHC apportions catch limits for the Pacific halibut fisheries among regulatory areas. The Bering Sea ecosystem area is included within the IPHC's Area 4, which is subdivided into 5 areas, 4A through 4E (Figure 3-3).

Figure 3-3 IPHC regulatory areas for Pacific halibut in the Bering Sea



In 1991, the Council recommended an IFQ program for the management of the commercial fixed gear (hook-and-line) halibut and sablefish fisheries off Alaska. In this same action, the Council recommended allocations of halibut and fixed gear sablefish to the CDQ Program. The IFQ and CDQ programs were designed to allocate specific commercial harvesting privileges among U.S. fishermen to resolve conservation and management problems that stem from ''open access'' management and to promote the development of the seafood industry in western Alaska. The Secretary of Commerce approved the Council's IFQ Program and CDQ allocations as a regulatory amendment on November 9, 1993 (58 FR 59375), and the program was implemented by NMFS for the 1995 fishing season. The IFQ Program was implemented in response to growing concerns about issues that had emerged from management of the fixed-gear halibut and sablefish fisheries under the open access regime. In both fisheries, growth in fishing capacity under open access had necessitated large reductions in length of the fishing seasons and caused a host of undesirable biological, economic, and social effects. The fixed gear halibut and sablefish IFQ program successfully reduced the previously overcapitalized fleet, extended the fishing season, reduced gear conflicts, reduced deadloss from lost gear, increased fisher safety, reduced bycatch and discard mortality and resulted in increased economic stability in the fisheries.

Summary

Through the requirements of the Magnuson-Stevens Act and the Council's stated ecosystem policy objectives, the Council approaches Bering Sea fishery management with EBFM principles. The Magnuson-Stevens Act requires the Council to take the protection of the marine environment and the social, economic, and ecological factors into account when setting the fishery OY; to take into account the effects of conservation and management measures on fishing communities; and to minimize any adverse effects of fisheries on EFH. Moreover, the Council has used an ecosystem approach to groundfish fishery management since 1981, to halibut fishery management since 1991, and has expanded those broad ecosystem principles to all FMPs through its 2014 ecosystem approach value statement, vision statement, and implementation strategy.

3.5 Existing Ecosystem-based Fishery Management in the Bering Sea

This section describes examples of existing processes employed by the Council to take ecosystem considerations into account during the annual TAC setting process and the existing ecosystem-based conservation and management measures that the Council has recommended (and NMFS has implemented) in the Bering Sea fisheries in accord with the overarching policies, objectives, and applicable law described above. The following sections address each of these topics:

- Protecting marine food webs
- Monitoring ecosystem health
- Evaluating ecological, social, and economic tradeoffs of different management actions
- Reducing bycatch
- Conserving important habitat
- Avoiding impacts to seabirds and marine mammals
- Adapting management to maintain resilient fisheries and ecosystems in a changing climate

3.5.1 Protecting Marine Food Webs

Optimum Yield

All OY amounts account for protection of marine ecosystems

- The OY of the BSAI groundfish complex is 85% of the historical estimate of MSY, or 1.4 to 2.0 million mt.
- Salmon OY specifications vary according to species and area and are based on the State of Alaska's MSY escapement goal policies.
- The weathervane scallop OY (BSAI and GOA combined) is 1.284 million lbs and is based on the average retained catch from 1990 through 1997 plus additional fishing mortality from discards mortalities in the directed scallop fishery, the groundfish fisheries, and agency surveys.
- The OY for king and Tanner crab is 0 to < OFL where OFL is the annualized MSY. The annualized MSY is derived through the annual stock assessment process using a five-tier system.

Ecosystem Considerations for Total Allowable Catch

The annual groundfish fishery TAC setting process considers the marine food web. Formally, stock assessments focus on biological limits and stock production variability; account for uncertainty at each step to manage in a precautionary manner; account for natural mortality, including predation mortality; and aim to continually reduce uncertainty through continually improved understanding of functional relationships. The status of ecosystem indicators in the Ecosystem Status Report (ESR, also referred to as the "Ecosystem Considerations Report") are considered through informal steps in the annual groundfish TAC setting process[8]. Interdisciplinary experts serve on the Council's FMP teams and on the Council's SSC and consider ecosystem factors in the recommendation of the annual ABCs. The Council considers socio-economic tradeoffs when it specifies the TAC for each groundfish fishery at an amount not to exceed ABC.

With reference to the groundfish management cycle, one current best practice is to present contextual ecosystem information from the ESRs immediately preceding the review of species-specific harvest recommendations. This allows for general discussion of ecosystem status and observations that are outside the scope of individual stock assessments yet may have impacts to the considerations of harvests. These may reflect new or very recent observations or an accumulation of observations across multiple

[8] Currently there is no stock assessment model for weathervane scallops. OTHERS

ecosystem indicators that suggest a widespread shift. This process allows for rapid incorporation of ecosystem information that may or may not be based on previously established causal relationships or mechanisms. Examples would be temperature patterns outside the range of that previously observed ("the Blob") and unusual die-offs of seabirds and marine mammals that may indicate that additional caution is warranted (or not) in the consideration of individual harvest recommendations. With this process, all single-species harvest recommendations are then evaluated in light of the overall ecosystem status. There are multiple documented occurrences of this process supporting adjustments or maintenance of max ABC.

A complementary effort still in development, currently identified as an Ecosystem Socio-Economic Profile or ESP, is the identification of ecosystem indicators with established mechanistic relationships mapped to the managed species life cycle conceptual model. These indicators can be presented alongside the stock assessment and can be evaluated in stoplight or scoring form with reference to the species. Additionally, ecosystem indicators with valuations or thresholds may eventually be directly incorporated into the stock assessment model. A best practice is for the ESP to be coordinated by the stock assessment author with an ecosystem scientist(s) and/or specialists in ecosystem factors influencing different life stages of the assessed species. The ESP enters the annual groundfish management cycle through the stock assessment, presented concurrent to the individual stock assessments.

IPHC Harvest Strategy for Halibut

The IPHC Harvest Strategy Policy is designed to manage the Pacific halibut resource for long-term ecological sustainability and economic viability and has been developed to be consistent with the Pacific halibut in the food web and marine environment during the establishment of annual harvest levels.[9]

Forage Fish Protections

Groundfish FMP Amendment 36 (1998) established a forage fish category as an FMP ecosystem component. Regulations to implement FMP Amendment 36 prohibited directed fishing on forage fish species to conserve prey for marine mammals, seabirds, and commercially important groundfish species. The forage fish category includes sand lance, herring, capelin, smelts, gunnels, sand fish, krill and species in the Stichaeidae and Gonostomatidae family.

In 2017, the Council recommended that squid species be reclassified from their current classification as target species to non-target ecosystem component species in the BSAI groundfish FMP. Squid are caught incidentally in other directed fisheries for groundfish. Squid are short-lived, highly productive, and there are currently no conservation concerns about incidental harvest of squid. However, given their ecological importance as prey, the Council recommended keeping squid species in the FMP and recommended that directed fishing for squid be prohibited, that a maximum retainable amount be established to discourage retention of squid in other fisheries, and that recordkeeping and reporting of squid catch be required to continue to monitor squid catch. This proposed amendment to the BSAI groundfish FMP is under review by the Secretary of Commerce.

Conserving Prey for Steller sea lions

Since the listing of Steller sea lions under the Endangered Species Act in 1990, the Council and NMFS have taken many actions to reduce the potential for the groundfish fisheries to compete for prey with Steller sea lions.

Beginning in 2001, NOAA Fisheries implemented a modified harvest control rule for three Steller sea lion prey species (Atka mackerel, pollock, and Pacific cod) targeted in the groundfish fisheries.[10] There

[9] Source: https://iphc.int/the-commission/harvest-strategy-policy, accessed January 9, 2018.
[10] 66 FR 7276, January 22, 2001 and 67 FR 956, January 8, 2002

are directed fisheries for pollock and Pacific cod in the Bering Sea. The 2001 emergency interim rule and 2002 final rule, modified the harvest control rule for these species to reduce the fishing mortality rate when the biomass of a pollock or Pacific cod stock is projected to be below a biomass necessary to achieve maximum sustainable yield; when the spawning biomass per recruit is estimated to be 20 percent of its unfished level (or lower), fishing for that species would be prohibited. For all other groundfish species, fishing for a target species would be prohibited when the spawning biomass per recruit of the target stock is reduced to 2 percent of its unfished level.[11] This modified harvest control rule is designed to ensure adequate levels of prey for Steller sea lions.

Beginning in 1999, NMFS closed important foraging areas around Steller sea lion rookeries to fishing with trawl gear to conserve prey for Steller sea lions. Additional areas around Steller sea lion rookeries and haulouts were closed to directed fishing for pollock and Pacific cod starting in 2002. The number of sea lion sites closed to each Bering Sea fishery within 10 and 20 nm of the site is shown in Table 3-1. Fishing for pollock and Pacific cod is prohibited within 20 nm of all five Steller sea lion rookeries in the Bering Sea.

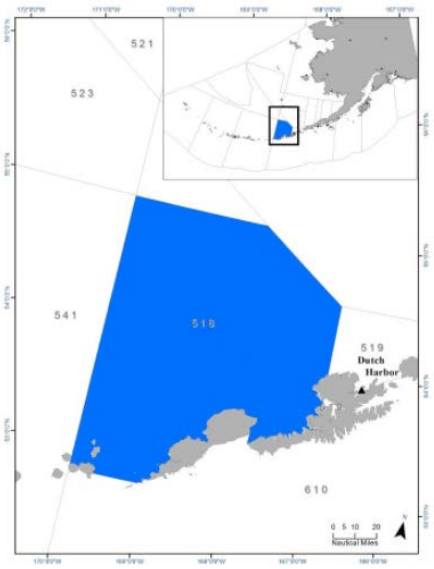
Annual Bering Sea pollock and Pacific cod TACs are apportioned among seasons to disperse harvest and reduce the potential that the fisheries deplete Steller sea lion prey on time scales relevant to foraging sea lions.

Table 3-1 Number of sites in the Bering Sea where directed fishing for pollock or Pacific cod is closed out to 10 or 20 nm to conserve prey for Steller sea lions.

Closure Area	Pollock Trawl [1]	Pacific Cod		
		Trawl [1]	Hook and Line [1, 2]	Pot [1, 2]
10 nm	8	10	2	0
20 nm	7	5	7	7

[1] The Bogoslof Area (Figure 3-4) is also closed to these
[2] One site, Sea Lion Rock, is closed out to 7 nm to hook-and-line and pot gear

Figure 3-4 The Bogoslof Area, closed to fishing for pollock and Pacific cod.



Source: Steve Lewis, AKR.

[11] Regulations at 50 CFR 679.20(d)(4)

3.5.2 Monitoring Ecosystem Health

Stock Assessments and Annual Catch Limits

Annual catch limits are based on the biological condition of the stock and socioeconomic considerations ~ based on annual stock assessments, annual stock assessments based on current survey and fishery dependent data. [Need to add expanded overview].

Bottom Trawl Surveys

The AFSC Groundfish Assessment Program (GAP), in cooperation with the AFSC Shellfish Assessment Program, conducts bottom trawl surveys to assess the condition of groundfish and and king and Tanner crab stocks in the Bering Sea shelf (annually since 1979) and Bering Sea slope (intermittently from 1979 to 1991 and biennially in even years since 2000). Biennial bottom trawl surveys in the Northern Bering Sea began in 2017. GAP also investigates biological processes and interactions with the environment to estimate growth, mortality, and recruitment to improve the precision and accuracy of forecasting stock dynamics. Impacts of bottom trawls on the seafloor and the description of bottom type are also being studied in the Bering Sea via data generated from these surveys. The ADFG conducts triennial stock assessment surveys for red king crab in Norton Sound.

Midwater/Acoustic Trawl Surveys

The AFSC Midwater Assessment and Conservation Engineering Program has assessed the status of Bering Sea pollock since 1977. Pollock assessment is conducted with midwater trawl surveys combined with acoustic (echo integration) technology to develop distribution and abundance time series. Winter surveys of spawning pollock abundance have been conducted annually in the Bogoslof Island area of the Bering Sea since 1988. Assessment of summer pollock abundance in the Bering Sea has occurred routinely since 1979. The acoustic/midwater trawl survey estimates of distribution and abundance are documented in various scientific reports and incorporated into stock assessment advice to the Council.

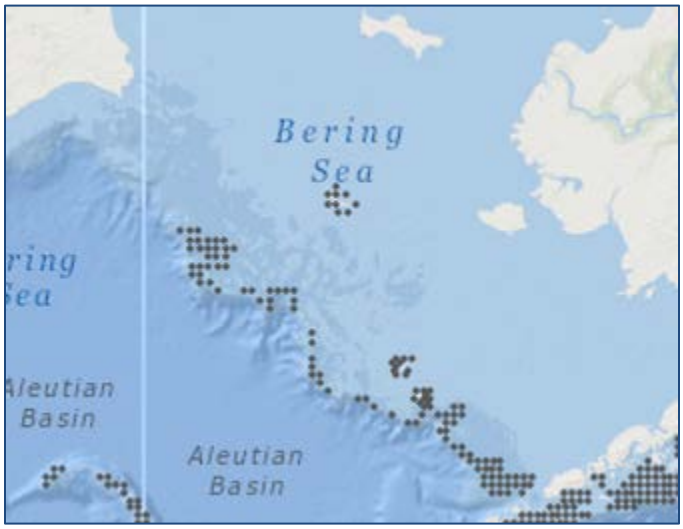
Longline Survey

The AFSC Marine Ecology and Stock Assessment Program conducts annual longline surveys to assess the sablefish stock in the Bering Sea. These data are combined with fishery-dependent data to estimate abundance and determine ABC for several groundfish species.

IPHC Fishery-Independent Setline Survey (FISS)

The IPHC FISS is conducted across Pacific halibut fishing grounds each summer. Biological data collected on the FISS are used to monitor changes in biomass, growth and mortality of the Pacific halibut population. These data are also valuable for other stock assessments (e.g., Pacific cod). IPHC's FISS is one of the most extensive fishery-independent surveys in the world.

Figure 3-5 IPHC FISS stations in the Bering Sea.



Source: https://iphc.int/data/fiss-data-query, assessed January 17, 2018.

Bering Sea Integrated Ecosystem Research Program

The Bering Sea Project, a partnership between the North Pacific Research Board (NPRB) and the National Science Foundation (NSF), sought to understand the impacts of climate change and dynamic sea ice cover on the eastern Bering Sea ecosystem. NOAA also committed major in-kind resources of personnel, equipment, and ship time as well program leadership.

More than one hundred scientists engaged in field research and ecosystem modeling to link climate, physical oceanography, plankton, fishes, seabirds, marine mammals, humans, traditional knowledge and economic outcomes to better understand the mechanisms that sustain this highly productive region.

Field research began in 2007 and concluded in 2010. Synthesis and reporting concluded in 2016. Major program results were reported at the 2014 Alaska Marine Science Symposium and to NPRB and NSF.[12]

Alaska Integrated Ecosystem Assessment

NOAA's Integrated Ecosystem Assessment Program (IEA) supports EBFM by providing a tool to help transfer scientific information to management. IEAs are intended to provide a structure to assess ecosystem status relative to objectives, account for the holistic impact of management decisions, and guide management evaluations. The Alaska IEA leverages substantial ongoing ecosystem assessment work conducted by the AFSC Resource Ecology and Ecosystems Modeling (REEM) group. This group works closely with the AFSC Status of Stocks and Multispecies Assessment group to address fisheries impacts on Alaska marine ecosystems including non-target and ESA listed species. Members from both groups have been appointed by the Council to participate on the assessment Plan Teams. In particular, the Council requires that FMPs in Alaska include annual updates of an Ecosystems Consideration chapter of the Groundfish Stock Assessment and Fishery Evaluation (SAFE) reports. The ecosystems considerations (EC) chapter is currently assembled in part with programmatic support from FATE (Fisheries And The Environment) and many scoping and indicator selection efforts have been completed to meet the needs of the EC chapter. The Alaska IEA will compliment this process, leverage current efforts, and provide an assessment tool that will be used to evaluate various concomitant ecosystem outcomes from climatic or

[12] A presentation of the major results is available online: https://www.afsc.noaa.gov/HEPR/docs/2014_04_30_AMSS_2014_revised_for_NPRB.pdf

fishery effects under different management and/or climate scenarios. In particular, the Alaska IEA will be used to further quantify and strengthen the Implications section of each ecosystem indicator of the EC chapter.

Marine Mammal Assessment

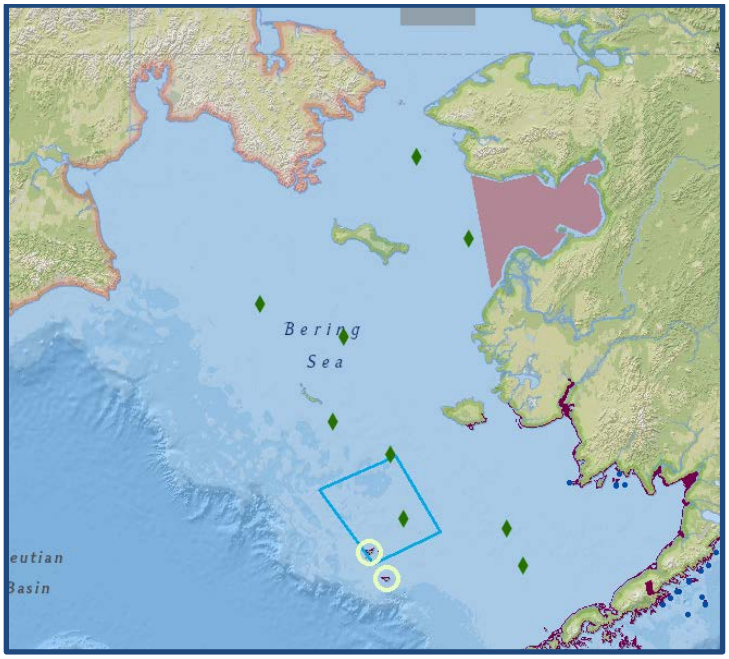
Marine mammal research in support of NOAA's mission in Alaska is conducted by the AFSC Marine Mammal Lab (MML). MML uses a variety of methods and tools to obtain needed marine mammal information. Determination of status and trends of marine mammal populations requires information on abundance, stock structure, mortality and net productivity. To obtain these data, censuses are carried out from ships, aircraft and on land. Radio and satellite-linked telemetry is used to determine movements and migrations, critical feeding areas and depths, and other behavioral data. Sophisticated analyses and modeling are carried out to determine necessary population parameters. Research programs are carried out cooperatively with many other federal, state and private sector collaborators.

Ecosystem Component Species

Ecosystem component species are stocks that a Council has determined do not require conservation and management but are listed in an FMP to achieve ecosystem management objectives. In addition to the forage species mentioned above, the Council has designated grenadier species as ecosystem component species in the BSAI groundfish FMP. The Council also designated all non-targeted scallop species, including pink or reddish scallops, spiny scallops, and rock scallops as ecosystem component species in the Scallop FMP. Directed fishing on these species is prohibited and they will continue to be monitored to ensure they are not targeted and that incidental catch does not reach a point where there are concerns for the sustainability of these stocks.

Figure 3-6 Location of National Marine Mammal Lab fieldwork in the Bering Sea in 2017.

Green diamonds are locations of marine mammal passive acoustic recorders, the blue box represents northern fur seal foraging and diet study locations, the shaded polygon in Norton Sound represents the location of EBS beluga aerial surveys, the maroon nearshore polygons represent the location of harbor seal aerial surveys, blue dots indicate Steller sea lion aerial survey locations, and yellow circles on the shelf represent the location of northern fur seal demographic studies.



Source: ??

3.5.3 Evaluating Ecological, Social and Economic Tradeoffs of Different Management Actions

Available information and processes allow for varying degrees of formal evaluations of ecological, social and economic tradeoffs of different management actions. Existing evaluations of tradeoffs are conducted through NEPA, RFA and E.O. 12866 analyses. Tradeoff analyses could be advanced to allow for more systematic, formal evaluations which explicitly consider tradeoffs among multiple, relevant ecosystem components. Continued development of the Alaska IEA is intended to support these types of analyses going forward.

The AFSC Economic and Social Science research program collects economic and sociocultural data for the conservation and management of living marine resources off Alaska and provides information in support of analyses conducted under NEPA, the RFA and E.O. 12866 to evaluate ecological, social and economic impacts of fishery management actions. The AFSC Economic and Social Science Research Program prepares an annual Economic Status Report for the BSAI groundfish fisheries and for the King and Tanner Crab Fisheries of the BSAI. The Groundfish Economic Status Report presents summary statistics on catch, discards, prohibited species catch, ex-vessel and first-wholesale production and value, participation by small entities, and effort in these fisheries. The BSAI Crab Economic Status Report includes information on: production, sales, revenue, and price indices in the harvesting and processing sectors; income, employment, and demographics of labor in both sectors; capital and operating expenditures in the fishery; quota share lease and sale market activity; changes in distribution of quota holdings; productivity in the harvesting sector; U.S. imports and exports of king and Tanner crab; price forecasts; performance metrics for catch share programs and other information regarding data collection and ongoing economic and social science research related to the BSAI crab fisheries and related communities.

In addition, the Council's Ecosystem Committee reviews pending Council actions with ecological implications and provides input to the Council on potential impacts of fishery management decisions on ecological and social tradeoffs of various fishery management decisions.

3.5.4 Reducing Bycatch

The Council has adopted measures to limit the catch of species taken incidentally in directed fisheries. Certain species are designated as prohibited species in the FMPs because they are the target of other, fully utilized domestic fisheries. For example, halibut, herring, salmon, steelhead trout, king crab and Tanner crab are prohibited species in the groundfish fisheries. The Council has managed salmon prohibited species catch (PSC) in the Bering Sea since 1981 (beginning with Amendment 1a to the BSAI groundfish FMP). With limited exceptions (e.g., for food donation, for a full salmon census, and some exceptions for operators with halibut IFQ), PSC may not be retained and must be returned to sea immediately, with a minimum of injury, regardless of its condition. [Need to add explanation of PSC caps and fishery closures, development of abundance-based management approaches.]

The Council has taken numerous actions to control and reduce PSC in the BSAI groundfish fisheries (Table 3-2).

Table 3-2 Amendments to the BSAI Groundfish FMP that addressed prohibited species catch

Amendment number	Year	Action
1a	1981	Foreign Fleet Salmon PSC Caps
3	1980	Halibut, Crab, and Salmon PSC Caps for Foreign Fleet
8	1983	1984 and 1985 Salmon PSC Caps for Foreign Trawl Vessels
10	1986	Crab and Halibut PSC Caps
12	1988	PSC Framework
12a	1988	Revised Crab and Halibut PSC Caps
16	1990	Revised Crab and Halibut PSC Caps
16a	1990	Herring PSC
19	1991	Establish PSC Caps for Non-Trawl Fisheries
21	1992	Halibut PSC Framework
21b	1995	Chinook Salmon Savings Area
25	1992	Adjust Trawl Halibut PSC Caps
29	1993	Salmon Bycatch Accounting
35	1995	Chum Salmon Savings Areas
37	1996	Red King Crab PSC Caps
40	1996	Establish Opilio PSC Caps
41	1996	Reduce Bairdi PSC Caps
50	1997	Halibut Donation Program
57	1998	Reduce Crab and Halibut PSC Caps
58	1999	Reduce Chinook Salmon PSC Caps
84	2005	Salmon Bycatch—Exemption for rolling hotspot closures
91	2009	Salmon Bycatch
110	2014	Salmon Bycatch Measures
111	2014	Reduce Halibut PSC Caps

Seabird Bycatch Mitigation Measures

In 1996 the Council adopted seabird bycatch avoidance measures for all hook-and-line vessels fishing for groundfish in the BSAI (and GOA) and expanded similar measures for the Pacific halibut fisheries using hook-and-line gear in 1997. These measures were designed to reduce interactions between the hook-and-line fisheries and seabirds, including the rare, but occasional interactions with short-tailed albatross. From 1999 through 2005, several research projects were conducted to test the efficacy of various seabird avoidance tactics on hook-and-line vessels. As a result of this research, the seabird avoidance requirements for hook-and-line vessels were revised in 2007 (72 FR 71601) and again in 2009 (74 FR 13355).

Each year, NMFS provides a report to the USFWS on the amount of seabird bycatch in the fishery in the prior year. The USFWS issued a biological opinion under section 7 of the ESA on the effects of the groundfish hook-and-line fisheries on endangered short-tailed albatross in December, 2015 and concluded that the fisheries were not likely to jeopardize the continued existence of the short-tailed albatross. NMFS reinitiated ESA section 7 consultation on the effects of the hook-and-line halibut fisheries with the USFWS on September 1, 2017.

Annual crab Bycatch Limits

Annual crab bycatch limits in the Bering Sea scallop fishery are specified red king crab and Tanner crab by the State of Alaska Board of Fisheries.

3.5.5 Conserving Important Habitat

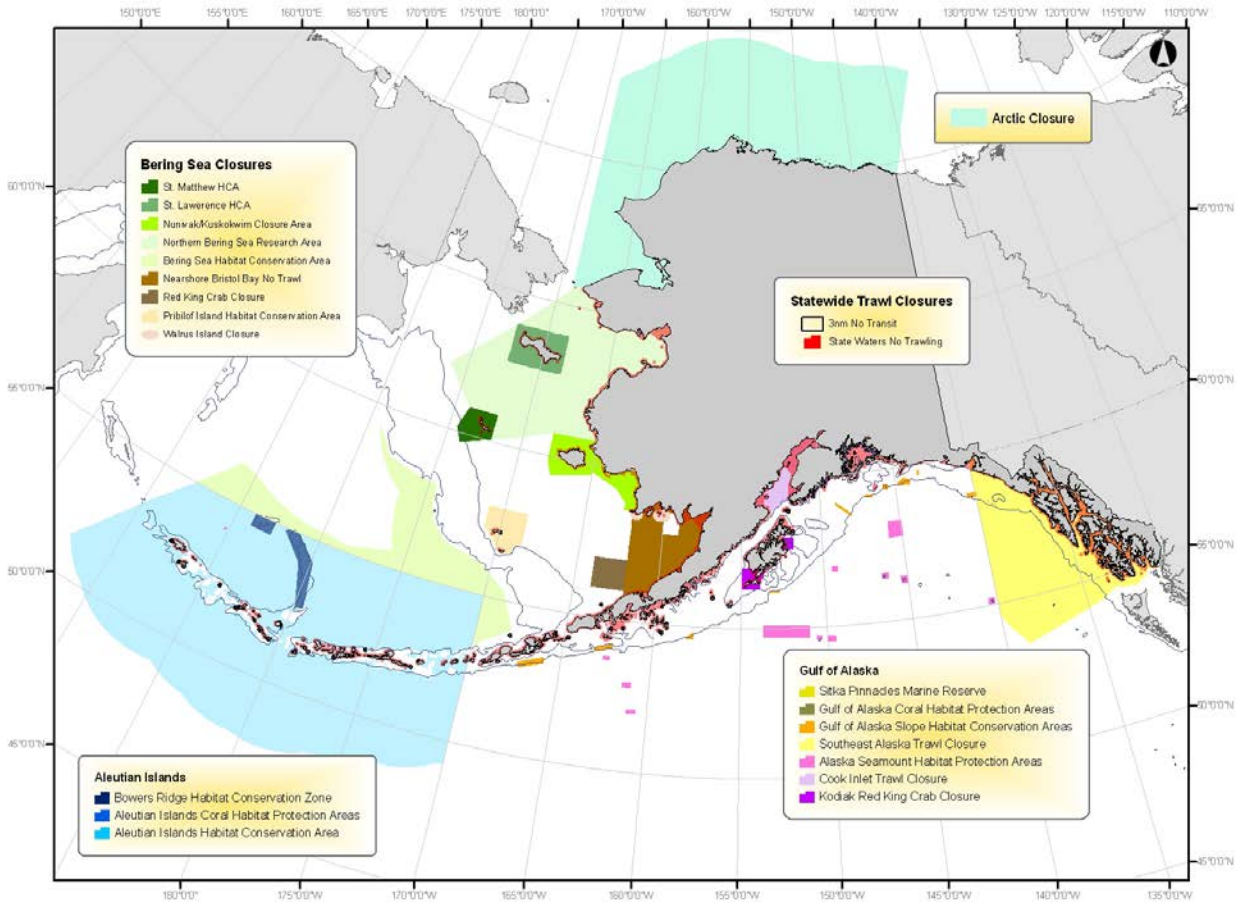
The Council has taken numerous actions to conserve essential Bering Sea habitats (Table 3-3, Figure 3-7).

Table 3-3 Amendments to the BSAI Groundfish FMP that addressed habitat protection

Amendment number	Year	Action
9	1985	Incorporate Habitat Protection Policy
21a	1992	Establish the Pribilof Island Habitat Conservation Area (HCA)
37	1996	Establish Bristol Bay Red King Crab Savings Area
55	1998	Define EFH
57	1998	Pollock Bottom Trawl Prohibition
78	2005	EFH EIS
89	2007	Bering Sea Habitat Conservation Area
94	2009	Required bottom trawl sweep modification to revise boundaries of the Northern Bering Sea Research Area and the Saint Matthew Island HCA
98	2011	Essential Fish Habitat Omnibus Amendments
104	2013	Develop Skate HAPCs
115*	2017	Essential Fish Habitat Omnibus Amendments

***** Pending public notice and Secretarial approval as of January 18, 2018.

Figure 3-7 North Pacific habitat conservation areas, including areas closed to fishing in the Bering Sea.



Bering Sea Habitat Conservation Area

In June 2007, the Council adopted precautionary measures to conserve benthic fish habitat in the Bering Sea by "freezing the footprint" of bottom trawling by limiting trawl effort only to those areas more recently trawled. Implemented in 2008, the new measures prohibit bottom trawling in a deep slope and basin area (47,000 nm^2), and three habitat conservation areas around St Matthew Island, St Lawrence Island, and an area encompassing Nunivak Island-Etolin Strait-Kuskokwim Bay. The Council also established the Northern Bering Sea Research Area that includes the shelf waters to the north of St.

Matthew Island (85,000 nm^2). The northern Bering sea was set aside for research on impacts of bottom trawling on benthic habitat. Bottom trawling is prohibited in the Northern Bering Sea Research Area. The Council sought to develop a research plan that would provide data to allow better understanding of the potential impacts of trawling on the benthic and epibenthic fauna of the northern Bering Sea before any commercial trawling was authorized.

Bering Sea HAPC

The most recent call for HAPC proposals was April 26, 2010. The process concluded with the designation of the only HAPCs in the Bering Sea to date, the designation of six areas in the eastern Bering Sea where relatively high concentrations of skate eggs occur for several skate species (family Rajidae). Fishing activities are not restricted within these skate egg HAPCs.

- Large areas around Pribilof Islands, Bristol Bay and the Bering Sea Red King Crab Closure Area closed to scallop fishing and bottom trawling to protect crab and other sensitive habitat
- Ten miles around St. Lawrence, King and Little Diomede Islands closed to king and Tanner crab fishing to protect subsistence fisheries for crab.

Bering Sea Canyons and Deep Sea Corals

The North Pacific Fishery Management Council has consistently acted to identify significant concentrations of deep sea corals and to protect those areas from fishery impacts. [Need to expand discussion].

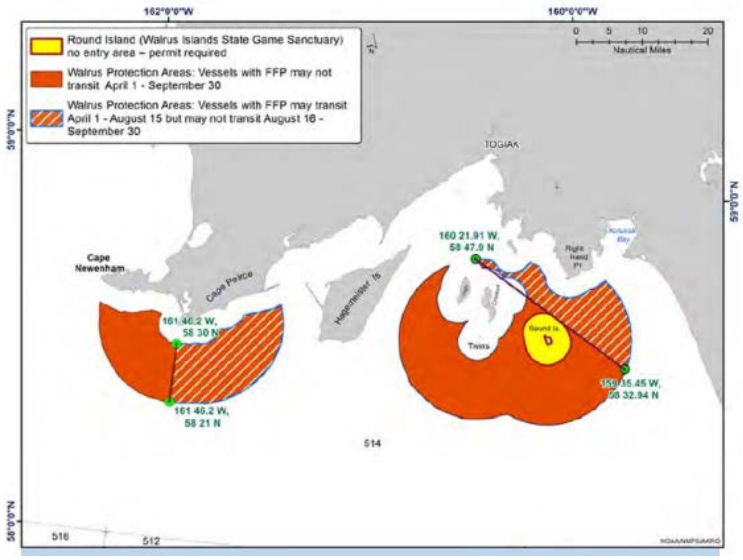
3.5.6 Avoiding impacts to seabirds and marine mammals

In addition to required seabird avoidance gear requirements and Steller sea lion protection measures described above, the Council has adopted measures to reduce vessel disturbance on Pacific walrus.

Walrus Transit Areas

Beginning in 1990, waters surrounding the Walrus Islands (Round Island and the Twins) and Cape Pierce, between 3 and 12 nm were closed to fishing for groundfish from April 1 through September 30 to protect hauled-out walrus from fishing vessel disturbance (BSAI Groundfish FMP Amendment 13; renewed via Amendment 17). In 2014, the Council adopted Amendment 107 to the BSAI Groundfish FMP to permit vessels with Federal Fishing Permits to transit in designated areas near Round Island and Cape Pierce (Figure x) from April 1 to August 15 each year. Vessels are still prohibited from deploying fishing gear in these areas.

Figure 3-8 Cape Pierce and Round Island Walrus Protection Areas



3.5.7 Adapting management to maintain resilient fisheries and ecosystems in a changing climate

[placeholder]

3.6 Management onramps to achieving EBFM

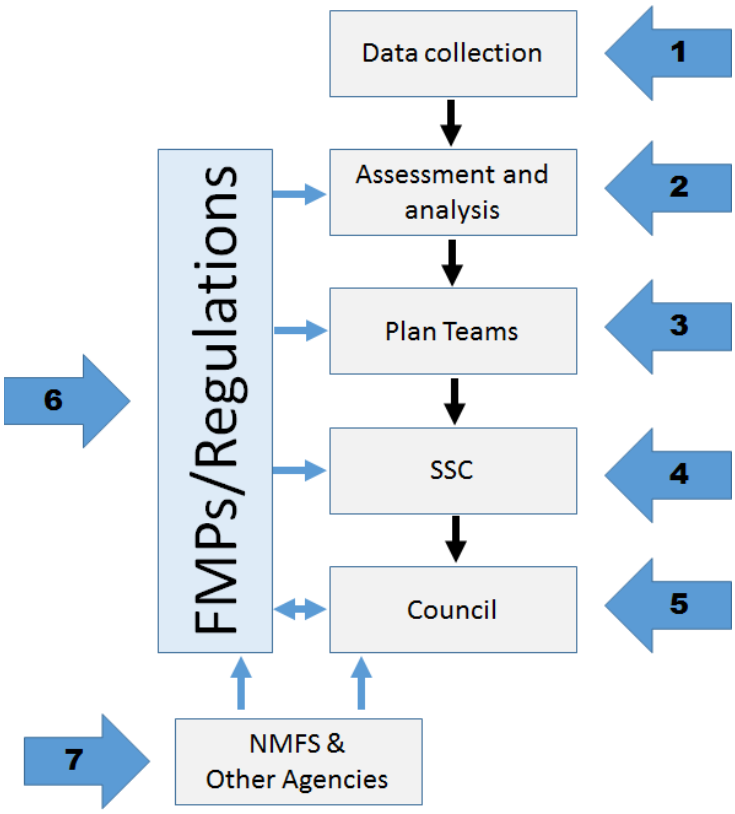
This Bering Sea FEP is inclusive of broad perspectives, and is intentionally flexible as a management guide for fisheries in the Bering Sea. At the same time, a key goal of this FEP is to provide clear paths for turning strategic objectives into Council action related to EBFM. One way that this FEP aims to provide pathways for progress along the EBFM continuum is through highlighting specific onramps for action. An on-ramp to EBFM from an FEP can take many forms.[13] Seven modes of existing onramps are highlighted below, and six case studies are highlighted. Onramps in this document highlight starting points for Council actions related to EBFM, and are not meant to limit the development of additional onramps in the future.

3.6.1 Specific Council management onramps

The Council's management framework includes specific opportunities for information derived from an FEP to provide guidance (Figure 3-9). It may be of value to identify *a priori* which of these potential onramps will be targeted for a specific set of results, in order to accommodate the transfer of information during the applicable part of the process. For example, adjustments to Harvest Control Rules would require an FMP amendment, and thus should be presented to the SSC (ramp 4) and Council (ramp 5), whereas guidance on adjusting annual OYs would go directly to the Council's annual deliberations.

[13] For considerations with the development of a conceptual model for the FEP, this note is intended to provide ideas for how it can feed into the catch specification process as well as other actions taken by the Council.

Figure 3-9 Schematic of potential onramps for Fishery Ecosystem Plan results to provide information for use in Council management.



List of current NPFMC ecosystem "onramps" and examples:

1. **Inputs to data collection planning:** Biological data to be collected, survey timing, geographic range of surveys, the observer program, targeted research studies, etc.

2. **Inputs to analysts and/or stock assessment authors:** Covariates for potential consideration for stock assessment or MSE, model structural considerations, etc.

3. **Inputs to the FMP Plan Teams:** Ecosystem considerations report, recommendations on model structural considerations, contextual ecosystem information (based on indicators), for setting ABCs relative to OFLs (scientific buffers), for research prioritization, etc.

4. **Inputs to the SSC:** Ecosystem considerations report, contextual ecosystem information (based on indicators), recommendations for setting ABCs relative to OFLs (scientific buffers), for research prioritization, for amendments to the FMPs (e.g., control rules, reference points), etc.

5. **Inputs to directly the Council:** Ecosystem considerations report, recommendations for amendments to the FMPs, guidance on setting TACs relative to ABCs, spatial closures, identification of thresholds for management action, etc.

6. **Inputs to regulation:** OY limits, Biological opinions

7. **Inputs to NMFS and other agencies:**

Note that specific actions will often move through several onramps, but that clearly identifying where they might start and stop is important.

3.6.2 Case studies

Several examples of case studies are outlined below, illustrating the onramp for new data into the management process.

1. Yellowfin sole response to temperature and growth

Wilderbuer and Ianelli have modeled yellowfin sole growth in the Bering Sea to be linked to temperature. This approach allows estimating the relationship between spawning biomass per recruit (SPR) values and mean temperatures.

How it feeds into management measures or process: While longer term, this approach provides estimates of temperature observations directly on growth. This gives some indication of how the current ABC methods will change given higher future sea temperatures. ABC considerations (Ramp 4, in Figure 3-9) and FMP revisions (Ramps 4 and 5, in Figure 3-9) could both result from this work.

2. Sablefish sperm and killer whale depredation

The act of longline fishing attracts depredation by whales on sablefish from the fishermen's hooks. Estimates of this interaction are available based on observer data.

How it feeds into management measures or process: The estimated biomass of depredation was deducted from the maximum permissible ABC. This illustrates use of Ramp 2 in Figure 3-9, as ecosystem information is being directly incorporated into the stock assessment.

3. Pacific Halibut recruitment

The PDO is presently tied to the recruitment patterns for Pacific halibut. This relationship was first identified via a research analysis and white paper (Clark et al. 1999, Clark and Hare, 2002), and was then later included in the annual stock assessment methods.

How it feeds into management measures or process: Although the IPHC does not have the same set of on-ramps available to the NPFMC, the PDO is embedded in the harvest control rule, as well as the stock assessment models.

4. Stock delineation for Pacific cod

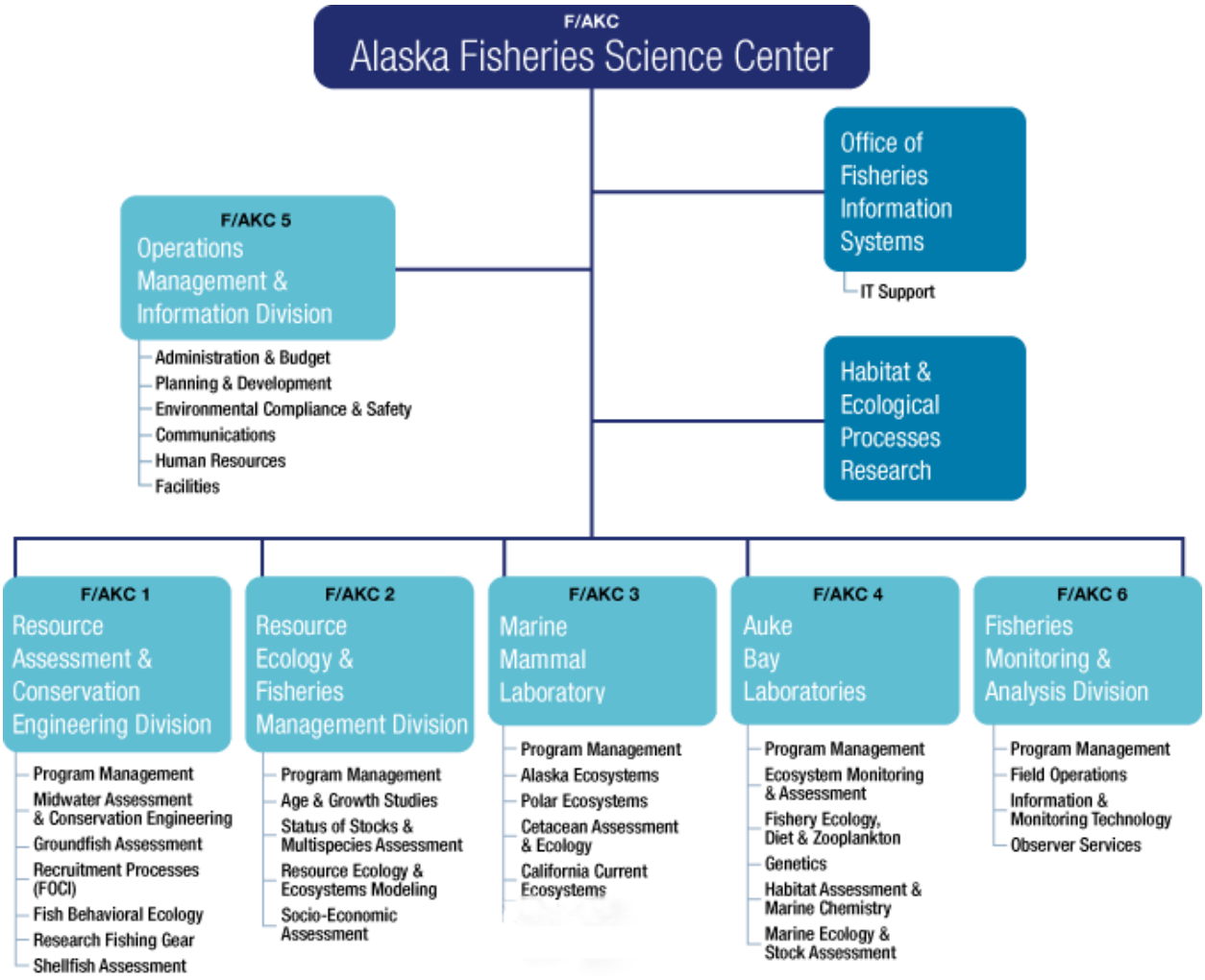
The Bering Sea and Aleutian Islands were historically combined for the purposes of performing the Pacific cod stock assessment. Based on a variety of factors identified through ecosystem analysis...

How it feeds into management measures or process: The stock assessment analysis was partitioned into two geographical areas (Ramp 2). The Plan Teams (Ramp 3) and SSC (Ramp 4) both explored and ultimately endorsed this change. Stock abundance and status are now reported for each assessment.

3.7 NMFS/NOAA process

Placeholder – Briefly describe how EBFM occurs within NMFS' areas of responsibility that intersect with the Council, including stock assessment, ecosystem modeling, ecosystem research, and how that information filters into the Council process. Figure 3-10 is a placeholder, but the intent is to show how information flows from different divisions into the Council process. Will also eventually show how IEA is cross cutting. This section will likely be merged into the sections above (e.g. Section 3.5.2).

Figure 3-10 Organizational chart of the Alaska Fisheries Science Center



4 How will the FEP function?

This FEP will use and improve upon the Council's existing open and transparent process of public involvement in decision making. The Council has designed the FEP as a strategic planning document that describes a process for addressing Council management concerns about ecological goals, as expressed in the Council's ecosystem policy statement (Section 2.1), and is able to be flexible to new information and changing resources. As such, the recommended structure is to develop a core FEP document identifying Council goals and policies, which forms a structured framework to regularly evaluate and initiate specific analyses or tasks (i.e., action modules) to address Council priorities. This type of structure is responsive to the Council's concerns about staff resources, as the action modules can be initiated progressively as and when management needs and available resources allow.

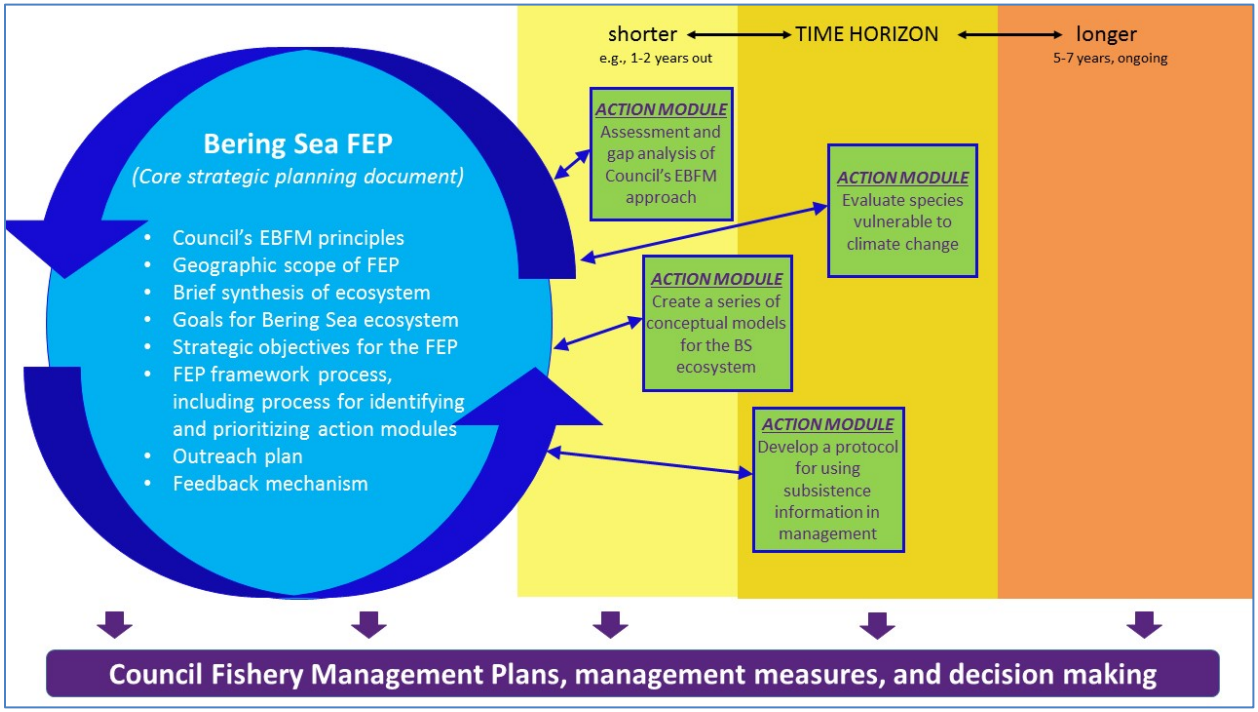
The Council has developed a core FEP with the potential for various action modules to be developed under the FEP framework, as time and resources allow. In order for the FEP to be useful and used in the Council process, there needs to be clear forethought about how the core FEP, and the action modules initiated under the FEP framework, will be incorporated into the Council management process. This process is described below.

4.1 Core FEP

The core FEP (Figure 4-1) contains a series of strategic components for the FEP. There are sections describing the purpose and structure of the FEP, and assessing the current management approach for its ecosystem-based elements. This section describes how the FEP functions as a framework process, with strategic elements in the core document, and tasking of individual projects through specific action modules. This includes explaining how the FEP process is adaptive to new information and changing circumstances.

Section 1.2 describes what is ecosystem-based fishery management, and Section 2 provides the Council's ecosystem vision statement as a benchmark against which to evaluate the Council's management. The core FEP identifies goals for the Bering Sea ecosystem, and strategic objectives for the Bering Sea FEP to achieve those goals. The Council will approve and prioritize a list of action modules which can be tasked as resources/staff time permits. The FEP also identifies the role of public involvement in the development of the FEP and resulting decision making, and describes the framework process for prioritizing and initiating specific action modules under the "umbrella" of the FEP.

Figure 4-1 Illustration of the relationship between the core FEP and example action modules



Currently, management of fisheries through FMPs does not account for interactions across multiple FMPs to the extent that an FEP may allow. The cumulative effects of fishery management actions, including ecological impacts on habitat or bycatch issues, as well as impacts to communities, are not fully accounted for in individual FMPs. Additionally, an FEP may provide a better means to account for interactions between federal and state fisheries. By managing fisheries under an FEP, ecological, economic, and social goals and tradeoffs can be considered simultaneously. While FMPs are statutorily required by the Magnuson-Stevens Act, an FEP is more discretionary. Although it can be challenging to make an FEP 'actionable' in the way an FMP is, the FEP process encourages thinking 'outside the box' about novel solutions to complex problems (Lenfest 2016). The flexibility of the FEP process might allow for analysis of interactions between federal and state fisheries, whereas FMPs are constrained to fulfill mandated goals. The broad scope and open-ended nature of an FEP also mean that cumulative impacts across the entire Bering Sea ecosystem might be considered. Finally, it is expected that an FEP will be able to addressed National Standards 4 (fairness and equitability of allocation) and 8 (minimize adverse community impacts) more 'appropriately' than an FMP (Lenfest 2016).

4.2 Action modules

Action modules are specific analyses or research efforts that can be initiated within the framework of the FEP, but are projects with their own scope, tasking, and timeline. The action modules are linked directly to the FEP's strategic objectives, and the purpose and scope of each task, as well as a description of how the outcome will be used in management (e.g., whether it will lead to an FMP amendment analysis), is defined in this core FEP. In this way, the action modules will be responsive to the Council's management needs, and their outcomes will have a direct effect on the Council's decision-making process. The Council also has the flexibility to prioritize action modules, and initiate them concurrently or sequentially depending on Council needs and resource constraints. As they are completed, modules should be synthesized and evaluated in aggregate; modules should leverage other modules where possible.

Section 7 of the core FEP will eventually include the Council's approved list of action modules, and a description of each one, along with its priority. To be included as a module in this FEP, a series of specific questions must be addressed for each candidate project:

1. Synopsis of the task, including how it will be accomplished
2. Purpose it will achieve (relationship to the FEP's objectives)
3. How it will inform the Council's decision making and management process
4. How it will be integrated in the Council's decision making and management process
5. Estimate of time and staff resources required to achieve it
6. Plan for public involvement

A website will be developed to track the action modules, assessing progress that has been made in each active action module, and reviewing findings of previous modules.

One of the advantages of this strategic FEP/action module structure is that it requires the Council to consider the utility of a project's outcome for Council decision making and management, its staffing requirements, and how it will be applied, before it is initiated. By requiring the Council to specify at the outset how the work product will be used in Council decision making, the Council ensures that there is a constant connection between the FEP and direct management action.

Identifying the staffing resources required for completing each module will also help with staff tasking. Some modules will be largely synthetic exercises, with Council and NMFS staff pulling together information from disparate sources to create an evaluation for the Council (e.g., a compilation of information available about climate change impacts or ecosystem information to inform Council NEPA analyses). Others will require specific data, knowledge, and tools and thus may be projects of longer duration requiring more than Council and agency staff in their development. For example, an action module that proposes to develop ecosystem decision tools to address a specific problem would require AFSC expertise. In fact, each action module might engage a diverse set of stakeholders and agency personnel and it is envisioned that there will likely be different module teams for each FEP module, although with some common participants to ensure consistency. This has the advantage of providing an opportunity for broader participation in the FEP process, and involving diverse stakeholders that are impacted by the issue, including local communities or fishermen, in the FEP process.

In order to accommodate the appropriate range of public participation in the development of an action module, a public involvement plan delineates how the public participation process will be facilitated. To ensure the FEP achieves the Council's intent for it to be a transparent, inclusive communication tool, the plan identifies stakeholders potentially impacted by or interested in the action module, and opportunities for them to interact in its development. This includes the Council's existing public process, which provides the opportunity for public involvement throughout the multiple stages of the decision making process, but may also identify other opportunities. The plan should also addresses how both Local and Traditional Knowledge (LTK) will be considered. For example, LTK is especially useful to supplement or validate local, small-scale ecosystem observations, in combination with large scale scientific efforts.

Application of action module results to inform the Council process will vary depending on the nature of the action module. Depending on the nature of the action module, its findings may be relevant to monitoring/research priorities, vulnerability assessments, stock assessments, annual harvest limits, spatial management actions, international agreements, and emerging fisheries. First, and in all cases, the action module will likely result in a report or presentation to the Council. Second, for some modules, the analysis or research may suggest the Council consider some immediate fishery response. In this instance, the Council is expected to use the action module outcome to initiate an FMP analysis to consider how to implement change based on the module's findings. Third, the action module may provide tangible information that affects future Council decision making, for example identifying an indicator threshold

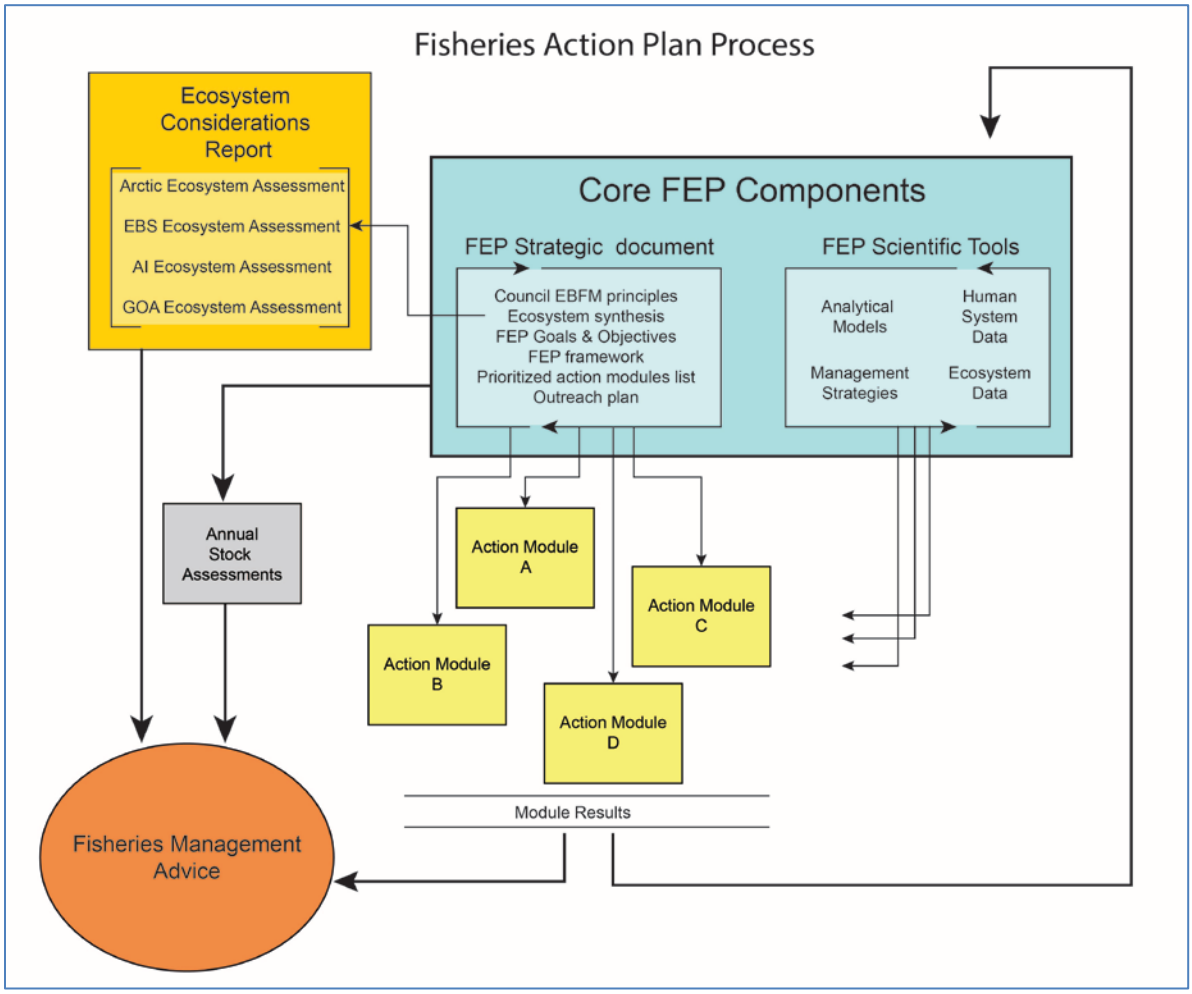
that will be a pivot point for Council action once it is reached. Finally, the outcome of an action module may require iterative Council feedback, and may lead the Council to re-evaluate this FEP or re-prioritize other action modules.

The Council envisions that the modules will be an evolving part of the FEP that change over time to meet novel management challenges and ecosystem pressures. The FEP specifies the process for how action modules were proposed, considered, and adopted by the Council into the FEP. The Council has also worked with NMFS and the AFSC to identify management needs and how action modules could be designed to address them. This process has been an opportunity for researchers conducting fisheries-relevant research to bring their science forward into management, by proposing modules for Council consideration, such as the climate change module (Section 7.3). As with other aspects of this FEP development, we anticipate that there would be public involvement in scoping possible action modules, and opportunities for input on how they are prioritized. The Council may wish to initiate a periodic review process to consider whether action modules should be revised, new modules added, priorities changed, or actions initiated. Results of action modules will also be presented publicly and made accessible through a public website.

The relationship of the core FEP with four example action modules is demonstrated in Figure 4-1. Action modules should be designed to focus on a specific Council need, to ensure a strong connection between FEP work and its utility in the Council process. By prioritizing the action modules, the Council is also signaling its interests and priorities to other agencies, especially NMFS and the AFSC. At the same time, NMFS, while responsive to the Council's needs, also has other clients for its work. Therefore, even though the Council may not yet have initiated a specific module, NMFS may have other reasons to be conducting research that may inform that module in the future. By providing the list and prioritization, however, the Council is also signaling a future interest in specific topics that may allow a research project to be designed to accommodate a variety of needs.

As individual action modules are initiated by the Council and eventually completed, they will contribute to the broader understanding of the Bering Sea ecosystem, the EBFM actions that the Council is undertaking, and the tools available to the Council to make informed decisions. Figure 4-2 provides a general illustration of the potential elements of specific action modules and how they may relate to the scientific understanding of the Bering Sea ecosystem as a whole.

Figure 4-2 Recurrence / feedback between individual action modules, the core FEP, and the management process



4.3 Role of the FEP team

Following the adoption of the Bering FEP, an FEP Plan Team will be formed and "function" similarly to the other Council Plan Teams such as BSAI Groundfish and Crab Plan Teams.

With respect to groundfish management, the proposed cycle for the FEP team is to meet in January, with meeting summaries to be presented to the Council during the February Council meeting. The goal of the January FEP team meeting would be to:

1. Review the ecosystem status report and other ecosystem information that passed through the fall groundfish review cycle as well as the SSC/Council review.
2. Provide a strategic review of ecosystem products, red flags, discussion points from the previous fall cycle.
3. Provide prioritization for ecosystem research topics in time for spring requests for proposals for NOAA funding programs and in time for May AFSC Activity Plan development.

Other roles:

The FEP Plan Team will provide overview of the coordination of AFSC ecosystem products to the Council groundfish management cycle. AFSC ecosystem products include the ESRs, which include ecosystem data from sources outside the AFSC such as academia and outside agencies (e.g. USFWS).

Outside the groundfish management cycle:

The FEP Plan Team will "track" how and what ecosystem products enter the council process at an annual scale, defined as review of previous year and anticipated for upcoming year. This differs from the general outline of how ecosystem products reach the Council as defined in the "onramps". The FEP Team would consider, for example, the separate USFWS reports to the Council – how many, when, are there other groups that might benefit from hearing/reading these reports, etc.

4.4 FEP interaction with Council processes

The BSAI groundfish FMP outlines the management measures that govern Bering Sea and Aleutian Island groundfish, excluding salmon, steelhead, Pacific halibut, Pacific herring and tuna. The fishery mainly targets pollock, cod, flatfish, mackerel, sablefish, and rockfish. The BSAI management area encompasses the U.S. Exclusive Economic Zone (EEZ) of the eastern Bering Sea and that portion of the North Pacific Ocean adjacent to the Aleutian Islands west of 170W longitude. The northern boundary of the Bering Sea is the Bering Strait, defined as a straight line from Cape Prince of Whales to Cape Dezhneva, Russia.

Management measures within the BSAI FMP range from excluding foreign vessels from the fishery to allocating catch shares to individuals and communities. The measures define the management areas as well as how to establish and apportion the total allowable catch (TAC) for target species. Within the measures are applicable gear and catch restrictions as well as conservation measures to protect marine mammals, seabirds, and non-targeted fish stocks. Lastly, the FMP lays out the management protocols for delegating some management authority to the State of Alaska, and defines the rationale and actions allowed for in-season adjustments to a fishery. These measures are accounted for through recordkeeping and observer monitoring. These measures are regularly reviewed by the Council and may be adjusted through the amendment process.

FEPs are defined by scale of the fishery system, and provide a means for considering inconsistencies among FMPs. FEPs also provide a platform to examine cumulative impacts in a system. FEPs can integrate across FMPs. The new process (updated for FEPs) includes steps to modify FMPs with the results of the FEP. As previously stated, the Bering Sea FEP does not necessarily aim to develop new groups of processes within existing Council infrastructure. Rather, it is a key aim of the FEP to be operationalized within existing groups and processes, to the extent practicable. Examples of existing groups and processes for operationalizing the Bering Sea FEP are outlined below. These are meant to highlight potential avenues for operationalization, and are not meant to exclude other possibilities.

Interaction with Council groups

Council: The FEP is the Council's document, and any policy embodied in the FEP, or actions undertaken under the "umbrella" of the FEP must all be authorized by the Council. The FEP does not have inherent authority, but the FEP can provide context for the Council to take action through its existing authority under the Magnuson-Stevens Act.

SSC: As the Council's scientific advisory body, any recommendations from the BS FEP team, or recommendations arising from information undertaken through an action module of the FEP, should be reviewed by the SSC as per the Council's standard procedure.

Ecosystem Committee: The Council has designated the Ecosystem Committee with oversight for BS FEP team's development of the BS FEP. The Committee will continue to liaise with the BS FEP team, and will provide policy recommendations to the Council on the appropriate direction for the FEP and action modules.

Plan Teams: To the extent that FEP information affects a particular FMP, that information should be shared with stock assessment authors and the Plan Teams.

Social Science Planning Team (SSPT): The SSPT was established to improve the quality and application of social science data that informs management decision-making and program evaluation. Human considerations are an important component of EBFM, and the FEP team will work closely with the SSPT to develop appropriate protocols for considering human aspects of the Bering Sea ecosystem, especially as pertains to local and traditional knowledge (LTK). Understanding that LTK may not be relevant for every issue facing the Council (Huntington 2000), it is expected that the SSPT will be a key player in assessing and integrating LTK into Council processes as relevant. It is also expected that the SSPT will facilitate communication and linkages between LTK and other social sciences (e.g., economics, human geography), and other disciplines (e.g., ecology, oceanography), as well as other Council groups (e.g., AP, Ecosystem Committee).

Interaction with existing processes

Ecosystem status report (or ecosystem considerations report): The FEP has been designed to integrate closely with the annual ESR for the Bering Sea. The FEP team will review the annual ESR and use the information as a basis for recommendations for developing and prioritizing action modules and the work that they instigate.

Research priorities: The consideration of action modules for the BS FEP will likely identify gaps and research needs. The Council has an established research priorities process by which it annually reviews and produces a list of 5-year research recommendations, which are disseminated to other agencies. It is anticipated that the information from the BS FEP will feed into this established research priorities review.

4.5 FEP interaction with other agencies

4.5.1 Interaction with NOAA

In 2016, NOAA Fisheries adopted a national EBFM Policy and Roadmap to assist the agency in coordinated implementation of EBFM across its mandates, in part by establishing a framework of EBFM guiding principles (see Section 1.3). In 2017, Roadmap implementation was begun at a regional level by the formation of regional teams, consisting in each U.S. fishery region of members from the science centers, regional offices, and Council staffs, in order to develop region-specific plans. The Alaska regional team further separated its EBFM implementation plan into LME-specific implementation plans for each of the Bering Sea, Gulf of Alaska, Aleutian Islands and High Arctic LMEs.

The development of implementation plans for each Alaska ecosystem is staged, beginning with the Bering Sea EBFM Roadmap in conjunction with the current core FEP. The staging of ecosystem plans is specifically aligned with (1) the completion of ecosystem-wide scientific studies and synthesis through NPRB Integrated Ecosystem Research Programs (IERPs, completed for the Bering Sea in 2012) and (2) Council interest in strategic EBFM planning as reflected through the development of ecosystem-specific FEPs. All members of the Alaska regional EBFM team are also members of the core Bering FEP team. As NPRB is currently completing IERP synthesis for the Gulf of Alaska, it is anticipated that Bering Sea efforts will be followed by similar development in the GOA.

The national policy recognizes that EBFM has been ongoing for many years in many places, but serves to coordinate and communicate this work, while the regional implementation plans allow differing regional approaches to match regional needs. It does not in itself add effort or resources, but helps to organize, prioritize and coordinate EBFM activities while identifying gaps.

Strategically, the Bering Sea EBFM Roadmap describes specific regional research and efforts to fulfill the EBFM Roadmap's guiding principles. Tactically, Roadmap progress (progress of implantation in each region) will tracked at the national level with annual updates. Many elements of the Bering Sea Roadmap (Table 4-1) focuses on aligning EBFM milestones with Council needs through the FEP. As the FEP Action Modules change over time, tracking their implementation through the Roadmap provides a handshake between Council priorities and both regional and national NOAA research and implementation.

Table 4-1 Bering Sea EBFM Roadmap milestones organized by Roadmap principles and goals

Gray entries are national rather than regional milestones.

GOAL ID#	Action Items	Timing	AK Milestones
EBFM Principle 1: Implement Ecosystem Level Planning			
1a1	Establish EBFM Point of Contact at each Regional Office, Fisheries Science Center, and HQ Offices	Short	Kerim Aydin (AFSC), Brandee Gerke (AKR), Diana Evans (NPFMC)
1a2	Develop National and Regional EBFM engagement strategies	Short	Initial engagement with Council through scoping of Bering FEP (2014-2016). Bering FEP to include extensive engagement strategy
1a3	Develop best practices where there are overlapping jurisdictions	Mid	
1a4	Develop Standardized EBFM Policy and Road Map Materials for widespread use (e.g. NOAA Fisheries personnel, Sea Grant extension agents)	Short	
1a5	NOAA Fisheries supports any Ecosystem Plan Development Teams, Ecosystem Committees (or equivalent groups) that Councils establish	Continuing	NPFMC Bering Sea FEP is major guiding document for AK EBFM processes
1a6	Continue to explore tradeoffs in the context of EBFM issues and relevant statutory mandates	Mid	Analysis and summary of statutory mandates is part of Bering FEP
1a7	Create "X-prize" like competition for visualizing and communicating EBFM	Mid	
1b1	Establish Fishery Ecosystem Plan Coordinator/Analyst for each NOAA Fisheries Regional Office and in appropriate Headquarters Office	Mid	
1b2	Review and develop inventory of existing Fishery Ecosystem Plans and Ecosystem Considerations in fishery management plans, documenting best practices	Short	Best practices as applied to AK is section of FEP
1b3	Assist Councils, Commissions, regional fisheries management organizations, and other bodies as requested, in their development of new, or revision of existing Fishery Ecosystem Plans	Continuing	Bering Sea FEP adoption by Council

GOAL ID#	Action Items	Timing	AK Milestones
EBFM Principle 2: Advance our understanding of ecosystem processes			
2a1	Advance resources to conduct EBFM	Continuing	Research tracking (from Council request to NOAA research to Council delivery) being implemented as part of Bering FEP
2a2	Develop capacity for NOAA Fisheries to conduct end-to-end ecosystem studies	Mid	Partnership of North Pacific Research Board's Integrated Ecosystem Research Programs (Bering and GOA) and NOAA AK-IEA program for 3-5 year ecosystem studies
2a3	Conduct biennial EBFM Science & Management Conference	Mid	Regional IEA workshop conducted biennially (alternating with national IEA meeting)
2a4	Develop and maintain core data and information streams	Continuing	Multiple surveys (groundfish and ecosystem surveys) coordinated through IEA, the AFSC Recruitment Processess Alliance (RPA), and NP observer program
2a5	National review of the data collection programs across a wide range of disciplines, including but beyond the typical abundance and basic biological data	Mid	
2b1	Conduct a national review of existing ecosystem status reports to assess fishery science center indicator information needs to identify where ecosystem status reports address similar indicators across large marine ecosystems	Short	
2b2	Establish routine, regular and dynamic reporting of ecosystem status reports for each large marine ecosystem	Mid	ESRs for Bering and GOA completed annually; Aleutiens and Arctic biennially
EBFM Principle 3: Prioritize vulnerabilities and risks of ecosystems and their components			
3a1	Conduct Systematic Risk Assessments for relevant NOAA regional ecosystems	Long	Framework developed - projects underway?
3a2	Explore protocols for conducting regional habitat risk assessments for those areas known to serve important ecological functions for multiple species groups or will be especially vulnerable or important in the face of climate change	Mid	Bering Sea climate vulnerability analysis
3a3	Ensure more integrated, systematic, risk assessments, which could be used to coordinate regional NEPA analyses	Long	
3b1	Ensure that factors which impact 800+ US managed species are being considered	Continuing	Robust system for implementing harvest control rules for groundfish and crab ongoing; includes ecosystem considerations for stocks. (Protected Resources?)
3b2	Conduct Habitat Assessment Prioritization for all NOAA Fisheries regions	Mid	
3b3	Conduct Fishing Community vulnerability assessments for all NOAA Fisheries regions	Short	AK community assessment/website ongoing work

GOAL ID#	Action Items	Timing	AK Milestones
EBFM Principle 4: Explore and address trade-offs within an ecosystem			
4a1	Assess and bolster ecosystem and living marine resource modeling needs in each fishery science center	Short-Mid	Internal model priority/development planning part of IEA 3-year planning
4a2	Development of an EBFM analytical toolbox that includes ecosystem modeling tools and best practices; data-poor qualitative and semi-quantitative tools; and related decision support tools	Mid	AK Bering IEA has focused on developing and maintaining an extensive modeling suite across many tools (Rpath, ecosim, size-structured, multispecies statistical, oceanographic, bioenergetics)
4a3	Encourage and expand the use of multi-model inference	Continuing	Alaska Climate (ACLIM) project extends multi-model inference to climate forecasts
4a4	Establish suitable review venues and deliberative bodies for ecosystem models and associated information in each fishery science center region	Mid	EBFM models are part of CIE review cycle for AFSC - multispecies statistical model CEATTLE to be reviewed in 2018
4b1	Develop functional system-level management strategy evaluations	Mid	ACLIM project is performing multi-model MSE analysis for harvest strategies
4b2	Explore novel Harvest Control Rules (HCRs) and develop associated guidelines, as appropriate and consistent with National Standards, especially to test & explore robust Ecosystem Level strategies	Long	ACLIM project is performing multi-model MSE analysis for harvest strategies, including novel, stakeholder-driven strategies
4b3	Create "X-prize" like competition for visualizing and communicating complex ecosystem model and management strategy evaluation outputs	Long	
EBFM Principle 5: Incorporate ecosystem considerations into management advice			
5a1	Delineate, evaluate, and explore best practices for estimating and using system-wide or aggregate group harvest limits, eco production measures, and other ecosystem level reference points, to inform management decisions	Mid	Developing multi-model inference suite for examining guild-level limits for EBS; evaluating long-term effects of current 2M MT cap for Bering Sea fisheries
5a2	Explore best measures of cross-pressure, cumulative impacts in an ecosystem in conjunction with principle 3.	Short-Mid	
5b1	Develop and track fishery stock status indices that denote when ecosystem considerations are used	Mid	Species-specific ecosystem considerations reports under development, reported in Council process by Plan Teams
5b2	Support consistent and effective implementation of the NS1 guidelines, which includes guidance on incorporating ecosystem information into stock management	Mid	Ecosystem considerations are incorporated into stock assessments and presented during the review process (groundfish and crab Plan Teams and SSC) - Bering FEP is formalizing inclusion and review process
5b3	Identify best practices for incorporating ecosystem considerations into management decisions	Short-Mid	Best practices indentification is chapter of Bering FEP
5b4	Establish ecosystem-related Terms of References for stock assessments, stock assessment reviews, and support ecosystem-related terms of reference for status review groups, harvest control rules, and science and statistical committee review processes	Mid	chapter of FEP
5c1	Explore protocols for considering ecosystem-level information in essential fish habitat reviews, identifying ecosystem-level habitat areas of particular concern, and setting habitat conservation objectives and/or indicators	Short	

GOAL ID#	Action Items	Timing	AK Milestones
5c2	Finalize and implement National Bycatch Reduction Strategy	Short	
5c3	Evaluate ecosystem effects of offshore aquaculture	Long	
5c4	Implement the National Allocation Policy	Short	
5c5	Review long-term protected species recovery and rebuilding plans to ensure they account for the potential effects of near-term and long-term climate change, particularly relating to alterations to food web structure	Long	
EBFM Principle 6: Maintain Resilient Ecosystems			
6a1	Evaluate and Track Ecosystem-level reference point to assess changes in ecosystem-level resilience	Continuing	Several guild-level indicators tracked in ESR; more under development
6a2	Evaluate, conduct and track ecosystem goods and services valuation methods and best practices	Mid	
6a3	Develop best practices for tradeoff evaluation with respect to overall ecosystem and community resilience and well-being	Mid	
6a4	Develop National EBFM Performance measures	Mid	
6b1	Explore community health and well-being socio-economic metrics	Mid	Several included in ESR and Economic status reports
6b2	Adopt community vulnerability analyses to a broader range of cumulative factors	Mid	
6b3	Track community health, well-being and vulnerability socio-economic metrics	Mid-continual	Several included in ESR and Economic status reports

4.5.2 Other agencies

USFWS, etc. Placeholder.

4.6 Relationship with funding agencies

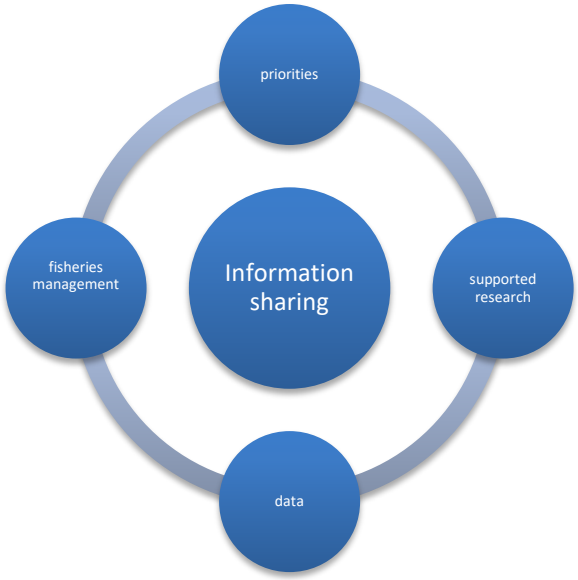
The Council prepares and modifies fishery management plans (FMPs) for fisheries under its jurisdiction. FMPs and fishery regulations are dynamic and are continuously changing as new information or problems arise. Council and NMFS staff prepare regulatory and fishery management plan amendment analyses for decision-making, with a focus on economics, social science, biology, ecosystems, and habitat. The Council relies on original research from federal, state, and academic organizations to evaluate potential management actions.

In keeping with the shift to integrated science in general, and to EBFM in particular, many agencies and organizations are actively pursuing ways to strengthen existing collaborations, engage new partners, and increase the effectiveness of their outputs beyond traditional metrics (e.g., publications). The platform for these endeavors is enhanced communication and information sharing among groups that share mission commonalities. Providing an understanding of the flexibility and accessibility within organizational protocols allows for both general and specific on-ramps for effective information sharing (Figure 4-3). A practical level of detail can be identified in the initial stages to ensure a productive outcome.

In its simplest form, a partnership consists of two organizations with additional groups as relevant to a specific action module or larger FEP effort (see Section 7.5). The two-factor model provided in this

overview chapter uses the Council and the North Pacific Research Board as an example for one method of approaching enhanced communications. This includes a description of the overlap in mission, a draft agreement for information sharing, and types of optional actions to be considered for specific needs.

Figure 4-3 Information cycle. Connections are bi-directional and cross-organizational.



4.6.1 Example Partnership: North Pacific Research Board

The mission of the North Pacific Research Board is 'To develop a comprehensive science program of the highest caliber that provides a better understanding of the North Pacific, Bering Sea, and Arctic Ocean ecosystems and their fisheries.' NPRB has historically funded basic and applied science that has relevance to Council management actions. NPRB's protocol for the development of requests for proposals also includes several portals for Council priorities to be considered, making it a prime candidate for a strong partnership effort.

Despite several formal and informal linkages, no standard protocol for the transfer of information that would be relevant to both NPRB and the NPFMC existed. Similar to the Council, NPRB has significant interest in developing and strengthening relationships that promote effective application of funded research and contribute to the development of robust research programs. Modern approaches to the assessment of impacts are likely to be most effective with a wider-ranging, collaborative effort and bi-directional flow of information. A review of the basic and enhanced avenues for communications from NPRB, as a representative funding agency, to the Council and other potential partners (e.g., ADF&G, NOAA, as described in the research tracking action module in Section 7.5) is summarized in Table 4-.

Table 4-2 Basic and enhanced avenues for information transfer among partners

NPRB	Basic	NPRB Board includes a seat for the Council
		NPRB Science Panel typically includes one Council staff member
		Council staff participate in external peer reviews of NPRB proposals
		consideration of Council priorities during the development of the Core RFP
		inclusion of "Management and Ecosystem Implications" narrative section in proposals
		regular distribution of final reports to Council Staff (quarterly to semi-annually)
		Council staff engage NPRB staff on relevant teams (e.g., Bering Sea FEP)
	Enhanced	development of a standard practices document that outlines intent and defined pathways to share information in a meaningful manner for both parties
		specific Council priorities highlighted to the NPRB during RFP development (e.g. FEP relevance)
		inclusion of Council-specific tracking tags to proposal metrics (e.g., FEP, risk analysis)
		Information on newly-funded projects provided to Council staff
		facilitation of access to NPRB embargoed data for time-sensitive analyses
		Enable early dialogue between appropriate active research projects and Council staff
		identification of Council awareness/consideration of NPRB-funded research in management decisions
		participation of NPRB-funded researchers in Council meetings

While many avenues were pre-existing, and some actions were already in place, a single document that outlined current formal and informal practices was lacking. A standard practices document was drafted to serve as a template to incorporate both general information sharing and specific attributes as needed (e.g., Bering Sea FEP, see research tracking action module in Section 7.5 for more information). Implementation will also include adoption of the standard practices and evaluation of appropriate enhanced features.

Early considerations of partnerships have not only included larger organizations. Engagement as early in the process as practicable is also highly encouraged to increase the potential window for collaboration.

4.7 Tracking and feedback mechanisms

The FEP team wants to ensure that the development and implementation of the FEP are transparent and effective and afford the opportunity to adapt in response to feedback from stakeholders. One important question to consider is: how do we know if the FEP is working?

What to communicate to Council (SSC, Ecosystem Committee, Plan Teams, etc?).

This requires defining our performance measures and management strategies (Lenfest 2017)

1. **Effectiveness monitoring** (Lenfest 2017) or performance measures
   Used to evaluate whether specific management actions had the desired effect on the system component that is directly targeted by the management action. It links threat reduction to changes in the status of the fishery system components that are specified in the operational objectives.
   - New EBFM indicators, tracked in the Ecosystem Considerations, in Table 1 ECR format discussed (objective, significance threshold, indicators).
   - Example: Describe specific example of current indicator that can monitor effectiveness or description of new indicator to develop.
   - Annual synthesis of performance measures with specific reference to FEP objectives

2. **Trend monitoring** (Lenfest 2017) Did we make it? Comparing monitoring data with predictions. Have unanticipated outcomes or trade-offs occurred since implementation of the management strategies?
   A systematic series of observations over time for the purpose of detecting change in the state of

the fishery system (Metcalf et al., 2008). It is directly tied to the initial "taking inventory" activities of the FEP, and to the subsequent adaptive management process, risk analyses, and management strategy evaluations. These subsequent activities will reveal if additional indicators need to be included as part of the monitoring process. Typically, trend monitoring is not used to evaluate management actions, although some indicators may prove useful for this.

- Ecosystem Considerations Reports, Report Cards
- Already included in the Assessment. Expand to specifically include discussion of predictions and outcomes.

3. **Uptake of FEP information into Council management process -** These are metrics for representing success, defined as uptake by Council and others. Ideally, all summaries listed below would be undertaken at least once per year. Metrics that are quantifiable (such as word searches in minutes) could be presented in time series. Other summaries could be provided in a report presented to Council bodies according to the timeline listed below in the When To Communicate To Council section.
    - Summary of SSC and Council minutes pertaining to FEP-provided information.
        - Track the volume (number of ecosystem-related words, other measure of text?) and location (SSC discussion of stock assessments vs. ecosystem status reports vs. FEP). Are there changes over time in how ecosystem information is being used by the Council? [to be shown in slides during Sept mtg]
    - Use the Fine/Not Fine framework to document contextual ecosystem information usage in annual harvest specifications. Taken from Zador and Harvey (in prep). [to be shown in slides during Sept mtg]
    - Real-time recording/note-taking by Council staff of when Council *considers* FEP-related information either in discussion or in the analysis and this occurs in say, the preamble to regulatory actions such as FMP amendments
    - Feedback that affects research priorities - FEP-related issues added to research priorities indicates success
    - Uptake of research priorities/action modules into external RFPs
        - Inclusion in RFP - keyword searches in RFPs and/or proposals
        - Funding through RFP (and how many proposals)
    - Summary of FEP-informed actions in other sources
        - Reports, publications?
        - Databases (e.g., surveys, environmental indices, ?)
    - Summary reports of action module status
        - Action module status
        - Action module completion
        - Documentation of action module incorporation/use in management - annual tracking, whose responsibility?

4. **Update on outreach activities.** Summaries of activities that are relevant to the FEP
    - Partnerships - who, what, etc.
    - Stakeholder workshops - who, what, when, etc.
    - Website Google Analytics - how many views? how many section downloads (as appropriate depending on downloadable content on website)?

<u>How to communicate (these metrics) to Council?</u>

- Website - same as for public outreach?
    - Social media - primarily for public outreach
    - Online database (information delivery platform)

- Report (other than that which goes into Council minutes)
    - New report
    - Metrics for success/uptake statistics
    - Action module status
    - Ecosystem Considerations Report
    - FEP objective indicators summary
- Presentations
    - During various Council meetings
- Align with onramps (whatever form these take)

When to communicate (these metrics) to Council?

- April is likely the best time for a regular update on the FEP, with the FEP team meeting beforehand to prep.
- To SSC and/or Ecosystem committee?

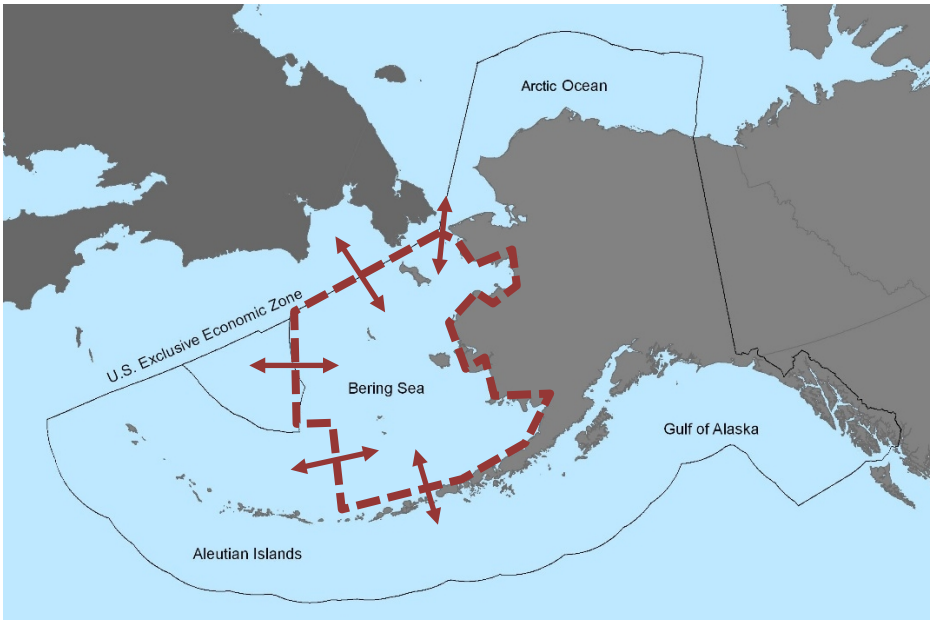
5 Synthesis of the Bering Sea Ecosystem

This section provides descriptions of the Bering Sea ecosystem, beginning with overarching physical geography of the FEP region (Section 5.1), and continuing through major ecological and oceanographic characteristics (5.2), before describing key human networks throughout the region (5.3).

5.1 Geographical area of the FEP

The geographic area of the FEP is approximated by the eastern Bering Sea LME, excluding the Aleutian Islands west of 169° W. longitude (Figure 5-1). In the development of the FEP, the area should be refined by assessing biophysical characteristics, rather than be limited to the boundaries of the U.S. EEZ, and where appropriate, the geographic boundaries should be relaxed to allow understanding external pressures, impacts, and drivers (e.g., in the Alaska Maritime National Wildlife Refuge, or in the community of Adak). It may be useful in some cases to assess pressures, impacts, and drivers as they related to nearby regions, including eastern Russia, the North Slope region in Alaska, or the western Gulf of Alaska. Studies have shown that there may also be multiple biogeographic regions within the core FEP area identified in Figure 5-1 (e.g., Sigler et al 2011), and there is considerable connectivity of the ecosystem with neighboring areas, especially north of Bering Strait, and westward with Russia. The arrows in Figure 5-1 are intended to indicate that the FEP boundary of the Bering Sea ecosystem is flexible.

Figure 5-1 Initial map of FEP core boundary



The bulk of federally managed fisheries in the Bering Sea are concentrated in the southern region, which also includes the southern shelf and the whole of the Bering Sea slope area. The southern region of the Bering Sea is distinguished by annually variable bottom temperatures.

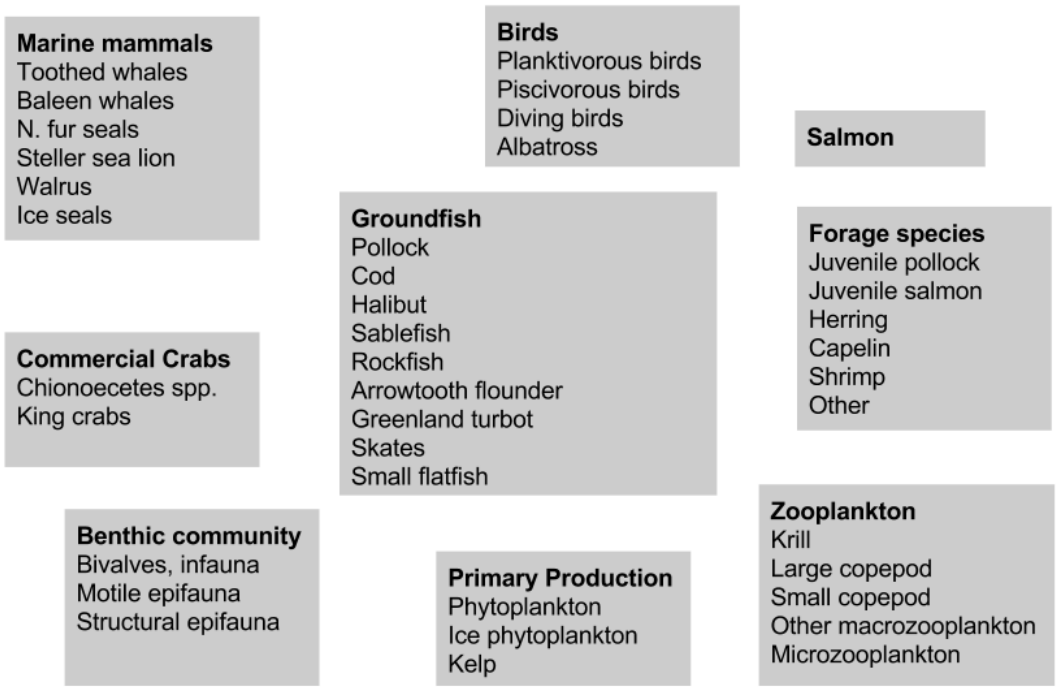
This FEP encompasses relationships among fisheries, communities, prey and predators of target and non-target species, habitat, climate impacts, and cumulative impacts on the ecosystem from all fisheries and non-fishing impacts. In order to understand all of these components and their potential or realized impacts on the Bering Sea ecosystem, influences from areas external to the core FEP geographical area will be considered at the geographical range that is appropriate to each component. This may be especially important for the area north of Bering Strait.

5.2 Bering Sea ecosystem

[This section is a placeholder for right now. It will be substantially updated.]

Figure 5-2 shows the dominant species groups with ecological and management importance in the Bering Sea. This section will provide a synthesis of information about each of these groups.

Figure 5-2 Dominant species groups with ecological and management importance in the Bering Sea



The Bering Sea is delineated by a broad (>500 km) continental shelf and narrow slope leading to a deep-sea basin (Stabeno et al., 1999). The shelf ecosystem is highly productive owing to on-shelf flow of nutrient-rich waters (Duffy-Anderson et al., 2006). Based on oceanographic properties and front conditions (Hunt and Stabeno, 2002), the shelf is classified into three domains: the inner shelf domain (inside of the 50 m isobath) is defined by weak stratification; the middle domain (between 50 and 100 m isobaths) has a strong two-layered stratification; and the outer domain (between 100 and 200 m isobaths) has a mixed upper layer and lower layers segregated by increasing density (Coachman, 1986). The Bering Sea is a transition region between warm maritime air to the south (subarctic) and cold, dry Arctic air masses to the north (Overland and Stabeno, 2004) and connects the North Pacific and Arctic Oceans (Napp and Hunt, 2001).

Climate-mediated changes to this ecosystem impact one of the largest commercial fisheries in the world (Walleye pollock, *Gadus chalcogrammus*; hereafter 'pollock') (FAO, 2017). The southeastern Bering Sea pelagic ecosystem has undergone remarkable changes over the last few decades, including an increased dominance of pollock beginning in the 1970s (Brodeur et al., 1999). To date, northward shifts of species' ranges and altered community compositions by latitude have been observed, which may lead to atypical species interactions (Mueter and Litzow, 2008) or may impact commercial and subsistence harvests as Arctic species are displaced by subarctic species (Overland and Stabeno, 2004).

The Bering Sea is particularly susceptible to climate-mediated variability as even small changes in wind velocities can have a large impact on the timing, extent, and duration of winter sea-ice cover (Hunt et al., 2002, 2011; Stabeno et al., 2012). The seasonal advance and retreat of sea-ice in the Bering Sea is the

largest exchange for any Arctic or subarctic region (Minobe, 2002). Multiple scales of environmental variability impact the Bering Sea shelf ecosystem: decadal trends (Macklin et al., 2002), multiple years of above- or below-average temperature states (stanzas) (Stabeno et al., 2012), and interannual fluctuations (Wyllie-Echeverria and Wooster, 1998).

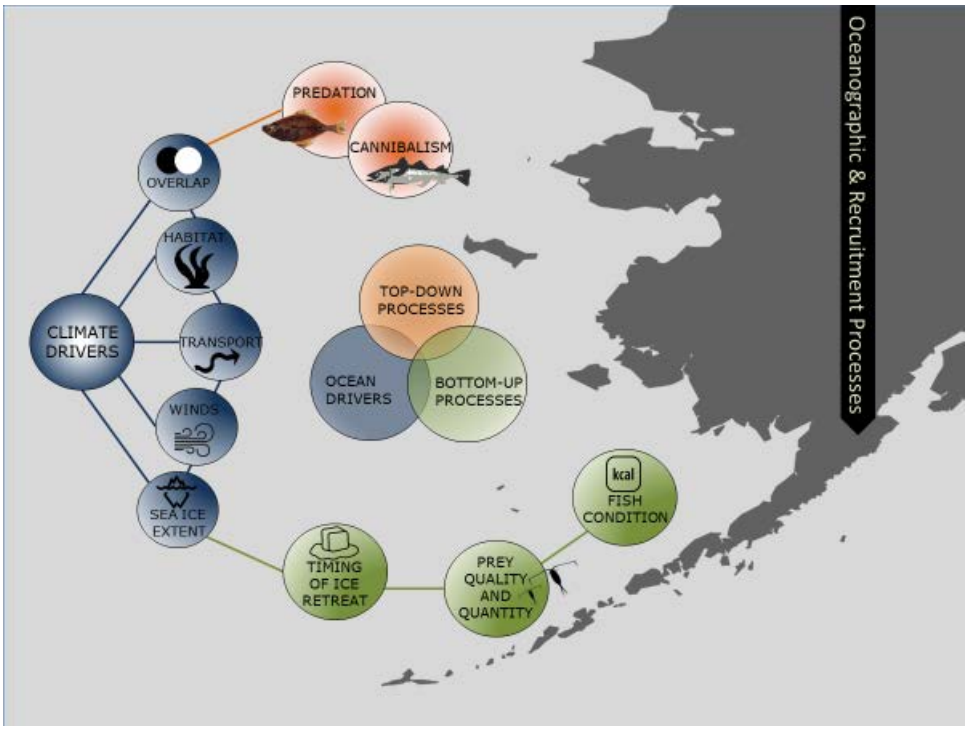
Scales of climate variability

Interactions among climate indices with different periods, such as the Pacific Decadal Oscillation (PDO; 20-30 year cycles; Mantua et al., 1997) and El Nino Southern Oscillation (ENSO; 3-7 year cycles; Macklin et al., 2002), lead to amplification or dampening of climate signals depending on the synchrony of the oscillations. For example, two oscillations were additively in-phase (amplification), both reversing sign in 1977, to cause a strong regime shift in the North Pacific Ocean in the winter of 1976/1977. The PDO shifted from negative to positive phase and the Aleutian Low Pressure System (ALPS) shifted from weak to strong (Wilderbuer et al., 2002; Overland and Stabeno, 2004). Resulting ecosystem responses included strong recruitment of groundfish following the 1977 regime shift (Hare and Mantua, 2000).

The Bering Sea ecosystem demonstrates shifts in community structure in response to such atmospherically forced oscillations (Napp and Hunt, 2001). As the Aleutian Low strengthens, southerly winds pump warm maritime air poleward (Wyllie-Echeverria and Wooster, 1998) and warm sea surface temperatures in the eastern North Pacific (Miller and Schneider, 2000). Conversely, weak phases of the ALPS bring cold air southward over the Bering Sea (Coyle and Pinchuk, 2002).

Variability in wind stress also contributes to the timing of the spring bloom (Saitoh et al., 2002) and affects larval drift trajectories (Lanksbury et al., 2007; Duffy-Anderson et al., 2010). The onset and location of oceanographic fronts affect water current trajectories (Kachel et al., 2002), larval transport pathways (Duffy-Anderson et al., 2006; Petrik et al., 2016), and subsequent community composition (Siddon et al., 2011). On-shelf wind forcing is correlated with increased flatfish recruitment as larvae are advected to suitable juvenile habitat (Wilderbuer et al., 2002). In addition to advection towards suitable habitat, pollock, for example, have stronger year classes when winds advect larvae away from cannibalistic adults (Hunt et al., 2002).

Figure 5-3 Oceanographic and recruitment processes in the Bering Sea



The role of sea ice in structuring the ecosystem

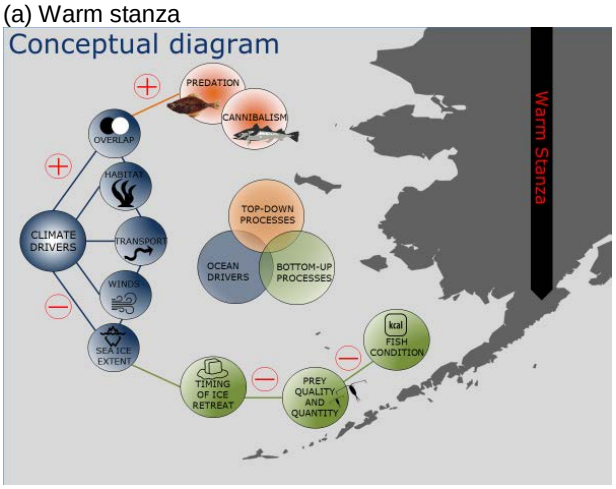
Oscillations of 3- to 5-year stanzas of above average (warm year) or below average (cold year) conditions have occurred in the eastern Bering Sea since the early 2000s (Stabeno et al., 2012; see Fig. 4B within). These climate stanzas are driven in large part by seasonal sea-ice dynamics. The timing of sea ice retreat and extent of ice coverage varies in relation to the strength and position of the Aleutian Low. Sea ice affects the seasonal progression of oceanographic conditions (e.g., stratification, hydrography, phytoplankton bloom timing; Sigler et al., 2015) with subsequent impacts to lower trophic level community composition (Eisner et al., 2017), trophic transfer pathways (Heintz et al., 2013), and ultimate survival and recruitment success of fishes (Siddon et al., 2013).

Under warm conditions, the zooplankton community is dominated by smaller species (e.g., *Pseudocalanus, Acartia;* Coyle et al REF), which are also lower in lipid content (Heintz et al., 2013), so age-0 pollock end their first summer with lower energy content. In addition, the age-0 fish experience higher rates of cannibalism in warm years because the adult fish are also looking for better prey resources because of the lipid-poor zooplankton community. Under warmer conditions, fish have higher metabolic demands, therefore these age-0 fish go into their first winter with low energetic condition and experience increased overwinter mortality resulting in fewer fish surviving to age-1. Multiple consecutive warm years, with strong year classes of recruiting pollock, begin to exert additional top-down control of larvae through cannibalism (Hunt et al., 2002). Therefore, climate forcing may need to be sustained over several years if it is to generate demonstrable changes in fish abundance (Conners et al., 2002).

In contrast, in cold years, the zooplankton community is comprised of larger species (e.g., *Calanus marshallae*) as well as lipid-rich euphausiids (e.g., *Thysannoessa raschii*). The age-0 fish experience lower levels of cannibalism, enter winter in better energetic condition, and experience greater overwinter success and survival to age-1.

Figure 5-4 Oceanographic and recruitment relationships under (a) warm or (b) cold stanzas in the Bering Sea

(a) Warm stanza



(b) Cold stanza

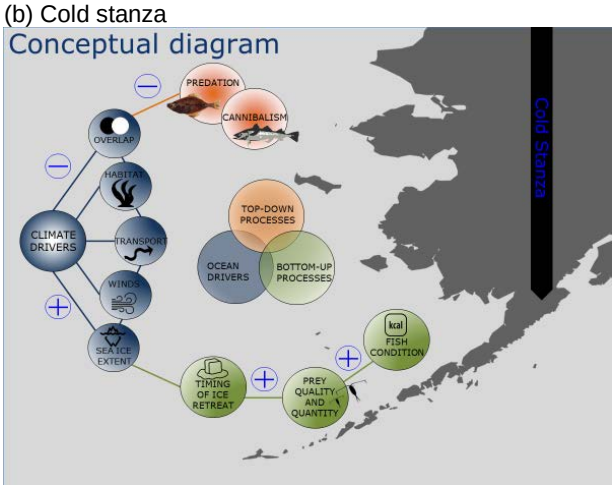


Table 5-1 Characteristic Features of the eastern Bering Sea shelf ecosystem

Characteristic Features	Consequences
Physical Features	
Large Continental Shelf	• High standing stocks of biota
	• High fish production
	• Large food resources for mammals
High latitude area	• Nutrient replenishment with seasonal turnover
	• Environmental distribution limits for many species
	• Large seasonal changes
	• Seasonal presence of ice
	• Accumulation of generations
Large seasonal changes	• Seasonally changing growth
	• Seasonal migrations
	• Possibility of large anomalies
Ice	• Presence of ice-related mammals
	• Migration of biota (in and out) caused by ice
	• Limited production in winter
Cold bottom water	• Out migration of biota
	• Higher mortalities and lower growth of benthic and demersal biota
	• Accumulation of generations
High runoff	• Low salinities (near coasts)
	• High turbidities
	• Presence of euryhaline fauna
Sluggish circulation	• Local biological production
	• Local pelagic spawning
Biological Features	
High production and slow turnover	• High standing stocks
Fewer species than in lower latitudes	• Few species quantitatively very dominant
High amounts of marine mammals and birds	• High predation by apex predators
Pronounced seasonal migrations	• Great local space and time changes of abundance
Fisheries Resource Features	
Pollock dominate semidemersal species	• Flexible feeding and breeding habits, especially environmental adaptation
Yellowfin sole dominate demersal species	• Abundant benthos food supply
Herring and capelin dominate pelagic species	• Important forage species in the ecosystem
Abundant crab resources	• Large, relatively shallow shelf. Few predators on adults, especially environmental adaptation.
Abundant marine mammals	• Abundant food supply, no enemies, insignificant hunting. Competes with man on fishery resources
Man-related Features	
Fisheries development rather recent	• Ecosystem in near-natural state, not yet fully adjusted to effects of extensive fishery
Little inhabited coasts	• Ample space for breeding colonies for mammals and birds. Very limited local fisheries.

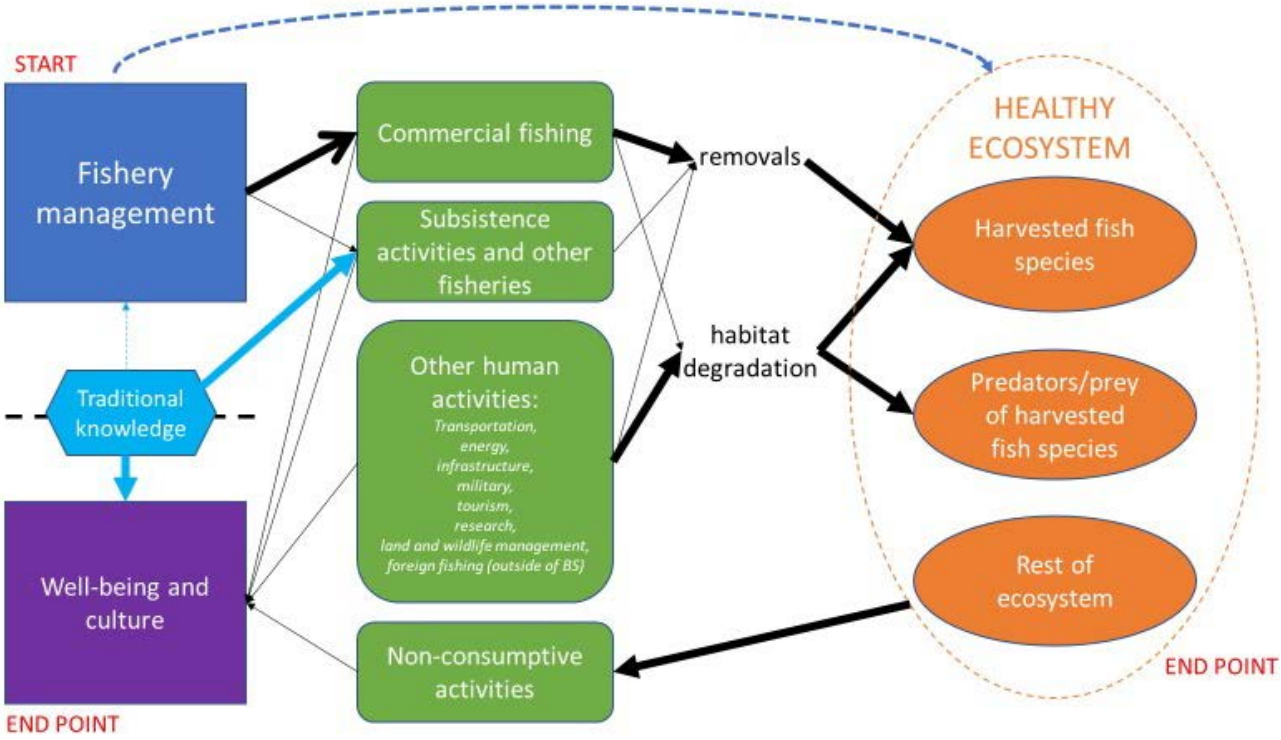
Source: Favorite and Laevastu, 1981

5.3 Human networks

This section summarizes five key human networks that exist in the Bering Sea ecosystem. This set of examples is not meant to be exhaustive, but is meant to act as a starting point for conceptualizing human components within the Bering Sea ecosystem.

Figure 5-4 presents some of the ways that different human networks interact and influence one another in the Bering Sea ecosystem. Overall, this figure is meant to communicate the interrelatedness of all components within the ecosystem. Additionally, it is shown that comprehensive assessment—such as that outlined in the FEP—should not be limited to addressing *some* environmental, economic, and social factors in an ecosystem, but should strive to address the complex and interrelated networks within each of these categories as well.

Figure 5-5 Schematic of the connections between fishery management, human activities, maintaining a healthy ecosystem, and human well-being and culture.



NOTE: Development of a list of communities to be counted and/or addressed within this Bering Sea FEP is ongoing (21 are listed in Section 5.3.2). Potential approaches to this might include, in a new subsection of Section 5:

- Listing communities that lie within the geographical boundaries of interest for this FEP as 'core' communities, and listing peripheral communities (e.g., north of the Bering Strait, in the GOA, Seattle area, rest of the US) as still relevant but not within the scope of every aspect of the FEP;
- Listing only communities that lie within the geographical boundaries of interest in this FEP, with a caveat statement that other regions and communities may be considered on a case-by-case basis when relevant to an action module or other action;
- Listing only communities that lie within the geographical boundaries of interest in this FEP, and ignoring other communities.

Until a list of communities is completed, Sections 5.3.15.3.25.3.4, and 5.3.5 will not be complete.

5.3.1 Commercial fishing

Table 5-2 Alaska's Groundfish Economy (in millions of dollars)

Groundfish ($millions)	GoA	BSAI	Other	Consumption	Investment	Receipts
GoA	16	0	1	328		346
BSAI	0	114	10	2,319		2,444
Other	208	1,466	18,902	20,255	7,667	48,498
Labor	76	538	18,454			
Capital	46	325	11,130			
Expenditures	346	2,444	48,498			

Data for Figure 5-6 through Figure 5-14 come from the NMFS AFSC "Fishing Communities of Alaska" profiles, available at: https://www.afsc.noaa.gov/REFM/Socioeconomics/Projects/CPU.php.

Figure 5-6 Wholesale revenues

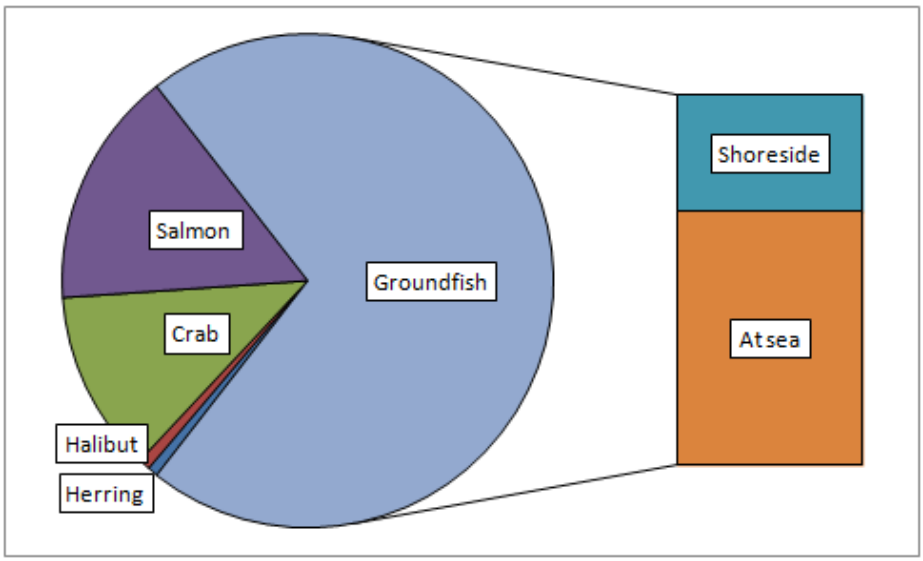


Figure 5-7 Input output

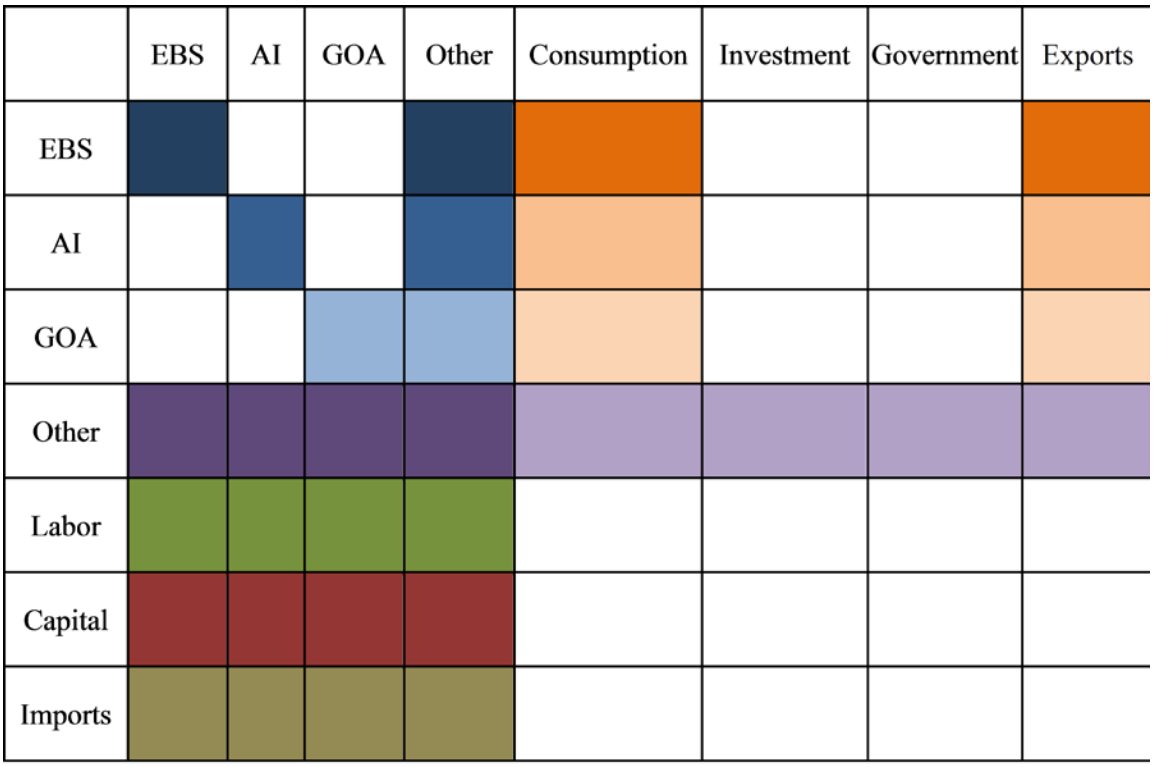


Figure 5-8 Processors

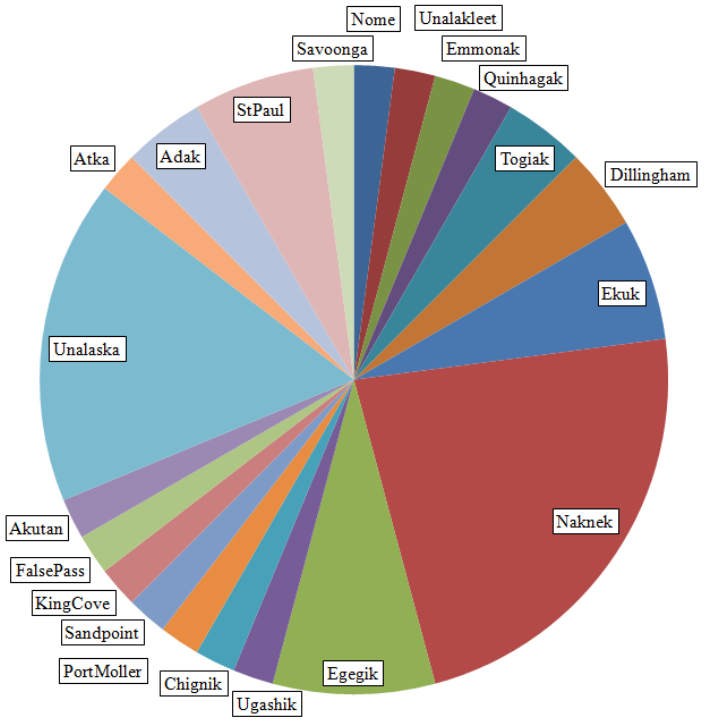


Figure 5-9 Vessels homeport

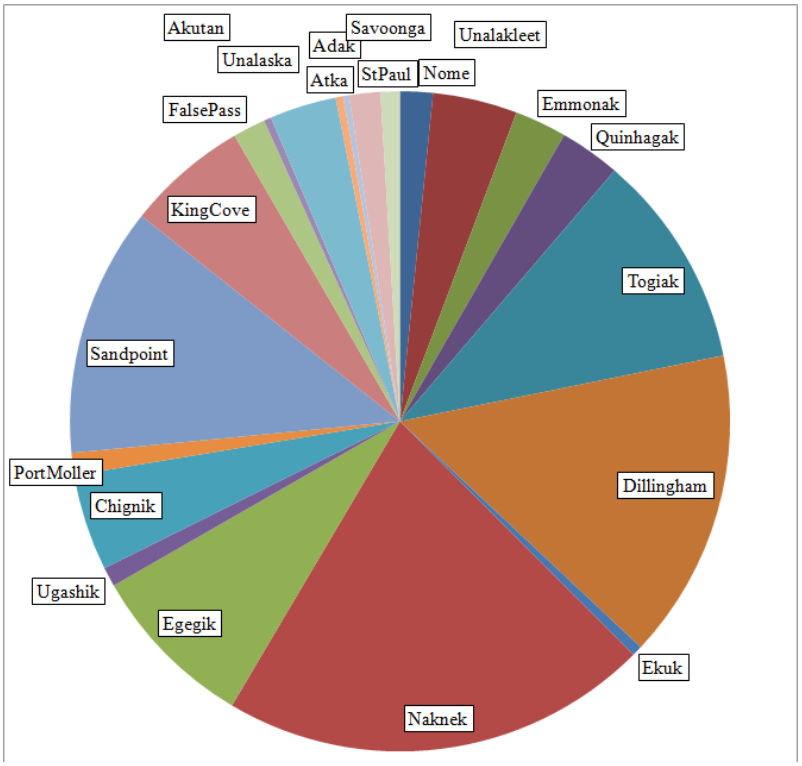


Figure 5-10 Vessels - resident

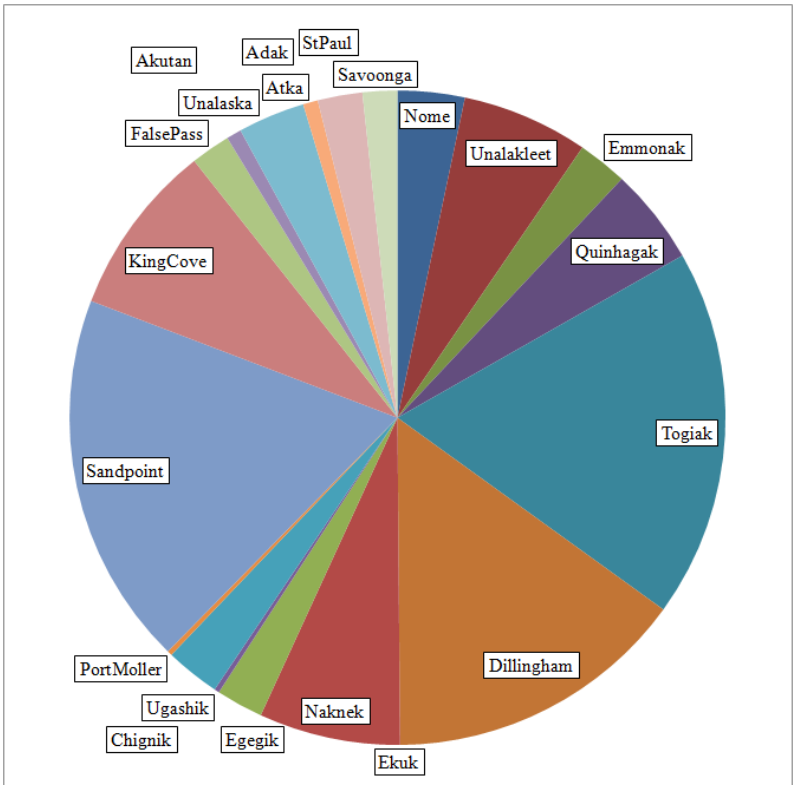


Figure 5-11 Vessels - landings

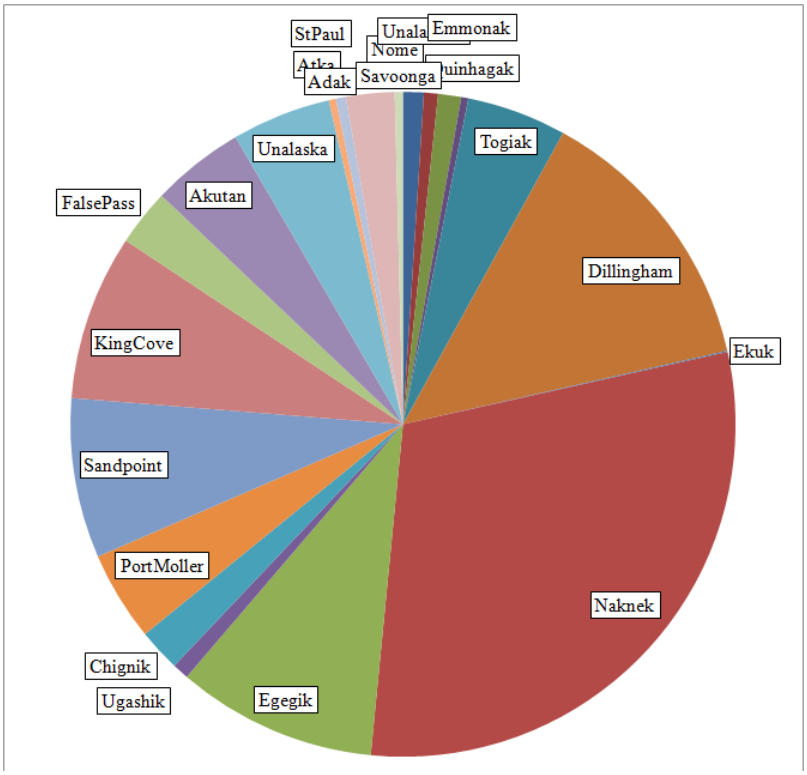


Figure 5-12 Landings in pounds

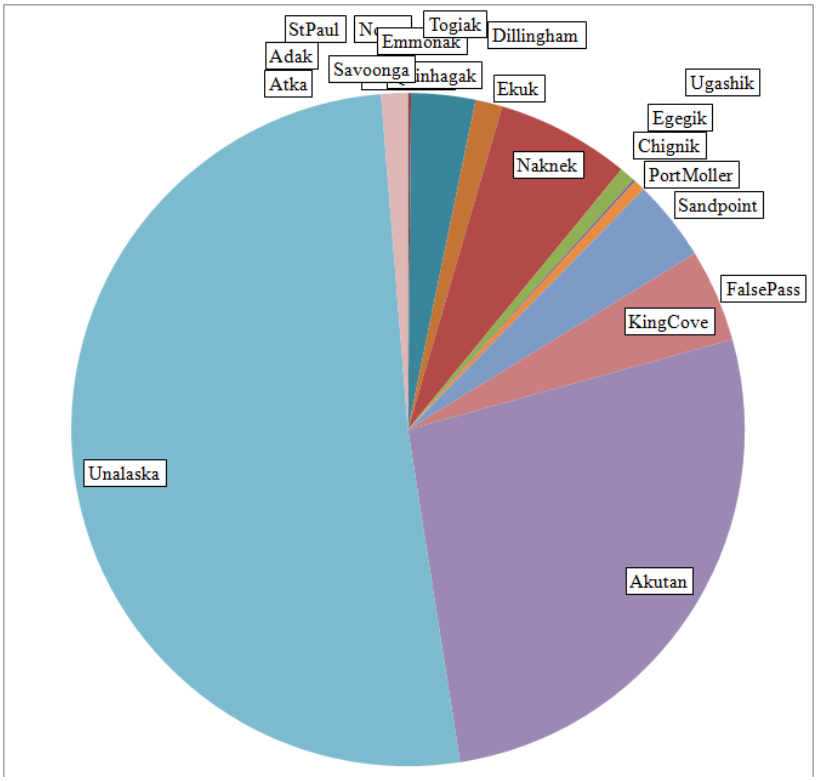


Figure 5-13 Ex-vessel revenue

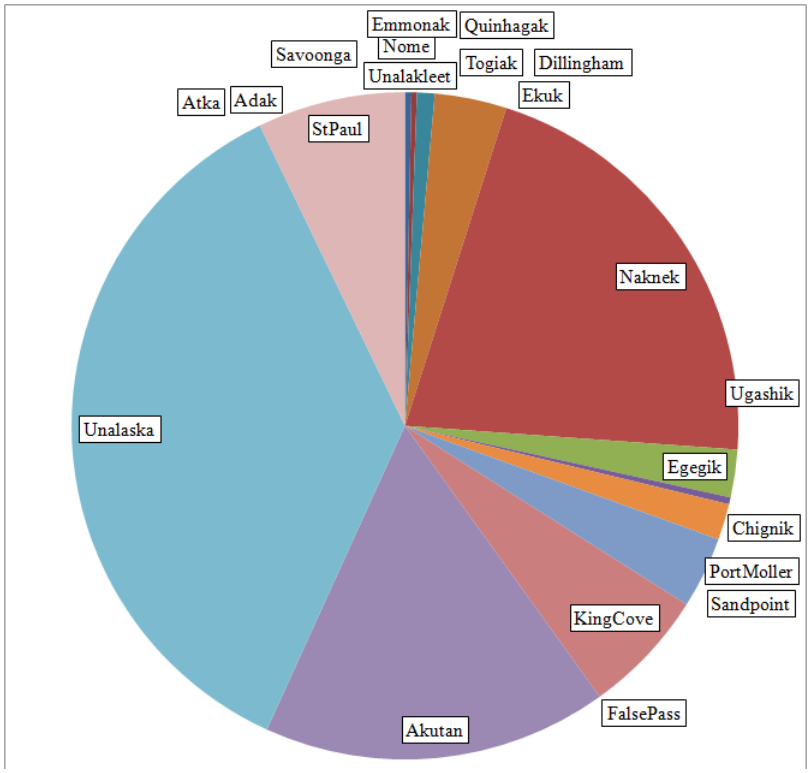
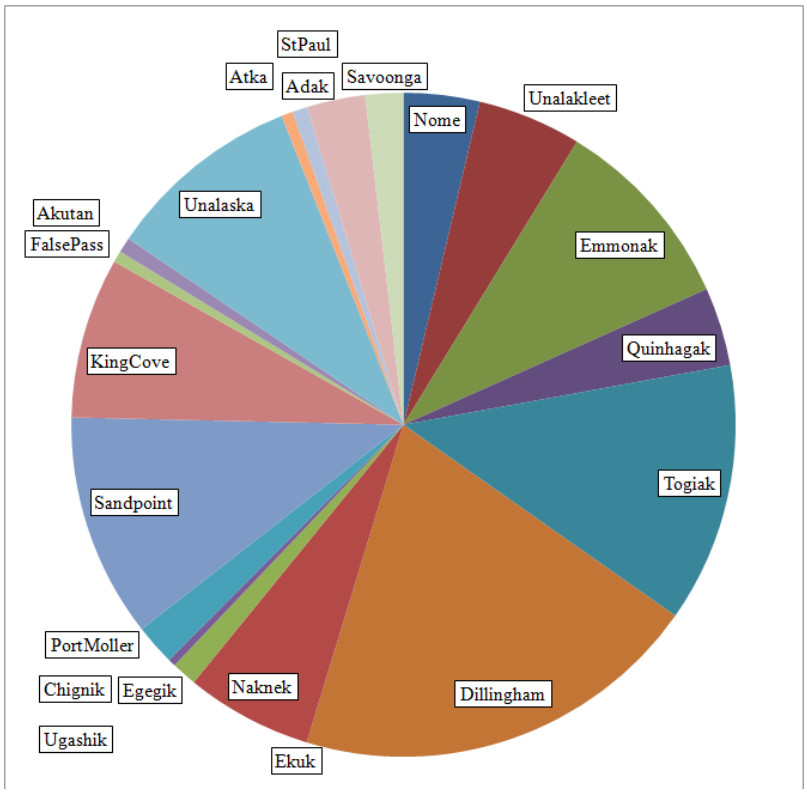


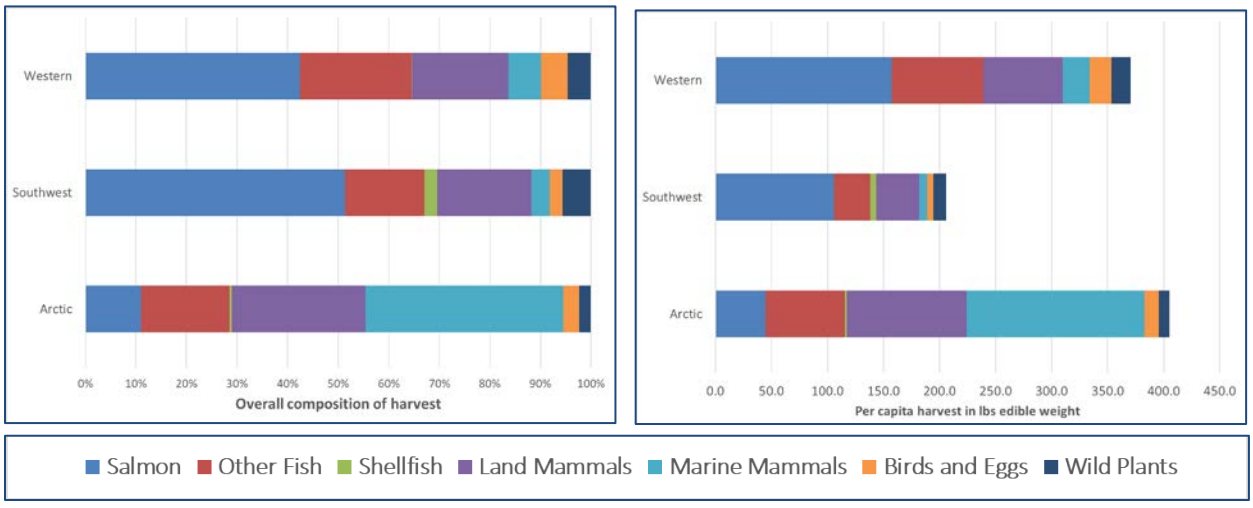
Figure 5-14 Crew license



5.3.2 Subsistence activities

Harvest and use of wild resources in coastal communities in the Bering Sea is diverse across the region, as well as between neighboring communities. Figure 5-15(a) shows the overall composition of harvest (based on pounds edible weight) for three areas of Alaska; the Arctic which is the north slope of Alaska to Norton Sound, Western which mainly comprises Yukon and Kuskokwim River area communities, and Southwest which is Bristol Bay, the Alaska Peninsula and the Aleutian Islands. Figure 5-15(b) shows the same composition in terms of overall per capita harvest of pounds (lbs) edible weight. In Southwest Alaska for example, in lbs edible weight, salmon make up 51% of the harvest, while in the Arctic the largest source of protein comes from marine mammals at 39% of the harvest in lbs edible weight (Fall 2016). The Arctic area also has the highest per capita harvest of wild foods at 405 lbs per person, while Western Alaska have an average harvest of 370 lbs per person, and Southwest Alaska an average harvest of 205 lbs per person (Figure 5-15(b)). Both Southwest and Western Alaska, as shown in Figure 5-15(a), are mainly comprised of fisheries resources, with a broader diversity of resource harvested in Western Alaska, and in the Arctic marine mammals are dominant in the diet. Of the recommended daily allowance of protein, residents of the Arctic region receive 259%, Western Alaska 237%, and 131% in Southwest Alaska from locally harvested wild sources (Fall 2016).

Figure 5-15 Subsistence harvest composition in 2014 in the western, southwestern, and Arctic coastal areas of the Bering Sea, in terms of (a) overall composition and (b) composition in terms of overall per capita harvest in pounds.



Source: Adapted from Fall (2016) by D. Holen.

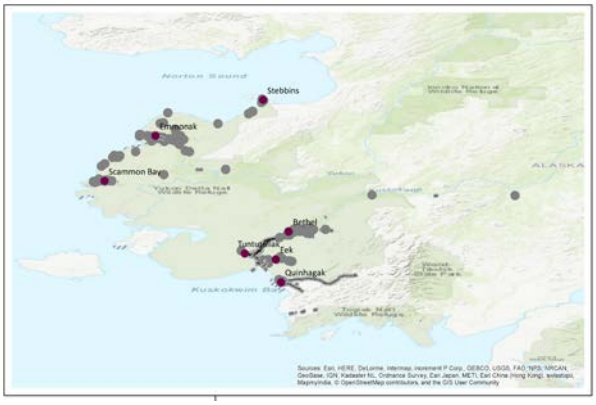
Figures NN to NN show the locations of harvest by coastal communities in the three regions of the Bering Sea illustrated above; Arctic, Western, and Southwest. The data used in Figures 1 and 2 represent all rural communities in these three regions of Alaska where data is available (see Fall 2016), while Figures NN to NN are maps from select coastal communities in those three regions. The communities noted on the maps represent recent studies where face-to-face household surveys were completed between 2008 and 2015. The data represent a single calendar year of harvest effort. Data was collected at the household level and include either a census of smaller communities to a stratified sample of larger regional hub communities in the Bering Sea region such as Bethel, Kotzebue, and Dillingham. Typically, data collection occurs between January and April for the previous calendar year to ensure an adequate recall survey takes place so only activities conducted during the study year are recorded. Spatial data collection methodology is consistent across the study communities and the methodology as well as other characteristics such as sample size for each study are described in study reports (Braem et al. 2017; Evans et al. 2013; Fall et al. 2012; Holen et al 2012; Holen et al. 2011; Hutchinson-Scarbrough & Koster *in prep*; Ikuta et al. 2016; Magdanz et al. 2010, Rufola et al. 2017). Final scale detailed maps are also found

in the reports by community and in some cases by individual species. Data was collected using point data for specific harvest locations, line data for areas where fishing may occur along rivers or trap lines are set, and polygon data that shows a general harvest area for berries for example, or a search area for land mammals or marine mammals. The shape used best represents the activity as described by the respondent to characterize their harvest and use as specifically as possible. Although point data for specific harvest locations for land mammals such as moose and caribou, and marine mammals such as seals is collected, the data is not included in the maps based on agreed upon confidentiality standards and only general search areas are shown. The Alaska Department of Fish and Game, Division of Subsistence provided the GIS data through a data sharing agreement with Davin Holen, Alaska Sea Grant, College of Fisheries and Ocean Sciences, University of Alaska Fairbanks.

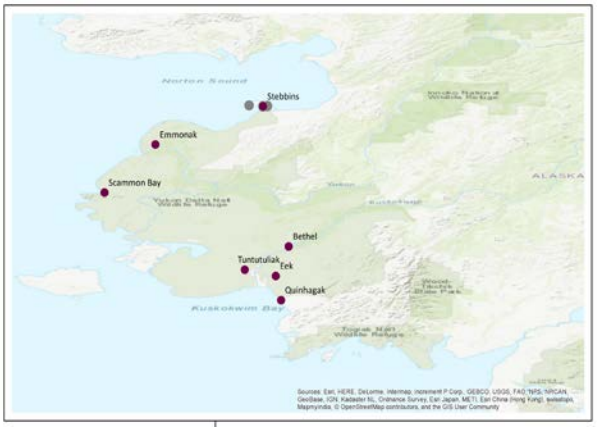
The maps are designed to show the diversity of harvest by coastal communities in the Bering Sea region. In the Arctic, the maps represent the coastal communities of Deering (study year 2013), Diomede (2013), Golovin (2012), Kivilina (2007), Kotzebue (2014), Noatak (2007), Norvik (2012), Point Hope (2014), Point Lay (2012), and Shishmaref (2014). In Western Alaska, the maps represent the coastal communities of Bethel (study year 2012), Eek (2013), Emmonak (2008), Quinhagak (2013), Scammon Bay (2013), Stebbins (2013), and Tuntutuliak (2013). In Southwest Alaska, the coastal communities represented in the maps are Akutan (study year 2008), Clark's Point (2008), Dillingham (2010), Egegik (2015), King Salmon (2007), Manokotak (2008), Naknek (2007), Pilot Point (2015), South Naknek (2007), Togiak (2008), and Ugashik (2015). Each of the maps correlates to a category in Figures NN and NN, salmon, other fish including freshwater and marine fishes, shellfish including crab and clams, land mammals including large land mammals, small land mammals and furbearers that are eaten by residents, birds and eggs including migratory waterfowl, resident upland birds, and sea ducks, and wild plants which includes berries and other edible plants.

Figure 5-16 Locations of subsistence harvest around communities in the <u>western</u> coastal areas of the Bering Sea, based on studies from 2008, 2012, and 2013.

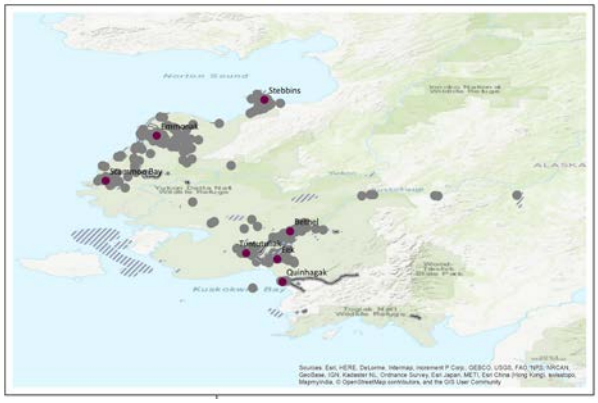
(a) salmon



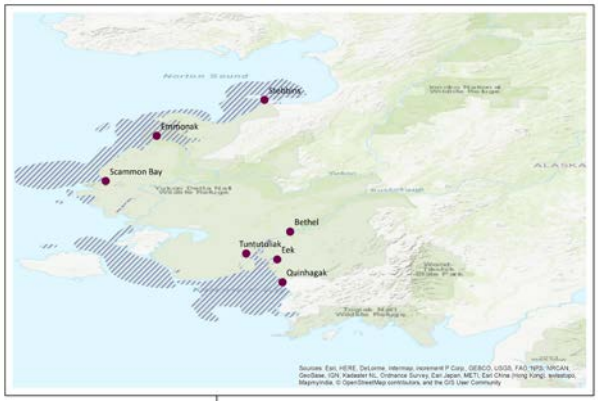
(b) shellfish



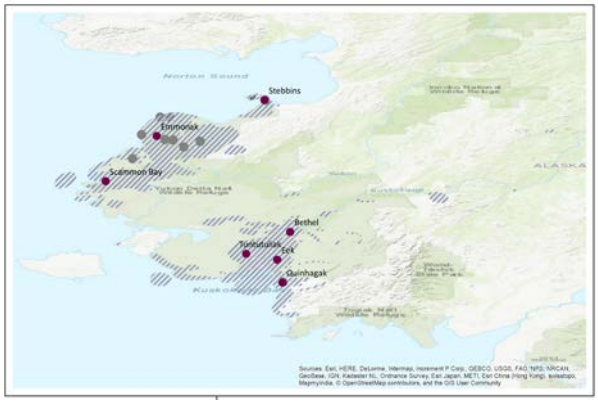
(c) other fish



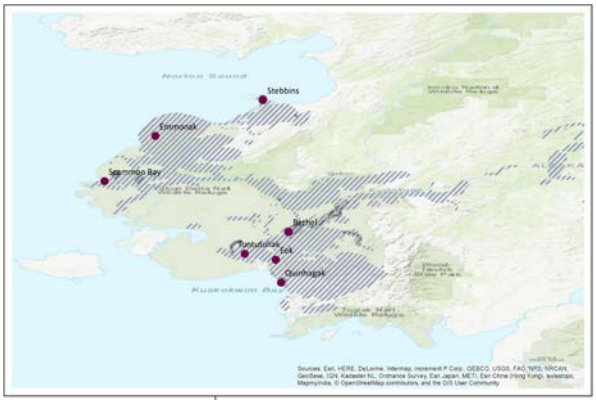
(d) marine mammals



(e) birds and eggs



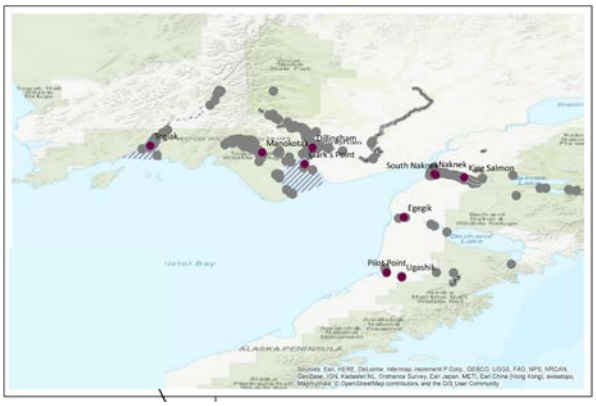
(f) land mammals



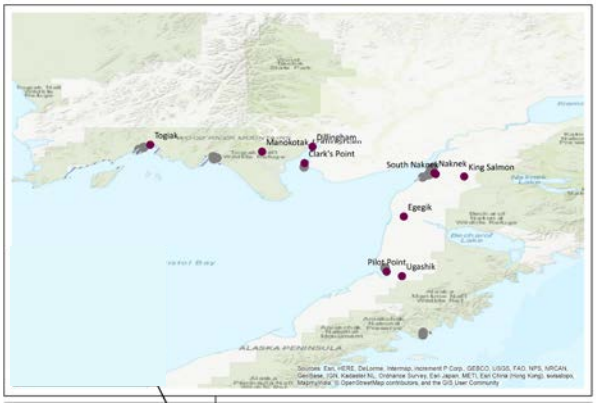
Source: Braem et al. 2017 (Stebbins), Fall et al. 2012 (Emmonak), Ikuta et al. 2016 (Eek, Quinhagak, Scammon Bay), Runfola et al. 2017 (Bethel)

Figure 5-17 Locations of subsistence harvest around communities in the southwestern coastal areas of the Bering Sea, based on studies from 2007, 2008, 2010, and 2014.

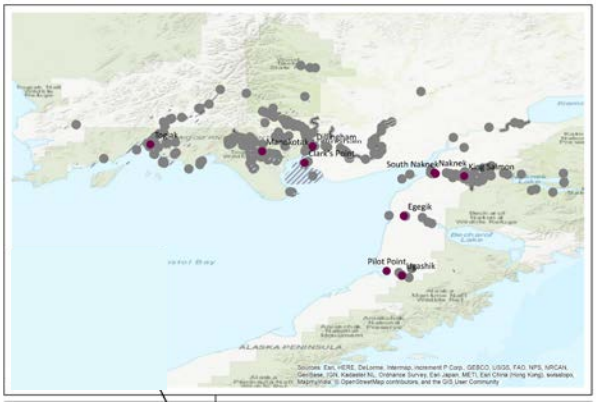
(a) salmon



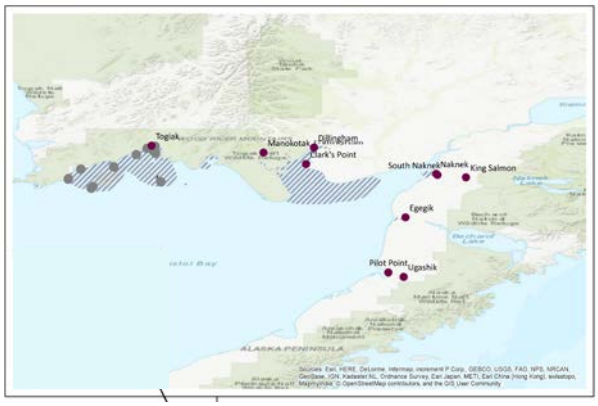
(b) shellfish



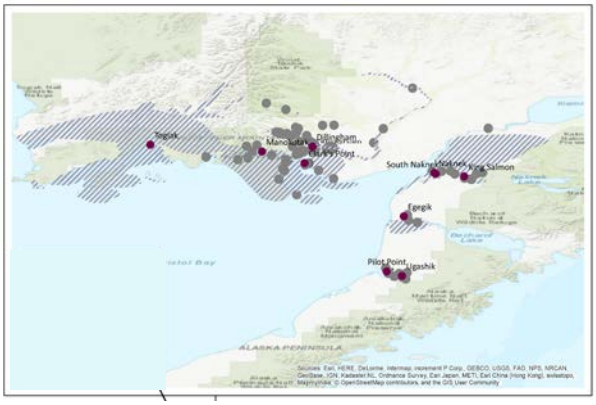
(c) other fish



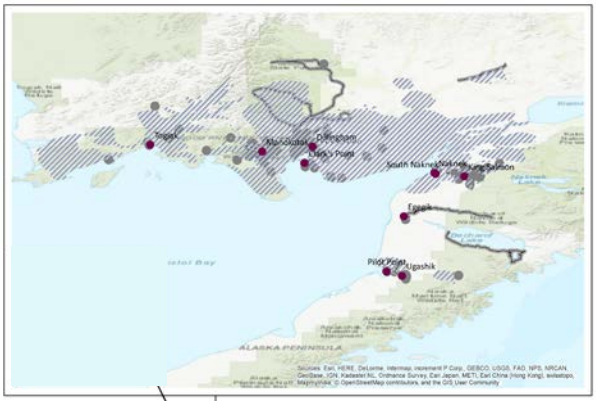
(d) marine mammals



(e) birds and eggs



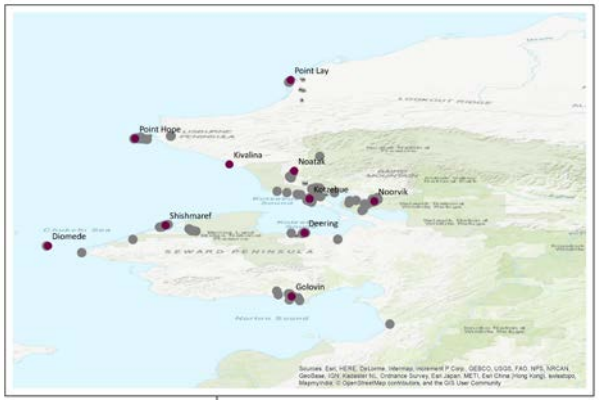
(f) land mammals



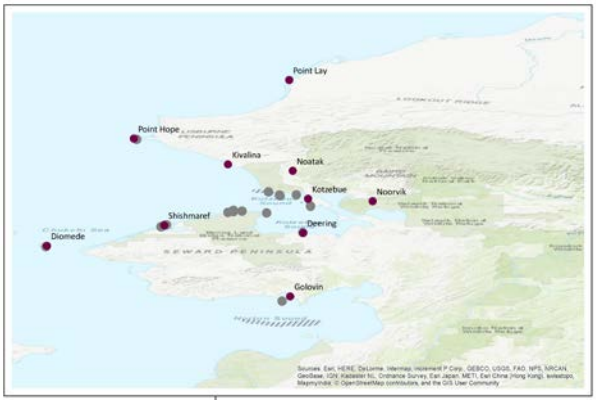
Source: Evans et al. 2013 (Dillingham), Fall et al. 2012 (Akutan, Togiak), Holen et al. 2012 (Clark's Point, King Salmon, Manokotak, Naknek, South Naknek), Hutchinson-Scarbrough & Koster in prep. (Egegik, Pilot Point, Ugashik).

Figure 5-18 Locations of subsistence harvest around communities in the Arctic coastal areas of the Bering Sea, based on studies from 2007, 2012, 2013, and 2014.

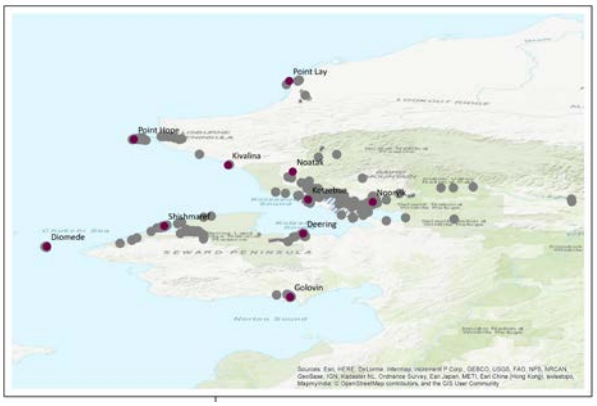
(a) salmon



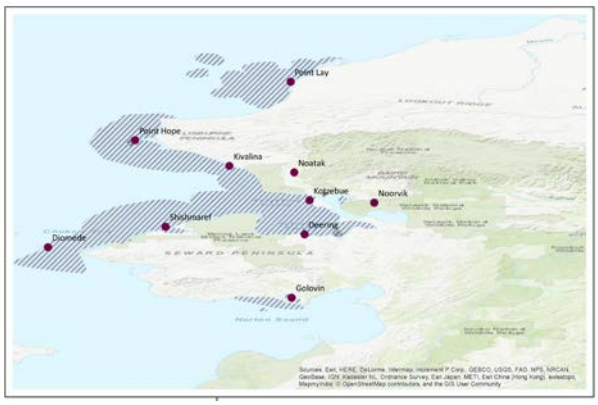
(b) shellfish



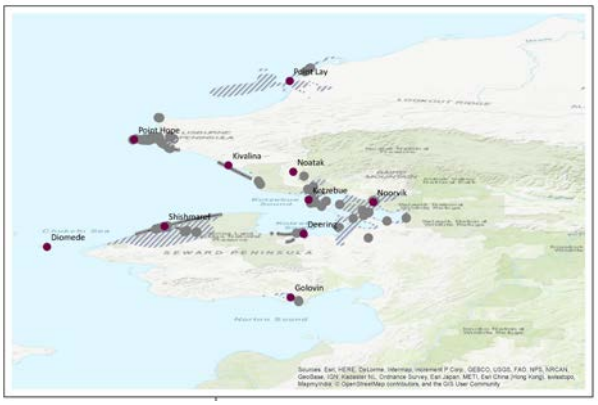
(c) other fish



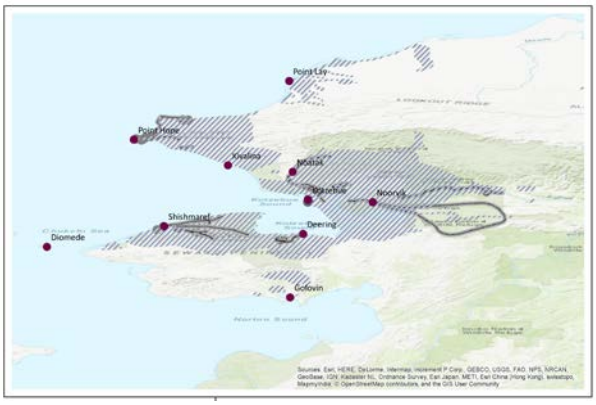
(d) marine mammals



(e) birds and eggs



(f) land mammals



Source: Braem et al. 2017 (Diomede, Golovin, Kotzebue, Norvik, Point Hope, Point Lay, Shishmaref), Magdanz et al. 2010 (Kivilina, Noatak).

5.3.3 Local and Traditional knowledge

In ecosystem-based fisheries management (EBFM), "the point is to not necessarily include more complex data or analytical approaches but rather to be more comprehensive in the range of factors being considered to manage a fishery" (Patrick and Link, 2015). One way that the North Pacific Fishery Management Council (hereafter, the Council) intends to become more comprehensive in managing the Bering Sea ecosystem is through the incorporation and integration of local and traditional knowledge (LTK) into fisheries management.

Defining Local and Traditional Knowledge (LTK)

LTK broadly includes the observations and experiences of local people in a region who may be, but are not necessarily, indigenous. Local knowledge is the product of knowledge formation and dissemination based on personal, shared and inherited experience (Martin et al., 2007). It is a way of knowing, a worldview, that is connected to a specific place, or locale. Bearers of local knowledge are often relatively small groups of people, living in or connected to a common geographic location. These people may or may not be indigenous to the area or base their understandings on knowledge that evolves over many generations (PFRCC, 2011). Traditional knowledge is:

> *a living body of knowledge which pertains to explaining and understanding the universe, and living and acting within it. It is acquired and utilized by indigenous communities and individuals in and through long-term sociocultural, spiritual and environmental engagement. [Traditional knowledge] is an integral part of the broader knowledge system of indigenous communities, is transmitted intergenerationally, is practically and widely applicable, and integrates personal experience with oral traditions. It provides perspectives applicable to an array of human and nonhuman phenomena. It is deeply rooted in history, time, and place, while also being rich, adaptable, and dynamic, all of which keep it relevant and useful in contemporary life. This knowledge is part of, and used in, everyday life, and is inextricably intertwined with peoples' identity, cosmology, values, and way of life. Tradition – and [traditional knowledge] – does not preclude change, nor does it equal only 'the past'; in fact, it inherently entails change.* (Raymond-Yakoubian et al., 2017)

In the Bering Sea Ecosystem, LTK is relevant for all fisheries sectors and all aspects of fisheries management. LTK is relevant not only to subsistence right issues, but also to commercial and recreational fisheries issues as well. For example, LTK knowledge holders might be members of large-scale commercial fishing groups or residents in remote communities that depend on subsistence fishing and harvesting (e.g., marine mammals, seabirds) for survival.

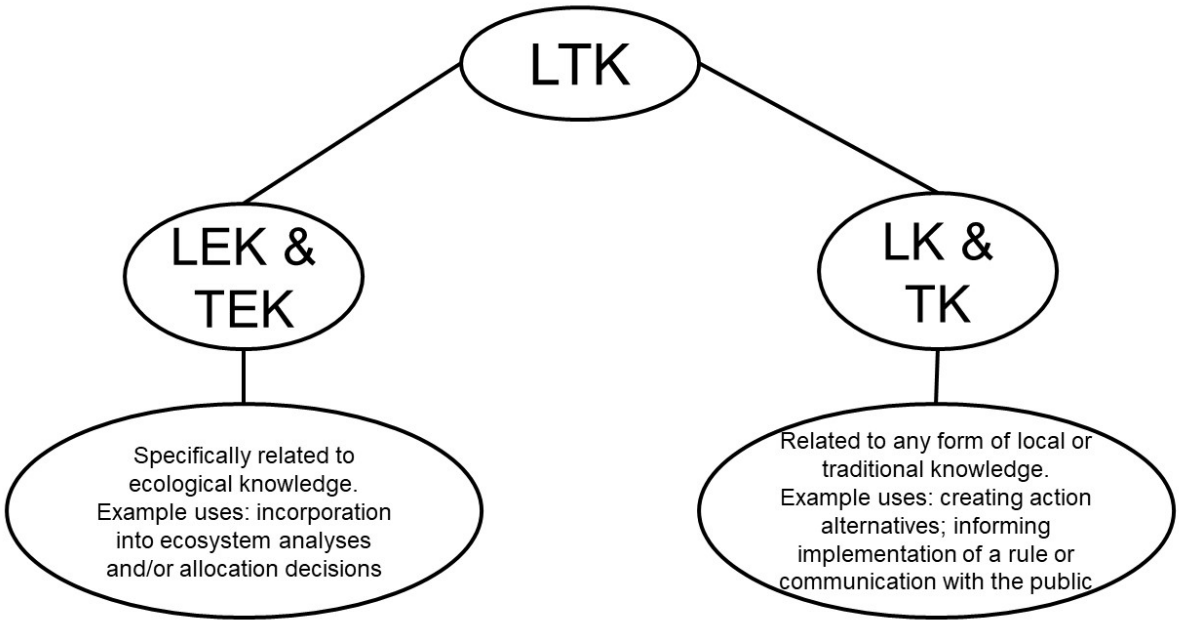
Local and Traditional Ecological Knowledge (LEK and TEK)

NOAA Fisheries recognizes the value of local and traditional ecological knowledge (LEK and TEK) as they relate to EBFM of our Nation's fisheries. *Local ecological knowledge (LEK) generally refers to what people know about the particular environments in which they work or subsist that is acquired through observations and experience* (NOAA, 2007). *Traditional ecological knowledge, or TEK, is the compendium of environmental knowledge indigenous people have accumulated over numerous generations observing and interacting with the local environment* (NOAA, 2017). TEK involves indigenous peoples with self-determined ways of life and political sovereignty.[14]

The Bering Sea fishery ecosystem plan is part of a 'next generation' of FEPs aimed at assessing tradeoffs between environmental, economic, and social costs and benefits of management decisions (Marshall et al., 2017). As such, this ecosystem plan explicitly includes the human dimension, and aims to continue making forward strides in formalizing the use and review of social science. Social science information obtained through LTK includes (but is not limited to) local ecological knowledge (LEK) and traditional ecological knowledge (TEK) (Figure 5-19).

[14] There is some concern from stakeholders that Tribal consultation is legally mandated but not happening. Formal consultations lie outside scope of current Council staffing capabilities, but might be able to be developed between NMFS staff and Tribes.

Figure 5-19 Schematic illustrating the relationship between LTK, TEK, and LEK.



Recent academic work has identified evaluative criteria for how best available social science—especially qualitative social science—might be incorporated into the Council process alongside other forms of best available science (Huntington, 2013; Charnley et al., 2017; Raymond-Yakoubian et al., 2017). Qualitative social science "does not seek a single or generalizable truth, but rather uncover[s] multiple perspectives and interpretations" of the world (Charnley et al., 2017). Qualitative social science can take many forms, including methods that utilize the TEK of indigenous people. Traditional and local ecological knowledge is:

> *not an information source of last resort when others are limited; traditional and local ecological knowledge can provide a rich source of scientific information to consider in any best available natural or social science effort. Traditional ecological knowledge (TEK) constitutes a body of knowledge and insight about species or ecosystems that has developed through engagement with the environment in specific places and been transferred over multiple generations (Berkes et al., 2000; Huntington, 2000). Like TEK, local ecological knowledge (LEK) includes knowledge regarding species or ecosystems that is gained through extensive personal observation of and interaction with local ecosystems, and is shared; but it is more recent…These unique forms of knowledge are not simply "anecdotal", but rather can provide valuable ecological information based on long-term observations of and interactions with natural resources for which there may be no other long-term data sets. TEK and LEK are fundamentally tied to the placebased individuals and communities who hold and transmit this knowledge, and as such, are often excluded from best available social science (BASS) that seeks to generalize information for wider application. There are many methods (both quantitative and qualitative) for producing robust and reliable information about TEK and LEK; this information should be subjected to the same standards for BASS as information on other topics, depending on which of…three categories (scientific, suggestive, supplementary) it falls under. The most useful integration of TEK and LEK into BASS is likely to occur through collaborations between conventional scientists, natural resource managers, and TEK/LEK knowledge holders in which the latter are included at the start of the process, and are treated as equal participants in the effort. Although it may take*

considerable time to build relationships of trust, expertise to navigate cultural differences, and a willingness to transform standard practices of collecting BASS, the potential outcome is likely to be more equitable and inclusive science-based management. There are several examples of such collaborations in the USA that combine different forms of knowledge for a more complete understanding of natural processes and phenomena (e.g., Beaudreau and Levin, 2014; Finlayson and McCay, 1998; Knapp and Fernandez-Gimenez, 2009; Vellucci, 2007). Of course, the TEK and LEK held by different groups, and western scientific knowledge, may also be quite different or contradictory. Such cases call for collaborative processes to vet differences and find productive ways of moving forward. When attempting to include TEK and LEK as a source of BASS, it is important to recognize that some TEK and LEK is sacred or proprietary; and, that use and engagement with TEK or LEK and its knowledge holders should follow established local protocols for free, prior, and informed consent (c.f. Harding et al., 2012; Williams and Hardison, 2013). (Quotation source: Charnley et al., 2017)

LEK and TEK may be understood as offshoots or more specific aspects of LTK. Therefore, LTK will be used for the remainder of this document, to refer to LTK, LEK, and TEK.

Implications for Council Management Strategies

With the understanding that LTK may not be relevant in every ecological research and management activity, LTK will be "promoted on its merits, scrutinized as other information is scrutinized, and applied in those instances where it makes a difference in the quality of research, the effectiveness of management, and the involvement of resource users in decisions that affect them" (Huntington, 2000).

The intent is for LTK to be incorporated into the Council decision-making process *from the beginning* through meaningful collaboration with local and indigenous peoples throughout the Bering Sea region. LTK will not simply be integrated *into* Western science, as it currently exists in the Council process. Instead, to the extent practicable, space will be made for LTK to influence the decision-making process on a case-by-case basis, and in forms that LTK knowledge holders feel are appropriate and relevant.

NMFS has a responsibility for government-to-government consultation with tribal governments, and the NMFS Alaska Regional Office is encouraged to conduct formal consultation with federally-recognized tribes[15] in the Bering Sea region and share that information with the Council. Council staff are encouraged to develop collaborative relationship with bearers of LTK, through communications with tribal governments, community organizations, Alaska Native organizations, fisheries organizations, individuals, and others, as well as through reviews of existing literature pertaining to LTK in the Bering Sea region.

Best practices will be outlined[16] for how LTK may be gathered, communicated, and considered *from the beginning* of the Council decision-making process. Emphasis is placed on developing appropriate ways to build relationships between LTK knowledge holders and Council members, Council staff, and other groups (e.g., the SSC, AP), at all levels of the Council process. Short-term perspectives may be developed that focus on making space for LTK in the existing management process. Medium and long-term perspectives may be developed that focus on ways for LTK knowledge holders to inform the evolution of federal fisheries management in the North Pacific, to more closely reflect the standards of EBFM.

[15] Politically sovereign federally-recognized tribes within the Bering Sea region can be identified for consultation, from the list at → https://www.bia.gov/regional-offices/alaska/tribes-served.

[16] Best practices could be outlined in this document, or at a later date as assigned to another group (the SSPT, for example) with input from stakeholders; perhaps best practices in a general way could be put in here, and specifics hashed out later?

Operationalizing LTK in the Council Process

Implementation of EBFM is not a single large action but rather a series of ongoing and cumulative actions leading to comprehensive management. (NMFSPD 01-120)

The following represents some initial suggestions for short, medium, and long-term actions that the Council could consider in the process of developing best practices for LTK.

Short-term

- A question may be added to the analytical template used by Council staff, that reads, "Are there sources of LTK relevant to this topic?"
- Prepare a compendium of information resources for LTK. Some of these resources are listed in the section that follows.

Medium-term

- Forming a subcommittee for LTK within the recently formed Social Science Planning Team (SSPT) offers a potential route for incorporating LTK of indigenous peoples into the Council process in a way that makes use of existing resources. The SSPT could facilitate meaningful contributions of LTK to ongoing analyses, as well as thoughtful review of completed analyses. The SSPT could further facilitate the longer-term goals for LTK to take part in evolving the Council management process to reflect EBFM. The SSPT might consider inviting a member from an agency (e.g., ADFG) with expertise in LTK work.
- The Council could consider forming an LTK Committee to allow for a dedicated space in the existing Council process for LTK to inform management.
- The Council could appoint/hire an LTK liaison staffer, who would facilitate the inclusion of LTK at all levels of the Council process. Some other organizations have dedicated staff liaisons for this purpose (i.e., US Fish & Wildlife Service).

Long-term

- The Council might consider how to shift towards an adaptive co-management approach (Berkes, 2009) that more fully incorporates LTK into the process at all stages. One example of this type of approach is the Arctic Borderlands Ecological Knowledge Co-Op[17].

NOTE: Usher (2000) describes four categories of TEK for use in Environmental Assessment and management using a case study from Canada. A similar approach might be considered for incorporation into the Bering Sea FEP (paraphrased):

> **Category 1:** Factual/rational *knowledge about the environment*.
>
> **Category 2:** Factual *knowledge about past and current use of the environment*.
>
> **Category 3:** *Values about the environment*, including culturally based value statements about how things should be, and what is fitting and proper to do, including moral or ethical statements about how to behave with respect to animals and the environment, and about human health and well-being in a holistic sense.
>
> **Category 4:** Culturally based cosmology; *the knowledge system itself*.

[17] https://glosbe.com/en/fr/Arctic%20Borderlands%20Ecological%20Knowledge%20Co-op; https://www.arcticborderlands.org/about-us

According to Usher (2000), each category of TEK has different potential uses within existing fisheries management structures and processes. If the management process is conceptualized in terms of four phases of public review (as is the case in Canada), uses of TEK might look like (paraphrased):

Phase 1: Scoping
Recommendation→*Categories 2, 3, and 4 are often a good fit*

Phase 2: Preparation of an Environmental Impact Statement (EIS)
Recommendation→ *All categories might be included, but often no TEK is appropriate for a formal EIS*

Phase 3: Public Review
Recommendation→*Categories 1, 2, and 3 are often a good fit; Categories 1 & 2 might be technical-based or community-based, while Category 3 TEK is more likely to be community-based*

Phase 4: Monitoring/Follow-up
Recommendation→*Category 1 TEK is often a good fit* (because the legal stipulation for follow-up in Canada is 'to verify the accuracy of the [EIS] and determine the effectiveness of mitigation measures')

Information Resources for LTK

The Alaska Fisheries Science Center and the Alaska Fisheries Information Network (AKFIN) maintain a database with information about Bering Sea Communities, which may be consulted during planning stages of these collaborative activities. Other resources may be consulted on an issue-by-issue basis:[18]

Bering Sea LTK Resources

Arctic Research Consortium of the United States https://www.arcus.org/
Principles for the conduct of research in the arctic http://ankn.uaf.edu/IKS/conduct.html
Products of social science research with Bering Strait communities www.kawerak.org/socialsci.html
Heritage Program Archives www.kawerak.org/ehp.html
Marine Program at Kawerak www.kawerak.org/marine.html
A video about best practices for research on the North Slope https://vimeo.com/197939591
Information about the North Slope http://www.leadershipandstrength.com/collaboration/
Database maintained by the University of Alaska Fairbanks http://jukebox.uaf.edu/site7/
Principles and guidelines for the protection of the heritage of indigenous people http://ankn.uaf.edu/IKS/protect.html
Research ethics: a source guide to conducting research with indigenous peoples http://www.indigenousgeography.net/ethics.shtm
Source of information about changes related to climate change around the region (mix of LEK and TEK) http://adaptalaska.org/stories/

Bering Sea Elders Advisory Group: The Northern Bering Sea

This resource is explicitly "not an in-depth inquiry into traditional ecological knowledge of the natural history of species and their environment". It includes maps of the Bering Sea and coastal areas which were developed through interviews and mapping activities with experts from tribes, local commercial fishermen, and the Coastal Resource Service Areas. Accompanying these maps are biological descriptions from a combination of western science sources, information produced by TEK related to the subsistence or local commercial use of certain species, cultural practices, and short anecdotal quotes describing specific knowledge of the resource provided by community elders. Migratory routes included in these maps illustrate routes from both TEK sources as well as NOAA DATA.

[18] This list is a work in progress

The maps depict areas used for hunting walrus, seals, whales, and important habitat areas for each of these species, such as migratory routes. Additionally, this book contains maps with general areas for harvesting subsistence fish and shellfish, as well as areas for small-scale commercial fisheries for halibut, herring, salmon and crab. Areas that elders and hunters believe to be important habitat for eiders were also illustrated, as these areas are also thought to be ecologically important to marine mammals. Often species are grouped together in terms of their distribution on the maps, so use of the maps for species-level information may not be feasible. It seems that the biological information is strictly generated from western science, while harvest data and information on cultural comes from TEK, leaving questions for how to really utilize the TEK portion of this in the FEP.

BS FEP species maps which incorporate TEK:

- Pacific walrus (subsistence use areas & migratory routes)
- All seals (subsistence use)
- Bearded, ribbon, ringed, spotted seals (migratory routes)
- All whales (category includes bowhead, beluga, gray as one) (subsistence use)
- Beluga whales (subsistence use, feeding grounds, migratory routes)
- Bowhead whales (subsistence use, feeding grounds, migratory routes)
- Shellfish: clams, mussels, king crab, shrimp (subsistence use, commercial harvesting)
- Blue and red king crab (subsistence use, commercial harvesting)
- Herring, salmon, halibut (migratory routes, commercial harvesting, subsistence)
- Area of potential growth for commercial halibut fishery

Oceana and Kawerak: Bering Strait Data Synthesis

This resource includes ecological information specifically about the Bering Strait, not the entire Bering Sea, using data from both TEK and Western scientific studies. The primary source of TEK used in the synthesis is the Kawerak Ice Seal and Walrus Project (ISWP). This synthesis consists of seasonal subsistence use areas for bowhead whales, belugas, walruses, polar bears, seals, fish (grouped as one category) & invertebrates (grouped as one category). Additionally, local community experts used their traditional knowledge to edit landfast ice extents in the ISWP which was used in this document.

Data limitations: subsistence use areas only cover regions where they are hunted, many of these species are migratory and conservation policies would need to reflect habitat and prey throughout life history. See Concentration Area maps to fill in these data gaps. Some seasons for certain species are missing maps. Data for subsistence use was patchy and old. Any information that conflicted with ISWP data or local expert experience was removed from analysis.

Species-level fish distributions within this synthesis did not employ TEK, however a different Kawerak document includes a non-salmon subsistence harvest survey in five Bering Strait communities, followed by semi-structured ethnographic interviews with local experts. Spatial information was documented during interviews and a map was produced for each community. This report documents local knowledge regarding when, where and how residents harvest non-salmon fish; information about fish abundance and biology; the cultural values associated with fish; climate change observations; community concerns related to fishing; and other topics.

Ecological Atlas of the Bering Sea

The Atlas has represented TEK as expressed in subsistence-use areas and species use patterns. The Atlas contains spatial information derived from Kawerak's ISWP. Natural history maps (species' ranges and

concentrations) for BS FEP species where TEK was used: Pacific walrus, ice seal, beluga whale. Additionally, TEK data was used for the "subsistence harvest by species" maps.

5.3.4 Other human and non-consumptive activities

Some human and non-consumptive activities are detailed below. This list is not meant to be exhaustive, but instead it is meant to highlight and summarize a broad spectrum of human and non-consumptive activities.

Recreational fisheries

Recreational fisheries are currently not a significant factor in the Bering Sea ecosystem, due to the relative remoteness of the ports. Most recreational fishing occurs nearshore, and less than 1% of all halibut removals were those recreationally caught in the Bering Sea.

Transportation

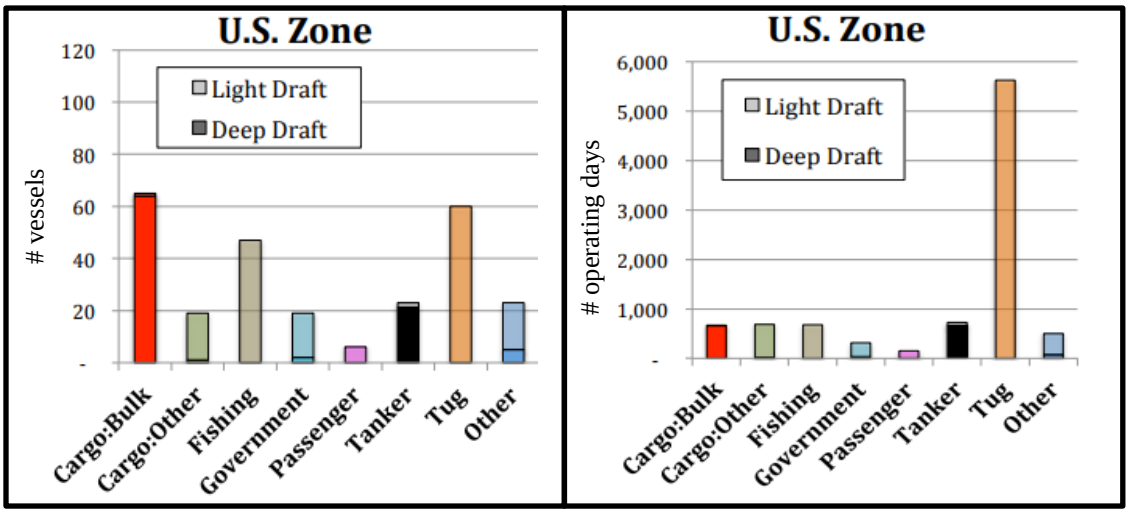
Several types of vessels travel through the Bering Sea (Figure 5-20). Bering Sea shipping is dominated by traffic through the Aleutian Islands between North America and East Asia, particularly during the summer and fall. In U.S. waters, this traffic is dominated by fishing vessels and vessels serving communities and industrial activity in the area (Nuka Research and Planning Group, LLC 2016) (Figure 5-21). Commercial fishing vessels operate in the southern Bering Sea year-round, traveling back and forth from fishing grounds to ports and processing plants. Cargo ships and containerships carry processed seafood to global markets throughout the region. Tankers, cargo ships, and barges carry goods and materials to communities in western Alaska. The hub port of Nome receives fuel deliveries from barges for transport to outlying communities. The Arctic Marine Shipping Assessment found that community supply activity, primarily by tug/barge combinations in the Bering Sea region, is likely to grow as populations increase in the Arctic (Arctic Council 2009).

As a chokepoint between the Arctic and Pacific Oceans, shipping activity in the Bering Sea and the Bering Strait is expected to continue expanding as Arctic sea ice retreats and both trans-Arctic shipping and resource extraction increase. Shipping between Europe and Asia through this region could increase significantly if global climate change opens a summer shipping route through the Arctic.

Figure 5-20 Example vessel types operating in the Bering Sea.

Source: Nuka Research Planning Group, LLC 2016.

Figure 5-21 Vessels by type and draft operating in the U.S. Bering Sea, 2013-2015, by (a) number of vessels and (b) number of operating days.



Source: Nuka Research and Planning Group 2016.

An estimated 480 transits were made through the Bering Strait in 2012 (Nuka Research and Planning Group, LLC 2014) and 540 in 2015 (USCG 2016). In comparison, there were over 4,500 transits the same year through Unimak Pass, where the "Great Circle" shipping route between the United States and Asia enters the southern Bering Sea (Nuka Research and Planning Group, LLC 2014). This speaks to the vast difference in traffic between the southern and northern Bering Sea. However, the general trend is towards increasing maritime activity in both regions, as transits through the Bering Strait had more than doubled between 2008 and 2012 (Nuka Research and Planning Group, LLC 2014). Figure 5-22 depicts cumulative vessel tracks in the Bering Strait region from 2013-2015 for each vessel type studied. The dataset included Automatic Identification System (AIS) data from 532 unique vessels operating for a total of 18,321 days in the area. Due to the extensive use of barges to serve ports on the U.S. side, tugs are far more prevalent there than in Russian waters. Similarly, fishing vessels are more common on the Russian side where there is less sea ice coverage and different fishing rules. Note that barges are not required to carry AIS transmitters, but most of the tugs that move them do.

Figure 5-22 Vessel traffic Automatic Identification System (AIS) data from 2013-2015 for the Bering Strait region.

Source: Nuka Research and Planning Group, LLC 2016

Shipping and transportation in the Bering Sea region creates an overlap between human and animal communities in the region and the noise, air emissions, and waste associated with increased vessel activities. It also increases the potential for marine mammals strikes or spills of oil or other hazardous substances (Nuka Research and Planning Group 2016). Vessels and animals both use the narrow corridor of the Bering Strait to travel between the Arctic Ocean and Bering Sea. Additionally, many vessels are in "innocent passage" and not subject to U.S. oil spill response planning regulations (Nuka Research and Planning Group, LLC 2014). The Arctic Marine Shipping Assessment states:

> *"The migration corridors used by marine mammals and birds correspond broadly with the main shipping routes into and out of the Arctic. Currently, there is limited overlap during the spring migration as all shipping activity will typically occur later in the spring than the animal migrations. In the fall, there is likely more opportunity for interaction between ships and migrating species, as both are leaving the Arctic ahead of the formation of the pack ice. As the Arctic climate continues to change, it is very likely that the shipping season could extend earlier in the spring and later into the fall. The spring migration corridors are particularly sensitive and vulnerable areas to oil spills, ship strikes and disturbances, and could be a time of vulnerability for marine mammals and birds. In the future, there will be a need to consider the potential risk and interaction between ships and animals during this vulnerable period."* (Arctic Council 2009)

The likelihood, size, and potential impacts of increased vessel traffic are directly related to the quantity, type, and location of vessels moving through the region. The USCG and the Alaska Department of Environmental Conservation track marine pollution incidents. Many of the incidents in the Bering Sea involve small oil spills associate with fishing vessels (Nuka Research and Planning Group, LLC 2016). The U.S. Coast Guard has been working to propose safer shipping routes that avoid shallow waters and areas of heightened concern for subsistence and environmental considerations such as the Diomede Islands, Saint Lawrence Island, and King Island (USCG 2016). Shipping routes through the Bering Strait are to be pursued through the International Maritime Organization.

Energy

A few public offshore gold mining areas exist around Nome, both less than 350 acres in size (Alaska DNR n.d.). Some suction dredging activities occur in offshore waters in Norton Sound. The DNR will likely not have another lease sale offshore of Nome until these leases expire in 2021. As some state lands are open to mining, extraction of mineral resources in areas that border the Bering Sea (such Bristol Bay) have the potential to affect salmon fisheries in that region.

As of January 2018, the Trump Administration has included the northern Bering Sea in their Five-Year Outer Continental Shelf Offshore Leasing Program for oil and gas. While this proposal is just a draft, there is potential for one sale each in Bering Sea areas such as Norton Basin, St. Matthew-Hall, Navarin Basin, Aleutian Basin, St. George Basin, and Bowers Basin in the year 2023. There is also potential for one sale each in the Aleutian arc, and Hope Basin which border the FEP region (BOEM 2018).

In the long-term, vessel activity associated with exploration, development, production, and extraction of massive petroleum reserves and mineral resources are expected to grow (Bird et al. 2008). The extraction of natural resources in the Arctic has the potential to increase traffic through the Bering Sea. This can include vessel activity associated with supply or construction, pollution response, and offshore drilling rigs, depending on the type of activity. With the extraction of mineral resources and oil and gas development both expected to expand in the Arctic, related shipping is expected to increase as well (Nuka Research and Planning Group, LLC 2016).

Infrastructure

The current trend in decreasing arctic sea ice extent has initiated the construction of cable projects in the Arctic region. The Alaska Arctic portion (Phase 1) of the international Quintillion Subsea Cable System was completed in October 2017. This is a 1,200-mile submarine fiberoptic cable main trunk line between Nome and Prudhoe Bay, Alaska. Additional branches are installed into the Alaskan communities of Kotzebue, Point Hope, Wainwright and Utqiagvik (Barrow). The system has been in service since December 1, 2017, enabling 21st Century communications in the Alaska Arctic for the first time. The Quintillion Subsea Cable System is ultimately intended to connect Asia to Western Europe through the Alaska and Canadian Arctic via the Northwest Passage (Phases 2 and 3) (Quintillion 2016). There is

potential for this cable system to expand to other parts of the Aleutian Islands in the future, and oil, shipping, and mining companies which can benefit from faster internet will continue to increase with access to ice-free waters.

When installing an undersea cable, a plow digs a narrow trench, which self-seals when dirt collapses over the cable. Fishing gear causes the "vast majority" of damage to underwater cable, however in Alaska, ice scouring is a larger issue than fishing gear hitting the cable. The burial of the Quintillion cable several feet under the sea floor should aid in prevention of damage. Figure 5-23 illustrates the current extent and future plans for the Quintillion Subsea Cable System.

Figure 5-23 The three phases of the Quintillion Subsea Cable System. Phase 1 was completed in 2017

Source: Quintillion 2016. http://qexpressnet.com/system/.

Military

Military presence in the area is mostly limited to the 17th Coast Guard District cutters conducting lengthy patrols. These vessels' primary objectives are to provide law enforcement and ensure safety for the domestic fishing fleet in the Bering Sea. As countries such as China and Russia boost their military presence in the resource-rich far north, these vessels may traverse the Bering Sea with more frequency.

Tourism

Tourism is relatively limited in the Bering Sea ecosystem but is expected to grow. Marine tourism on cruise ships of various sizes is on the rise globally and cruises through the Arctic sometimes pass through the Bering Sea. 2016 marked the first voyage of a larger cruise ship through the Northwest Passage, from Seward, AK, to New York City. The 1,000 passenger *Crystal Serenity* stopped in Nome, Alaska on its way through the Bering Sea. The fuel capacity of these large ships can be over 20,600 bbl (Nuka Research and Planning Group, LLC 2016). Many smaller cruise vessels which carry up to 200 passengers also offer expeditions on these routes.

Research

The Bering Sea and its surrounding areas host ongoing oceanographic, ecological, climatological, anthropological, and other research conducted by many agencies, academic bodies, research foundations, and other entities. In 2008, the NPFMC implemented the Northern Bering Sea Research Area (NBSRA) which prohibited bottom trawling in the northern part of the Bering Sea. The purpose for this was to gain further understanding of the potential impacts of trawling on the benthic and epibenthic fauna of the northern Bering Sea before authorizing commercial trawling. Research on Alaskan coastal communities

in the Bering Sea has increased in recent years, particularly as these communities face the direct impacts of climate change and the importance of local, traditional, and indigenous knowledge gains acceptance.

Could include in an Appendix with other specific Bering research groups or projects that should be mentioned:

The Bering Sea Project, a partnership between the North Pacific Research Board (NPRB) and the National Science Foundation (NSF), sought to understand the impacts of climate change and dynamic sea ice cover on the eastern Bering Sea ecosystem. The Bering Sea Fisheries Research Foundation works to provide a means for industry members, fisheries managers and crab scientists to interact and work cooperatively to conduct scientific research to expand scientific knowledge and improve the sustainability and management of fishery resources of the Bering Sea. In 2008, the NPFMC implemented the Northern Bering Sea Research Area (NBSRA) which prohibited bottom trawling in the northern part of the Bering Sea. The purpose for this was to gain further understanding of the potential impacts of trawling on the benthic and epibenthic fauna of the northern Bering Sea before authorizing commercial trawling.

Land and wildlife management

[Ask Heather for USFWS/Refuge info here]

Areas around the Bering Sea host administrative and research facilities for land and wildlife management purposes. Some areas contain remote camera facilities which aid in the collection of natural resource data. Continued efforts in this region include ecological monitoring, updating of fish and wildlife inventories, habitat improvement projects, native wildlife species introduction, and wildlife stocking.

Foreign fishing (outside of Bering Sea)

In Figure 5-22, the map in the top right illustrates the vast difference in fishing tracks between the eastern (US) Bering Sea and the western (Russian) Bering Sea. Fishing vessels dominate the overall number of vessels and operating days associated with the Russian portion of the Bering Sea, operating mostly south and west of the Bering Strait (Nuka Research and Planning Group, LLC 2016). Fishing fleets of the Far Eastern Basin annually produce and process 2.6–2.8 million tons of various aquatic living resources including 1.5–1.7 million tons of pollock. About 200 catchers and processors of various types and classes operate annually in the pollock fishery in the Far Eastern Basin (Pollock Catchers Association 2015).

In 1994, the United States and Russia formed the Convention on Conservation of Pollock in the Central Bering Sea. This international agreement between China, Japan, Korea, Poland, Russia, and the U.S. banned commercial fishing in the area between U.S. and Russian territorial waters. In this area, known as the “Donut Hole”, unregulated catches in the 1980s caused long-lasting damage to the resource. Due to political disputes over the U.S./Russian Maritime Boundary Line (MBL), the U.S. continues enforcement efforts against foreign fishing vessel activity in the area. In 2017, foreign fishing vessel activity was low along the MBL with an average of two vessels detected within 20 miles of the MBL during October (USCG, 2017).

The United States and Russia have been working to address illegal, unregulated, and unreported fishing in the Bering Sea. The Agreement Between the Government of the United States of America and the Government of the Union Soviet Socialist Republics on Mutual Fisheries Relations was signed in 1988 and set the stage for conservation, management and optimal utilization of shared fisheries resources between both nations. Other agreements to combat IUU fishing have been signed by the U.S. and Russia, as it remains a concern in the western Bering Sea, particularly for illegally harvested Russian king crab.

Non-consumptive activities

Armchair tourists appreciate knowing Bering Sea ecosystem is healthy. People who may not directly interact with the ecosystem often still share an intrinsic value for healthy marine ecosystems such as the Bering Sea. Mainstream media and shows such as “Deadliest Catch” have brought much attention to this ecosystem and the living marine resources it supports.

5.3.5 Regulatory authority

Although the geographical boundary of the FEP is fixed, fishery management boundaries vary with respect to species and agency. The FEP considers the interactions of Federal and State fisheries with each other, and with other components of the ecosystem.

[MAP OF JURISDICTIONAL BOUNDARIES]

Federal fisheries within the geographical area include those for groundfish crab, scallops, and halibut. Groundfish species in Federal waters are managed under the authority of the Bering Sea/Aleutian Islands fishery management plan. The BSAI FMP defines the Bering Sea subarea as that area of the exclusive economic zone (from 3-200 miles offshore) that is north of the Aleutian peninsula, south of Bering Strait, and does not include the Aleutian Islands subarea (that area west of 170° W. and south of 55° N.). The Bering Sea subarea accounts for approximately 95% of BSAI groundfish catch.

For management purposes, the Bering Sea subarea is divided into a series of reporting areas. Certain groundfish species may also be harvested in State of Alaska waters, within 3 nm of shore. The State of Alaska is also responsible for day-to-day management of the king crab, Tanner crab, and snow crab fisheries that take place in the Bering Sea. These fisheries are managed under the oversight of the Bering Sea and Aleutian Islands King and Tanner Crab Fishery Management Plan, which defers direct management to the State. Additionally, the State manages herring and salmon fisheires in the areas, which are wholly prosecuted within State waters. The State of Alaska uses its own grid of statistical areas to record catch and manage these fisheries.

The other regulatory areas within the Bering Sea are those of the International Pacific Halibut Commission (IPHC). DESCRIBE

Inseason data are collected at many spatial levels, including Federal reporting areas, State of Alaska statistical areas, IPHC areas. Additionally, for some directed fisheries, precise global positioning systems provide specific haul locations.

Jurisdiction for subsistence activities in the Bering Sea falls under the remit of…

Figure 5-24 describes the regulatory responsibility of various international, Federal, State, and municipal agencies over the resources and people of the Aleutian Islands ecosystem.

Figure 5-24 Regulatory responsibility in the eastern Bering Sea

Resource, Population	Agency	Responsibility
groundfish	NPFMC/NMFS ADF&G	3-200nm; population abundance; setting harvest levels, fishery management, monitoring, and enforcement 0-3nm
halibut	IPHC NPMFC/NMFS	population abundance, setting harvest levels management of fishery
crab	NPFMC/NMFS ADF&G	monitor overfishing levels, allocations harvest levels; fishery management, monitoring, enforcement
scallop	NPMFC/NMFS ADF&G	monitor overfishing levels harvest levels, fishery management, monitoring, enforcement
salmon	ADF&G NPFMC/NMFS	population abundance, harvest levels, fishery management retention prohibited 3-200nm
herring	ADF&G	population abundance, harvest levels, fishery management
other fish	NMFS	advisory authority for habitat for all fish incl nearshore watersheds
marine mammals (except walrus and otters)	NMFS	population abundance, advisory authority, protection under MMPA and ESA
walrus and otters	USFWS	population abundance, advisory authority, protection under MMPA and ESA
birds	USFWS	population abundance, advisory authority, protection under MBTA
citizens of each coastal community	Municipal entity [update]	municipal responsibility
Land [update]	USFWS BLM, DNR	protection of Alaska Maritime National Wildlife Refuge, including marine responsibility extending offshore own some small parcels
shipping	DEC USCG	oversight of spill response ensure safety of vessels in US ports and waterways
oil and gas development	BOEM DNR or DEC	3-200nm 0-3nm
military activity	Alaskan Command, Pacific Command	add
formerly used defense sites	AFCEE	cleanup
Other?		

KEY: ADF&G – Alaska Department of Fish and Game; AFCEE – US Air Force Corps of Engineers; DEC – Alaska Department of Environmental Conservation; DNR – Alaska Department of Natural Resources; DOD – Department of Defense, EPA – Environmental Protection Agency, MMS – Minerals Management Service, NMFS – National Marine Fisheries Service, NPFMC – North Pacific Fishery Management Council, USFWS – US Fish and Wildlife Service

5.4 Summary

Implementation of EBFM is not a single large action but rather a series of ongoing and cumulative actions leading to comprehensive management of LMRs. (NMFSPD 01-120).

EBFM and FEP literature sources typically highlight the importance of simultaneously considering the environmental, the economic, and the social during consideration of costs, benefits, objectives, and priorities of potential or proposed actions (e.g., Marshall et al., 2017; NMFS, 2017). This section attempted to summarize overarching characteristics of physical geography, ecological and oceanographic characteristics, and key human networks that exist in the Bering Sea ecosystem at present. Comprehensive consideration is useful for EBFM, but it does not mean that all of these characteristics will be relevant for every action. FEPs can help prioritize systemic issues that managers face, and establish goals, so that comprehensive consideration can occur in an organized way that leads to specific actions.

6 Risk analysis – PLACEHOLDER

Kerim to provide basic description for next draft.

7 List of Action Modules

Four example action modules were proposed to the Council in December 2015 when the FEP was initiated. These four modules were selected from a longer list of potential candidates by the Ecosystem Committee, to illustrate the range of ecosystem and management objectives that could be addressed through the action module process. The intent is for each action module to link specifically to one or more of the strategic objectives identified in Section 2. Not all of the example action modules are outlined in the same level of detail, but the four examples are:

- Assessment and gap analysis of Council's Bering Sea fishery management with respect to EBFM best practices
- Create a series of conceptual models of the Bering Sea based on key ecosystem and human system focal points
- Evaluate the vulnerability of key species and fisheries to climate change in order to build climate resilience climate change
- Develop a protocol for using subsistence information in management

Additionally, in spring 2017, the Team suggested, and the Ecosystem Committee concurred with, including an additional example action module:

- research tracking.

7.1 Assessment and gap analysis of Council's EBFM approach against best practices

1. Synopsis of the task, including how it will be accomplished
Conduct an assessment of the Council's Bering Sea management with respect to EBFM best practices. Evaluate different sources for a list of best practices, and then evaluate Council management across Council-managed fisheries with respect to the criteria. Also compare Council practice against the Council's Ecosystem Vision Statement, groundfish management approach statement (i.e., the objectives that came out of the 2004 Groundfish Programmatic SEIS), and the NOAA EBFM definition. Identify areas of success, and gaps indicating opportunities for improvement. Report the findings of the study in a format that communicates with a diverse audience of stakeholders.

2. Purpose it will achieve (relationship to the FEP's strategic objectives)
This assessment would serve as an internal assessment of the Council's state of EBFM practice, and a gap analysis of areas where there may be opportunity for further action. Such a gap analysis would help to prioritize areas of future work, for Council management and for other action modules. This action module is specifically responsive to Strategic Objective 2, which calls for the implementation of a cohesive plan for Bering Sea EBFM. This action module also dovetails with an identified benefit of an FEP, to be an effective tool for better communication about the Council's current integration of the ecosystem approach in its management, and is consistent with the Council's ecosystem policy.

3. How it will inform the Council's decision making and management process
On the basis of this study, the Council will have a more informed understanding of the strengths and areas of improvement of its ecosystem approach to management, and its findings will be incorporated in the core FEP. As such, there may be some benefit to begin work on this module concurrently with the preparation of the core FEP document. This module will allow the Council to prioritize its efforts with respect to initiating other action modules, and to exercise increased precaution in certain areas if appropriate. The results of the study itself will not be implemented as an FMP amendment, but if the study identifies areas in need of Council action, the Council will be prompted to initiate an appropriate response, be it a request for more research, or specific analyses.

4. How it will be integrated in the Council's decision making and management process

5. Estimate of time and staff resources required to achieve it
The assessment will require a dedicated staff person to spend two to three months compiling the background information and criteria on which to base the evaluation, and making an initial assessment of the Council's management program with respect to each criterion. Once a draft is prepared, the assessment will need input from a variety of stakeholders, ideally through an interdisciplinary team, to ensure that the review accurately captures the state of Council EBFM. Once the assessment is reviewed and finalized, staff time will also be required to turn the findings into a glossy report.

6. Plan for public involvement
Public participation in the development of this action module will be most important in reviewing the initial assessment of the Council's management program with respect to EBFM best practices. All stakeholders are affected by the process by which the Council manages fisheries, and may have input into the assessment of both EBFM best practice benchmarks, and how the Council management program measures up against them. While the Council process will provide one avenue for facilitating input from stakeholders, it may be more inclusive to schedule other opportunities to solicit input on the review. A discussion of EBFM practices should address how human observations, whether from TK and LTK, are used in Bering Sea fishery management, and there should be specific outreach to experts to review the findings on this topic. Once the report is prepared, there should also be a broader effort to publicize the findings outside of the Bering Sea ecosystem region.

7.2 Create a series of conceptual models for the Bering Sea ecosystem

1. Synopsis of the task, including how it will be accomplished
Non-quantitative ecosystem "conceptual models" (system diagrams) will be created to each highlight a key ecosystem component (e.g. "groundfish", "crabs", "salmon", "marine mammals", "Norton Sound coastal communities") and detail our conceptual understanding of the pressures and drivers that contribute to the status and trends of that sector. This will allow the scope to be organized from the entire ecosystem into a set of connected ecosystem components, each one of which may be researched separately or as a whole. For the development of these models, the analysts will consider the appropriate geographic scope, even if it is outside of the Bering Sea ecosystem boundary that is defined in the FEP.

2. Purpose it will achieve (relationship to the FEP's strategic objectives)
It is envisioned that using these conceptual models to frame the scope will greatly improve the targeting of specific research, as well as ensuring that no critical components are missed. These conceptual models will also serve to synthesize ecosystem information for the Council as well as the public, through inclusion in glossy documents and presentations. As such, this action module is directly responsive to Strategic Objective 1, as well as the FEP intent to serve as a communication tool for ecosystem science.

3. How it will inform the Council's decision making and management process
By illustrating connections among ecosystem components, both environmental and human, the models will help the Council in assessing tradeoffs of management actions on different components of the ecosystem, leading to more informed decision making. It may be that the conceptual models are most effective integrated into the FEP strategic document.

4. How it will be integrated in the Council's decision making and management process

5. Estimate of time and staff resources required to achieve it
The development of the models will require an interdisciplinary and interagency team of scientists, and a graphic designer or scientist with exceptional graphic design skills. The time commitment will vary based on how many different models are determined to be most useful.

6. Plan for public involvement
For this module, the Council may solicit public input in order to identify priorities for conceptual models (for example, which three specific ecosystem components should be the focus of the first conceptual models). Stakeholders will also be involved in the review process for conceptual modules, through the Council process.

7.3 Evaluate the short- and long-term effects of climate change on fish and fisheries

1. Synopsis of the task, including how it will be accomplished

One out of every two fish captured annually in the US comes from Alaska, and regional fisheries represent a 4 billion dollar a year industry, nearly half of which is supported by Bering Sea groundfish harvest. Groundfish fisheries in the Bering Sea have a long history of sustainable management and population vitality, fueled in part by cold nutrient rich sea-ice dynamics and seasonal recharging of the marine ecosystem. These processes are highly driven by climate conditions that are projected to change markedly over the next 50 to 100 years; specifically water temperatures are anticipated to increase and the duration and frequency of productive "cold" regimes is projected to decline.

Future fisheries management in the Bering Sea will face two major challenges with respect to climate change. On one hand climate change may have rapid and widespread effects on fish and fisheries that may result in both "losers" and "winners" under future conditions. Climate change may cause changes in survival, growth, phenology (timing), distribution, behavior, fisheries catchability, and strength of species interactions, which may contribute to declines in some species while benefiting others. Some of these changes may occur gradually, whereas other species may exhibit sudden, novel, and threshold-like changes in abundance and distribution in response to changing climate conditions (i.e., as conditions cross ecological "tipping-points").

At the same time, as a major contributor to national capture fisheries, Bering Sea fisheries will also need to maintain or increase the amount of protein extracted from the sea in order to feed the future population of 9 billion people (2050 UN estimate). This will require efficient and sustainable approaches to fisheries and cutting edge, "climate-ready" fisheries management tools and policies. Some of these tools may already be in-hand (e.g., annual harvest rates, sloping control rules, ecosystem-based limits) and should be preserved going forward, others, especially long-term and absolute management policies (e.g., protected areas, annual biomass caps, minimal biomass thresholds), which by design remain stationary even when conditions are variable, may be vulnerable to the one-way trajectory of changing conditions and might require modification or periodic revaluation.

Under this climate module, climate change research teams associated with various ongoing projects would coordinate to provide a synthesis of climate change impacts on Bering Sea fish and fisheries, present results to the Council for feedback, and work with the council and stakeholders to develop management scenarios for additional, targeted climate-change management strategy evaluations (MSEs). The end product is a climate change and fisheries MSE report (e.g., " Bering Sea Fisheries and Climate Change Assessment Report"), specifying short-, medium-, and long-term management actions to build climate resilience in regional fisheries, develop or expand fisheries for species thriving under climate change, and mitigate for climate-induced declines for species negatively impacted by future conditions. These tactical and strategic policies could be implemented as needed between module cycles (see section 3 for more detail).

The primary goal of this climate module is to leverage ongoing and completed projects at AFSC in order to ensure climate resilience in the region's fishery management. Specifically the module will:

1. coordinate to synthesize results of various ongoing and completed climate change research projects including, but not limited to:
    - *The Rapid Climate Vulnerability Assessmen*t (funded; 2016), which will identify "winners" and "losers" under climate change.
    - *ACLIM: A multi-model assessment of climate change impacts on fish, food-webs, and fisheries in Alaska* (funded; 2015-2017), which will use management strategy evaluations (MSEs) to produce biomass trajectories for 5 target species under high and low future emission scenarios and various alternative harvest strategies.
    - *Predicting changes in habitat for groundfishes under future climate scenarios using species distribution modeling (proposed; 2017), which will project EFH under future climate scenarios in order to estimate potential shifts in BSAI FMP species distributions and potential fishing grounds.*
2. evaluate the scope of impact on few priority species identified in studies from step (1),
3. strategic revaluation of management strategies (every 5-7 years). The climate change module team would work with the council to iteratively identify and assess the performance of potential short-term, medium and long-term management actions for climate adaptation (i.e., derive alternative strategies for MSEs).

2. Purpose it will achieve (relationship to the FEP's strategic objectives)

Results of this module will help the Council track climate impacts on Bering Sea fish and fisheries and ensure that fisheries management in the region is flexible enough to adapt to rapid shifts in species distributions or abundances under future conditions. This action module is specifically responsive to Strategic Objective 3, to establish a process for addressing change under novel or intensified stressors, as well as the implementation strategy of the Council's ecosystem policy vision statement. Initial studies suggest that the realized outcome of potential climate change impacts on fish and fisheries in the Bering Sea largely depends on harvest strategies in the region. Climate change represents an additional source of variability to the system that needs to be accounted for in trade-off analyses and future policies. Fortunately, completed and ongoing studies have advanced regional understanding of potential climate change impacts.

The challenge that remains is to identify management measures that provide scope for fisheries to adapt to future climate conditions. This includes management actions to attenuate declines for target species and species of concern negatively impacted by climate change as well as potential increased harvest of species that benefit from future climate conditions and changes in accessibility to fishing grounds. Of particular interest is the future performance of existing management approaches, and ecosystem-based management measures such as protected areas, no-fishing zones, sector/gear specific fishing grounds, minimum biomass thresholds, and aggregate total harvest limits.

Nesting this action module within the Bering Sea FEP provides two specific benefits to the Council. While the action module leverages ongoing AFSC research projects on climate change, including it in the FEP provides a direct link for the Council to be involved in prioritizing that research to focus on questions that are most relevant for the Council's fishery management. This is in keeping with the FEP's purpose to facilitate dialogue between managers and scientists. Secondly, this action module would also remove year-to-year reactivity by the Council to the annual state of environmental variables, by providing a better context of the longer-term trends of those variables. This module will provide a seven-year climate context within which to interpret and respond to annual signals, and will establish a more formal process for considering those variables. This is responsive to the FEP purpose to build resiliency into the Council's management strategies, and to provide options for responding to changing circumstances.

3. How it will inform the Council's decision making and management process

Climate-ready fisheries management will help continue the legacy of sustainable fisheries management in the region, including management to promote a productive marine ecosystem and healthy vibrate marine fisheries. Results of the module will inform short, medium, and long-term "climate ready" tactical and strategic management measures, such as:

Short-term (1-3 years):

- preservation of in-hand "climate-ready" fisheries management approaches that are flexible enough to adjust to rapid and long-term shifts in species distributions and abundances (e.g., annually or bi-annually updated % biomass-based F rates, minimum biomass thresholds, sloping control rules).
- Development and evaluation of frequency of stock assessments (e.g., are assessments conducted on a 2 or 3 year cycle more likely to "get it wrong" under climate change than annual assessments?).
- Development and performance of climate-enhanced single- and multi-species reference points (e.g., temperature-conditioned FABC from multi-species assessment models).
- Evaluation of economic and biological impacts of changes in the timing of seasonal openings/closures (i.e., to compensate for shifts in phenology under climate change).

Medium-term (5-10 years):

- Evaluation, scoping, and market development for new or increasing fish species
- Development of climate-specific biomass targets for fishery rebuilding plans under future trajectories (i.e., when declines are also due to climate change).
- Strategic planning for gradual (rather than abrupt) fishery closures for populations projected to decline under future conditions
- Gear modifications and technological development to decrease by-catch rates for new or expanded "choke" species under climate change

Long-term:

- Periodic evaluation of long-term management measures to ensure continued conservative performance (e.g, MPA boundary adjustments to encompass expanded or retracted distributions or reductions in harvest cap to reflect potential reductions in groundfish biomass)
- Increases or decreases in lower limits of sloping control rules to reflect long-term shifts in abundances of forage species.

4. How it will be integrated in the Council's decision making and management process

Short-term "climate-ready" management actions can be developed and implemented relatively quickly, thus climate change management strategy evaluations would be focused on testing their performance under the full scope of potential future conditions. In contrast, modification of medium- and long-term management measures require more specific characterization of risk and uncertainty around future trajectories, mandating thorough scientific evaluation as well as ample stakeholder and council review and feedback and would take years to develop and implement if deemed necessary. Thus evaluations should be initiated early on and should continue until performance under various policies options is fully evaluated.

The climate module proposed here could include a strategic revaluation every 5-7 years, reflecting but not concurrent with the cycle of the IPCC Assessment Report, which provides updated projections of climate conditions under future carbon emission scenarios every 7 years. The module would require between 1-2 years to complete (depending on the number and complexity of management strategy evaluations developed by the team, Council, and stakeholders). The end result would be specific recommendations to inform short, medium-, and long-term management measures. Short- and medium-term management measures (see section 4 for examples), could be implemented or modified according to module results and included in the assessment cycle. As an example, the module could be initiated in 2017 and synthesis of current research presented to plan teams and the Council along with proposed species and management strategy evaluations in the fall of 2018. Based on Council and public feedback, refined MSEs and target species would be finalized in the winter of 2018, and MSEs conducted during 2019 and presented to the Council in late 2019 (and/or 2020 depending on the scale of the analyses) in the form of *The Bering Sea Fisheries and Climate Change Assessment Report*. Results would also be communicated to IPCC authors for inclusion in the next IPCC Assessment Report (2021) chapter on climate change impacts on the world's oceans. During the module interim years of 2020-2025, research would continue independent of the module, using updated global forecasts with new IPCC emission scenarios; in 2025 the module would be initiated again.

While the strategic revaluation could be updated every 5-7 years, information from the module could be included in annual assessments in the form of tactical and strategic management policies. For example, climate projections and vulnerability scores for species evaluated under the climate module could be included in annual species-specific stock assessments and/or the Bering Sea Ecosystem Assessment of the Ecosystem Consideration Report in order to provide broader context for current biomass trends (e.g., species A has been identified as a species that may decline under climate change therefore current declines in biomass may reflect long-term declines rather than annual variation). This information can provide a frame of reference for setting harvest recommendations and implementation of other management actions. Alternatively, climate-specific biomass reference limits (e.g. temperature-specific F_{ABC}) are derived using projections of environmentally enhanced single- or multi-species assessment models, and can be used to set harvest rates that account for future climate variability. If management strategy evaluations as part of objective (3) of the module determine the performance of these reference points is acceptable or preferable, they could be used to set harvest recommendations (or alternatively, could be presented along with status-quo assessment values). See above for additional examples.

5. Estimate of time and staff resources required to achieve it

Multiple ongoing projects at AFSC are already providing the logistical and analytical support to meet objectives 1 and 2 of the module, as well as provide the modeling platforms for objective 3. These climate assessment teams are working closely together with each other and with PMEL researchers to expand the suite of climate projections, which are updated roughly every 5-7 years when new global climate model results are made available under revised IPCC carbon emission scenarios. These climate teams have already assembled a number of ecosystem and climate-enhanced single species models, essential fish habitat models, as well as management strategy evaluation sub-modules for some of the ecosystem and assessment models. Thus the expert teams, analytical capacity, and climate scenarios are already available for some species. The rapid climate assessment being conducted during 2016 provides a framework for quickly and efficiently identifying additional species that may be impacted. Similarly, the other projects maintain the operational readiness of AFSC to evaluate climate impacts on Bering Sea species and additional ecosystem models or species additions to existing models could be readily be implemented for future evaluations.

Inter-disciplinary teams like those already assembled for ongoing projects will be needed to conduct the full 5-7 year MSE evaluations, but personnel needs will depend greatly on the number and complexity of MSE scenarios and the number of new species evaluations.

6. Plan for public involvement

For this module, the Council may solicit public input in order to identify priorities for MSE evaluations. Stakeholders will also be involved in the review process for conceptual modules, through the Council process.

7.4 Develop a protocol for using subsistence information in management

1. Synopsis of the task, including how it will be accomplished

Subsistence use of marine resources has been a part of the Alaska Native's relationship with the Bering Sea for thousands of years. In recent years, the potential impacts of commercial fisheries on subsistence resources or use patterns have received increasing attention. Organizations such as the Alaska Marine Conservation Council and the Bering Sea Elders, and Pew Charitable Trusts, Oceana, and Kawerak, Inc. have begun working to describe and document the subsistence use patterns of Alaska Native communities in the Bering Sea region[19]. These traditional use data are now available in map and GIS formats that allow managers to evaluate them for potential conflicts with commercial fisheries. In addition to NGO data sources, the State of Alaska Department of Fish and Game Subsistence Division has ongoing projects to document traditional use patterns and would provide a wide range of subsistence use data. Now, the North Pacific Fishery Management Council is interested in understanding the ways that removals from commercially important fish stocks may affect the subsistence resources important to Alaska Native communities, or affect the resource use patterns of those communities.

A Bering Sea Fishery Ecosystem Plan provides opportunity for the Council to prescribe how subsistence use and other traditional data will be used to describe and understand the potential impacts of commercial fisheries on subsistence resources and use and, if appropriate, mitigate those potential impacts to ensure that subsistence use of marine resources continues unabated in the Bering Sea. Where subsistence use data are available, they can be incorporated into models that predict fishery behavior or responses to changes in conditions or regulations. Where the potential for conflict (methods to be determined later) exists, that potential can be evaluated and mitigation measures proposed, where necessary.

2. Purpose it will achieve (relationship to the FEP's strategic objectives)

The subsistence module of the Bering Sea FEP will prescribe the way that subsistence data are incorporated into Council analyses, and will describe the circumstances in which measures may be necessary to mitigate potential impacts to subsistence resources, or the use of those resources by Alaska Natives. The FEP will not automatically require mitigation for circumstances where the potential for impacts exist, nor will the FEP limit the sorts of actions that the Council may take. Rather, the FEP will provide a roadmap for the Council to follow to assess the likelihood of impacts and develop mitigation measures should they be necessary. This action module is responsive to Strategic Objectives 1 and 2, to synthesize the current understanding of Bering Sea ecosystem processes, and create a cohesive plan for EBFM.

3. How it will inform the Council's decision making and management process

The subsistence module of the Bering Sea FEP, once completed, will affect the Council's decision-making by directly providing an assessment of the likelihood that a Council action would affect subsistence resources or the ability of Alaska Natives to access those resources. The subsistence module would provide ready access to subsistence data for use in analyses, and provide a guideline for when mitigation may be necessary. Management measures may be changed by consideration of subsistence data, but there are likely to be many circumstances when subsistence resources or subsistence use would not be affected by a management decision. Where management measures may be changed, the Council may, ultimately, be more responsive to National Standard 8, when fishing communities also rely on subsistence resources.

[19] Northern Bering Sea Mapping Project available at http://www.akmarine.org/fisheries-conservation/protect-habitat/northern-bering-sea-initiative/ and Bering Strait Marine Life and Subsistence Use Data Synthesis available at http://oceana.org/publications/reports/the-bering-strait-marine-life-and-subsistence-data-synthesis.

4. How it will be integrated in the Council's decision making and management process
The subsistence module of the Bering Sea FEP will provide a framework and data for analysts to consider whether fishery activities or changes in regulation are likely to impact subsistence resources or patterns of subsistence use. It is anticipated that incorporating subsistence data in to the Council process would involve adding a section to future analyses. Some actions would require no additional section, for other actions the additional section could be much longer and more involved. If included in the discussion paper and preliminary draft stages, it is likely that subsistence data would be considered during the development of alternatives, and impacts to subsistence resources or use would be considered throughout the Council process.

5. Estimate of time and staff resources required to achieve it
The major hurdle to incorporating traditional use data into management decisions has been the collection of data and preparation of data products. The State of Alaska Division of Subsistence reports, and the Northern Bering Sea Mapping Project and Bering Strait Marine Life and Subsistence Use Data Synthesis are products that have made subsistence use and subsistence species occurrence data available to fishery managers. The collection and preparation of these data products are major undertakings that the Council is not staffed to accomplish. The Council will, therefore, continue to rely on other organizations to collect and prepare subsistence data. To develop the subsistence module of the FEP, it is likely that the Council would need to develop a partnership with Alaska Native organizations (Kawerak, Bering Sea Elders…), organizations that are familiar with subsistence data (Pew Charitable Trust, Oceana, AMCC…), social scientists, and agency scientists to ensure data quality and ensure that data and products are in a form that is useful to fishery analysts. This would likely be a 6-12 month process to collect existing data, and a smaller recurring commitment to maintain the dataset. Once the data are in a format (GIS, maps, other?) that can be accessed and used by analysts, there would be little commitment of Council time or staff resources to incorporate the data into analyses. Some regular staff time would be required to update descriptions in the FEP.

6. Plan for public involvement
As described above, the Council is reliant on partnering with other organizations to collect and prepare subsistence data, and for this module, it is anticipated that subsistence experts would need to be actively involved on the development team for this module. Outreach to those partner agencies and their constituents would be important in verifying the data and products to use in management.

7.5 Research tracking

The Council prepares and modifies fishery management plans (FMPs) for fisheries under its jurisdiction. Each FMP contains a suite of management tools that together characterize the fishery management regime. These management tools are defined in the FMP and its implementing regulations and require a formal plan or regulatory amendment to change. Amendments to the FMPs or regulations are considered at each meeting by the Council, with proposed amendments submitted by both the resource agencies and the public. As a result, the FMPs and fishery regulations are dynamic and are continuously changing as new information or problems arise.

Council and NMFS staff prepare regulatory and fishery management plan amendment analyses for decision-making, with a focus on economics, social science, biology, ecosystems, and habitat. The Council relies on original research from partners such as NMFS, ADF&G, IPHC, other Federal agencies and academia in order to evaluate potential management actions.

The Council identifies priorities for research relevant to the activities that are most important for the conservation and management of fisheries, to provide guidance to the research community and funding agencies. Research priorities are currently organized into four categories: critical ongoing monitoring, urgent, important (near term), and strategic (future needs). These categories place less emphasis on the relative value of research topics and more emphasis on the correspondence of research to the Council's time horizon of management concerns.

For several years, the Council has been working to make the identification of research priorities more relevant and useful. This includes both providing better guidance to researchers about the Council's needs for information for management, and better tracking of new research that is being undertaken and may be useful. This has led to an effort to develop a research tracking process, that relates the Council's research priorities to specific management actions that are affected by that research. In the context of the FEP, the focus would be on tracking research that is relevant to the FEP action modules, and how that information is subsequently used in management. The Council seeks to strengthen existing partnerships with organizations that support and perform research, as sharing reciprocal information about the research needs and outcomes is mutually beneficial.

7.5.1 Identification of Partners

Primary partners to participate in active information sharing with the Council for the Bering Sea FEP were identified as the North Pacific Research Board, Alaska Department of Fish & Game, and NOAA National Marine Fisheries Service. These partners were chosen based on pre-existing relationships and an active research presence in the Bering Sea region. Direct examples of existing engagement are noted under each organization. A full listing of identified on-ramps for collaboration is presented in **Table 1**.

North Pacific Research Board

The mission of the North Pacific Research Board (NPRB) is 'To develop a comprehensive science program of the highest caliber that provides a better understanding of the North Pacific, Bering Sea, and Arctic Ocean ecosystems and their fisheries.' The NPRB has historically funded basic and applied science that has relevance to Council management actions. Despite several informal linkages, there is no standard protocol for the transfer of information that would be relevant to both NPRB and the NPFMC. Similarly to the Council, the NPRB has significant interest in developing and strengthening relationships that promote effective application of previously-funded research and contribute to maintaining robust research programs.

Examples of existing NPRB engagement with the Council:

- the NPRB Board includes a member of the Council, and Council staff participate in Science Panel and peer review activities
- final report summaries are provided to Council staff on a regular basis
- a summary of newly-funded projects is provided for each Core program RFP

Alaska Department of Fish & Game

The Alaska Department of Fish & Game (ADF&G), Westward Region, conducts ongoing shellfish, groundfish, salmon, and herring research to support and improve fisheries management in the Bering Sea and Aleutian Islands. This effort often involves both traditional and innovative cooperative research ventures with other State, Federal, International, and private agencies including the National Marine Fisheries Service. Research projects encompass state-managed fisheries within state waters and fisheries that are managed under a cooperative state-federal management regime. The goal of ADF&G is to ensure that some of the largest and most valuable fisheries in the world (Bering Sea/Aleutian Islands and Gulf of Alaska groundfish, shellfish, and salmon fisheries) are limited to a sustainable harvest in accordance with state and federal regulations. ADF&G is an example of an agency that could greatly benefit from a enhanced partnerships with the Council and NPRB, as research needs continue to grow and budgets continue to shrink.

Examples of existing ADF&G engagement with the Council

- Within the respective Council FMPs the State of Alaska, through ADF&G, is delegated certain management responsibilities, or shares management of certain fisheries with NMFS, in Alaska (BSAI crab, statewide scallops, etc).
- At each Council meeting ADF&G staff presents a report to the Council updating fisheries managed by the State of Alaska that are also managed under federal rules, or are delegated within an FMP.
- ADF&G staff participate on various Council Plan Teams, working groups, and Committees (Scallop Plan Team, Gulf of Alaska and Bering Sea Aleutian Islands Plan Teams, Crab Plan Team, Electronic Monitoring Working Group, Enforcement Committee, Legislative Committee, etc.). As part of Council Plan Teams, ADF&G staff compile various stock assessments either as a lead or co-author, which are included in the Council's Stock Assessment and Fishery Evaluation (SAFE) reports. Additionally, ADF&G staff not actively members of Council Plan Teams give presentations to various Council Plan Teams, working groups, and Committees on various topics relevant to stock assessments or fishery management (e.g., BSAI crab observer program).
- ADF&G currently has two staff members on the Science and Statistical Committee.
- The Commissioner, or designee, is a voting member of the Council. Through this seat, the Commissioner can develop and present motions for specific issues, incorporating public input, and biological or scientific recommendations from the Council Plan Team(s), committees or working groups.

National Marine Fisheries Service

Will pull in information from Section 4.5.1

7.5.2 Synergistic Opportunities

Modern approaches to the assessment of impact are most effective with a wider-ranging, collaborative effort and bi-directional flow of information. A review of the basic and enhanced avenues for communications from NPRB, as a representative funding agency, to the Council and other potential partners (e.g., ADF&G, NOAA) is summarized in Table 7-1 and Table 7-2, and illustrated in Figure 7-1.

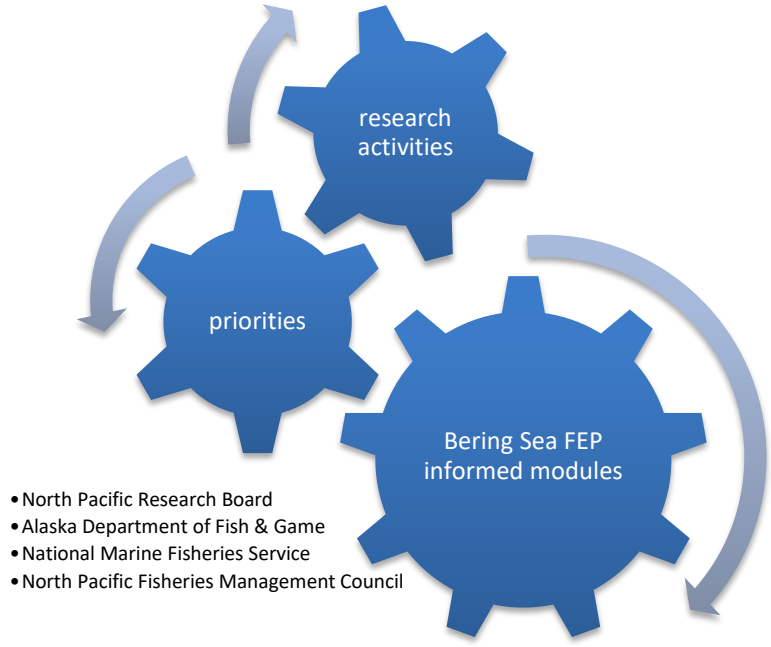
Table 7-1 Basic and enhanced avenues for information transfer among partners

NPRB	Basic	NPRB Board includes a seat for the Council
		NPRB Science Panel typically includes one Council staff member
		Council staff participate in external peer reviews of NPRB proposals
		consideration of Council priorities during the development of the Core RFP
		inclusion of "Management and Ecosystem Implications" narrative section in proposals
		regular distribution of final reports to Council Staff (quarterly to semi-annually)
		access to NPRB publication library
		information of newly-funded projects provided to Council staff
	Enhanced	development of a standard practices document that outlines intent and defined pathways to share information in a meaningful manner for both parties
		specific Council priorities highlighted to the NPRB during RFP development (e.g. FEP relevance)
		inclusion of Council-specific tracking tags to proposal metrics (e.g., FEP, risk analysis)
		Council staff engage NPRB staff on relevant teams (e.g., Bering Sea FEP)
		facilitation of access to NPRB embargoed data for time-sensitive analyses
ADFG	Basic	ADF&G engages NPRB staff with list of research needs for improving management capabilities.
	Enhanced	Develops research plan that aligns with NPRB RFP and NPFMC action module priorities
		Makes specific action module recommendations
		Submits proposals to NPRB with specific relevance to NPFMC action module objectives
NMFS	Basic	
	Enhanced	

Table 7-2 Synergistic information transfer summary

Action	COUNCIL	NPRB	ADF&G	NMFS
Shared panel membership (e.g., NPRB Science Panel, BS FEP)	•	•	•	•
Data access	•	•		
Active project listings shared on annual basis	•	•		
Research priorities shared on annual basis	•	•		
Funding opportunities		•	•	•
Targeted PI engagement during research activities		•	•	•

Figure 7-1 Synergistic information transfer summary



7.5.3 Specific Action Items

The following initial list of action items is described in greater detail below.

- Listing of completed NPRB-funded research with Council management relevance (provide narrative for one example, remainder in Table/Appendix)
- Full listing of Bering Sea related newly-funded 2017 NPRB Core program projects for test case(s) selection
- Consideration of additional tracking methods in the NPRB Core Program (proposal tracking tags, reporting format, RFP encouragement)
- FEP reporting to other research modules (mini-report of ongoing relevant research)
- Identify algorithm for context-specific use of relevant keywords in Council-related meetings

Listing of completed NPRB-funded research with Council management relevance (example).

While the mission of NPRB includes both basic and applied science at equal measure, projects submitted to and funded by NPRB have historically been encouraged to identify relevance to management issues. Project 1304, A stock assessment method for north Pacific fish and invertebrate stocks which allows for age and length dynamics (André Punt, University of Washington), is used below as an example of the type of project that may have specific management relevance, as well as to demonstrate the information currently provided during the course of the project. Text provided is an excerpt from the initial proposal (Summary of Proposed Work) and final report received in 2016 (Abstract, Conclusions and Management or Policy Implications). Considerations may be taken on how to increase the amount of useful information transfer in future NPRB-funded research as discussed above (e.g., proposal tags, specific proposal text relating to management, sharing of progress and final reports, encouragement of presentations to Council and NPRB-related groups).

> ***Project 1304: A stock assessment method for north Pacific fish and invertebrate stocks which allows for age and length dynamics (André Punt, University of Washington)***

Abstract. Fishery stock assessments are frequently based on age-structured population dynamics models for fish and size-structured population dynamics models for invertebrates. A new modeling framework is developed and implemented to account for both age and size dynamics for an individual fishery. An age-size assessment model is unique in its ability to capture the dynamics of fishing and natural mortality on fished populations, which are functions of both length and age. The new modeling framework can make use of a broad range of data types, including time-series of catches, bycatch, indices of absolute and relative abundance, size- and age-compositions, conditional age-at-length data, and information on growth from tagging. The modeling framework is applied for illustrative purposes to data for three stocks managed by the North Pacific Fishery Management Council: Eastern Bering Sea Tanner crab (Chionoecetes bairdi), Pribilof Islands blue king crab (Paralithodes platypus) and Eastern Bering Sea Pacific cod (Gadus macrocephalus). A simulation study is used to explore several key questions related to conducting stock assessments for North Pacific fish and invertebrate stocks. These simulations identified that 1) purely age-based approaches lead to bias due to model mis-specification when the population dynamics are age- and size-based, 2) model selection methods have the potential to improve the accuracy of quantities of importance to management, and 3) estimation performance is improved by estimating time-varying selectivity, even when selectivity is actually time-invariant.

Conclusions. This project has developed one of the first frameworks for conducting stock assessments based on an age- and size-structured population dynamics model. This framework has the potential to unify the methods typically used for stock assessments of fish stocks (which tend to be based on age-structured models) and those typically used for stock assessments of invertebrate stocks (which tend to be based on size-structured models). The framework can be applied to a broad range of types of stocks for which assessments are needed and lead to results that are generally comparable with those for the actual assessments. However, results can differ substantially, which motivated and focused simulation evaluation of estimation performance. The simulation analyses highlighted the impacts of basing assessments on the "incorrect" population dynamics models and the sensitivity of the assessments to the treatment of time-varying selectivity in assessments.

Management or Policy Implications. The results suggest that violations of the assumptions of stock assessments can lead to biased estimates of spawning stock biomass and other quantities of management importance, including overfishing levels computed using the types of harvest control rules used by the North Pacific Fishery Management Council (NPFMC). Biases can be minimized through the use of stock assessment methods that (a) are based on an age- and size-structured model, or (b) the best model from a set of candidate models with different structural assumptions. The models considered in relation to multi-model inference were structurally quite different (although the size-structured model was a special case of the age- and size-structured model). This is in contrast to current assessments which when they present results for multiple models, consider alternative models that differ in terms of, for example, patterns of selectivity and how they change over time. If the type multi-model-based approaches to stock assessment considered in Chapter 5 were to be adopted broadly this could lead to marked increases in demands related to resources (in particular time for analysts and for peer-review) in addition to lower levels of bias and increased precision.

The model developments have fed into the NPFMC Crab Plan Team process. In particular, Equation 3.3a, which provides an equation for total mortality accounting for survival of some discards, is considered the correct approach and will be used in the September 2016 assessments for eastern Bering Sea Tanner crab and St Matthew Island blue king crab. The use of this equation was presented to the Scientific and Statistical Committee of the NPFMC. In addition, some of lessons (programming and mathematical) learned during the development of

*the age- and size-structured model have fed in into the development of assessment models for crab stocks, and in particular the structure of the GMACS framework (*https://github.com/seacode/gmacs*), which should eventually be the basis for the stock assessments conducted for crab stocks in the North Pacific.*

Full listing of Bering Sea related newly-funded 2017 NPRB Core program projects for test case(s) selection.

Currently, NPRB informs the Council about final projects. This would be an opportunity to let the Council know early on about projects that may have relevance and which are just beginning. It is the goal of this particular action item to work more closely with the PI throughout the life of the project, rather than providing unidirectional information.

The tracking system would be piloted in 2017 with a limited number of select cases recommended by the NPRB program manager and endorsed by the research tracking module team. A report will be provided to the team for selection which includes the project title, summary, and the management implication section of the proposal.

PIs of selected projects will be contacted to determine their interest in participating in research tracking module. Participation levels may vary, but may include items such as:

- sharing semi-annual progress reports with the Council
- provide an opportunity for the Council to present direct feedback to the PI
  - for example, informing the PI if the Council is particularly interested in a related research question or management actions
- direct presentation of the research outcome to the Council/Council bodies (eg, SSC, Plan Teams), as relevant

The first test case identified (1713 Genetics of mating dynamics in EBS snow crab) has clear management application, and includes both ADF&G and UAF investigators.

NPRB project 1713, Genetics of mating dynamics in EBS snow crab (Laura Slater, ADF&G and Gordon Kruse, UAF) has agreed to be a test project.

Abstract: Snow crab (Chionoecetes opilio) in the eastern Bering Sea (EBS) support the largest and most valuable crab fishery in Alaska, which is managed with large male-only harvest policies. Yet, little is known about the influence of male-only harvest on female reproductive output. Indicators of female reproductive potential that integrate information on mating success are needed to improve upon the proxy for stock productivity, mature male biomass, currently used in management. Female sperm reserves are a direct indicator of mating success between the harvested portion of the stock and female contribution to population renewal processes. Evaluating spatiotemporal trends in female sperm reserves has provided critical insight into functional relationships among female reproductive potential, maternal characteristics, and mating success. However, interpretation is hampered by a lack of empirical information on contributing male mates, including the extent to which interspecies mating occurs, as evidenced by the presence of viable snow-Tanner hybrid crab in the EBS. Our research approach is to determine the extent of snow crab polyandry, multiple paternity, and interbreeding between species using genetic methods. We will develop and validate genetic markers and determine the number and species of males contributing to sperm reserves of primiparous and multiparous snow crab in the EBS and the paternity of the embryos brooded by those females. These data will allow for better understanding of spatiotemporal trends in sperm reserves and fecundity in relation to the relative abundance and distribution of males by species and size-shell-maturity

classes. That improved understanding is essential for development of measures or indices of effective spawning biomass or fertilized egg production for EBS snow crab, which would bring greater clarity to annual stock assessments and fishery management.

Management or Ecosystem implication: Fishery management of snow crab is based on reference points, which ideally index the productive capacity of the stock. However, mature male biomass is used as a proxy due to a lack of understanding of how large-male harvest may influence female reproductive potential (NPFMC 2016). Female sperm reserves are a direct indicator of mating success (e.g., connectivity) between the harvested portion of the stock (large-males) and female contribution to population renewal processes (eggs). Determination of the males contributing to the sperm reserves and brooded embryos of snow crab will provide critical insight for interpretation of a decade-long quantitative index of female sperm reserves by providing empirical information. This of particular importance in the SE region of the EBS shelf where snow crab sperm reserves are persistently higher than in other regions, harvest is intensive, and female snow crab are co-distributed to a higher degree with mature male Tanner crab than in other regions. Ultimately, our data on spatiotemporal variation in monandry vs. polyandry could be associated with fishery intensity and estimates of sex ratio to develop a refined index of reproductive potential that integrates empirical information on male harvest. Such an index could be incorporated into future research to develop improved methods for length-based stock assessments (Zheng et al. 1998), stock-recruit analyses (e.g., Zheng and Kruse 2003), management strategy evaluations of harvest policies (Zheng and Kruse 1999), and analyses of rebuilding plans (Zheng and Kruse 2000). Additionally, our development of robust genetic methods to distinguish between crabs within the snow, Tanner, and snow-Tanner hybrid crab complex can be leveraged to address a pressing fishery management issue by providing a tool to quantify the proportion of snow-Tanner hybrid crab in annual snow and Tanner crab harvests, which has been demonstrably unachievable based on morphological criteria (Urban et al. 2002).

Consideration of additional tracking methods in the NPRB Core Program (proposal tracking tags, reporting format, RFP encouragement)

The prospect of adding research tracking tags to the 2018 NPRB Core program RFP with the intention to provide approximately 5 tags that are robust enough to be used consistently over several years. This concept was presented to the SSC in June 2017, however, agreement was not reached on ideal selections. There may be potential to discuss this on a broader scale in conjunction with an evening work group at a spring Council meeting, with incorporation into the 2019 Core Program RFP.

The FEP team provided input at the April and September 2017 meetings. The request was to specifically identify if unique BS FEP tags would be useful, or if general Council tracking tags would be sufficient when combined with existing geographic and methodology tags. It was recommended by the group that the addition of EBFM and risk analysis would be preferred identifiers.

- Addition of “Management and Ecosystem Implications” section to semi-annual reports?
- Addition of “Management recommendations” section to final reports?
- Add broad language to NPRB RFP to encourage participation and presentation to relevant Council groups as part of budget considerations

8 Public involvement plan

In order for the Bering Sea FEP to become fully operational, it is important that outreach and public involvement take place at every stage of planning, composing, finalizing and operationalizing this document. The Council already has a robust system for receiving stakeholder input (e.g., through public comments during meetings, as well as participation on Plan Teams, Committees, and Workgroups). One of the primary goals of the Bering Sea FEP is to continue to strengthen processes for conducting meaningful outreach and integrating input from the public in the fisheries management process.

The public have a space for involvement at every stage of the FEP process, and the Council supports involvement from the public in all arenas of creating and operationalizing the Bering Sea FEP. The Lenfest group (2016) produced a conceptual model for translating goals into action, named 'The FEP Loop' (Figure 8-1). Figure 8-1 provides a visual representation of the 'Loop', as a nonlinear process based on learning and adjusting over time. There is potential for public outreach and involvement to fall within every aspect of the FEP Loop (Lenfest, 2016). The Loop recommends five considerations be re-assessed on a continuing basis throughout the FEP process: 1) Where are we now? 2) Where are we going? 3) How will we get there? 4) Implement the plan, and 5) Did we make it?

Figure 8-1 The FEP Loop.

Source: Lenfest 2016, page 23

The primary Federal mandate for Native consultation is Executive Order 13175, which requires executive agencies to establish regular and meaningful consultation and collaboration with Indian tribes in the development of Federal policies that have tribal implications. "Policies that have tribal implications" refers to regulations, legislative comments or proposed legislation, and other policy statements or actions that have substantial direct effects on one or more Indian tribes, on the relationship between the Federal government and Indian tribes, or on the distribution of power and responsibilities between the Federal government and Indian tribes. The Council does not fall under the definition of executive agency for the purposes of E.O. 13175 and is not required to provide formal consultation with tribes. This does not mean

that the Council could not be party to a consultation process undertaken by NMFS, but it does mean that the responsibility for consultation as required under E.O. 13175 remains with NMFS.

Notwithstanding, it is the Council's independent desire to improve communication and consultation with communities and Alaska Native entities. In 2004, the Council adopted the following priority goal statement and accompanying objectives in the groundfish management policy that is in the Council's groundfish FMPs:

> *Increase Alaska Native and Community Consultation*
>
> *a. Develop a protocol or strategy for improving the Alaska Native and community consultation process*
> *b. Develop a method for systematic documentation of Alaska Native and community participation in the development of management actions*

The Council and the Ecosystem Committee have reaffirmed the importance of these objectives throughout the development of the FEP. While the Council is proud of the existing framework for public outreach and involvement in Council groups and processes, there is also a desire to increase that communication and consultation over time. Staff is looking for input from the Ecosystem Committee and the Council about the appropriate level of outreach during the development of the FEP, and also ways to improve ongoing public involvement in the FEP. Some preliminary ideas include the following.

- Identify in the FEP the tribes and communities who may be affected
- Within existing groups (e.g., the Social Science Planning Team, the Ecosystem Committee), consider developing public involvement plans on a community by community basis;
- Conduct a review of existing participants in the Council process with stakeholder interests in the Bering Sea region. Who is left out? How would they would like to a) communicate; b) get information; c) provide feedback? Are there communities who prefer to not be engaged regularly by the Council?
- Develop a list of key contact organizations for getting the word out in different Bering Sea communities about Council activities?
- Work to ensure an equitable playing field for public involvement and outreach. Specifically, work to ensure that any expansion of public involvement and outreach does not push to the side stakeholders that regularly participate in the Council meetings, the public comment process, etc., or label their input as less important than newer input.
- When appropriate to a Council action, consider holding in-person meetings, video conferences, and/or teleconferences as necessary. Consider sending Council members and/or staff to communities for outreach. Participate in national, regional, and local conferences pertaining to tribal and rural community fishing interests. Some examples include:
    - Tribal Environmental Conference
    - Alaska Tribal Conference on Environmental Management
    - Alaska Forum on the Environment
    - Alaska Federation of Natives
    - Bristol Bay Leadership Forum
    - Bristol Bay Borough—Southwest Alaska Municipal Conference
    - Norton Sound Indigenous Women's Gathering
    - Aleutian Life Forum
    - Bering Sea Fisheries Conference
    - Western Alaska Interdisciplinary Science Conference

9 Preparers, Glossary, References

9.1 Preparers

BS FEP team

Kerim Aydin (Co-chair), Michael Dalton, Ben Daly, Diana Evans (Co-Chair), Anthony Fischbach, Brandee Gerke, Brad Harris, Davin Holen, Jim Ianelli, Jo-Ann Mellish, Heather Rennder, Elizabeth Siddon, Phyllis Stabeno, Ian Stewart, Stephani Zador

Other contributors

Sara Cleaver, Elizabeth Figus, Kirstin Holsman,, Steve MacLean

9.2 Glossary of terms

To include: sustainable, ecosystem, well-being, stanza, LTK, TK, Lk, community

- Seafood production — Landings by functional group, mariculture
- Profits — Revenue by functional group
- Recreation — Numbers of anglers and trips
- Employment — Indicator under development
- Stability — Diversity indices (fishery and species)
- Social-Cultural — Community vulnerability, fishery engagement and reliance
- Biomass — Biomass or abundance from surveys, biomass relative to reference
- Productivity — Condition and recruitment, fishing mortality relative to reference
- Trophic structure — Relative biomass of trophic groups
- Habitat — Thermal habitat volume, physical properties

Term	Definition
ADF&G	Alaska Department of Fish and Game
AFCEE	US Air Force Corps of Engineers;
DEC	Alaska Department of Environmental Conservation
DNR	Alaska Department of Natural Resources
DOD	Department of Defense
EPA	Environmental Protection Agency
MMS	Minerals Management Service
NMFS	National Marine Fisheries Service
NPFMC	North Pacific Fishery Management Council
USFWS	US Fish and Wildlife Service

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Appendix A: EBFM Gap Analysis Module *[PRELIMINARY NOTES]*

Comparing Council fishery management against EBFM benchmarks, in an effort to identify gaps and areas for FEP focus.

1999 EPAP report

1. Geographic extent of the ecosystem; characterize biological, chemical, and physical dynamics and "zone" the area for alternative uses.
    - Information on the biological, chemical, and physical dynamics are available, areas have been "zoned" set-aside for particular uses or purposes
2. Conceptual model of the food web.
    - FEP would provide
3. Habitat needs for all plants and animals in the "significant food web;" how are they considered in conservation and management measures?
    - EFH is defined for all managed species. Critical habitat is designated for Steller sea lions, North Pacific right whales, and Stellers and spectacled eiders. FEP could define for other significant food web taxa (other marine mammals, seabirds, etc.)
4. Total removals, including incidental mortality. Show how they relate to standing biomass, production, optimum yields, natural mortality and trophic structure.
    - FEP could combine total removal information across Federal and State fisheries, recreational fisheries, subsistence fishing and hunting. Could provide historical perspective; may be hard to update on routine basis?
5. Characterization of uncertainty and kinds of buffers against uncertainty for conservation and management.
    - Defined for target species; designed to protect food web by conservative ABC when uncertainty high. FEP could explore whether uncertainty buffers are sufficient for other ecosystem components.
6. Indices of ecosystem health as management targets.
    - Currently use B40% as an index for target stocks, use three-river index for Chinook salmon PSC limit in BS groundfish fisheries, set PSC caps for some species – though not based on "ecosystem health" indices. FEP could define these indices for key ecosystem objectives (which would also be defined in the FEP).
7. Available long-term monitoring data and how used.
    - Described in SAFE reports, Steller sea lion surveys. FEP could catalog available information sources, which could be helpful reference for analysts.
8. Assess which ecological, human, and institutional elements of the ecosystem most significantly affect fisheries, and are outside the Council/DOC's authority. Include a strategy to address those influences to achieve both FMP and FEP objectives.
    - Does not exist currently. Opportunity for FEP.

Wilkinson and Abrams (2015)

Suggest three additional elements not in the EPAP report that should be central to development of future FEPs.

1. Establish ecosystem goals and objectives;
    - Opportunity for FEP. Support Council's 2014 ecosystem approach through all FMPs, would extend groundfish EBFM objectives to all EBS fisheries.
2. Use ecosystem indicators to monitor progress in achieving goals; and
    - Opportunity for FEP.

3. Analyze trade-offs across objectives.
    - Currently done to some extent through the NEPA/RIR/IRFA process. Could be made more explicit and deliberate through new methods developed through the FEP.

NOAA Science Advisory Board 2014 Report

I. Questions on Science for Management

1. What is the state of regional EBFM science for fisheries management?
2. How is the fishery management council using EBFM science in management? Concomitantly, are Councils getting the science they need for management?

II. Questions for progress toward EBFM in fisheries management regions

3. Cease overfishing and develop rebuilding plans for overfished species
4. Delineate extent of ecosystem/interactions
5. Develop a conceptual model of the foodweb
6. Describe habitat needs of different life history stages of animals and plants in the "significant foodweb" and develop conservation measures
7. Calculate total removals – including incidental mortality and relate them to standing biomass, production, optimum yields, natural mortality and trophic structure
8. Assess how uncertainty is characterized and define what buffers against uncertainty are included in management actions
9. Develop indices of ecosystem health as targets for management. Has council set an ecosystem goal[s]?
10. Describe long term monitoring data and how they are used.
11. Assess the ecological, human and institutional elements of the ecosystem which most significantly affect fisheries, and are outside Council/NMFS jurisdiction and define a strategy to address those influences.
12. Is there a Fishery Ecosystem Plan/ Fishery Management Plan employing EBFM?
13. Does the Council have a lead entity designated to advance EBFM in the Council process?
14. Are ecosystem models developed and available for use in the Council process?
15. Are decision support tools for EBFM / trade-off analysis employed [e.g., management strategy evaluation, risk assessments, ecosystem indicators, and scenarios]?
16. To what extent are spatial management tools applied [besides EFH measures above] to accomplish EBFM? [as opposed measures for allocation].
17. Other – Unique efforts that offer information

Lenfest 2016 report

1. Where are we now?
    a. System inventory and conceptual model
    b. Select indicators
    c. Inventory threats
2. Where are we going?
    a. Vision statement
    b. Strategic objectives
    c. Assess risk to objectives
    d. Prioritize objectives
    e. Operationalize objectives

3. How will we get there?
   a. Performance measures
   b. Management strategies
   c. Evaluate strategies
   d. Select strategy
4. Implementation
5. Did we make it?

NMFS (2016) EBFM Policy Guiding Principles

1. Implement ecosystem-level planning
2. Advance understanding of ecosystem processes
3. Prioritize vulnerabilities and risks to ecosystems and their components
4. Explore and address trade-offs within an ecosystem
5. Incorporate ecosystem-level reference points
6. Maintain Resilient Ecosystems

NMFS EBFM Roadmap Guiding Principles and Associated Core Components		Status	Provision or Project
1. Implement ecosystem-level planning	Engagement Strategy		
	Fishery Ecosystem Plans	Under development	
2. Advance understanding of ecosystem processes	Science	Ongoing	
	Ecosystem status report	Yes	EBS Ecosystem Considerations Chapter in annual groundfish SAFE
3. Prioritize vulnerabilities and risks to ecosystems and their components	Ecosystem-level risk assessment	No	
	Managed species, habitats and communities risk assessment	Partially	
4. Explore and address trade-offs within an ecosystem	Modeling capacity for trade-offs	Yes	
	Management Strategy Evaluations	Some	Single species MSEs; BS pollock, BS flatfish
5. Incorporate ecosystem considerations into management advice	Ecosystem level reference points	Some	OY
	Ecosystem considerations for LMRs	Some	
	Integrated advice for other management considerations	Yes	
6. Maintain resilient ecosystems	Resilience		
	Community well being		

EBFM survey from NMFS HQ from 2016

1. What is the current management approach to mitigating risks and hedging against scientific uncertainty?
2. Does the OY for a fishery consider interdisciplinary or ecosystem-specific goals in a trade-off analysis?
3. Does management use ecosystem models to consider trade-offs of increasing or decreasing fishing effort of certain fisheries to optimize overall yield of the ecosystem?
4. Does the fishery include ecosystem-level performance indicators?
5. Can any of the ecosystem-level performance indicators be considered reference points?
6. Has the Council used or considered using a management strategy evaluation (or similar tool) to improve ecosystem-level analyses of FMP-related actions?
7. Does the FMP contain measures that minimize the impacts of the fishery on non-EFH marine habitat?
8. Does the FMP contain measures that minimize discards within a fishery?
9. Does the Council evaluate the effects of FMP actions on coastal fishing community well-being?

	What is the current management approach to mitigating risks and hedging against scientific uncertainty.
Groundfish	ABC accounts for scientific uncertainty in the OFL estimate and any other scientific uncertainty. The FMP's ABC control rule accounts for scientific uncertainty in two ways: First, the control rule is structured explicitly in terms of the type of information available, which is related qualitatively to the amount of scientific uncertainty. Second, the size of the buffer between maxFABC in Tier 1 of the ABC control rule and FOFL in Tier 1 of the OFL control rule varies directly with the amount of scientific uncertainty. For the information levels associated with the remaining tiers, relating the buffer between maxFABC and FOFL to the amount of scientific uncertainty is more difficult because the amount of scientific uncertainty is harder to quantify, so buffers of fixed size are used instead. The FMP provides that ABC may be set lower than the maximum permissible level based on data uncertainty.
Salmon	
Crab	The Council utilizes the Crab Plan Team process to evaluate stock assessment data and models used to determine OFLs and ABCs. The Crab Plan Team uses a very conservative process to set ABCs and OFLs. Additionally, the crab fisheries are managed seasonally, and stock assessments are reevaluated yearly.

	Does the OY for a fishery consider interdisciplinary or ecosystem-specific goals in a trade-off analysis?
Groundfish	The OY of the BSAI groundfish complex (consisting of stocks listed in the 'target species' category, in Table 3-1 of the FMP) is 85% of the historical estimate of MSY, or 1.4 to 2.0 million mt. The 2004 Final Programmatic SEIS analyzed trade-offs for alternative methods of specifying OY, these analyses included ecosystem-specific policy goals. See also: http://safmc.net/sites/default/files/meetings/pdf/SSC/2016/SEP_05_2016/SEPAtt1d_BSAIGroundfishBackground.pdf
Salmon	
Crab	(A) The Council revised the definition of OY for the crab fisheries in Amendment 7 to the Crab FMP, published in 1999. And again with Amendment 24, published in 2009. For each crab fishery, the optimum yield range is 0 to < OFL catch. For crab stocks, the OFL is the annualized maximum sustainable yield (MSY) and is derived through the annual assessment process, under the framework of the tier system. Recognizing the relatively volatile reproductive potential of crab stocks, the cooperative management structure of the FMP, and the past practice of restricting or even prohibiting directed harvests of some stocks out of ecological considerations, this optimum yield range is intended to

	facilitate the achievement of the biological objectives and economic and social objectives of this FMP under a variety of future biological and ecological conditions. It enables the State of Alaska to determine the appropriate TAC levels below the OFL to prevent overfishing or address other biological concerns that may affect the reproductive potential of a stock but that are not reflected in the OFL itself. Under the FMP, the State establishes TACs at levels that maximize harvests, and associated economic and social benefits, when biological and ecological conditions warrant doing so.

	Does management use ecosystem models to consider trade-offs of increasing or decreasing fishing effort of certain fisheries to optimize overall yield of the ecosystem?
Groundfish	No. NMFS is developing ecosystem models that consider trade-offs of increasing or decreasing fishing effort in the marine waters off Alaska, however they are not yet used by the Council in establishing TACs because the available information is deficient to evaluate differential fishery effects on overall ecosystem yield.
Salmon	
Crab	NMFS is developing ecosystem models that consider trade-offs in increasing or decreasing fishing effort, however these are not specific to the crab FMP. The Council also utilizes the ecosystem consideration chapter of the groundfish SAFE to evaluate broad scale changes that affect the crab stocks.

	Does the fishery include ecosystem-level performance indicators?
Groundfish	Yes. In addition to specifying a two million mt OY cap, the Council established global control rules for Steller sea lion prey species-- Atka mackerel, pollock and Pacific cod. Under the global control rule, the ABC for these three Steller sea lion prey species would be reduced when the spawning biomass is estimated to be less than forty percent of the projected unfished biomass. Greater reductions in ABC would occur with greater decreases in the spawning biomass. If the spawning biomass is estimated to be less than 20 percent of the unfished biomass, directed fishing for that species would be prohibited. WOULD THIS INCLUDE SALMON AND HALIBUT PSC LIMITS?
Salmon	
Crab	The Crab Plan Team is currently working on ecosystem-level performance indicators (in a report card format) for the stocks included under the FMP.

	Can any of the ecosystem-level performance indicators be considered reference points?
Groundfish	The two million metric ton OY cap and Steller sea lion prey species control rules are reference points. ABCs in the BSAI consistently sum to more than 2 million mt, but the FMP limits the combined TACs to 2 million mt for ecosystem considerations.
Salmon	
Crab	Not yet.

	Has the Council used or considered using a management strategy evaluation (or similar tool) to improve ecosystem-level analyses of FMP-related actions?
Groundfish	In addition to using MSEs for BS pollock in a changing environment (Ianelli et al. 2012); BS flatfish (http://www.afsc.noaa.gov/quarterly/jas2011/jas11feature.pdf and http://nsgl.gso.uri.edu/aku/akuw94002/akuw94002_part6b.pdf); MSEs are an important element of the Regional Action Plan for Bering Sea Groundfish under NOAA Fisheries Climate Science Strategy.
Salmon	
Crab	No.

	Does the FMP contain measures that minimize the impacts of the fishery on non-EFH marine habitat?
Groundfish	The FMP restricts fishing in several important non-EFH marine habitats (e.g., Crab and Halibut Protection Zone, Pribilof Island Area Habitat Conservation Zone, Chum Salmon Savings Area, Chinook Salmon Savings Area, Red King Crab Savings Area, Nearshore Bristol Bay Trawl Closure, Catcher Vessel Operation Area, and around numerous Steller sea lion rookeries and haulouts and special foraging areas).
Salmon	
Crab	The FMP defers some management to the State of Alaska which sets limits on the number of pots used (the only legal gear) and other gear related restrictions that limit the impact of the fishery on marine habitat.

	Does the FMP contain measures that minimize discards within a fishery?
Groundfish	A central policy objective of the BSAI FMP is to manage incidental catch and reduce bycatch and waste. The FMPs require that all pollock and Pacific cod be retained and processed. The FMPs provide for retention of incidental species up to the maximum retainable amounts specified for each species.
Salmon	
Crab	Discards are a component of determining OFL and ABC, the state of Alaska uses observers to monitor discard rates and adjusts total mortality estimates accordingly.

	Does the Council evaluate the effects of FMP actions on coastal fishing community well-being?
Groundfish	Yes. Economic impacts on coastal fishing communities are evaluated in a regulatory impact review for each of the Council's FMP actions. Direct and indirect economic impacts on the community are considered, however the results are not usually couched in terms of "community well being."
Salmon	
Crab	Yes, through Regulatory Impact Reviews and Social Impact Assessments.

Trochta et al 2018

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1. **Table 1. EBFM scoring criteria.** Criteria used to score the fisheries listed in S1 File and justification for each scoring criteria.

#	Criteria	0	0.5	1
11	Management plan defines the bounds of the ecosystem	Bounds of ecosystem not mentioned	Bounds set poorly, not reflective of ecosystem	Full trophic and spatial considerations
12	Ecosystem-based goals	No mention of ecosystem goals	Non-specific ecosystem goals	Specific ecosystem goals
13	Goals emerge from participatory process	No participatory process	Stakeholders involved but not directly in decision-making	Stakeholders involved in decision-making
44	Considers the impact on humans (economic, cultural, social)	No social consideration	Social or economic impacts considered	Uses social-ecological-systems or other social-ecological-economic system
45	Process for evaluation and adaptability of the management plan	No built-in adaptability or evaluation	Local level legislative adaptability and evaluation	Single agency evaluation and adaptability
66	Management plan recognizes uncertainty and makes allowances	Does not acknowledge uncertainty	Takes some uncertainty into account	Provides scenarios for uncertainty and evaluates how scenarios will impact management in the future
77	Interaction of multiple species are considered	Single-species	Multiple species including non-targeted species	Ecosystem models with species/age components
88	Tradeoffs in ecosystem services are evaluated	No mention of ecosystem services	Ecosystem services are identified but not measured	Ecosystem services identified and trade-offs measured
99	Specific ecosystem targets	No mention of ecosystem targets	Ecosystem targets are identified but not evaluated	All ecosystem targets defined and evaluated
110	Fisheries-independent data collection and monitoring of more than target species	No independent data collection available	Independent data collection is available only for target species	Independent data collection available for target and non-target species
111	Harvest control rules including non-target species	No harvest control rules for non-target species	Mentions harvest controls on non-target species, but no rules stated	Separate harvest control rules for non-target species included
112	Evidence that regulations are effectively enforced	No evidence	Mentions how regulations are enforced (e.g. listed resources such as boats and workforce)	Evidence that regulations are effective (e.g. clear knowledge of illegal activity and listed enforcement actions to combat this)
113	Bycatch is monitored	No mention of bycatch observations	Bycatch is acknowledged, but not well-quantified	Bycatch rates well-defined through monitoring (e.g. full observer program)
114	Bycatch is minimized	No mention of effort to minimize or reduce bycatch	Actions to reduce bycatch (e.g. gear restrictions, area closures, timing restrictions) are considered	Enforced actions to reduce bycatch are successful
115	Sensitive habitats are identified and mapped	No mention of sensitive habitats	Potential sensitive habitats are identified but not adequately mapped	Sensitive habitats are identified and mapped
116	Sensitive habitats are protected	No mention of sensitive habitats	Sensitive habitats are protected but some use is still allowed	Sensitive habitats are protected from all use
117	Ecosystem models are available	No ecosystem models are available	Ecosystem models are available for strategic use (explore ecosystem dynamics)	Ecosystem models are available for tactical use (explore policies)
118	Ecosystem models are used in evaluating policies	No ecosystem models are available	Ecosystem models are used to strategically evaluate policies	Ecosystem models are used to tactically evaluate policies

Notes

Notes to flesh out:

- Council's 2014 Ecosystem Approach ~ vision statement underlying all the Council's work
- Ongoing research to understand climate effects on SE BS fisheries (AFSC, PMEL, others)
- Lenfest case study concluded that Alaska groundfish management incorporates all FEP elements except for one:
- prioritize objectives [however, they pull examples from various FMPs such as the GOA and AI management, thus it is worthwhile to examine for Bering Sea specifically].
- Management evaluation complete for effects of fishing on deep sea corals, determined negligible overlap between fishing and coral habitat.
- Salmon PSC management in the groundfish fishery considers bycatch stock composition to ensure fishery effects do not threaten sustainability of any stocks.
- Fisheries managed to avoid reducing the likelihood of survival or recovery of threatened or endangered species.
- Seabird avoidance gear is required on longline vessels in the groundfish fishery.
- Seabird working group (groundfish and halibut) with representation from ADFG, WDFW, NOAA, USFWS - this group will provide annual report to Council

Gaps (incomplete):

- Climate thresholds for when or if current management should be altered to sustain fish and fisheries (Consider, are these needed in light of sloping control rules used in crab and groundfish management)?
- Information needs to achieve stated goals or measure (e.g., process studies, models, surveys, landings data, TEK, etc.) if goals are being met.