

Development of a Bering Sea Fishery Ecosystem Plan 10/22/2015

DRAFT for Ecosystem Committee discussion in October 2015¹

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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.

The Council has acknowledged that moving toward ecosystem-based fishery management (EBFM) is a process, and as new information or tools become available, the Council has responded by improving the fishery management program. Nonetheless, while there are strong relationships between management and ecosystem science in Alaska, which are recognized worldwide as exemplary, they often remain informal. Fisheries Ecosystem Plans (FEPs) are a tool that can serve as a framework for continued incorporation of ecosystem goals and actions in regional management. An FEP for the Bering Sea could 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 could document current procedures and best practices for EBFM, provide brief, targeted, and evolving descriptions of the interconnected physical, biological, and human/institutional Bering Sea ecosystem and through ecosystem thresholds and targets, and direct how that information can be used to guide fishery management options. With the development of a Bering Sea FEP, the Council has another opportunity to progress on the continuum of EBFM, allowing Alaska to lead internationally 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 has been considering whether to develop a Bering Sea Fishery Ecosystem Plan (FEP) since June 2013, including scoping objectives for a Bering Sea FEP and evaluating how the plan should be structured to benefit fishery management decision making. Between February and October 2014, the Council received public input from stakeholders and its advisors, which expressed interest in developing an FEP. In October 2014, the Council requested the Ecosystem Committee continue developing an approach and format for an FEP, and draft goals and objectives for Council consideration. Given concerns about the staff resources needed for this project in relation to other Council priorities, the Council has not

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yet committed to tasking the FEP, but rather has asked for more information to support a future Council decision, and illustrate how an FEP would function in the Council process. This preliminary paper has been prepared for the Ecosystem Committee's discussion in October 2015, with the intent that it will be revised to incorporate Committee recommendations before it is presented to the Council.

The Ecosystem Committee recommends that the Council initiate work on a Council Fishery Ecosystem Plan for the Bering Sea. The Ecosystem Committee has held several workshops and meetings over the last two years, to consider lessons learned from developing the Council's Aleutian Islands FEP (Attachment 1), what information is available about the Bering Sea ecosystem (Attachment 2), how the development of an FEP might provide additional benefit to the Council that is not duplicative of those other information sources, and what process and format the Council should employ for developing an FEP. This discussion paper summarizes the findings of the Committee over that time period. The Ecosystem Committee's interest is to develop an FEP that:

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

The Council has also heard that **the SSC is supportive of the Council's effort to develop a Bering Sea FEP**, both in October 2014 and April 2015 SSC minutes. The SSC noted that the FEP could provide a framework for strategic planning that would guide and prioritize research and modeling. The SSC also recognized that the Council has already adopted EBFM goals and objectives through the PSEIS process, and has implemented numerous provisions to address ecosystem considerations. For the FEP, the SSC supports an incremental, iterative process designed to address key gaps in the existing approach rather than an attempt to overhaul the existing management framework. The SSC noted that a necessary first step will be to advance from the current practice of describing the status of the ecosystem to one that defines thresholds for Council action.

Public comment has supported the development of a Bering Sea FEP. The Council held a public comment period during which input was solicited, and a synthesis of public comments is provided in Attachment 3. Generally, public comment themes were similar at the various hearings, including broad support for continuing with development of a Bering Sea FEP. Stakeholders provided comments about the FEP process, potential goals and objectives, and tasks that might be included within an FEP. It is the view of staff that the approach to the FEP proposed by the Committee in this paper is consistent with the process comments that were heard in public comment.

2 How can a Bering Sea FEP add value to the Council process?

The Ecosystem Committee has identified the following benefits from developing an FEP for the Bering Sea:

- 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
- Identify connected Bering Sea ecosystem components, and their importance for specific management questions
- Serve as a communication tool for ecosystem science and Council policy
- Create a transparent public process for the Council to identify ecosystem values and management responses

- Provide a framework for strategic planning that would guide and prioritize research, modeling, and survey needs
- 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.)

A first purpose of the FEP will be to document our current procedures and best practices for EBFM. While the Committee and the Council believe that our current approach is precautionary and effective, documentation will be helpful to demonstrate this to the broader public. Additionally, a gap analysis will allow the Council have a more informed understanding of the strengths and areas of improvement of its EBFM approach.

The Committee also believes it will be valuable to synthesize our scientific understanding of the Bering Sea ecosystem specifically from a fishery management perspective. The Committee is not interested in creating a redundant compilation of information that is available elsewhere, but rather to develop our understanding of ecosystem connectivity as it may relate to specific management concerns (e.g., the halibut stock, Norton Sound communities, or red king crab spawning habitat in Bristol Bay). The FEP would build off the existing Eastern Bering Sea Ecosystem Assessment, which already synthesizes ecosystem information on an annual basis, and FEP-relevant findings can be readily incorporated into the existing process.

The FEP will also provide value by facilitating dialogue between stakeholders, scientists, and fishery managers. Public outreach and stakeholder involvement throughout the process helps develop a common understanding of the Bering Sea ecosystem by managers, scientists, and user groups. Although this can 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 into management decisions and communicate with stakeholders that are affected by management policies. Similarly, it would provide a framework 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 would make the decision-making process more accessible.

If the Council chooses not to initiate a Bering Sea FEP, the strong atmosphere of collaboration at the AFSC between ecosystem scientists and the management process will still continue. 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. With or without an FEP, this and other “bottom up” efforts (beyond the Ecosystem Considerations report) to incorporate ecosystem science into management products will continue, albeit informally and opportunistically.

The FEP, however, can provide specific advantages for both the Council and the AFSC by improving communication about management needs and the relationship to research. The 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 both timely and actionable for managers, while managers need to be prepared and expected to receive and (as relevant) act on results. The proposed structure of this FEP ensures that this “handshake” takes place for individual pieces of research before they are conducted, thus setting clear expectations on both sides for any given analysis or piece of research.

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

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. It is also beneficial to be operationally ready 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 can help 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.

3 How should we design an FEP?

The Ecosystem Committee recommends that the FEP be designed as a strategic planning document that describes a process for addressing Council management concerns, 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 values and policies, which forms a structured framework to regularly evaluate and initiate specific analyses or tasks (action modules) that move forward as and when the Council has the staff resources available to prioritize them.

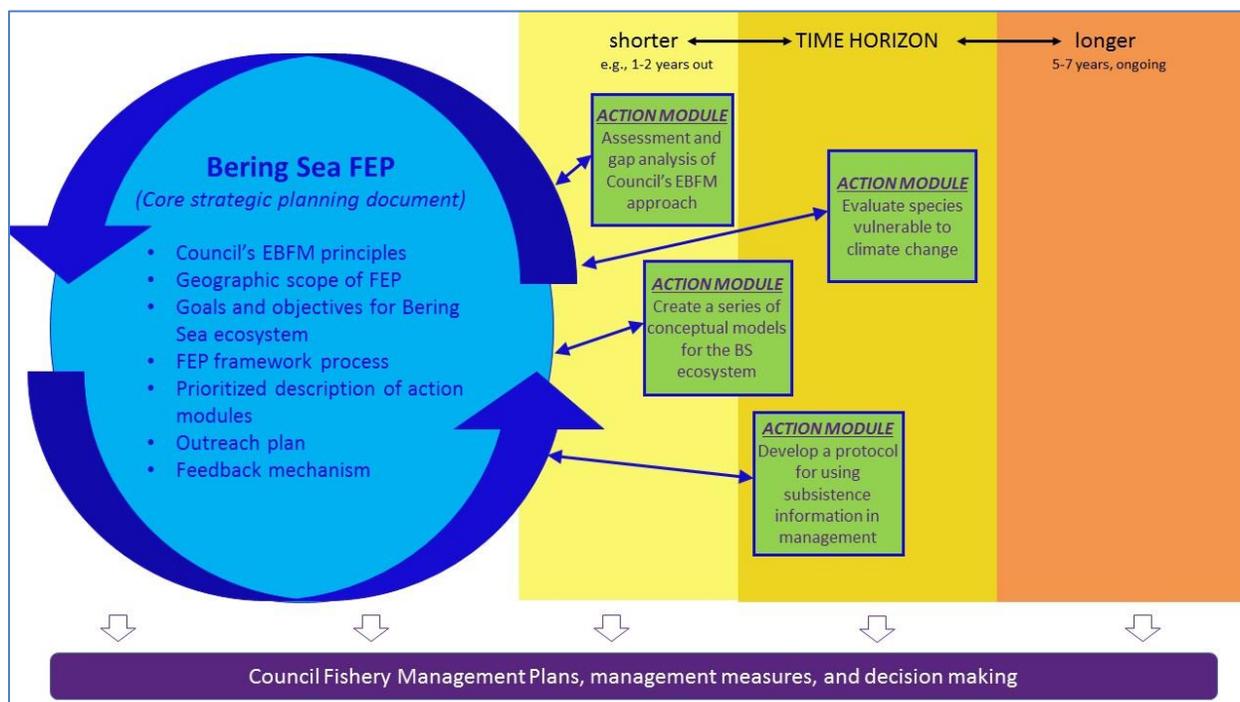
The Ecosystem Committee discussed different structures for the FEP, but was convinced that a more traditional synthesis document would not be effective for the Bering Sea. The Committee adopted the PFMC mantra that an FEP should “inform but not overwhelm”, and so the goal should not be a huge compilation of material, especially as the Bering Sea ecosystem is so well studied. The Committee also identified that the FEP should be action-informing rather than action-forcing; the intention is not for the FEP to replace the FMPs, or management measures implemented under the authority of the FMP. At the same time, in order for the FEP to be useful and used in the Council process, there needs to be clear forethought about how the FEP, and the action modules initiated under the FEP framework, will affect the Council management process. Committee members suggested that the FEP should provide specific, actionable metrics.

Core FEP

The core FEP (Figure 1) would contain a series of strategic components for the FEP. There would be sections describing the purpose and structure of the FEP. The FEP would need to describe 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 would include explaining how the FEP process is adaptive to new information and changing circumstances.

In the core FEP, the Council should include a definition of ecosystem-based fishery management, as a benchmark against which to evaluate the Council’s management. The core FEP would identify goals for the Bering Sea ecosystem, and strategic objectives for the Bering Sea FEP to achieve those goals. The Council would then describe and prioritize a list of action modules (described further below) in the core FEP, which could be tasked as resources permit. The FEP would also need to identify the role of public involvement in the development of the FEP and resulting decision making, and a description of the framework process for prioritizing and initiating specific action modules under the “umbrella” of the FEP.

Figure 1 Illustration of the relationship between the FEP and draft action modules



Proposed outline for the core FEP

1. Introduction
2. Purpose of the FEP
3. Background/EBFM theory
4. Scope of FEP – geographic, jurisdictional, fisheries
5. Brief synthesis of Bering Sea ecosystem (i.e., the Eastern Bering Sea Ecosystem Assessment), and current data sources, surveys, models
6. Bering Sea ecosystem goals
7. Bering Sea FEP strategic objectives
8. Framework of FEP action modules
 - a. Process for identifying action modules, prioritizing, tasking, periodic reevaluation
 - b. List of action modules
9. Outreach plan and public involvement
10. Recurrence/feedback mechanism

At the request of the Council to be more specific in demonstrating how an FEP might function, the Committee has included a strawman FEP example in Attachment 4 to this discussion paper. The attachment lays out the FEP outline, and includes some example text for various sections, as well as four example action modules that might be developed for the FEP. Note that final decisions as to the FEP components will wait until the Council has formally initiated the Bering Sea FEP as a Council project.

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, is defined in the 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.

The core FEP would include the list of action modules, and a description of each one, along with its priority. In the description of each module in the core FEP, a series of specific questions must be addressed:

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

Additionally, the core FEP would also prioritize modules, assess progress that has been made in each active action module, and review findings of previous modules. An effective method to track action modules and their linkages to the core FEP would be to design an interactive website.

One of the advantages of the strategic FEP/action module process 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, 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. 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 would likely be different module teams for each FEP module under a central FEP coordinator. This has the advantage of providing an opportunity for broader participation in the FEP process, and also presents an opportunity to involve diverse stakeholders, including local communities or fishermen, in the FEP process.

Application of action module results to inform the Council process will vary depending on the nature of the action module. 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 would initiate an FMP analysis to consider how to implement change based on the findings of the FEP action module. 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 also lead the Council to re-evaluate the FEP or re-prioritize other action modules.

We envision that the modules would be an evolving part of the FEP that change over time to meet novel management challenges and ecosystem pressures. The FEP would specify how action modules would be proposed and adopted into the FEP. Presumably the Council would also work with NMFS and the AFSC to identify management needs and how action modules could be designed to address them. This process

could be an opportunity for researchers conducting fisheries-relevant research to bring their science forward into management, by proposal a module for Council consideration. As with other aspects of the FEP development, we anticipate that there would be public involvement in scoping possible action modules, and opportunities for input on how they are prioritized. Once the FEP strategic document is prepared, the Council may wish to initiate a periodic review process to consider whether action modules should be revised, new modules added, priorities changes, or actions initiated. Results of action modules will also be presented publically and made accessible through a public website.

The relationship of the core FEP with four example action modules is illustrated in Figure 1. Figure 1 Attachment 4 outlines example action modules to illustrate the concept. The four example action modules (in no particular order) are:

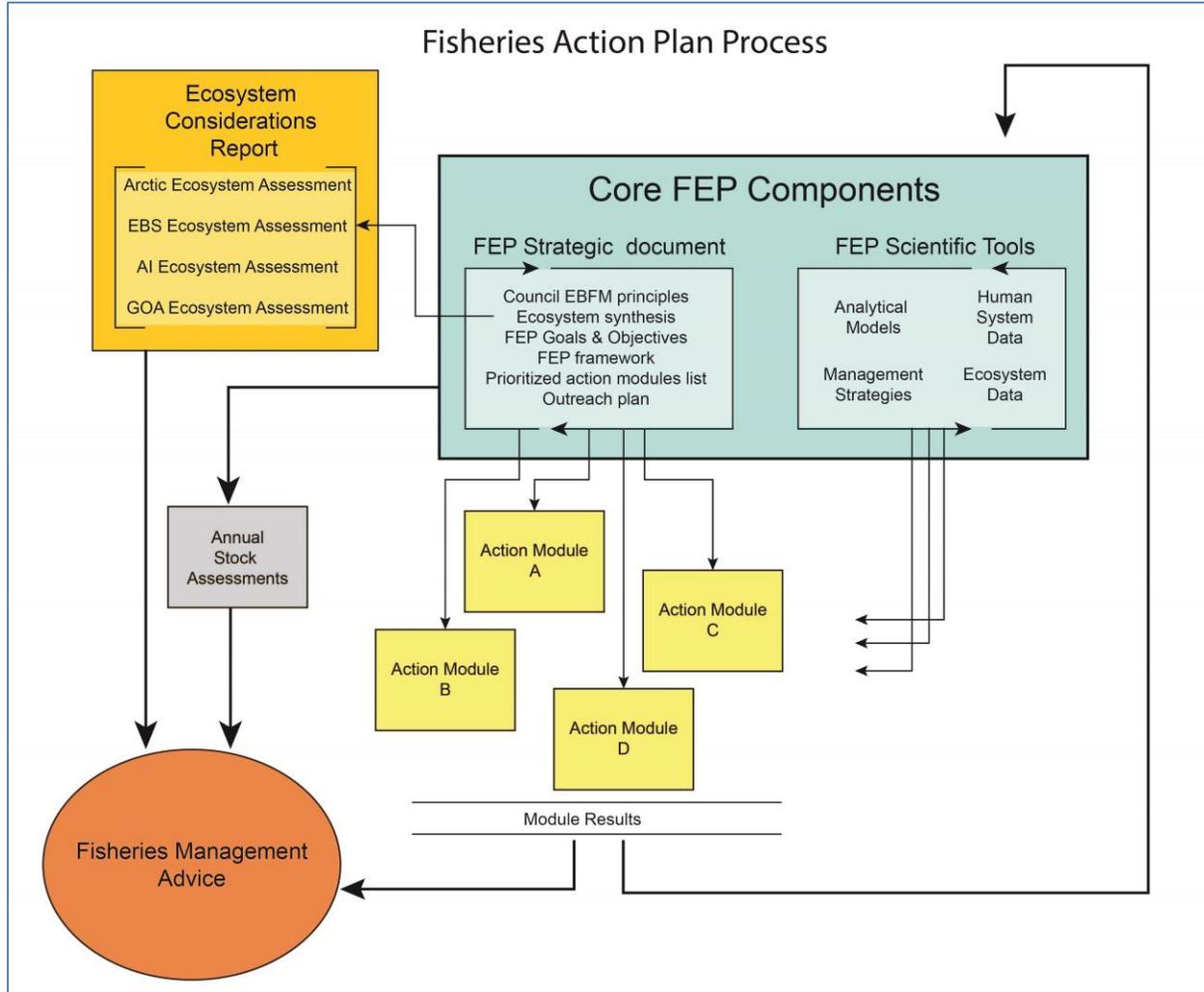
- Comprehensive assessment of the Council’s Bering Sea fishery management with respect to EBFM best practices – assessment of successes, and gap analysis of areas to strengthen regional EBFM
- Define conceptual models of the Bering Sea based on key ecosystem and human system focal points (e.g., groundfish, crab, Norton Sound communities, etc.)
- Evaluate the vulnerability of key species and fisheries to climate change in order to build climate resilience
- Develop a protocol for using subsistence information in management

Three of the four examples that are listed here are process-based action module examples. Other process-based action modules that could be considered by the Council might include modules focused on development of a step-wise framework for conducting ecosystem risk assessments based on the timeline of assessment needs and the complexity of ecological and human interactions (e.g., rapid scoping to identify vulnerable ecological and human components, semi-quantitative ecosystem analyses to assess indirect effects and prioritize interactions for a full ecosystem-based risk evaluation under various shipping intensities). The Council could also choose to design action modules that respond to Council concerns, for example, about a particular area, species, or physical phenomenon as well. These topic-specific action modules are more likely to engage the Council in evaluating the tradeoffs associated with a specific management issue and provide decision tools for Council tradeoff analyses.

The action modules are 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 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 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. It will be important to specify a process for how the Bering Sea FEP gets updated and refreshed.

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



4 Next steps if the Council decides to move forward

The Council asked the Ecosystem Committee to come back with a full proposal for a Bering Sea FEP. If the Council decides to move forward with an FEP following this discussion, staff would begin undertaking the following steps:

1. Develop the strategic document, including outlining action modules
2. Consider whether any of the action modules should be initiated concurrently (for example, work on conceptual models as a starting point for the synthesis of ecosystem information)
3. Appoint a Bering Sea FEP Team to develop the strategic document
 - a. Who should be on it? Think through the tradeoffs between having a manageable size, and having broad representation.
 - b. Ideas from AI team: major stock authors, Kerim's group, seabird/ marine mammal/ habitat/ PMEL reps, anthropologist, persons from each of Council's AI plan teams, NPRB, socio-economist, LTK/ subsistence

- c. Committee's initial thought is that the team should be similar to the AI FEP team, which was all agency membership, and structured similarly to a Plan Team. But think about whether can we get the right expertise.
4. Consider the Terms of Reference for the Bering Sea FEP Team
 - a. How will the team interact with the Ecosystem Committee, the Council process, stakeholders? Again, use AI Ecosystem Team as an example – the team developed the FEP content, and scientific concepts, which were vetted through the Ecosystem Committee for review and policy input.
 - b. What will be the role of the primary Bering Sea FEP team in relation to the development of specific action modules? For example, would you always try to have at least one or more member of the primary FEP team on any action module subgroup, for continuity? Do the action module teams report to the FEP team, or to the Ecosystem Committee?
 - c. What is the time commitment we are asking of team members
5. Outreach/ public involvement plan for developing the FEP
 - a. Develop an outreach/public involvement plan to consider how we intend to accommodate stakeholder input? Public comment at team meetings and Ecosystem meetings?
 - b. Is it appropriate to have public membership on some action module teams?
 - c. Should we be trying to do outreach meetings and public hearings? or targeted outreach to key stakeholders? It will be important to be clear about timelines and when there will be opportunities for public input.
 - d. Develop a website for disseminating FEP documents, gathering public comments, and facilitating stakeholder involvement

In initiating the FEP, Council may also be interested in prioritizing some action modules to be considered concurrently with preparing the core FEP document, as the findings may fold directly into the FEP. For example, it may make sense to begin work on an assessment of the Council's management with respect to EBFM best practices concurrently, or to begin building conceptual models of the Bering Sea ecosystem, while developing the core FEP document.

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Attachment 1: Experiences and lessons learned from the Aleutian Islands FEP

In 2005 to 2007, the Council developed and adopted an Aleutian Islands Fishery Ecosystem Plan (NPFMC 2007a). The goal of the AI FEP was “to provide enhanced scientific information and measurable indicators to evaluate and promote ecosystem health, sustainable fisheries, and vibrant communities in the Aleutian Islands region”. Through the AI FEP, the Council experimented with the concept of FEPs, to see whether they could be a useful tool for fishery management. The Council purposely selected the Aleutian Islands ecosystem area because it is the least predictable of the ecosystems in which the Council manages, and therefore the Council might be in need of non-traditional tools. Additionally, the AI is managed jointly with the Bering Sea for groundfish, and the Council wanted to consider whether area-specific management was warranted.

The FEP was written by an interagency team, the Aleutian Islands Ecosystem Team, appointed by the Council. Members represented various scientific disciplines and different agencies (although most members were from NOAA, and especially the Alaska Fisheries Science Center). The Council’s initial invitation letter suggested that the time commitment would be for approximately ten work days over the period of a year, including two team meetings. In actuality, most of the participants invested considerably more of their time on the project.

Contents of the AI FEP

- Synthesized AI ecosystem processes: what do we know about the AI ecosystem
 - The resulting document successfully described and synthesized the main ecosystem processes and interactions in the Aleutian Islands ecosystem, using available information from multiple sources.
- Identified key interactions and relationships: what should we understand and monitor as fishery managers
 - The document provides an understanding of the AI ecosystem by highlighting historical perspectives, and the physical, biological, socioeconomic, and management relationships of the area.
- Qualitative risk assessment of interactions: how to prioritize concerns
 - A qualitative ecosystem risk assessment then identifies key ecosystem interactions relevant for fishery management, and how risk associated with these interactions is currently addressed by managers.
- Discussed management implications: what is the Council already doing / what more might be done to mitigate risks?
 - A discussion of what else might be done to address any risk, the indicators that could be used to monitor the interactions, and priority data gaps and research needs are also identified.
- Research and data gaps

Has the AI FEP been effective as an EBFM tool? Yes – examples:

- Evaluations of AI ecosystem have been used in some Council analyses
 - A key finding of the FEP is that interactions and relationships within the AI area are clearly distinct from neighboring systems of the Bering Sea and Gulf of Alaska, and that this should be recognized in fishery management. Information synthesized in the FEP has been used by the Council in some discussions of area specific stock assessment, or other analyses (most recently, the Steller Sea Lion EIS).
- FEP selection of indicators was beginning of AI ecosystem assessment process
 - As described above, the FEP began the process of filtering useful indicators for the AI ecosystem, relating them to the key interactions identified in the document. This work was continued by the AFSC, with participation by the AI Ecosystem Team, after the FEP

was adopted, and has been used to develop an AI ecosystem assessment as part of the annual Ecosystem Considerations report.

- 20 page overview brochure has been a tool for science communication
 - As a companion to the ~200 page FEP, the team prepared a ‘glossy’ overview of the AI FEP (NPFMC 2007b), which summarized the key information in ~20 pages. Information in the overview pamphlet has been widely shared among stakeholders and further afield.
- Alaska Marine Ecosystem Forum created to discuss with other agencies the effects of all activities on the marine ecosystem
 - The FEP also highlighted the influence of non-fishing activities on the AI ecosystem, and the Council’s development of the Alaska Marine Ecosystem Forum, as a venue to communicate with other agencies about issues affecting the marine ecosystem, was partially driven by discussions generated by the AI FEP.

But there have also been challenges in making it effective

- No direct management action outcome included, so where does the Council go from here?
 - The FEP was, however, consciously designed as a guidance document and resource to the Council, rather than a document with legal standing, such as a fishery management plan (FMP). The intent was that all management actions would continue to be analyzed through the regular Council process, but would be informed by the FEP. The FEP design purposely omitted an avenue leading to direct management action.
- Ad hoc use of FEP by team members/ others, but not a mainstream resource
 - The document was intended to provide information to the Council process at every level: stock assessment scientists, FMP teams, the Council’s SSC and Advisory Panel, and the Council itself. In practice, information from the FEP has been used in an ad hoc fashion, largely at the instigation of members of the interdisciplinary team in their other work.
 - Much of the discussion by members of the Aleutian Islands Ecosystem Team since its adoption has been about how to improve the relevancy of the FEP in the management process.

AI FEP lessons learned

- Need clear pathway for FEP information to feed into the Council process
 - What is the objective of FEP for fishery managers?
 - How will it be used in the current fishery management process, or how will it change the process?
- Consider the intended time frame for FEP information – will resources be available and prioritized to keep it updated and useful?

Attachment 2: Availability of ecosystem information for the Bering Sea

The Bering Sea is one of the most well-studied marine ecosystems in the world. Recent scientific efforts to describe the Bering Sea Ecosystem include publications from the National Research Council (1996), Alaska Sea Grant (1999), and the North Pacific Marine Science Organization (2010). There are annual research programs by the National Marine Fisheries Service, Bureau of Ocean Energy Management (BOEM), and projects funded annually by the North Pacific Research Board (NPRB).

Recently, the NPRB and the National Science Foundation (NSF) completed a multi-year (2007-2013) study of the impacts of a changing climate and dynamic sea ice cover on the eastern Bering Sea ecosystem. This collaborative project, known as the Bering Sea Project, included more than 100 scientists from around the world conducting studies to link climate, physical oceanography, plankton, fishes, seabirds, marine mammals, humans, traditional knowledge, and economic outcomes to better understand the mechanisms that drive this region. The project has resulted in nearly 150 peer-reviewed publications, to date, including three special issues of *Deep-Sea Research II*, with the fourth special issue on the way. Results are also available as project reports to the NPRB, and as “Project Headlines”, two page summaries of each project available on the NPRB website².

The data provided by these new and recurring studies are being used to develop models to better describe the dynamics of the Bering Sea ecosystem. These new models may allow resource managers to consider multi-step interactions between exploitable resources and other ecosystem components, including ecological interactions, environmental drivers, human activities, and human wellbeing. Current modeling efforts in the Bering Sea use hind cast models (such as ROMS, NPZ, FEAST) to forecast the effects of management scenarios (FAMINE).

The annual Ecosystem Considerations chapter of the SAFE Report, and the Bering Sea ecosystem assessment (Zador 2014) provide an annual summary of multiple ecosystem and management indicators of the Bering Sea ecosystem. Through the structuring theme of production, the Bering Sea ecosystem assessment focuses in on ten key community-level indicators of ecosystem-wide productivity. Together, these documents allows scientists and managers to track the state of the ecosystem across time.

Other studies have focused on the potential impacts of opening the Arctic, and an increase in transportation through Bering Strait. In 2015, the U.S. Coast Guard (USCG) published a Port Access Route Study (PARS) for the Chukchi Sea, Bering Strait, and Bering Sea. This study was designed to allow the USCG to designate necessary fairways and traffic separation schemes to provide safe access routes for vessels transiting through the Bering Straits region. The 2009 Arctic Marine Shipping Assessment was commissioned by the Arctic Council to address this question, and there have been periodic progress reports to update the assessment since then³. The Aleutian Islands Risk Assessment project⁴ also tracks the potential increase in Arctic shipping, which also affects the Aleutian Islands, and has developed a number of risk reduction strategies in the follow-up to its 2011 report (AIRA 2011).

Note, need to add references here to available subsistence information reports.

² <http://www.nprb.org/bering-sea-project/explore-the-science/project-headlines>

³ <http://www.pame.is/amsa>

⁴ <http://www.aleutianriskassessment.com/>

Attachment 3: Synthesis of public comments

Public comment hearings on the Bering Sea FEP were held in Nome, Seattle, and Anchorage in June, September, and October 2014, respectively. The Council also heard public testimony during their discussion in October 2014. The Council requested the following input from stakeholders:

- What should be the objectives of the Bering Sea FEP? What questions should the FEP answer?
- What kind of actions should be considered in the FEP? Should the FEP provide specific or general guidance for fishery management? (for example, strategies to respond to climate change, preserve subsistence fishing and hunting resources, maintain healthy populations of top level predators, etc.)
- Would the FEP provide added value over existing Council documents, and if so, how? (for example, annual SAFE reports, essential fish habitat descriptions, etc.)

A synthesis of public comments from each venue was prepared and is available on the Council's website⁵. Generally, public comment themes were similar at the various hearings, including broad support for continuing with development of a Bering Sea FEP. The following provides a summary of comments that addressed the process of developing an FEP, goals and objectives for the FEP, and tasks (syntheses, evaluations, research) that might be included within an FEP. There is some overlap between categories.

Process:

- The FEP must have a nexus to management action.
- The FEP should be a planning process rather than a plan.
- We need to identify how the FEP fits within Council management.
- FEP planning should take into account concerns raised about staff time and resources.
- The FEP should be a framework for how we move forward/ setting priorities.
- The Council should utilize a tool similar to the PFMC initiative process, to prioritize tasks every couple of years.
- The FEP should focus on procedural objectives in order to achieve ecosystem goals (tools).
- The FEP should be a social contract with the public, telling the public how the Council intends to act (a tool for accountability and transparency).
- Now is the time to do an FEP, while stocks are sustainable, as we look ahead at change to come.
- The scope of the FEP should include subsistence and other fisheries (halibut, State) as well as Council FMPs.
- The FEP planning should make a clear statement of what can and cannot be done; it is important to manage expectations.
- The FEP should be developed with close collaboration of Bering Sea communities, subsistence users, and other stakeholders.

Goals/objectives:

- Understand and plan for impacts of climate change
- Understand tradeoffs among ecological, social, and economic factors of fishery harvest
- Identify buffers needed to mitigate uncertainty
- Create a cohesive plan for Bering Sea EBFM (rather than current piecemeal approach); define EBFM for the Council
- Undertake precautionary management, and a shifting of the burden of proof
- Prioritize research, management based on ecosystem understanding, identify pathway of research to management

⁵ <http://www.npfmc.org/bsfep/>

- Identify areas of risk and opportunities to mitigate
- Consider subsistence needs and traditional ecological knowledge
- Define the Council’s management process for the broader public (for transparency and accountability – e.g., a social contract). The audience is largely a fishery audience, but the importance of food security is also applicable to a broader audience.
- Balance the different values of Bering Sea user groups

Tasks:

- Information on the Bering Sea ecosystem
 - Describe the **function** on the Bering Sea ecosystem, its processes, ecosystem services, baseline information on habitat
 - Identify **human linkages** with the ecosystem
 - Describe Bering Sea **forage fish**, the fisheries, forage fish habitat, and their relationship with the food web
 - MSE investigations regarding what happens when we perturb the ecosystem, how it affects **resiliency**, what are key nodes without functional resiliency
 - Document and collect information on **subsistence**
 - Describe the **values** different user groups have for the Bering Sea
- Compile information on **climate change** and its impacts
 - effects of shipping
 - information on presence of new species (including traditional knowledge)/ winners and losers under different climate scenarios
 - impacts to coast communities (especially small ones with few jobs)
 - research to understand how recruitment relationships will change under a changing climate – where are the thresholds
- Council management
 - Explain the **Council’s current ecosystem-based management** (how science is used, adaptive management)
 - **Gap analysis** of the Council’s EBM
 - **Risk assessment** of the Council fisheries/FMPs
 - Identify **ecological, social, and economic factors that contribute to optimum yield**, tradeoffs among them, and uncertainty associated with each
 - Develop a framework for **explicit protocols for ecosystem consideration** in TAC setting
 - Develop a framework for an **explicit process to include traditional knowledge** in management
 - **Explore models**/other tools to evaluate the impact of management actions on the ecosystem
 - Evaluate the **effects of fishing** over time on the ecosystem; specific focus on bottom-contact fisheries
- Monitoring/response
 - Identify and monitor **indicators**, including social and economic indicators, and consider in management measures
 - Identify **indicator thresholds** based on Council objectives, that tie to action or at least an alert

Attachment 4: STRAWMAN - Draft content of the FEP strategic document – INCOMPLETE EXAMPLE ONLY

As described in Section 3, the sections that follow pull together draft text solely as an example of a strategic FEP document, for the purpose of helping the Council’s discussion as to the value of initiating a Bering Sea FEP. If the Council chooses to move forward with the FEP, a more deliberative process would be undertaken to write the FEP. This section, and the example action modules that follow, are offered to help the Council get a sense for what an FEP might contain and how it might operate. The sections bring in draft text offered by Ecosystem Committee members, as well as staff’s contributions.

1 Introduction

Text would similar to the first part of this discussion paper

2 Purpose of the FEP

- 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
- Identify connected Bering Sea ecosystem components, and their importance for specific management questions
- Serve as a communication tool for ecosystem science and Council policy
- Create a transparent public process for the Council to identify ecosystem values and management responses
- Provide a framework for strategic planning that would guide and prioritize research, modeling, and survey needs
- 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.)

3 Background / EBFM theory

3.1 Operational EBFM definition

NOAA has released the following draft policy statement on EBFM:

NOAA Fisheries strongly supports the implementation of Ecosystem-Based Fisheries Management (EBFM) to better inform decisions and help achieve and optimize the benefits from marine fisheries by evaluation tradeoffs between fisheries, commercial, recreational, and subsistence), aquaculture, protected species, biodiversity, and habitats, while maintaining resilient and productive ecosystems.

In 2005, a diversity of scientists arrived at the following consensus statement on ecosystem-based management⁶:

⁶ McLeod, K. L., et al., *Scientific Consensus Statement on Marine Ecosystem-Based Management* (2005), available at http://www.compassonline.org/science/EBM_CMSP/EBMconsensus.

Ecosystem-based management is an integrated approach to management that considers the entire ecosystem, including humans. The goal of ecosystem-based management is to maintain an ecosystem in a healthy, bio-diverse productive and resilient condition so that it can provide the wide range of services humans want and need. Ecosystem-based management differs from current approaches that usually focus on a single species, sector, activity or concern; it considers the cumulative impacts of different sectors.

Specifically, ecosystem-based management:

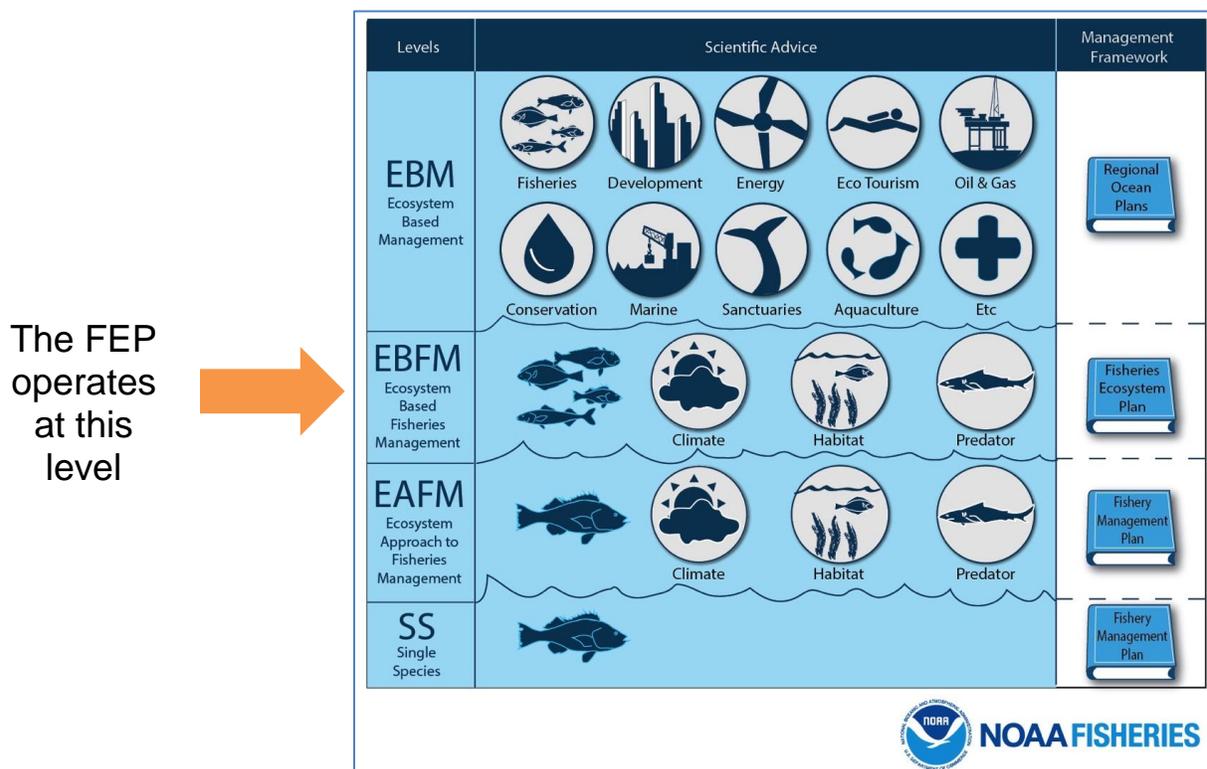
- emphasizes the protection of ecosystem structure, functioning, and key processes;
- is place-based in focusing on a specific ecosystem and the range of activities affecting it;
- explicitly accounts for the interconnectedness within systems, recognizing the importance of interactions between many target species or key services and other non-target species;
- acknowledges interconnectedness among systems, such as between air, land and sea; and
- Integrates ecological, social, economic, and institutional perspectives, recognizing their strong interdependences.

3.2 Background on EBFM theory

In their paper, Link and Brownman (2014) describe EBFM on the spectrum of management philosophies between EBM and single species management (Figure 3). 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 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; Samhoury 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.

Figure 3 The spectrum of ecosystem based fisheries management



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

Globally, EBM 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).

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 fishery ecosystem plans, 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.

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

- a. Regular incorporation of emergent science and tools to address novel challenges and changing conditions.
- b. 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.
- c. Regular evaluation of management tools, in particular stationary and static management limits in order to ensure that they are effective under changing environmental conditions.

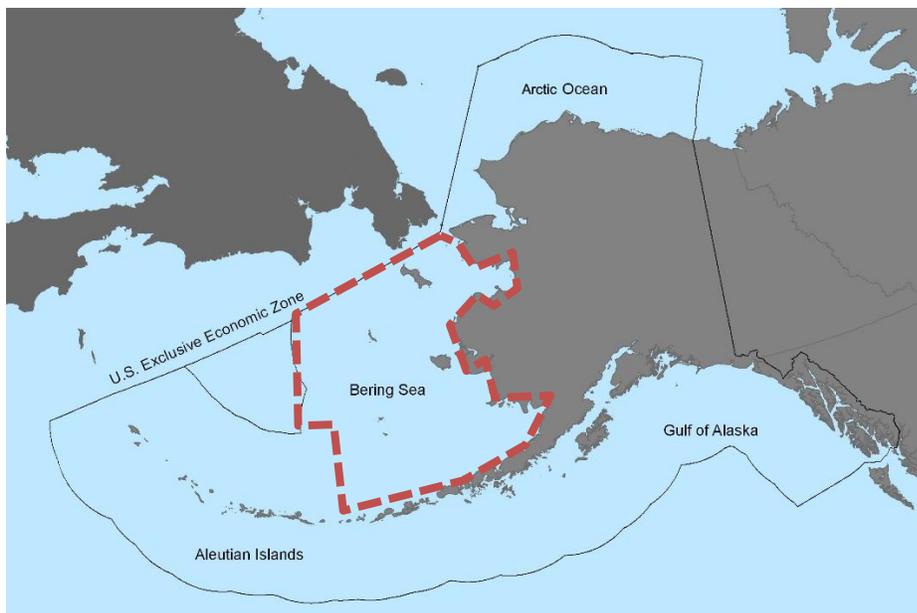
- d. Regular collaboration between stock assessment, physical, ecosystem, and socio-economic research scientists through action modules, and periodic ecosystem workshops reviewing new and existing science (assessment).
- e. Regular review and evaluation of ecosystem-level science as part of the ongoing stock assessment (in order to evaluate the integration of new science into management).
- f. 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.
- g. 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).
- h. Extent to which local and traditional knowledge is incorporated.

4 Scope of the FEP

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 4). In the development of the FEP, the area should be refined by assessing biophysical characteristics rather than bounded by the U.S. EEZ, and where appropriate, the geographic boundaries should be relaxed to allow understanding external pressures and drivers. Studies have shown that there may also be multiple biogeographic regions within the core FEP area identified in Figure 4 (e.g., Sigler et al 2011), and there is considerable connectivity of the ecosystem with neighboring areas, especially north of Bering Strait.

Figure 4 Initial map of FEP core boundary



The Fisheries are concentrated in the southern Bering Sea region, which also includes the southern shelf and the whole of the Bering Sea slope area, and is distinguished by annually variable bottom temperatures. If appropriate, the southeastern area should be prioritized, in a stepwise approach to FEP development.

Jurisdictional boundaries

The FEP will identify and describe jurisdictional boundaries that are contained within and that bisect the core geographic FEP area identified in Figure 4.

Fisheries included in the FEP

The scope of the FEP encompasses all Federal fisheries within the area, and considers the interactions of Federal and State fisheries with each other, and with other components of the ecosystem. Federal fisheries include those managed under the BSAI groundfish and the BSAI crab FMPs, the Alaska Scallop FMP, and halibut fishing by all sectors as authorized in Federal regulations. State fisheries for crab, herring, and salmon will also be considered, as well as subsistence activities that encompass both fishing and hunting of marine mammals.

Interconnectivity of ecosystem components

The FEP encompasses relationships among fisheries, communities, prey and predators of target and non-target species, their habitat, the impacts of climate, and the cumulative impact on the ecosystem from all fisheries and non-fishing impacts. In order to understand the impact of these components 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 that component. This may be especially important for the area north of Bering Strait.

5 Synthesis of Bering Sea ecosystem

What do we know about key relationships, vulnerable species, ecosystem focal points, and what is most important from a fishery management perspective.

6 Bering Sea ecosystem goals

One of the significant steps managers can take to move toward ecosystem-based management is to develop and implement Fishery Ecosystem Plans. These plans, though not legally binding, should incorporate 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 the following goals:

- 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; and
- 6) Provide a legacy of healthy ecosystems for future generations.

7 Bering Sea FEP Objectives

The following are strategic objectives for the Bering Sea FEP. The bullets underneath each objective represent action modules that have been identified and that are relevant to the strategic objectives. In this example, only four action modules have been identified.

- 1) Synthesize and update current scientific understanding 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.
 - Comprehensive assessment of the Council’s Bering Sea fishery management with respect to EBFM best practices – assessment of successes, and gap analysis of areas to improve
 - Define conceptual models of the Bering Sea based on key ecosystem focal points (e.g., groundfish, crab, Norton Sound communities, etc.)
 - Develop a protocol for using subsistence information in management
- 2) Create and implement a cohesive plan 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.
 - Comprehensive assessment of the Council’s Bering Sea fishery management with respect to EBFM best practices – assessment of successes, and gap analysis of areas to improve
 - Develop a protocol for using subsistence information in management
- 3) Establish a process for addressing change under novel or intensified stressors, including opportunities to use ecosystem information to inform decisions for adaptive management, to understand tradeoffs among ecological, social, and economic factors of fishery harvest, and to consider subsistence needs and traditional knowledge
 - Evaluate the vulnerability of key species to climate change
- 4) Review and evaluate the direct, indirect and cumulative effects of fishery management actions on the Bering Sea ecosystem (shelf, slope and canyons) to provide a baseline for evaluation of future council actions.

8 Framework of FEP action modules

8.1 Process for identifying, prioritizing, and tasking action modules

The FEP is a strategic plan, with goals and objectives as listed above, and project descriptions for specific action modules related to the FEP’s objectives. Each action module is described in the FEP, which will explain the purpose it would serve, the resources required to accomplish it, how it will affect Council decision making, and what is required for it to be implemented in the Council process.

The Council will prioritize these action modules and, if appropriate, initiate them for action, based on consideration of other Council’s priorities and available resources. The modules would be a fluid part of the FEP, and would change over time. A process for public involvement in identifying possible action modules will be developed, and opportunities for input on how they are prioritized. The development and outcome of the specific action modules would not be formally part of the FEP strategic document, a reporting and feedback mechanism would be developed to track action modules as part of the FEP document. Once the FEP strategic document is prepared, the Council may wish to initiate a periodic review process to consider whether action modules should be revised, new modules added, priorities changes, or actions initiated.

The sections that follow expand on several example action modules, illustrating how their description might be included in the FEP. For each action module, the FEP would answer five questions about the module’s purpose, the resources involved, and how it will affect the Council process. Once the Council starts initiating and then completing the action modules, we will likely also want to add in additional steps that provide for reporting, review and follow-up mechanisms appropriate to the action module. These will be developed at a later stage.

8.2 Example Action Module 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, and, if adopted, the operational definition of EBFM in the FEP. 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. 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.

3. Purpose it will achieve (relationship to the FEP's tactical 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 other action modules. Additionally, the Council has recognized that the FEP could be an effective tool for better communication about the Council's current integration of the ecosystem approach in its management, and developing a report would address that need.

4. How it will affect the Council's decision making and management

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. This will allow the Council to prioritize its efforts with respect to other action modules, and to exercise increased precaution in certain areas if appropriate.

5. How it will be implemented in the Council process

The study itself will not be implemented in the Council process, but by identifying areas in need of Council action, will prompt the Council to initiate an appropriate response, be it a request for more research, or specific analyses.

8.3 Example Action Module 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. 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.

3. Purpose it will achieve (relationship to the FEP's tactical 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.

4. How it will affect the Council's decision making and management

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.

5. How it will be implemented in the Council process

It may be that the conceptual models are most effective integrated into the FEP strategic document.

8.4 Example Action Module 3: Evaluate the short- and long-term effects of climate change on fish and fisheries

One out of every two fish captured annually in the US come 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 reevaluation.

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

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 sections 4 and 5 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 Assessment* (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 reevaluation 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. 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.

3. Purpose it will achieve (relationship to the FEP's tactical 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. 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 adaptation 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.

4. How will it will affect the Council's decision-making and management

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 vibrant 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.

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.

5. How it will be implemented in the Council process

The climate module proposed here could include a strategic reevaluation 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 reevaluation 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 FABC) 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 section 4 above for additional examples.

8.5 Example Action Module 4: Develop a protocol for using subsistence information in management

Subsistence use of marine resources has been a part of the Native Alaskan’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 region⁷. These traditional use data are now available in map and GIS formats that allow managers to evaluate them for potential conflicts with commercial fisheries. 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 Native Alaskan communities, or affect the resource use patterns of those communities.

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

A Bering Sea Fishery Ecosystem Plan provides opportunity for the NPFMC 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. 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 Northern Bering Sea Mapping Project and Bering Strait Marine Life and Subsistence Use Data Synthesis are two 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 NPFMC is not staffed to accomplish. The NPFMC 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 NPFMC would need to develop a partnership with Native Alaskan 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 NPFMC time or staff resources to incorporate the data into analyses. Some regular staff time would be required to update descriptions in the FEP.

3. Purpose it will achieve

The subsistence module of the Bering Sea FEP will prescribe the way that subsistence data are incorporated into NPFMC 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.

4. How it will affect the Council's decision-making and management

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 Native Alaskans to access those resources. The subsistence module would provide ready access to subsistence data for use in analyses, and provide a guideline

⁷ 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>.

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.

5. How it will be implemented in the Council 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.

9 Outreach / public involvement plan

Develop an outreach/public involvement plan to consider how to provide for stakeholder input.

10 Feedback mechanisms

Discuss how often will the FEP be revisited: e.g., at the completion of an action module; annually; every 5 years.