The North Pacific Marine Science Organization (PICES) / North Pacific Research Board Workshop on *Integration of Ecological Indicators for the North Pacific with Emphasis on the Bering Sea*

DRAFT Working Paper on the Development of Operational Objectives for the Southeast Bering Sea Ecosystem

By

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Background

Motivation for Workshop

This project responds to Project Need 1, Item 2, in the North Pacific Research Board's (NPRB's) request for proposals for 2005:

> ***Evaluate the Utility of Ecosystem Indicators in Explaining Processes underlying Marine Production.*** *Processes related to physical (e.g., atmospheric forcing, ocean temperature, salinity, sea level, freshwater discharges, transport of planktonic life history stages, sea ice extent and duration, turbulence and cold pool extent), chemical (e.g., nutrient/micronutrient availability to phytoplankton), and biological (e.g., predation, timing of plankton/zooplankton production, commercial catch composition, biomass/abundance trends) phenomena provide indicators of ecosystem status. The project would report on the current understanding of ecosystem indicators in the Bering Sea and Aleutian Islands, evaluate pros and cons of existing indicators, and identify next steps toward developing and/or validating indicators and evaluating their performance (e.g., using hind-casts of indicators and various marine populations). In addition, the report will describe how indicators can best be used as a tool for resource managers. The approach would include a*

workshop of regional experts to address the challenge of developing indicators and interpreting their utility.

The Approach

In overview, four activities will be conducted during the workshop:

1. Involve the Bering Sea and international communities in developing of a set of operational objectives for the southeast Bering Sea ecosystem
2. Evaluate two status reports with a goal of integrating results and streamlining the presentation. The two reports are:
    a. NPFMC. 2005. Appendix C: Ecosystem Considerations for 2006. North Pacific Fishery Management Council, Anchorage, Alaska. (available at: http://access.afsc.noaa.gov/reem/ecoweb/index.cfm)
    b. PICES. 2004. Marine Ecosystems of the North Pacific, PICES Special Publication 1, 280 p. (available at: http://www.pices.int/)
3. Investigate methodologies that monitor system-wide structural changes within the marine ecosystem
4. Identify steps in validating indicator performance, improving the monitoring network, and integration into predictive models.

In conducting these activities, there is a focus on the southeastern Bering Sea, because it represents the center of the Bering Sea/Aleutian Islands large marine ecosystem (LME), one of three LMEs (the other two are the Gulf of Alaska and Arctic Ocean) defining the NPRB research region (NPRB 2005). Although we focus on the southeastern Bering Sea, the intent is for this exercise to provide insights, findings, and recommendations more broadly applicable to the northern North Pacific and adjacent seas, a larger area representing the PICES region including waters bordering China, Japan, South Korean, Russia, Canada, and the United States.

Project Products

Pre-workshop activities include the development of working papers on the first three tasks. This report represents a draft working paper toward task #1. The second and third working papers, addressing tasks #2 and #3, will be made available shortly before the workshop.

The primary product of this project will be a PICES Scientific Report, which will include the three working papers, a summary of workshop discussions, and a set of workshop recommendations. Because outcomes of the workshop will be utilized by NPRB in the planning of an integrated ecosystem research plan for the Bering Sea during summer 2006, an interim meeting summary will be prepared immediately following the workshop so that key workshop findings are made available to this planning process

Introduction

According to the United Nations' Convention on Biological Diversity, an **ecosystem approach [to management, EAM]** is *a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way* (http://www.biodiv.org/default.shtml). In the northeast Pacific Ocean, contemporary conservation and management issues include fisheries, mariculture and ocean ranching, invasive species including rats and foxes on Aleutian Islands, preservation of heritage sites, coastal development, coastal erosion from rising sea level, oil and gas exploration and development, oil spill prevention and response, and risks associated with toxic waste sites from defunct military facilities. Among these concerns, management plans have been most fully developed for commercial fisheries. Therefore, while we maintain the broader view of EAM, we focus on fisheries management for the purposes of this workshop.

Traditional fisheries management compares the status of an exploited fish stock to the well-being of users of that resource. Since the 1990s, fisheries managers have been advised to broaden their scope of awareness beyond single-species considerations owing to a greater appreciation of the following (FAO 2003):

- General poor performance of single-species fishery management worldwide
- Heightened awareness of interactions among fisheries and ecosystems
- Better understanding of the functional value of ecosystems to humans
- Recognition of the wide range of societal objectives associated with marine fishery resources and ecosystems

As a result, fisheries management has been moving slowly toward multispecies and ecosystem approaches. That is, within the broader context of EAM, fisheries have been shifting toward an ecosystem-based fisheries management (EBFM), also called an ecosystem approach to fisheries (EAF). An EAF *strives to balance diverse societal objectives by taking into account the knowledge and uncertainties of biotic, abiotic, and human components of ecosystems and their interactions and applying an integrated approach to fisheries within ecologically meaningful boundaries* (Garcia et al. 2003).

An appreciation of diverse societal objectives recognizes that benefits arising from fish harvests form just one of the "services" that humans derive from marine ecosystems. Instead, an EAM approach strives to balance the suite of ecosystem services according to objectives and priorities set by society. Ecosystem services may be categorized into the following types (MEA 2005):

- Provisioning Services – food, water, fuel, fiber, biochemicals, genetic resources
- Regulating Services – climate, disease, water purification, floods
- Cultural Services – spiritual, recreational, ecotourism, aesthetic, educational
- Supporting Services – necessary for production of all other ecosystem services, e.g., primary production, nutrient cycling, ecological value

Making EAF Operational

To make EAF operational, there is a need to establish a policy, management, monitoring and assessment framework for a system with measurable operational objectives. An operational objective might consist of a verb (e.g., reduce), a specific measurable indicator (e.g., bycatch mortality), and a reference point (e.g., 1% of standing biomass) (Jamieson et al., 2001), Indicators are used to quantify the performance of management with respect to these objectives (Fig. 1).

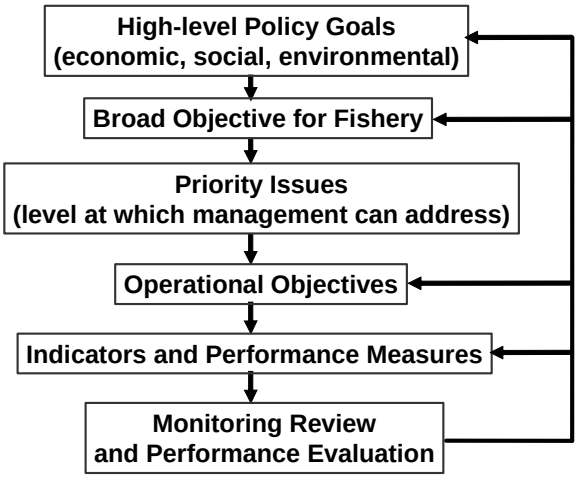

Figure 1. Relationship between policy goals, broad fishery objectives, operational objectives, and indicators and performance measures for an ecosystem approach to fisheries (adapted from FAO 2003).

The following is a simple example of how such a framework might be developed for a groundfish fishery. A high-level policy goal is to maintain ecosystem structure and function. While noble and perhaps somewhat naïve, this goal is too vague to allow unequivocal determination whether it has been attained. So a broad objective for a groundfish fishery, that is consistent with the policy goal, may be to maintain the community of predators within ecologically viable levels. Some might consider that this objective is still too broad to allow definitive measurement of management success. So operational objectives with increasing levels of specificity can be developed, such as maintaining the spawning biomass of the predators (e.g., sharks, cod and halibut) at 35% or more of their unfished levels while banning the harvest of forage species (e.g., capelin, eulachon, sand lance) to maintain natural fluctuations in prey abundance. An objective becomes operational only if there are agreed-upon target and limit reference points associated with the objective, as well as a routinely monitored indicator that, when compared to the limit and target reference points, provides a performance measure about how well management is achieving the objective (Fig. 2).

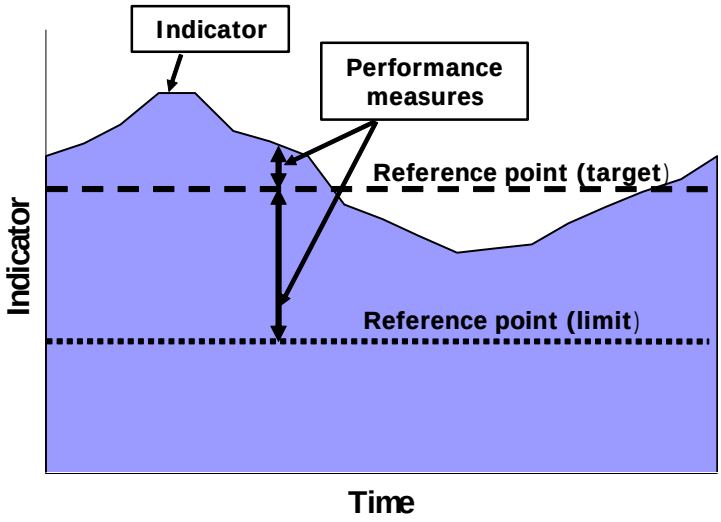

Figure 2. Illustration of an indicator, reference points, and performance measures relative to an ecosystem operational objective (modified after FAO 2003).

Ecosystem Considerations in Fisheries Management in the Eastern Bering Sea

The U.S. North Pacific Fishery Management Council (NPFMC) recommends regulations for federally managed fisheries in the U.S. Exclusive Economic Zone (EEZ, 3-200 nautical miles, nm) in the Gulf of Alaska, Aleutian Islands, and eastern Bering Sea; federal regulations are implemented and enforced by NOAA/Fisheries. For state-managed fisheries, regulations are set and fisheries are managed by the Alaska Board of Fisheries and Alaska Department of Fish and Game, respectively. The State of Alaska manages fisheries within state waters (0-3 nm), and management authority for some fisheries in the EEZ is delegated to the State of Alaska (e.g., crabs, lingcod, some rockfishes in the Gulf of Alaska), whereas still others (e.g., crabs in the Bering Sea and Aleutian Islands, scallops and salmon throughout Alaska) are managed under cooperative state-federal management plans.

Fisheries off the coast of Alaska tend to be conservatively managed, and exploited fish stocks have faired much better in this region than many other areas of the world (POC 2003). The NPFMC has a long track record of setting precautionary catch limits (Witherell et al. 2000, Witherell 2004). Conservative estimates of overfishing limits (OFLs) and acceptable biological catches (ABCs; where ABC < OFL) are recommended to the NPFMC by their Scientific and Statistical Committee (Fig. 3). Moreover, total allowable catches (TACs) are always set at or below ABC levels and fishery removals are managed inseason so as not to exceed the TACs (Fig. 3). In addition, total catch for the BSAI groundfish complex is constrained to 2 million mt, so that the sum of TACs for invidividual groundfish species is considerably less than the sum of ABCs. This limit provides a buffer against the uncertainties of single species harvest targets.

Other conservative single-species aspects of federal fishery management in Alaska include capacity reduction programs for most fisheries, individual transferable quotas for crab, sablefish and halibut, and excellent data-collection programs, including fishery-

independent surveys and an at-sea observer program. Likewise, the State of Alaska constrains groundfish and invertebrate catches by guideline harvest levels (similar to TACs) and does not allow commercial fisheries to be prosecuted if stocks fall below a precautionary threshold level of abundance.

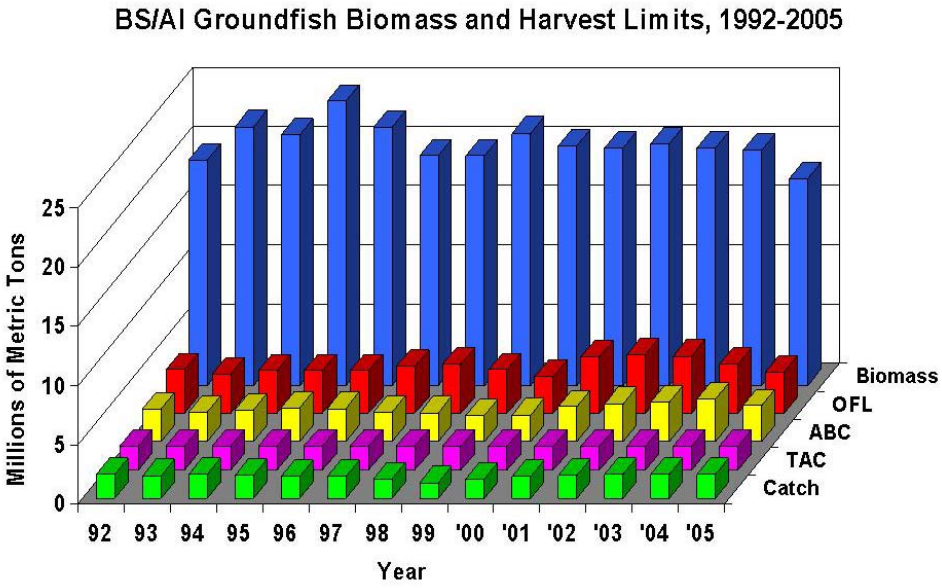

Figure 3. Estimates of biomass, overfishing level (OFL), acceptable biological catch (ABC), and total allowable catch (TAC), and actual catch in millions of tons for groundfish in the Bering Sea/Aleutian Islands region during 1992-2005 (source: North Pacific Fishery Management Council).

The NPFMC incorporates many ecosystem considerations into fishery management (Witherell et al. 2000, Witherell 2004). Examples include limits on bycatch and discards in the Bering Sea groundfish fisheries. Prohibited species catch (PSC) limits are established as a small fraction of crab and herring biomass and chinook and chum salmon abundance; when PSC limits are attained, specific areas close to fishing (Witherell and Pautzke 1997). Other ecosystem approaches include large area closures to bottom trawling and dredging to protect corals and sponges, crabs, and other bottom habitats. Ninety-five percent of the Aleutian Islands management area (~277,100 nm^2) has been closed to bottom trawling since 2005 (Witherell 2005). The State of Alaska has closed some state waters to trawling since the late 1960s in efforts to protect crab habitats. Presently, nearly all state waters in the Gulf of Alaska and southeastern Bering Sea are closed to trawling, where only fixed gears (e.g., pots, longlines, jigs) are allowed for groundfish (Kruse et al. 2000). Other ecosystem approaches include numerous measures to protect Steller sea lions and reduce seabird bycatch, full retention standards for pollock and cod fisheries to reduce discards, and a prohibition on forage fish fisheries throughout the Gulf of Alaska, Aleutian Islands, and Bering Sea, with the exception of ongoing commercial fisheries for Pacific herring.

Need for Further Development of EAF for the Bering Sea

Despite the healthy status of many fished stocks, some fish and wildlife populations have undergone significant declines in recent decades. In 2004, no overfishing occurred in any of the 58 assessed marine fish and invertebrate stocks, but four of 32 assessed stocks were determined to be overfished (NMFS 2005). The four stocks listed as overfished in 2004 were snow crabs (Bering Sea), blue king crabs (Pribilof Islands), blue king crabs (St. Matthew Island), and Tanner crabs (eastern Bering Sea). As many scientists attribute the cause of these low crab abundances to climate change, the term "depleted" may be more appropriate than "overfished." In the Gulf of Alaska, where the State of Alaska manages invertebrate stocks without a federal fishery management plan, most crab and shrimp stocks collapsed in the 1980s and abundance continues at low levels despite fishery closures for more than 20 years (Kruse et al. 2000). Significant declines in great whales, western stock of Steller sea lions, fur seals, sea otters, and some seabirds, such as Spectacled and Steller's eiders, are of much concern. Whereas the role of humans is clear in some declines (e.g., historical whaling, predation of seabird eggs by human-introduced rats and foxes on Aleutian Islands), others are less clear, but may involve a stronger role of climate (e.g., recent decline of fur seals, lack of recovery of crab and shrimps). A better understanding of the roles of humans and climate on these changes is necessary to strengthen the EAF, refine management objectives, and to develop useful indicators, reference points, and performance measures.

Goals and Objectives for the Bering Sea

In 2004, NMFS completed an Alaska Groundfish Fisheries Programmatic Supplemental Environmental Impact Statement (PSEIS), a comprehensive assessment of the overarching conservation and management policies and objectives of the Alaska groundfish fishery management plans (NMFS 2004). This PSEIS assessment was conducted through the environmental review process established by the National Environmental Policy Act (NEPA). Original, revised, and final versions of the PSEIS were developed and reviewed during a series of public hearings, as well as during meetings of the NPFMC during 2001 to 2004. As a consequence, the NPFMC recommended amendments to the fishery management plans for the Bering Sea/Aleutian Islands and Gulf of Alaska groundfish fisheries. The revised plans include a high-level policy statement, a broad goal and objectives for the fishery, a set of priority issues, and more specific set of objectives within each priority issue (NPFMC 2005; see Appendix 1 excerpted from the revised fishery management plan for the Bering Sea/Aleutian Islands).

The NPFMC's high-level policy statement for both the Bering Sea/Aleutian Islands groundfish fishery management plan and Gulf of Alaska fishery management plan is:

> *… to apply 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 NPFMC developed a set of broad objectives for the fishery, which are to:

(1) provide sound conservation of the living marine resources;
(2) provide socially and economically viable fisheries for the well-being of fishing communities;
(3) minimize human-caused threats to protected species;
(4) maintain a healthy marine resource habitat; and
(5) incorporate ecosystem-based considerations into management decisions.

The Council identified nine priority issues:

1. Prevent overfishing
2. Promote sustainable fisheries and communities
3. Preserve food web
4. Manage incidental catch and reduce bycatch and waste
5. Avoid impacts to seabirds and marine mammals
6. Reduce and avoid impacts to habitat
7. Promote equitable and efficient use of fishery resources
8. Increase Alaska Native consultation
9. Improve data quality, monitoring and enforcement

Within these nine issues, 45 specific objectives (i.e., "tasks") were adopted (see Appendix 1 for details). The NPFMC has developed a work plan to address these priority issues and objectives (Appendix 2). Progress on the work plan is reviewed during each Council meeting. Appendix 3 groups the 45 management objectives into those already included in the groundfish management program, those relating to actions currently under Council consideration, those relating to actions currently on hold or not initiated, and those that apply to all management actions.

Following the approach during a workshop on objectives and indicators in Canada (Jamieson et al. 2001), for purposes of our workshop, we will not consider issues that primarily concern *economic and social dimensions of human use* (i.e., issues 2, 7, 8, and 9). Instead, we focus on the remaining five issues that address issues concerning *conservation of species and habitats* (i.e., issues 1, 3, 4, 5, and 6).

Priority Conservation Issues with Examples of Operational Objectives and Indicators

The following are the five broad priority conservation issues identified by the NPFMC. For each conservation issue, an example of an operational objective and an associated indicator is provided.

- *Prevent Overfishing*
    - Operational objective – maintain harvest rates below those defined to be overfishing, F_{OFL}, for each exploited fish and invertebrate stock. Whereas the exact definition and value of F_{OFL} varies by stock based on the level of available data and stock-specific life history parameters, for most groundfish stocks managed by the NPFMC, F_{OFL} is based on $F_{35\%}$, a rate that will, on average, reduce spawning stock biomass to 35% of the unfished level.
    - Indicator – estimated annual fishing mortality based on the sum of landings, discards, and bycatch mortality divided by fishery-independent estimates of stock biomass.

- *Preserve Food Web*
    - Objective – do not "fish down the food web" by maintaining trophic level balance in the eastern Bering Sea relative to the mean trophic level range (3.32 to 3.77, mean 3.61) observed during the base period, 1954-1984.
    - Indicator – estimated annual mean trophic level of the catch of all groundfish and crabs from the eastern Bering Sea.

- *Manage Incidental Catch and Reduce Bycatch and Waste*
    - Operational objective – reduce discarded bycatch by 40% from levels estimated during 1994-1997.
    - Indicator – estimated discards as a percentage of total groundfish catch.

- *Avoid Impacts to Seabirds and Marine Mammals*
    - Operational objective – reduce total seabird bycatch on longline vessels by 30% from levels during 1994-1997.
    - Indicator – Estimated seabird bycatch based on counts on vessels with observers extrapolated to the total longline fleet based on the proportion of observed to estimated total fishing effort.

- *Reduce and Avoid Impacts to Habitat*
    - Operational objective – Reduce bottom habitat disturbance by 25% from the base period 1990-1999.
    - Indicator – annual bottom trawl effort (days fished).

Role of Participants with Respect to EAF Objectives

It is beyond the scope of the workshop to develop a full set of operational objectives for EAF for the Bering Sea. Nevertheless, we hope to make progress towards this end, and any advice from participants on operational objectives is welcome. It is hoped that the current suite of priority issues (and Council-defined objectives listed in Appendix 1) provide sufficient guidance for a fruitful discussion about ecosystem indicators and reference points that can be used to measure progress on these operational objectives.

During day 1 of the workshop, participants will hear presentations relevant to the project including operational objectives, ecosystem indicators, synthesis and complexity, analytical approaches, as well as perspectives from other regions.

Dr. Jake Rice (Canada) will start Day 2 with his perspective on what was presented on Day 1, including a review of the NMFS and PICES ecosystem reports (introduced on Day 1). This will be followed in the morning by four parallel break-out groups to discuss operational objectives and use of indicators in the Bering Sea. This is intended to be an opportunity to receive insightful feedback from the participants on the problem at hand. Scheduling concurrent breakout groups, each with the same task, should provide for interesting contrasts of opinion. In the afternoon, breakout groups will re-organize on the basis of subject matter: (1) matching indicators to objectives, (2) methodologies to monitor ecosystem-wide structural change, (3) monitoring networks and validating indicators and change, and (4) communicating results.

Day 3 will begin with a perspective from the NPRB, followed by a facilitated discussion to review and discuss participants' contributed indicator lists (provided in advance of the workshop).

Food for Thought: Input from two Pre-workshops on Objectives for Alaska

In preparing for the Seattle workshop, two preliminary events were held, one on 25 January 2006 in Anchorage and the other on 8 February 2006 in Seattle. The former was held as an afternoon session at the conclusion of the annual *Marine Science in Alaska* Symposium and the latter was held as an evening session during the meeting of the North Pacific Fishery Management Council. The first workshop was attended by approximately 75 participants, whereas the latter was attended by 20 participants.

A report on these two workshops was prepared by Gordon Kruse and has been posted on the PICES website for this workshop. Participants are encouraged to read the full report for details. However, a few of the more intriguing comments and questions are listed here to stimulate further thought in advance of the June 2006 workshop:

- We know the Bering Sea is a dynamic system and we also know that some reference points (e.g., crab biological reference points) aren't always robust, so how do we manage for performance measures in a dynamic system? The idea to "maintain" might not be the appropriate term.

- Objectives that have the phrase "to maintain" and those dealing with "ecosystem structure" are vague. There is a need to consider ecosystem states that may change over time (multiple states of the system) and there is a need to allow ecosystem indicators to fluctuate over time. There has been considerable work on the benthic intertidal that indicates the existence of multiple steady states.

- Consider species that are indicators of various kinds of ecosystem change: secular, cyclical, decadal.

- Consider the possibility that indicators themselves may change. For instance, if sea ice ultimately disappears from the Bering Sea, it would no longer be a useful indicator for the Bering Sea, but could remain useful in the Arctic Ocean.

- Often we can only see ecosystem shifts in hindsight (i.e., note that we are still arguing over the last El Niño), so it may be naive to say we will see an ecosystem change and respond accordingly.

- There is a focus on the use of single, sentinel species as indicators of ecosystem-level changes. It may be useful to broaden our consideration to consider looking at aggregate indicators, such as the biomass of a class of consumers.

- We are entrenched in methods that try to maintain the mean but eliminate the variance. What if the most important feature for sustaining variability is maintaining the variance and not the mean?

- It is important to consider the need to examine aspects of variability over time. Consider focusing on things for which you understand the variance structure well.

- Consider diversity versus richness as an indicator. Also, consider the spatial distribution of biodiversity.

- Are there desirable upper limits on species, such as particular marine mammal abundances? For example, how high does arrowtooth flounder need to get to trigger a halt to the pollock fishery or to hold the fishery harmless for their crab and halibut bycatch to foster removals of arrowtooth flounder from the system?

- Consider statistical versus functional methods to render indicators. For the latter, consider exploring groupings of species in the system by functional groups, such as winter spawners versus summer spawners, or predators of copepods versus predators of other plankton, etc.

- Consider using species with which we do not interact directly – e.g., walrus in the Bering Sea that feed on clams – as indicators. Then, use these species to compare to those species that are affected by fisheries to try to sort out our effects.

- There are other views of the role of humans in the system, such as Chuck Fowler's approach that argues that harvests are an order of magnitude too high, relative to other similar trophic level consumers.

- Some indicators are common across systems. Consider looking at degraded systems to see what indicators may have indicated a change in those systems and adopt those.

- Consider focusing on indicators that motivate management decisions. Sea ice indicators are nice, but what management decision hinges on this indicator?

Opportunity: Development of a Fishery Ecosystem Plan for the Aleutian Islands

For the past year, the NPFMC has been considering the development of a Fishery Ecosystem Plan (FEP) for the Aleutian Islands management area, as a more explicit ecosystem approach to fisheries. A discussion paper continues to be developed on this topic. The latest was drafted in March 2006 and is posted on the PICES workshop website.

Interest in establishing the first North Pacific FEP in the Aleutian Islands stems from several considerations. The area has attracted more interest in recent years concerning fisheries for walleye pollock, Pacific cod and Atka mackerel. To date, the Aleutian Islands has been lumped together with the Bering Sea under one fishery management plan for groundfish, however, some evidence suggests that stock structure for some commercial species may require separate management units.

Also, in recent years, the NPFMC has recognized the Aleutian Islands as a region containing unique ecological values that the Council wishes to preserve. The Aleutian Islands have been a focus for Steller sea lion protection measures and conservation of benthic habitats to protect coldwater corals and sponges.

The Aleutian Islands ecosystem was focus of a recent journal issue (Schumacher et al. 2005). Many papers in this issue indicated that the Aleutian Islands themselves may involve more than one region; for example, the Aleutian passes east of Samalga Pass are more shelf-like in nature, whereas those to the west are more oceanic. Significant differences in ecology are associated with these features.

The Aleutian Islands marine ecosystem remains an area of severely limited knowledge due, in part, to its remoteness. Schumacher and Kruse (2005) identified the need for increased funding for ecosystem research as well as the need to broaden management objectives to encompass a wider set of ecosystem services in an integrated ecosystem management plan. Quite possibly, timing may now be ripe for such progress.

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Appendix 1: Excerpt from Chapter 2 of the BSAI [GOA] Groundfish FMPs

2.2 Management Approach for the BSAI [GOA] Groundfish Fisheries

The Council's policy is to apply 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 productivity of the North Pacific ecosystem is acknowledged to be among the highest in the world. For the past 25 years, the Council management approach has incorporated forward looking conservation measures that address differing levels of uncertainty. This management approach has in recent years been labeled the precautionary approach. 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 the managed species. It will carry out this objective by considering reasonable, adaptive management measures, as described in the Magnuson-Stevens Act and in conformance with the National Standards, the Endangered Species Act (ESA), the National Environmental Policy Act, and other applicable law. This management approach takes into account the National Academy of Science's recommendations on Sustainable Fisheries Policy.

As part of its policy, the Council intends to consider and adopt, as appropriate, 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. All management measures will be based on the best scientific information available. Given this intent, the fishery management goal is to provide sound conservation of the living marine resources; provide socially and economically viable fisheries for the well-being of fishing communities; minimize human-caused threats to protected species; maintain a healthy marine resource habitat; and incorporate ecosystem-based considerations into management decisions.

This management approach 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. This policy will use and improve upon the Council's existing open and transparent process of public involvement in decision-making.

2.2.1 Management Objectives

Adaptive management requires regular and periodic review. Objectives identified in this policy statement will be reviewed annually by the Council. The Council will also review, modify, eliminate, or consider new issues, as appropriate, to best carry out the goals and objectives of this management policy.

To meet the goals of this overall management approach, the Council and NMFS will use the Alaska Groundfish Fisheries Programmatic Supplemental Environmental Impact Statement (PSEIS) (NMFS 2004) as a planning document. To help focus consideration of potential management measures, the Council and NMFS will use the following objectives as guideposts, to be re-evaluated, as amendments to the FMP are considered over the life of the PSEIS.

Prevent Overfishing:

1. Adopt conservative harvest levels for multi-species and single species fisheries and specify optimum yield.
2. Continue to use the 2 million mt optimum yield cap for the BSAI groundfish fisheries. [Continue to use the existing optimum yield cap for the GOA groundfish fisheries.]
3. Provide for adaptive management by continuing to specify optimum yield as a range.
4. Provide for periodic reviews of the adequacy of F_{40} and adopt improvements, as appropriate.
5. Continue to improve the management of species through species categories.

Promote Sustainable Fisheries and Communities:

6. Promote conservation while providing for optimum yield in terms of the greatest overall benefit to the nation with particular reference to food production, and sustainable opportunities for recreational, subsistence, and commercial fishing participants and fishing communities.
7. Promote management measures that, while meeting conservation objectives, are also designed to avoid significant disruption of existing social and economic structures.
8. Promote fair and equitable allocation of identified available resources in a manner such that no particular sector, group or entity acquires an excessive share of the privileges.
9. Promote increased safety at sea.

Preserve Food Web:

10. Develop indices of ecosystem health as targets for management.

11. Improve the procedure to adjust acceptable biological catch levels as necessary to account for uncertainty and ecosystem factors.
12. Continue to protect the integrity of the food web through limits on harvest of forage species.
13. Incorporate ecosystem-based considerations into fishery management decisions, as appropriate.

Manage Incidental Catch and Reduce Bycatch and Waste:

14. Continue and improve current incidental catch and bycatch management program.
15. Develop incentive programs for bycatch reduction including the development of mechanisms to facilitate the formation of bycatch pools, vessel bycatch allowances, or other bycatch incentive systems.
16. Encourage research programs to evaluate current population estimates for non-target species with a view to setting appropriate bycatch limits, as information becomes available.
17. Continue program to reduce discards by developing management measures that encourage the use of gear and fishing techniques that reduce bycatch which includes economic discards.
18. Continue to manage incidental catch and bycatch through seasonal distribution of total allowable catch and geographical gear restrictions.
19. Continue to account for bycatch mortality in total allowable catch accounting and improve the accuracy of mortality assessments for target, prohibited species catch, and non-commercial species.
20. Control the bycatch of prohibited species through prohibited species catch limits or other appropriate measures.
21. Reduce waste to biologically and socially acceptable levels.

Avoid Impacts to Seabirds and Marine Mammals:

22. Continue to cooperate with U.S. Fish and Wildlife Service (USFWS) to protect ESA-listed species, and if appropriate and practicable, other seabird species.
23. Maintain or adjust current protection measures as appropriate to avoid jeopardy of extinction or adverse modification to critical habitat for ESA-listed Steller sea lions.
24. Encourage programs to review status of endangered or threatened marine mammal stocks and fishing interactions and develop fishery management measures as appropriate.
25. Continue to cooperate with NMFS and USFWS to protect ESA-listed marine mammal species, and if appropriate and practicable, other marine mammal species.

Reduce and Avoid Impacts to Habitat:

26. Review and evaluate efficacy of existing habitat protection measures for managed species.
27. Identify and designate essential fish habitat and habitat areas of particular concern pursuant to Magnuson-Stevens Act rules, and mitigate fishery impacts as necessary and practicable to continue the sustainability of managed species.
28. Develop a Marine Protected Area policy in coordination with national and state policies.
29. Encourage development of a research program to identify regional baseline habitat information and mapping, subject to funding and staff availability.
30. Develop goals, objectives and criteria to evaluate the efficacy and suitable design of marine protected areas and no-take marine reserves as tools to maintain abundance, diversity, and productivity. Implement marine protected areas if and where appropriate.

Promote Equitable and Efficient Use of Fishery Resources:

31. Provide economic and community stability to harvesting and processing sectors through fair allocation of fishery resources.
32. Maintain the license limitation program, modified as necessary, and further decrease excess fishing capacity and overcapitalization by eliminating latent licenses and extending programs such as community or rights-based management to some or all groundfish fisheries.
33. Provide for adaptive management by periodically evaluating the effectiveness of rationalization programs and the allocation of access rights based on performance.
34. Develop management measures that, when practicable, consider the efficient use of fishery resources taking into account the interest of harvesters, processors, and communities.

Increase Alaska Native Consultation:

35. Continue to incorporate local and traditional knowledge in fishery management.
36. Consider ways to enhance collection of local and traditional knowledge from communities, and incorporate such knowledge in fishery management where appropriate.
37. Increase Alaska Native participation and consultation in fishery management.

Improve Data Quality, Monitoring and Enforcement:

38. Increase the utility of groundfish fishery observer data for the conservation and management of living marine resources.
39. Develop funding mechanisms that achieve equitable costs to the industry for implementation of the North Pacific Groundfish Observer Program.

40. Improve community and regional economic impact costs and benefits through increased data reporting requirements.
41. Increase the quality of monitoring and enforcement data through improved technology.
42. Encourage a coordinated, long-term ecosystem monitoring program to collect baseline information and compile existing information from a variety of ongoing research initiatives, subject to funding and staff availability.
43. Cooperate with research institutions such as the North Pacific Research Board in identifying research needs to address pressing fishery issues.
44. Promote enhanced enforceability.
45. Continue to cooperate and coordinate management and enforcement programs with the Alaska Board of Fish, Alaska Department of Fish and Game, and Alaska Fish and Wildlife Protection, the U.S. Coast Guard, NMFS Enforcement, International Pacific Halibut Commission, Federal agencies, and other organizations to meet conservation requirements; promote economically healthy and sustainable fisheries and fishing communities; and maximize efficiencies in management and enforcement programs through continued consultation, coordination, and cooperation.

Appendix 2: NPFMC Work Plan (Dec. 2005) for Implementing Groundfish Management Policy

General Priority (in no particular order of importance)	Specific priority actions	Related to management objective:	Status *(updated 12-13-05)*	2006					2007				
				Feb	Apr	Jun	Oct	Dec	Feb	Apr	Jun	Oct	Dec
Protection of Habitat	a. complete EFH action as scheduled	27	**Amendment approved by Council**										
	b. recommend to NOAA Fisheries increased mapping of benthic environment	29											
	c. develop and adopt definitions of MPAs, marine reserves, etc.	30	discussion paper presented in Feb 05										
	d. review all existing closures to see if these areas qualify for MPAs under established criteria	30	discussion paper presented in Feb 05										
	e. evaluate effectiveness of existing closures	26	discussion paper presented in Feb 05										
Bycatch Reduction	a. complete rationalization of GOA fisheries	17 (32)	rockfish demonstration program approved; analysis ongoing for broader rationalization										
	b. complete rationalization of BSAI non-pollock fisheries	17 (32)	partially addressed through IRIU Amd 80 (final action Feb 06); also Pacific cod sector allocations (initial review Feb 06)										
	c. explore incentive-based bycatch reduction programs	15	partially addressed through GOA rationalization and BSAI salmon vessel bycatch accountability analysis										
	d. explore mortality rate-based approach to setting PSC limits	20											
	e. consider new management strategies to reduce incidental rockfish bycatch and discards	17	review ranking system for species of concern										
Protection of Steller Sea Lions	a. continue to participate in development of mitigation measures to protect SSL including development of an EIS and participation in the ESA jeopardy consultation process	23	intention to consider revisions to SSL management measures in 2006-07										
	b. recommend to NOAA Fisheries and participate in reconsideration of SSL critical habitat	23	NMFS requested to re-initiate FMP-level Section 7 consultation on DoC species										
Prevent Overfishing	a. continue to participate in the development of "lumping and splitting" criteria	5	GOA 'other species' amd approved; 'other species' breakout analysis initiated										
	b. consider new harvest strategies for rockfish	4	report on MSE of rockfish harvest strategy in Apr 06										
	c. set TAC at or < ABC	1	**Amendment approved by Council**										
Ecosystem Management	a. revisit calculation of OY caps	11, 4	research paper presented to SSC in Feb 05										
	b. recommend to NOAA Fisheries and participate in the development and implementation of ecosystem indicators as part of stock assessment process	10	development ongoing; ecosystem SAFE to be presented each year; PICES workshops to develop indicators for the BS (Jan-Feb 06)										
Improve Data Quality and Management	a. expand or modify observer coverage and sampling methods based on scientific data and compliance needs	38, 39	initial review scheduled for Feb 06										
	b. develop programs for economic data collection that aggregate data	40	partially addressed through GOA rationalization										
	c. modify VMS to incorporate new technology and system providers	41	global VMS analysis initial review in Apr 05										

Appendix 3: Management Objectives from the Groundfish FMPs

* indicates that objective is reflected on Council's work plan

Goal	**Objectives relating to actions already established as part of groundfish management program** (does not preclude further actions under these objectives)	**Objectives relating to actions currently under Council consideration**	**Objectives relating to actions that are on hold from Council consideration, or have not yet been initiated**	**Objectives relating to considerations that are applied to all management actions**
Prevent Overfishing	2. Use existing OY caps. 3. Specify OY as a range.	*4. Periodic reviews of F_{40} and adopt improvements *5. Improve management through species categories		1. Adopt conservative harvest levels
Promote Sustainable Fisheries and Communities				6. Promote conservation while providing for OY 7. Promote management measures that avoid social and economic disruption 8. Promote fair and equitable allocation 9. Promote safety
Preserve Food Web	12. Limit harvest on forage species.	*10. Develop indices of ecosystem health *11. Improve ABC calculations to account for uncertainty and ecosystem		13. Incorporate ecosystem considerations in fishery management
Manage Incidental Catch and Reduce Bycatch and Waste	14. Continue and improve current incidental catch and bycatch program 18. Continue to manage incidental catch and bycatch through seasons and areas 19. Account for bycatch mortality in TAC accounting *20. Control prohibited species bycatch through PSC limits	*15. Develop incentive programs for bycatch reduction *17. Develop management measures that encourage techniques to reduce bycatch	16. Encourage research for non-target species population estimates	21. Reduce waste to biologically and socially acceptable levels

Goal	**Objectives relating to actions already established as part of groundfish management program** (does not preclude further actions under these objectives)	**Objectives relating to actions currently under Council consideration**	**Objectives relating to actions that are on hold from Council consideration, or have not yet been initiated**	**Objectives relating to considerations that are applied to all management actions**
Avoid Impacts to Seabirds and Marine Mammals	22. Continue to protect ESA-listed and other seabirds *23. Maintain or adjust SSL protection measures 25. Continue to protect ESA-listed and other marine mammals	24. Encourage review of marine mammal and fishery interactions		
Reduce and Avoid Impacts to Habitat	27. Identify EFH and HAPC, and mitigate fishery impacts as necessary		*26. Review and evaluate efficacy of habitat protection measures for managed species 28. Develop MPA policy *29. Encourage research on baseline habitat mapping *30. Develop goals and criteria for MPAs; implement as appropriate	
Promote Equitable and Efficient Use of Fishery Resources		*32. Maintain LLP and initiate rights-based management programs	33. Periodically evaluate effectiveness of rights-based management programs	31. Provide economic and community stability through fair allocation 34. Consider efficiency when adopting management measures
Increase Alaska Native Consultation			36. Consider ways to enhance local and traditional knowledge collection 37. Increase Alaska Native participation in fishery management	35. Incorporate local and traditional knowledge into fishery management

Goal	**Objectives relating to actions already established as part of groundfish management program** (does not preclude further actions under these objectives)	**Objectives relating to actions currently under Council consideration**	**Objectives relating to actions that are on hold from Council consideration, or have not yet been initiated**	**Objectives relating to considerations that are applied to all management actions**
Improve Data Quality, Monitoring, and Enforcement		*38. Increase utility of observer data *39. Develop equitable funding mechanisms for the NPGOP	*40. Increase economic data reporting requirements *41. Improve technology for monitoring and enforcement 42. Encourage development of an ecosystem monitoring program	43. Cooperate with NPRB to identify needed research 44. Promote enforceability 45. Coordinate management and enforcement programs with Federal, State, international, and local partners