ISSUES TO BE CONSIDERED BY THE EVALUATION TEAM FOR THE BERING SEA AND GULF OF ALASKA WALLEYE POLLOCK FISHERY

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1 EXECUTIVE SUMMARY

The fishery for walleye pollock, a member of the cod family, was the largest single species fishery in the world prior to 1992 in terms of the biomass of landed catch. Since that time, landings of this species have been exceeded only by those of the Peruvian anchoveta. Over 70 percent of the total catch is taken in the Northwest Pacific fishery (Okhotsk Sea, Sea of Japan and Western Bering Sea), which is fished mainly by Russia, Japan, Korea, and Poland. The remaining catch is taken in the Northeast Pacific (Eastern Bering Sea and Gulf of Alaska), more than 95 percent of which is landed by U.S. fishing fleets. About 86 percent of the U.S. catch is taken from the Eastern Bering Sea; the remainder, from the Gulf of Alaska.

The Eastern Bering Sea and Gulf of Alaska pollock fishery is the largest fishery by volume in the United States, landing approximately 2,000,000 mt of pollock per year. This species comprises more than one-half of the entire volume of groundfish landed, and about two-thirds of the value of the groundfish fishery. A portion of the quota is reserved for the purpose of helping Alaska coastal communities to develop commercial fishing capacity.

Garnering about $700,000,000 per year after primary processing, pollock is the single most valuable species for processors, representing nearly one-half of the total wholesale value of fish from Alaska. Pollock products include fillets that are used for fish and chips, fish sandwiches, and frozen fish items, surimi (minced fish that is used in the manufacture of imitation crab and similar products), and roe. Fish meal is produced as a secondary product, as a result of a mandate for full utilization of pollock, and is exported. The United States and Europe are the primary market for fillets. Japan is the principal export target for surimi and roe.

The North Pacific Fishery Management Council manages U.S. pollock as smaller components of two larger "groundfish" complexes under two separate fishery management plans: 1) the *Fishery Management Plan for the Bering Sea/Aleutian Islands Groundfish,* implemented in 1982; and 2) the *Fishery Management Plan for Groundfish of the Gulf of Alaska*, implemented in 1978. The National Marine Fisheries Service, under the U.S. Department of Commerce's National Oceanic and Atmospheric Administration, provides regulatory oversight.

The groundfish complexes are composed of more than a dozen species of cod, rockfish, flounders, sole, and mackerel species, in addition to pollock. But pollock is the most abundant species within the Eastern Bering Sea, and the second most abundant groundfish stock in the Gulf of Alaska. The Bering Sea and Gulf of Alaska ecosystems also support many other commercially important species such as salmon, crab, halibut, herring, and dozens of fish and shellfish, which are managed under separate fishery management plans.

There has not been a comprehensive scientific inventory of biological diversity in either of these ecosystems. But it is well known that they are also inhabited by more than 400 species of forage fish and other non-target fish species, along with molluscs, crustaceans, corals, and other marine life, ranging from micro-algae along the ice pack edge, to resident walrus, and to migrating whales.

The Bering Sea supports vast populations of 50 species of seabirds. The Pribilof Islands are referred to as the "Galapagos of the North" because of the exceptional abundance of marine organisms they support, including an estimated 2,500,000 seabirds, and nearly 75 percent of the world's northern fur seal population, which congregates around the Islands during the four to six month breeding season. Valuable habitats along the coastal fringe, such as eelgrass beds, coastal lagoons, deltas, wetlands, and estuaries, support an abundance and diversity of waterfowl and shorebirds. And the ice pack creates habitat for many other marine mammals, including seals, polar bears, and walruses.

Pollock constitute an important food source for many of the fish, seabirds, and marine mammals, with which they co-occur. And some hypothesize that a decrease in the availability of pollock in habitat determined to be critical to the endangered Steller sea lion is at least partly responsible for the continued decline in the western population of that marine mammal. The role of the pollock fisheries in the Steller sea lion decline has become a subject of great controversy and is now under review by the National Research Council.

The request of fishery participants to certify the pollock fishery as sustainable by the Marine Stewardship Council's standards has been controversial in and of itself. Because World Wildlife Fund was a partner in the development of the Marine Stewardship Council and the idea of independent certification of sustainable fisheries, we are interested in seeing the certification process carried out as an objective, science-based evaluation of fishery management systems and fishery performance. The evaluators should have the best available information before them.

The expansion of the initial scope of the certification evaluation from the Eastern Bering Sea to include the Gulf of Alaska as well creates some challenges for the evaluation team. These two fisheries differ significantly in fishing fleets, in fishing methods, and in the characteristics of the ecosystems within which they take place. Changes in the management of these fisheries in response to ongoing litigation further complicates the evaluation, making it difficult to define the scope of the review and to evaluate the overall sustainability of the pollock fishery.

The management system will continue to change as new information and new requirements develop. Lawsuits challenging the system's compliance with the National Environmental Policy Act and the Endangered Species Act are not settled. In any case, the most important issue is whether the evaluation team is satisfied that the court's rulings will be implemented once they have been reached and that there is a system in place to ensure commitment to compliance, to mark breaches of the rules, and to rectify breaches should they occur.

Several ongoing processes, including expanded environmental impact analysis and the National Research Council review of the competing hypotheses about the effects of the pollock fishery on Steller sea lion habitat, are generating material valuable to the evaluation team's review. World Wildlife Fund believes the evaluation team cannot complete its work without considering the views of one of the most highly respected scientific bodies in the nation, particularly since it may provide some resolution on one of the most controversial aspects of the fishery. Until this information is available and can be considered, World Wildlife Fund believes the fishery is not ripe for certification.

The certification process has begun, and the pollock evaluation is underway. Thus, we have developed this document to assist the evaluation team in assessing the sustainability of the U.S. walleye pollock fishery. The document is not intended to serve as a parallel assessment of fishery performance as it relates to each of the Marine Stewardship Council's individual scoring criteria, but rather to:

- Examine whether the principles and criteria are appropriate to the Bering Sea and Gulf of Alaska ecosystems or whether they should be modified in some respects;
- Highlight core issues deserving the attention of the evaluation team;
- Describe critical knowledge gaps;
- Describe the management system's response to uncertainty and other challenges related to sustainability; and
- Identify areas where the management system may need improvement in order to meet the Marine Stewardship Council's sustainability criteria.

Marine Stewardship Council Principle 1 requires that "A fishery must be conducted in a manner that does not lead to overfishing or depletion of the exploited populations and, for those populations that are depleted, the fishery must be conducted in a manner that demonstrably leads to their recovery." Scientists understand a great deal about the biology and life history of walleye pollock. Thus, in terms of the information needed for traditional, single species stock management, this fishery is relatively well positioned. The stock assessment is state-of-the-art. And the conservative exploitation strategy provides fishery managers flexibility to adapt to new information as it becomes available. As a result, this fishery management system has been effective in maintaining its target species at sustainable levels.

Marine Stewardship Council Principle 2 requires that "fishing operations should allow for the maintenance of the structure, productivity, function and diversity of the ecosystem (including habitat and associated dependent and ecologically related species) on which fishery depends." Significant issues for the evaluation team to consider under this principle relate to what scientists and managers *do not know* about the structure, productivity, and function of the highly complex and variable Bering Sea and Gulf of Alaska ecosystems, and about the ecosystem impacts of removing such a large tonnage of biomass from the system. These knowledge gaps are important because they are directly related to the ability to understand, predict, and manage in response to environmental variability, to sustain the pollock fisheries over the long term, and to maintain the structure, productivity, function, and diversity of the ecosystems on which the fisheries depend.

Marine Stewardship Council Principle 3 requires that "the fishery is subject to an effective management system that respects local, national, and international laws and standards, and incorporates institutional and operational frameworks that require use of the resource to be responsible and sustainable." The fishery operates under a management plan and regulations devised within the framework of the Magnuson-Stevens Fishery Conservation and Management Act, with its ten National Standards, the stakeholder process provided by the North Pacific Fishery Management Council, the procedural requirements of U.S. administrative law, and more than 30 years of conservation policy embodied in U.S. environmental law. These elements form the basis of a management system that fits within the global framework for fishery management and contains most of the elements called for as best practices.

Despite this framework, the system has not operated, or been implemented, entirely without challenge or controversy. Significant issues for the evaluation team to examine under Principle 3 relate to the degree of confidence in stock assessments, the availability, use, and integration of ecosystem information, the way the system deals with uncertainty, especially about ecosystem effects beyond the target species, and about fishery activity and management outside the U.S. Exclusive Economic Zone, and the vulnerability of the U.S. fishery management system to political and legal challenge.

This document captures these and other issues in a final summary of the ten main issues we believe are worthy of further examination by the evaluation team. These points summarize areas where management could be improved with additional information or analysis. We have not drawn conclusions or made specific recommendations on scoring, though it can be assumed that in areas where we have raised no concerns, it is our view that management meets the Marine Stewardship Council standard for that indicator.

The ten issues are:

1. Stock assessment modeling is state-of-the-art, but assessments could be improved with additional calculations predicting the probability of overfishing under current control rules.
2. Incomplete knowledge about the effects of fishing on population and ecosystem structure, and about the structure of Bering Sea pollock and fishing mortality in Russian waters, creates uncertainty about appropriate exploitation rates.
3. The observer system currently used in the Alaska pollock fishery is one of the best in the world. But improvements could be made in several areas.
4. Incomplete knowledge of environmental influences on stock dynamics and of the effects of fishing on ecosystem structure makes it difficult for managers to clearly distinguish the relative effects of natural and anthropogenic factors on stock dynamics and ecosystems, or to predict how changes in ocean climate will affect stocks and ecosystems in the future.
5. Bycatch reduction and monitoring programs are effective. But bycatch reporting could be improved.
6. Incomplete knowledge about the trophic relationships among pollock and other species in the Bering Sea and Gulf of Alaska ecosystems makes it difficult to determine management strategies that are optimal for preserving critical relationships.
7. Uncertainties regarding the impact of the pollock fishery on the protected Steller sea lion have made it difficult to implement regulatory measures that are certain to protect this listed species and that comply with U.S. environmental laws.
8. In setting objectives for the fishery, managers have not until recently incorporated ecosystem objectives that encompass species and habitats beyond the target stock.
9. Traditional fishery management approaches, along with constraints on resources and unclear guidance, have weakened compliance with administrative procedures and environmental

protection laws other than the Magnuson-Stevens Fishery Conservation and Management Act.

10. The fishery management system responds to stakeholder concerns on an ad-hoc basis, rather than considering them in the context of the goals and values of all stakeholders over the long term.

We recommend that:

1. Managers consider the benefits of adding an additional step to Gulf of Alaska assessments that would calculate the probability that various catch scenarios would be capable of maintaining fishing mortality and spawning stock biomass within threshold levels. The length of these projections should be determined by fishery analysts, but, at minimum, should equal the life span of the fish.

2. The evaluation team and managers examine the effect on population structure of the concentration of pollock fishing in time and space. Changes in mean age have been relatively slight compared to interannual variation in mean age for walleye pollock in the Gulf of Alaska. The evaluation team should examine whether the age structure of the Bering Sea stock has changed in response to fishing pressure.

   More research is needed on the reproductive biology of pollock to improve understanding of the effects of fishing on reproductive capacity. And managers should pursue ongoing work with Russian scientists to define stock structure and to improve understanding of genetic variations of pollock throughout the Bering Sea.

3. The National Marine Fisheries Service develop a mechanism under which the agency has direct control over the coverage levels, timing, and placement of observers, to ensure that bias is not introduced through non-random selection of vessels and periods for observer coverage.

4. Researchers continue to focus on better understanding the effects of environmental variability on stock dynamics, and that they designate no fishing areas that can be used to study the effects of fishing on ecosystem structure and to evaluate the impact of conservation measures on marine ecosystems, particularly on the predators of pollock. We also recommend that managers incorporate new information derived from these studies into stock assessments and ecological analyses.

   Recognizing, however, that no amount of money or research will eliminate all uncertainty, the management system should move away from an emphasis on predicting the most likely outcome. Instead, fishery managers should make much more use of scenario planning and other well developed tools that aid in developing management strategies that are robust under several possible futures.

   Though the draft Programmatic Environmental Impact Statement defines alternative management approaches, those approaches are considered independently and do not incorporate the more fully developed planning methods used in business, the military, crisis planning, and policy analysis.

5. Managers consider summarizing and publishing incidental catch and discards data at the fishery, as well as single-species, level to help the public to better understand the impacts of individual fisheries on non-target species.

6. The evaluation team consider current efforts to investigate concerns related to the impacts of the pollock fishery on the pelagic food web through multispecies and ecosystem modeling, and to incorporate in the Stock Assessment and Fishery Evaluation report's Ecosystem Considerations chapter a set of indicators of ecosystem status and trends that could eventually provide an early warning of adverse changes in the ecosystem.

7. The evaluation team keep abreast of research developments that provide improved understanding of the impact of the pollock fishery on the protected Steller sea lion, and that fishery managers adapt regulations to address new information as it becomes available.

   In addition, it would benefit the management system to be more "adaptive" and less "reactive." Providing scientists and managers greater flexibility to experiment and test different hypotheses could help to resolve current uncertainties. While the fishery management system has become more flexible and responsive to new information, the concept of actively and intentionally probing the system has, for the most part, been lost.

   In some cases, this may mean pursuing incidental take permits for scientific purposes, or using other tools in the Endangered Species Act to allow carefully controlled takes of protected species at risk in local situations (e.g., by fishing near some sea lion rookeries and not others). Where the knowledge payoff would be great, leading to better conservation and management of the ecosystem, ways should be found to carry out meaningful field experiments using the fishery.

8. The evaluation team examine plans and timetables for the new Programmatic Environmental Impact Statement, and inquire of managers and of the applicants how the performance of new conservation approaches will be evaluated. The team should also take into consideration the actions of managers over the past several years to protect forage species and habitat, and to reduce the take of non-target species.

   The evaluation team should also keep abreast of efforts to complete the Supplemental Environmental Impact Statement required to comply with legal mandates to designate essential fish habitat and to minimize the impacts of fishing on essential fish habitat. Managers should examine, under the framework that provides for the designation of habitat areas of particular concern, the potential for marine protected areas in the Bering Sea and Gulf of Alaska to conserve marine biodiversity.

9. The evaluation team find out when the National Marine Fisheries Service's report to Congress on actions underway to improve compliance with the National Environmental Policy Act and other laws will be released, and that it evaluate the adequacy of proposed improvements, and the timetable for implementing those improvements.

10. The evaluation team assess how the fishery management system as a whole builds in mechanisms to articulate the social, cultural, and economic values and goals of diverse fishery stakeholders, and to provide for flexibility to respond to large-scale ecological change.

2 INTRODUCTION

World Wildlife Fund (WWF) works in more than 100 countries to end destructive fishing practices, to curtail illegal trade in marine wildlife, to create marine protected areas, to curb subsidies that promote overfishing, and to promote independent certification of sustainable fisheries. Our Global 200—a list of the most outstanding ecoregions in the world—includes 43 marine habitats. Five of these, including the Bering Sea, are also included in a list of particularly outstanding, environmentally threatened priority regions where we will focus much of our conservation energy in the coming years.

Our Bering Sea Ecoregion Program began in 1998. Through this program, we work with organizations, governments, and communities on both sides of the Bering Sea to conserve Bering Sea marine and coastal ecosystems, to raise awareness about the ecoregion and the threats facing it, to build public support for Bering Sea conservation, to improve stewardship of Bering Sea resources, and to develop a comprehensive conservation strategy. The major threats to biodiversity in the Bering Sea identified by a WWF and Nature Conservancy workshop in 1999 are fishery mismanagement, global climate change, the introduction of alien species, and pollution. Activities of the program include promoting implementation of the Magnuson-Stevens Fishery Conservation and Management Act (M-SFCMA), particularly habitat protection and bycatch reduction, supporting and promoting efforts to improve law enforcement of fisheries regulations in Russia, facilitating community involvement in fisheries conservation, and working with communities to build support for marine protected areas.

In 1996, WWF formed a conservation partnership with Unilever, one of the world's largest fish processors, to create the Marine Stewardship Council (MSC), which became an independent organization in 1997. Not only are we interested in seeing the certification process carried out as an objective, science-based evaluation of fishery management systems and fishery performance, we also are concerned that fishing is one of the most significant activities affecting biodiversity in the Bering Sea. As such, we want to be sure the evaluation team assembled by Scientific Certification Systems examines a number of issues of concern to our organization.

The attached report summarizes significant issues in the Eastern Bering Sea and Gulf of Alaska pollock fisheries. In some cases we have recommended areas where we believe the evaluation team should concentrate its inquiry and assessment. In others, we have made specific recommendations about how management could be improved.

There are a number of performance indicators where sectors of these fisheries are doing well at meeting the MSC Principles and Criteria. The report spends less time on these issues than on areas where questions remain, where uncertainty demands a more cautious response on behalf of the environment, or where improvement is called for. Although, in cases where we believe improvements can be made, we have offered recommendations.

We have not drawn conclusions or made specific recommendations on scoring, though it can be assumed that in areas where we have raised no concerns, it is our view that management meets the MSC standard for that indicator.

The report is organized in three main sections: 1) background and overview, 2) issues and analysis, and 3) conclusions and recommendations.

- The background and overview section provides a detailed description of the fisheries, their history, management, and the ecosystems in which they occur. The material provided in this section is drawn from government, industry, and non-governmental organization documents, published scientific reports, interviews, and the fishery management and policy literature. It is intended to provide the basis for our discussion in the issues and analysis section.
- The issues and analysis section identifies issues for the evaluation team's consideration under the MSC Principles and Criteria. We have organized the issues and analysis according to the three MSC Principles, and have identified the issues by the criteria and sub-criteria published by Scientific Certification Systems for the pollock fishery evaluation.
- Finally, the conclusions and recommendations section summarizes the ten main issues we believe are worthy of further examination by the evaluation team, and provides recommendations for improvements in management, research, or fishery operations that could help address these issues. Each numbered issue is followed by a description of the problem, the specific performance indicator(s) under which the issues arise, and how the point relates to a fishery's performance for the specified indicator. The information supporting each point is referenced to the relevant issue subsection, with citations to data or other documentation in the background section.

The report was prepared pursuant to a contract with the National Fisheries Conservation Center. Principal authors were Dr. Brock B. Bernstein, president of the National Fisheries Conservation Center; Heather Blough, independent consultant; Suzanne Iudicello, Junkyard Dogfish Consulting; Dr. Graeme Parks, president of MRAG Americas Inc., and Robert J. Trumble, Senior Research Scientist, MRAG Americas Inc.

The report was reviewed by David Freestone; Dr. Susan Hanna, Department of Agricultural and Resource Economics, Oregon State University; Dr. Marc Mangel, Department of Environmental Studies, University of California, Santa Cruz; Dr. Victor Restrepo, International Commission for the Conservation of Atlantic Tunas; Dr. Andy Rosenberg, College of Life Sciences and Agriculture, University of New Hampshire; and Mike Weber, independent consultant. Reviewers were acting in their personal capacity and the views expressed are theirs as individual professionals and do not necessarily reflect the views of their respective institutions or organizations.

2.1 Scope of evaluation

2.1.1 Goal of this document

The goal of this document is to assist the evaluation team in assessing the sustainability of the U.S. walleye pollock fishery. The document is not intended to serve as a parallel assessment of fishery performance as it relates to each of the MSC's individual scoring criteria, but rather to:

- Examine whether the MSC criteria are appropriate to the Bering Sea and Gulf of Alaska ecosystems or whether they should be modified in some respects. (See comments to Scott Burns and Chet Chaffee, November 2001 (Appendix A));
- Highlight core issues deserving the attention of the evaluation team;
- Describe critical knowledge gaps;
- Describe the management system's response to uncertainty and other challenges related to sustainability; and
- Identify areas where the management system may need improvement in order to meet the MSC's sustainability criteria.

2.1.2 Spatial scope

We originally confined the scope of our comments to the Eastern Bering Sea pollock fishery to mirror the focus of the evaluation team's initial effort. But we later expanded our comments to cover the Gulf of Alaska fishery as well, in response to a similar expansion in the focus of the evaluation team.

While the management regimes regulating fishing in the Eastern Bering Sea and Gulf of Alaska are the same in many respects, the fishing vessels operating in these two management areas differ in number and type, in the gear they employ, and in the areas they fish. Most importantly, the pollock stocks fished in these two management areas are considered to be separate, and the broader ecosystems that support those stocks have distinct characteristics, particularly in regard to critical habitat for Steller sea lions.

Although the fishery under evaluation is a domestic U.S. fishery, straddling stock and transboundary stock issues must be recognized. Accordingly, this analysis touches upon management regimes, enforcement, and other issues in both international waters and the waters of the Russian Federation.

We recognize that management measures adopted by the State of Alaska for its coastal and marine systems also affect the federal pollock fishery, which occurs in waters between 3 and 200 miles from shore. For example, the State of Alaska manages fisheries for herring and other forage species and also exercises authority over land-based activities that affect water quality and nearshore habitat. These activities can affect essential fish habitat for pollock and forage species, as well as critical habitat for Steller sea lions and other protected species.

Because of time constraints, beyond recognizing this connection, we do not delve into state management issues. To the extent practicable, the evaluation team should take the opportunity to examine the interaction of the federal groundfish fishery with management practices adopted by the State of Alaska for its waters.

2.1.3 Temporal scope

Changes in the management of Eastern Bering Sea and Gulf of Alaska pollock fisheries in response to ongoing litigation created difficulties in defining the scope of our comments and in evaluating the overall sustainability of the fishery as a whole. The management system will undoubtedly continue to change, at least until the lawsuits challenging the system's compliance with the National Environmental Policy Act (NEPA) and Endangered Species Act (ESA) are concluded.

Thus, the most important issue is whether the evaluation team is satisfied that the court's rulings will be implemented once they have been reached, and that there is a system in place to ensure commitment to compliance, to mark breaches of the rules, and to rectify breaches should they occur. Litigation in the U.S. courts can be seen as an indication of the commitment of stakeholders to ensure that managers meet regulatory and legal requirements. Litigious bystanders keep the system honest and require it to comply with the highest standards.

Several ongoing processes, including expanded environmental impact analysis and the National Research Council review of the competing hypotheses about the effects of the pollock fishery on Steller sea lion habitat, are generating material valuable to the evaluation team's review. WWF believes the evaluation team cannot complete its work without considering the views of one of the most highly respected scientific bodies in the nation, particularly since it may provide some resolution on one of the most controversial aspects of the fishery.

2.2 Establishing context

2.2.1 Definitions

Throughout this document, we use several terms that are either open to interpretation, that have definitions within the fishery management literature, or that are taken from law or regulation. In order to avoid any confusion over the intended meaning, we provide the following list of definitions:

Ecosystem management: We use the term "ecosystem management" to mean "ecosystem-based approaches to fishery management." The Reykjavik Conference on Responsible Fisheries in the Marine Ecosystem in October 2001 explored numerous ideas for developing ecosystem-based approaches to fishery management as part of the implementation of the global Code of Conduct for Responsible Fisheries, negotiated in 1995 with the support of the United Nations Food and Agriculture Organization (U.N. FAO).[1]

The National Marine Fisheries Service (NMFS) is also developing guidelines for ecosystem-based approaches. In its 1999 report to Congress, the Ecosystem Principles Advisory Panel established by the agency stated that an ecosystem-based management approach would require managers "to consider all interactions that a target fish stock has with predators, competitors, and prey species; the effects of weather and climate on fisheries biology and ecology; the complex interactions between fishes and their habitat; and the effects of fishing on fish stocks and their habitat" (NMFS 1999).

Maximum sustainable yield: We assume the definition of maximum sustainable yield adopted by the NMFS in regulations dated August 4, 1997, which is "the largest long-term average catch

[1] FAO of the United Nations. 1995. Code of Conduct for Responsible Fisheries. Adopted 31 October 1995. Rome.

or yield that can be taken from a stock or stock complex under prevailing ecological and environmental conditions" (62 FR 41913).

Overfishing: The terms "overfishing," "overfished," and "approaching an overfished condition" are taken from the M-SFCMA, implementing regulations, and the specific definition for pollock overfishing in North Pacific groundfish fishery management plans.

The statute defines "overfishing" and "overfished" as "a rate or level of fishing mortality that jeopardizes the capacity of a fishery to produce the maximum sustainable yield on a continuing basis" (16 U.S.C. 1802(29)).

Federal regulations define "to overfish" as fishing "at a rate or level that jeopardizes the capacity of a stock or stock complex to produce maximum sustainable yield on a continuing basis," and "overfished" to describe "any stock or stock complex for which a change in management practices is required in order to achieve an appropriate level and rate of rebuilding" (62 FR 41909).

Section 3.3.4 provides a detailed explanation of the definition of overfishing used in managing North Pacific groundfish fisheries.

Precautionary approach: The global Code of Conduct for Responsible Fisheries calls for a precautionary approach to fishery management. According to Article 7.5.1 of the Code, when the best available scientific information is uncertain, unreliable, or otherwise inadequate, managers should proceed in a risk-averse manner. And the absence of adequate scientific information should not be used as a reason for postponing or for failing to take conservation and management measures.

Sustainability: We use the terms "sustainability" or "sustainable" in the context of the MSC standard for "sustainable fisheries." The MSC's Principles and Criteria for Sustainable Fishing state that a sustainable fishery should be based upon:

- The maintenance and re-establishment of healthy populations of targeted species;
- The maintenance of the integrity of ecosystems;
- The development and maintenance of effective fisheries management systems, taking into account all relevant biological, technological, economic, social, environmental, and commercial aspects; and
- Compliance with relevant local and national laws and standards, and with international understandings and agreements.

The Principles state further that a sustainable fishery can be continued indefinitely at a reasonable level, and that such a fishery maintains ecological health and abundance and biological diversity at all levels, minimizes adverse effects on habitat, is well-managed and operated responsibly, maintains present and future economic and social options and benefits, and is conducted in a socially and economically fair and responsible manner (MSC 1997). In this report, we interpret "sustainable" to mean a fishery that meets these standards and the particular scoring guideposts for the assessment of pollock that were published by the MSC in February and April 2002.

2.2.2 Recognizing responsible/affected parties

A separation in the roles and responsibilities of fishery participants and fishery managers presents the evaluation team and the regulated industry with an interesting dilemma. A private party triggered the certification request, yet most of the focus of the evaluation (e.g., government assessments, rules and actions) is not within the purview of the requesting party to affect. So, for example, even if the regulated industry is complying with all current rules and conducting its business within the four corners of the management regime, it will pay the price if the management regime or the way it is implemented fails to pass muster. It would benefit the regulated industry not only to ensure that fishery managers implement the adopted management regime, but also that the regime operates within the confines of the law, and that it meets the highest possible standard. The evaluation team should give consideration to actions taken by the regulated industry to support the implementation of regulatory actions and to advocate improvements in the system.

2.2.3 Setting standards

It is important to evaluate the sustainability of a fishery within the context of what is practically achievable as opposed to an unrealistic ideal. Fisheries, by nature, have unavoidable impacts on the species they target and the marine systems within which they take place. These impacts represent tradeoffs generally made in exchange for the benefits fisheries provide and, as such, are inconsistent with the maintenance of target species at peak abundance levels, or the support of ecosystems in a completely undisturbed state.

The MSC's Principles and Criteria recognize that some ecosystem impacts are unavoidable, but call on fishing operations to "allow for the maintenance of the structure, productivity, function and diversity of the ecosystem (including habitat and associated dependent and ecologically related species) on which the fishery depends." The intent of this principle is to encourage the management of fisheries from an ecosystem perspective under a system designed to assess and restrain the impacts of the fishery on the ecosystem. In a nutshell, while the MSC Standard recognizes that fishing, like many other human activities, has some unavoidable ecosystem impacts, it should not be permitted to substantially undermine ecosystem structure and function, or to significantly jeopardize biological diversity.

Numerous national, bilateral, multilateral, and international agreements and policies provide a differing array of standards for fishery management across the globe. In an in-depth review of the global framework for fisheries management, Weber (1998) suggests that, among these, several fishery policies represent a significant departure from a more traditional focus on achieving maximum production and resolving competitive exploitation conflicts. In particular, complementary conservation standards provided by the global Code of Conduct for Responsible Fisheries and the 1995 U.N. Agreement on Straddling Fish Stocks and Highly Migratory Fish

Stocks (U.N. Straddling Stocks Agreement)[2] are recognized as having the greatest potential to conserve biological diversity and to promote sustainable fishing practices (Freestone 1998).

These policies focus not only on the sustainable use of fishery resources, but also on the conservation and protection of associated species, supporting ecosystems, and habitats. They call for applying a precautionary approach to fishery management, using the best scientific information in fishery decision making, implementing effective monitoring and enforcement programs, improving data collection and research, developing sub-regional, regional, and global cooperation, ensuring transparency in decision making, and employing peaceful dispute resolution strategies.

An evaluation of the sustainability of a fishery must consider the protections afforded by governing policies and regulations within the context of practical standards established by such conservation-oriented policies. Of course, there is always room for improvement. In cases where the evaluation team determines existing best practices to be inadequate, it can use the promise of the MSC label to encourage the fishery to do more, especially in areas such as conserving biological diversity. In addition, where the evaluation team process identifies approaches, strategies or actions that surpass current, accepted best management practices, it can use its certification not only as a retrospective assessment of what is, but also as a prospective, action-forcing mechanism to help create what ought to be.

The conservation community has an enormous stake in the success of the MSC. It is important to WWF that the MSC standards are applied in a manner that is even-handed and fair, and that the decisions of certifiers are based on the best available science. We strongly believe that the MSC certification process can be an important vehicle for strengthening the sustainability of world fisheries and for promoting a more vigorous effort to reduce their ecosystem impacts.

3 BACKGROUND AND OVERVIEW

The walleye pollock fishery was the largest single species fishery in the world prior to 1992 in terms of biomass of landed catch. Since that time, landings of this species have been exceeded only by those of the Peruvian anchoveta. Figure 1 depicts the total annual walleye pollock catch taken from the northeast and northwest Pacific from 1970 to 1999. Total landings peaked at just over 6,750,000 metric tons (mt) in 1986, but declined to below 5,000,000 mt by 1991, and ranged from 4,000,000 to 5,000,000 mt between 1992 and 1998, before further decreasing to about 3,400,000 mt in 1999 (Froese and Pauly 2001). It should be noted that during this period, beginning in 1982, the U.S. catch was constrained by management actions.

Figure 2 describes historical average catches and estimated biomass of walleye pollock by stock or major fishing areas. Over 70 percent of the total catch is taken in the Northwest Pacific fishery (Okhotsk Sea, Sea of Japan and Western Bering Sea), which is fished mainly by Russia, Japan, Korea, and Poland. The remaining catch is taken in the Northeast Pacific (Eastern Bering Sea and Gulf of Alaska), more than 95 percent of which is landed by U.S. fishing fleets.

[2] United Nations Conference on Straddling Fish Stocks and Highly Migratory Fish Stocks, A/Conf.164/37, 8 September 1995.

About 86 percent of the U.S. catch is taken from the Bering Sea; the remainder, from the Gulf of Alaska. Table 1, Figure 3 and Table 2, Figure 4 provide data on U.S. historical catches in the Eastern Bering Sea and Gulf of Alaska, respectively, relative to total biomass and pre-season catch specifications.

3.1 Historical development of the Northeast Pacific pollock fishery

The historical development of the Northeast Pacific pollock fishery is well documented. Catches from the Eastern Bering Sea shelf initiated by Japanese vessels in 1954 remained at a low level until 1963 when the development of surimi processing led to large-scale expansion. Catches increased rapidly in the latter part of that decade, peaking at 1,900,000 mt in 1972, before being reduced under international agreement with Japan and the Soviet Union amid concerns over falling catch per unit effort (Wespestad 1993).

Only two years after Browning's 1974 speculation that "It is distinctly possible that…foreign fleets will cut the pollack [sic] resource to the point where a healthy fishery will be unattainable [for Americans and Canadians] unless international agreement on permissible catch preserves the stocks" (Browning 1974), the U.S. Congress expanded federal authority over fisheries by establishing a Fishery Conservation Zone under the Fishery Conservation and Management Act (FCMA) of 1976.

This Fishery Conservation Zone (the predecessor to the U.S. Exclusive Economic Zone defined in 1983 by Presidential Proclamation) extended U.S. fishery jurisdiction from 12 to 200 miles offshore. The FCMA prohibited foreign fishing in the Fishery Conservation Zone unless explicitly authorized. And the U.S. government set to work developing policies to replace foreign fishing with American fleets.

U.S. law set a catch priority for domestic fishermen. Federal assistance programs provided capital to build up the existing fleet and to convert crab boats to groundfish trawlers. Money, tax breaks, and other incentives provided by the State of Alaska paved the way for the development of onshore processing. Domestic processors also were accorded a priority, and only the catch they could not handle was made available to foreign companies.

During the mid-1980s, when domestic processing capacity was insufficient to meet demand, U.S. catcher vessels delivered catch to foreign motherships in a collection of joint ventures (Northern Economics 2000). Meanwhile, the State of Alaska pushed to develop domestic processing capacity onshore, and Seattle-based companies tooled up to create a catcher-processor fleet. The pollock fleet was transformed from a completely foreign to a completely American enterprise in less than a decade (Figure 5) (Northern Economics 2000).

In the mid-1980s, foreign vessels displaced from U.S. waters began targeting concentrations of pollock in the Central Bering Sea (the Aleutian Basin, including the so-called "Donut Hole," an area of international waters in the Central Bering Sea that is surrounded by the exclusive economic zones of the United States and Russia (see Figure 7)). Donut Hole catches grew from 181,000 mt to more than 1,000,000 mt in the two years from 1984 to 1986 and, the following year, exceeded the landed catch from the entire Eastern Bering Sea. The high seas catch peaked at about 1,450,000 mt in 1989, before rapidly declining to less than 2,000 mt in 1993. Since that time only trace amounts of walleye pollock have been taken from this area, which is under an international moratorium.[3]

In 1991, the year by which the Eastern Bering Sea fishery was completely Americanized, the fleet consisted of about 115 catcher vessels delivering pollock to inshore processors, 42 vessels operating as catcher-processors that both trawl for and process pollock, and one vessel serving as both a mothership (floating processor) and a catcher-processor (Kinoshita *et al.* 1997 in Northern Economics 2000). Each sector was required to take its share of the 1,300,000 mt quota in 148 fishing days, broken into an "A" and "B" season to extend fishing throughout the year (Miller *et al.* 1994).

In 1992 fishery managers proposed and approved regulations that divided the total allowable catch quota among the inshore sector, the offshore sector, and Alaska coastal communities, which participated in the fishery through local development projects, known as the "CDQ" or Community Development Quota program. This program provided eligible communities an entry into the lucrative groundfish fisheries by allocating them 7.5 percent of the total allowable catch (16 U.S.C. 1855). The remaining catch was split 65/35 between the offshore and inshore sectors, respectively.

By 1993, the fleet was composed of four motherships, 39 catcher-processor vessels (some serving as both motherships and catcher-processors), and 117 catcher vessels delivering catches inshore or to motherships. Although the total allowable catch remained steady at 1,300,000 mt, fishing capacity was two to three times in excess of that which was needed to take the quota (Greenpeace 1996; Miller *et al.* 1994). The fishing season had been reduced to 112 days for the inshore fleet and to 85 days for the offshore fleet (Kinoshita *et al.* 1997 in Northern Economics 2000). This was the first full year under an allocation split of fish between the offshore and onshore sectors, which commentators say exacerbated the overcapacity problem in the offshore sector and gave temporary relief to shoreside processors.

Excess capacity had intensified competition in the fishery, increasing allocation controversy between the inshore and offshore sectors. The problem of overcapitalization was illustrated not only by the race for fish and the accompanying bitter allocation disputes, but also by several industry bankruptcies, and by the exit of vessels from the fishery. To make matters worse, the bankrupt vessels did not exit the fishery, but were sold at a fraction of their cost and returned to the fishery where their reduced debt load made them more competitive than the rest of the fleet. This led to further offshore bankruptcies, eight in all by the middle part of the decade (APA 1999; Miller *et al.* 1994).

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[3] In 1993, the United States, China, Korea, Russia, Japan, and Poland negotiated the Convention on the Conservation and Management of Pollock Resources in the Central Bering Sea (Senate Treaty Doc. 103-27) to govern the catch and management of fish stocks migrating between international waters in the Bering Sea (the "Donut Hole") and adjacent waters under national jurisdictions (Buck 1994).

The catcher-processor sector was advocating some form of rationalization scheme to reduce fishing effort and to stop the race for walleye pollock. As stated in a 1992 North Pacific Fishery Management Council document supporting the implementation of a comprehensive rationalization plan "...the council must address the competing and oftentimes conflicting needs of the domestic fisheries that have developed rapidly under open access, fisheries which have become overcapitalized and mismatched to the finite fishery resources available" (Northern Economics 2000). The problems associated with overcapitalization enumerated by the Council ranged from gear conflicts to bycatch and waste, economic instability, disproportionate impacts on coastal communities, threats to marine mammals, and enforcement difficulties.

Conflicts over initial allocations and other issues thwarted the North Pacific Council's approval of a proposed quota regime. But in 1995, when the Council revisited the inshore/offshore split, it agreed to a license limitation program, to reauthorizing the existing 65-35 percent division of the catch between offshore and inshore processors, and to a dedicated effort to examine an individual fishing quota program for pollock (Hartley 2000). The license limitation program reduced the number of vessels allowed to participate in Alaska groundfish fisheries and prevented new vessels from entering the Bering Sea pollock fishery (Northern Economics 2000). But a 1996 Congressional action prohibiting the development of individual fishing quota programs for four years obviated any chance to proceed with the comprehensive rationalization plan as conceived (Iudicello 2000). That moratorium has since been extended through October 2002.

Despite the removal of fishing power through fleet consolidation and additional bankruptcies, the walleye pollock fishery had been reduced to just a three-month season by 1998 (APA 1999). That year the pollock industry developed a plan for a fishing cooperative, similar to one that had proved successful in the whiting fishery off the U.S. Pacific Coast. Supporters of the plan were hopeful that the cooperative would stop further investments in fishing capacity and help to better match fishing effort to the total allowable catch. Industry representatives took the plan to the U.S. Congress, after trying unsuccessfully to bring the idea before the North Pacific Council. And legislative action in the form of the American Fisheries Act (AFA)[4] facilitated the formation of cooperatives in the Bering Sea fishery. The first cooperative formed and operated in the 1999 fishing season (APA 1999).

Although cooperative members were pleased with the outcome, not all those who were part of the multi-sector, legislated allocation were certain they would realize promised benefits. And those who were not part of the deal that was negotiated in Congress liked it even less. According to some commentators, the AFA "created a closed class of fishing and processing companies" that have shut out Alaska's smaller trawlers. "Such schemes are intended to slow or halt the race for fish and reduce fishing capacity, but they have also left many of Alaska's smallest and most economically vulnerable communities with diminished and declining access to a traditional fishery resource" (Stump and Kline 2000).

Proponents of the AFA point out that conservation group advocates, Alaska Native representatives, non-pollock groundfish fishers, crabbers, representatives of small boat

[4] In 105 Pub. L. 277, Omnibus Consolidated and Emergency Supplemental Appropriations Bill for Fiscal Year 1999.

fishers, and coastal community officials and representatives were part of the negotiations (NPFMC 2002a). Moreover, they say that remote, Alaskan coastal communities with few sources or opportunities for economic development now have assets in a multi-million dollar fishing industry through their participation in the CDQ program created by the North Pacific Council in 1992. These communities did not traditionally participate in offshore groundfishing, although they relied on the sea for both subsistence use of marine resources and nearshore commercial fishing.

Today, 65 communities participating in the CDQ program hold a catch allocation of crab, halibut, groundfish and prohibited species through six non-profit corporations. Their allocation in 2000 amounted to 180,000 mt of groundfish, and about 1,361 mt each of halibut and crab. Revenues earned (mostly from pollock) in 2000 were about $63,000,000. The program has enabled the communities to invest in vessels, processing, developing local fisheries, job training, and fishing related businesses.[5]

Criticism of the AFA resurfaced when the legislation was reauthorized in 2001 even though it was not scheduled to expire until 2004. Opponents argued that the Act was passed without benefit of public hearings, and that it granted exclusive rights to the resource without consideration of royalties or some other means to return value to the public for the exclusive grant. Industry officials say no significant changes resulted from the reauthorization process and that the AFA continues improvements that led to a slower-paced, less wasteful fishery. Having completed their third year, the co-ops have resulted in some reduction in excess capacity. Annual reports to the North Pacific Fishery Management Council show that only 14 to 16 pollock catcher/processor vessels now participate in the Bering Sea fishery.

3.2 Description of the fishery

3.2.1 The fish

A member of the cod family, the walleye pollock, *Theragra chalcogramma*, is also known as Alaska pollock, bigeye cod or Pacific tomcod. It is a different species than the Atlantic or European pollock, *Pollachius virens*.

3.2.1.1 Biology/life history

The walleye pollock is a small, streamlined fish, olive green to brown in color, with a silvery underside and large eyes. It generally grows to 1.5-2 pounds and can reach up to 3 feet in length (Love 1996). Strong year-classes persist in significant numbers until about age 12, but very few individuals live past 16 years of age. The oldest recorded pollock was age 31 (BSAI EFH Technical Team 1998; GOA EFH Technical Team 1998). Natural mortality is estimated at 25 percent per year (DiCosimo and Kimball 2001; Witherell 2000a).

Walleye pollock exhibit seasonal inshore/offshore movements associated with feeding and spawning, respectively (Love 1996). Peak spawning occurs in late February to early March in the

[5] See Alaska Department of Community and Economic Development at http://www.dced.state.ak.us/cbd/CDQ/cdq.htm.

Aleutian Basin, in mid-March in the southeastern Bering Sea and eastern Aleutian Islands regions, and in April and May north of the Pribilof Islands. In the Gulf of Alaska, peak spawning occurs in March, principally in Shelikof Strait, but also around the Shumagin Islands, the east side of Kodiak Island, and near Prince William Sound (BSAI EFH Technical Team 1998; GOA EFH Technical Team 1998).

Female pollock in the Eastern Bering Sea area produce between 60,000 and 400,000 eggs (Witherell 2000a). Newly mature females in the Gulf of Alaska produce from 140,000 to 300,000 eggs (DiCosimo and Kimball 2001). Eggs are pelagic and developmental periods vary from 14 to 25.5 days depending on water temperature (BSAI EFH Technical Team 1998; GOA EFH Technical Team 1998).

Eastern Bering Sea pollock mature at about 4 years of age (Witherell 2000a), those in the Gulf of Alaska, at 3-4 years of age (DiCosimo and Kimball 2001). Pollock fisheries operating in both of those management areas target mature fish. Catches of immature fish (ages 2 and 3) are usually low, but increase when strong year-classes occur (See Section 3.3.5.2.1). There is some evidence that juveniles may comprise a major portion of the Russian catch (BSAI EFH Technical Team 1998; GOA EFH Technical Team 1998).

Copepods and euphausiids are the primary food source of immature pollock. Adult pollock are generally piscivorous, feeding on forage species such as capelin and herring, as well as juvenile pollock. Research suggests that cannibalism can regulate year-class size in areas such as the Eastern Bering Sea, where juvenile pollock are an important part of the diet of adult pollock (BSAI EFH Technical Team 1998; GOA EFH Technical Team 1998).

3.2.1.2 Habitat

Pelagic eggs develop on the outer continental shelf (Eastern Bering Sea) and the continental shelf and upper slope (Gulf of Alaska), generally in waters of 100-200 meters depth, but also in waters from 200-400 meters depth over basin and lower slope areas in the Aleutian Islands and the Aleutian Basin, which are likely characterized by upwelling or gyres (NPFMC 1999c).

Pelagic larvae are distributed in epipelagic waters on the continental shelf and upper slope throughout the Eastern Bering Sea, eastern portions of the Aleutian Basin, Aleutian Islands, and Gulf of Alaska. Larval survival is enhanced in areas that contain large concentrations of copepods and small euphausiids. These occur along semi-permanent fronts in the Eastern Bering Sea, within ephemeral gyres, and possibly in association with jellyfish (NPFMC 1999c).

In the Eastern Bering Sea, age-one juvenile pollock are pelagic and demersal. Distribution is widespread and no benthic habitat preference has been documented. Age-one juveniles from strong year-classes are believed to concentrate on the inner shelf and further north on the shelf. Those from weak year classes appear to concentrate on the outer continental shelf. Age-two to -three pollock are primarily pelagic and most abundant on the outer and mid-shelf area northwest of the Pribilof Islands. In the Gulf of Alaska, juvenile pollock occur in pelagic waters along the inner, mid and outer continental shelf, and may be associated with fronts and the thermocline (NPFMC 1999c).

Adult pollock in the Eastern Bering Sea are pelagic over deep Aleutian basin waters. They are meso-pelagic and semi-demersal along the middle and outer continental shelf from the U.S. Russia Convention Line to Unimak Pass, and northeast along the Alaska Peninsula and throughout the Aleutian Islands. Few adults occur in waters less than 70 meters depth. In the Gulf of Alaska, adult pollock are pelagic, inhabiting waters from 70-200 meters along the outer continental shelf and basin. They are believed to be associated with fronts and upwelling (NPFMC 1999c). More detailed information on the distribution of walleye pollock is provided in the following section.

3.2.1.3 Stock structure and distribution

The complex of walleye pollock stocks in the North Pacific has the distinction of being the largest groundfish population in the world (FAO 1997). Its distribution extends northwestward from southern Oregon into the southern Chukchi Sea, and as far south as the southern Sea of Japan (Bakkala 1993) (Figure 6). In 1993, the North Pacific Fishery Management Council estimated that walleye pollock accounted for approximately 50 percent of the total biomass of groundfish in the Eastern Bering Sea, Aleutian Islands, and Bogoslof district (NPFMC 1993).

For the purposes of this report, we use the term “stock” to represent a fishery management unit, and the term “population” to represent a genetically distinct unit. A population may consist of one or more stocks. Where overfishing of one of several stocks may result in local depletion of the stock and declining catch, it does not necessarily mean the population is overfished.

A review by Bailey *et al*. (1999) pointed out conflicting results of genetic studies and the need for comprehensive studies of population and stock structure. Within the Northeast Pacific, Bailey *et al.* (1999) report that Wespestad (1996) identified five geographically distinct “stocks” or centers of fishing activity. These stocks, which are not necessarily genetically distinct, are summarized in Table 3. Existing studies suggest varying gene flow among regions, and patterns of geographic stock structure. Genetic differences appear among broad regions, but resolution to differentiate within regions is lacking.

Pollock distributional data from surveys performed in 1994 by the National Oceanic and Atmospheric Administration’s research vessel, *Miller Freeman*, indicate a contiguous distribution of pollock from Bristol Bay to south of Cape Navarin (Figure 7). Data from 1996 indicate a continuous distribution to the U.S.-Russia Convention Line (Pautzke 1997). Dawson (1994) speculated that pollock in the Russian portion of the northwestern Bering Sea might be part of the same population as those found in the Eastern Bering Sea, while those of the southwestern Bering Sea might represent a separate population. Wespestad (1996) also agrees that walleye pollock from inside the U.S. Exclusive Economic Zone migrate westward from the Eastern Bering Sea, across the Convention Line, and intermingle with Russian pollock stocks.

Wespestad (1996) believes that pollock drift from the southeastern Bering Sea along the continental shelf to the north Bering Sea. They stay in the northwestern Bering Sea until they mature, and then move into the southeastern Bering Sea where they fall under U.S. jurisdiction. He notes that potentially large catches and discarding of juvenile pollock in the Russian Exclusive Economic Zone may reduce Eastern Bering Sea stocks below levels that have supported historic catches. This could require U.S. managers to significantly reduce catches in

U.S. waters. While some Russian scientists acknowledge an historical predominance of Eastern Bering Sea-origin pollock in the western Bering Sea, the current Russian opinion is that a recent oceanographic regime shift resulted in a small fraction (five percent) of Eastern Bering Sea pollock in the Navarin region (Ianelli *et al*. 2000).

Although the population structure within the Eastern Bering Sea is not well known (Ianelli *et al*. 2000), three stocks are defined for management purposes: 1) the Eastern Bering Sea stock, 2) the Aleutian Islands stock, and 3) the Bogoslof Island-Aleutian Basin stock (see Figure 7 for geographic reference points). The Eastern Bering Sea stock supports the vast majority of U.S. catches (Figure 2). The Aleutian Islands stock supports a minor fishery, with catch levels much lower than in other parts of the northeast Pacific (ranging between 1,000 and 82,000 mt from 1979 to 2000). Although this stock is defined separately for stock assessment and management purposes, doubts have been raised as to whether it constitutes a population that is separate from the main Eastern Bering Sea stock (Ianelli *et al.* 2000).

Large pollock catches (377,436 mt) from the Bogoslof Island area were first recorded in 1987.[6] Catches subsequently declined to less than 40,000 mt in 1989 before increasing to over 260,000 mt in 1991.[7] Catches from this area then fell to less than 1,000 mt in 1992, and have remained at this level ever since. The Parties to the Pollock Convention (NMFS 2000b) have agreed to a comprehensive research program for the Aleutian Basin that consists of a survey of the Bogoslof Region, the creation of an historical catch database, trial fishing for 2001, and planning for a cooperative vessel survey in 2002.

Gulf of Alaska pollock are managed as a single stock and single population, independent of Eastern Bering Sea and Aleutian Islands pollock (Dorn *et al*. 2000). Population separation of the Eastern Bering Sea and Gulf of Alaska pollock is supported by analysis of larval drift, allozyme frequencies, mtDNA variability, and microsatellite allele variability (Dorn *et al*. 2000).

One-way, density dependent movements of pollock have been postulated for the Aleutian Basin and the Gulf of Alaska. The Aleutian Basin population may receive periodic outflows of pollock from the Eastern Bering Sea. For example, only large, older (greater than four years old) fish occupy pelagic waters of the basin, whereas all ages are found on the shelf and Aleutian Islands areas. This apparent absence of juveniles in the Aleutian Basin led Bakkala (1993) to suggest that the pollock found there originate, or at least spend their early lives, in other areas, presumably one or more of the shelf areas surrounding the basin. Similarly, the Gulf of Alaska may have benefited from a movement of part of the large 1989-year class from the Eastern Bering Sea (see Bailey *et al.* 1999).

The Eastern Bering Sea and the Aleutian Islands stocks are believed to be at moderately high abundance levels (Ianelli *et al.* 2000). The Aleutian Basin stock was diminished greatly by exploitation in the international Donut Hole, and all fishing was stopped in that area in 1993 (FAO 1997). The Gulf of Alaska stock has been declining in recent years due to poor recruitment

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[6] Pollock from the Aleutian Basin are thought to spawn in this area.

[7] Wespestad (1993) indicates that the comparatively low catches in 1988 and 1989 may be a misrepresentation of true catches from the Bogoslof Island area, because reporting requirements in those years combined catches from this area and the Eastern Bering Sea.

(Dorn *et al.* 2000). Table 4 summarizes current information on the characteristics of the four defined stocks.

Pollock are considered to form two stocks in the Russian Exclusive Economic Zone: 1) the western Bering Sea stock near the Gulf of Olyutorsky, and 2) a northern stock located along the Navarin shelf from 171 deg East to the U.S.-Russia Convention Line of 1867[8] (Figure 7). While earlier morphometric and physiologic analyses indicated different populations in the northwestern Bering Sea, more recent DNA analyses found no genetic differences at a population level (Stepanenko *et al*. 1999) for the Navarin area. This stock is believed to be a mixture of eastern and western Bering Sea pollock, with the former predominant (Ianelli *et al.* 2000).

The definition and extent of separation of pollock stocks and populations within the U.S. management area will be a major topic of interest for the evaluation team. Important issues related to stock structure are described in Section 4.1.1.1.

3.2.2 The fishing fleet

3.2.2.1 Vessels

Pollock fishing in the Eastern Bering Sea is conducted primarily by a U.S. fleet composed of three kinds of trawlers: 1) trawlers that also fish crab pots, 2) trawlers designed exclusively as such, and 3) catcher-processor trawl vessels. The first two types of vessels deliver either to motherships or to onshore processing plants. Although there have been some trawlers under 60 feet that take pollock in the Eastern Bering Sea, most vessels of that size concentrate on Pacific cod, other higher value species, and pollock in the Gulf of Alaska (Northern Economics 2000).

Many of the trawlers that also fish for crab are modified crab pot vessels. These steel hulled vessels range from 79 to 172 feet in length, and have a large deck, stern ramp, and a forward cabin. Vessels designed exclusively as trawlers run from 73 to 193 feet long, with an average gross tonnage of 245, and engine horsepower of 1700. They, too, are steel hulled, and configured similarly to the modified crab pot vessels. Both types of vessels have refrigerated seawater tanks in the hold to keep pollock for delivery to processing plants onshore.

Catcher vessels without a refrigerated seawater hold must deliver their catch to motherships because they are not able to keep pollock fresh long enough to make the trip to port. These vessels are crewed by four to five persons, including the skipper, who may be the owner (Northern Economics 2000). Figure 8 shows a schematic of a catcher-processor trawl vessel. The largest of these vessels are up to 375 feet long, and have a similar overall configuration as the

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[8] Note there is some controversy remaining over the position of the Convention Line. On June 21 2001, the Fisheries Information Service web site www.fis.com reported that Russia was reconsidering the Russian-U.S. agreement on the division of the Bering Sea. According to the article, Russia intends to conduct more active negotiations with the United States to make changes to the agreement. Yevgeny Nazdratenko, head of the Russian State Fisheries Committee, believes that the agreement "clearly hurts the economic interests of Russia." In particular, the Russian economic zone is 180 miles long, while the United States zone is over 220 miles long. Nazdratenko apparently also noted that "this agreement has no legal force, as the Russian parliament has still not ratified the document."

other trawlers, but with onboard processing plants, cold storage facilities, and accommodations for 50 to 100 crew members, including a galley, lounges, and laundry facilities.[9]

3.2.2.2 Gear and operations

3.2.2.2.1 Trawl gear

The vast majority of landed pollock (91 percent in 1996) are captured with pelagic trawl gear (BSAI EFH Technical Team 1998). Pelagic trawl nets are symmetrical, cone-shaped nets that taper from the opening or "fishing circle" down to a cod end. The opening, which is flanked by "wings" or trawl doors to keep it open while towed, can be from 72 to 300 feet from the top to the bottom. Although net sizes vary depending on the length of the vessel, the circumference of the largest net opening used by both trawlers and catcher-processor trawl vessels is 1,800 feet. For comparison, this is about the same size as the opening of a coastal salmon purse seine (AFTA 1996).

The mesh at the open end of the trawl is large, to reduce drag, and then the mesh size declines to four to eight inches near the cod end. The cod end is a bag attached at the end of the cone where the catch collects as the net is drawn through the water. It is "unzipped" from the rest of the net after it is hauled up onto the stern deck. The size of the net used by an individual vessel is determined by the amount of horsepower available to haul it in (Northern Economics 2000).

Trawling operations involve locating dense schools of fish with sonar and other electronics, setting the net, towing anywhere from 30 minutes to several hours, hauling the net up the stern ramp with winches, detaching the cod end, emptying the catch into the hold, closing up the cod end, making any net repairs, and then setting and towing again. Electronics are used to monitor both the fish and the net's configuration and operation (Northern Economics 2000).

3.2.2.2.2 Fixed gear

Fixed gear vessels include longline and pot catcher vessels of different size classes (less than 32 feet long, 33 to 59 feet long, and longer than 59 feet), and target Pacific cod and flatfish as well as pollock in the Gulf of Alaska. Fixed gear vessels in the Gulf of Alaska are generally smaller than similar vessel types in the Bering Sea, but a number of them are larger than 59 feet in length. Sablefish is the principal target of longline catcher vessels in the Gulf of Alaska. The smaller fixed-gear classes participate in the groundfish fisheries to supplement participation in salmon, herring, and halibut fisheries (NMFS 2001a). These non-trawl sectors of the fleet combined account for about 30 percent of the total groundfish catch in the Gulf of Alaska, 25 to 50 percent of which is composed of pollock (NPFMC 1999a). These vessels deliver to processing plants on the Alaska Peninsula, the Aleutian Islands, and in Kodiak.

3.2.3 The ecosystem

A National Research Council panel identified four domains of the Bering Sea: 1) the continental shelf and slope, which are predominant in the northeastern segment, 2) the Aleutian Basin north

[9] Correspondence to Suzanne Iudicello dated 10 March 1997.

of the Aleutian Islands chain and extending westward to the Kamchatka Peninsula, 3) the Aleutian Islands, and 4) the Gulf of Alaska. These ecological domains are traversed by both water and organisms, particularly more mobile species at higher trophic levels. The atmospheric systems that influence surface ocean conditions extend well beyond them as well. In addition, the distributions of animals within these domains change over time. As a result, the boundaries of these ecological domains "tend to be ill defined and changeable" (NRC 1996).

For the purposes of groundfish management, the NMFS and the North Pacific Fishery Management Council have defined two ecosystems: 1) the Eastern Bering Sea/Aleutian Islands ecosystem (including the portion of the Bering Sea in U.S. territorial waters), and 2) the Gulf of Alaska ecosystem.

While many important questions remain unresolved (see Section 4.2), there is nevertheless a great deal of information about the structure and functioning of both the Bering Sea and the Gulf of Alaska ecosystems. This information comes from an extremely wide variety of sources in state and federal agencies, academic research institutions, and commercial industry, and has fortunately been summarized and synthesized in four key documents:

- *The Bering Sea Ecosystem* (NRC 1996), a National Research Council report produced in 1996 and triggered by concerns about declines in some marine mammal and seabird populations;
- The Gulf Ecosystem Monitoring and Research Program's draft Program Document (GEM 2001), produced in August 2001 by the Exxon Valdez Oilspill Trustee Council;
- The *Draft Supplemental Environmental Impact Statement* (NMFS 2001a) on the groundfish fisheries of the North Pacific, produced by the NMFS in January 2001; and
- The *Draft Biological Opinion and Incidental Take Statement* produced by the NMFS in August 2001 (subsequently finalized in October 2001 as the 2002 Biological Opinion) (NMFS 2001d).

Each of these documents reflects a somewhat different purpose but, taken together, they provide the most comprehensive and readily accessible source of information on our current understanding of these two ecosystems. Much of the information contained within this section is summarized from these sources.

3.2.3.1 Physical oceanography

3.2.3.1.1 Bering Sea

The Bering Sea basin is characterized by a general counter clockwise flow that includes an intensified western boundary current, the Kamchatka Current, and a northwestward flowing eastern boundary current (Figure 9) (NMFS 2001a). Pacific water enters the Bering Sea through the major passes in the Aleutian Islands (Favorite *et al.* 1976), although the actual volumes of water involved in this exchange are uncertain (NRC 1996). Water eventually exits the Bering Sea northward through the Bering Strait, or westward and south along the Russian coast, entering the western North Pacific via the Kamchatka Strait.

Well-defined fronts separate the Eastern Bering Sea into four domains, separated approximately by the 50-meter, the 80- to 100-meter, and the 170-meter isobaths, with the 170-meter isobath positioned at the shelf break. These domains are related to water circulation over the continental shelf (NMFS 2001a; NRC 1996). A special feature of the Bering Sea is the pack ice that covers most of its eastern and northern continental shelf during winter and spring, extending more than 1,700 km at its farthest extent and covering much of the shelf (Figure 10) (NMFS 2001a; NRC 1996). Sea ice affects ocean–atmosphere interactions in many ways, and its effect on bottom temperatures influences the distributions of many species (NRC 1996).

3.2.3.1.2 Gulf of Alaska

The Gulf of Alaska, with land masses only to the east and north, is a much more open system than the Eastern Bering Sea/Aleutian Islands. As described in NRC (1996) and NMFS (2001a), the dominant circulation in the Gulf of Alaska is characterized by the counter clockwise flow of the Alaska Gyre (Figure 9) (NMFS 2001a). Northward flow along the British Columbia shelf break is relatively wide and unorganized, but becomes much more coherent as it bends westward at the apex of the Gulf. Large amounts of precipitation and runoff of fresh water in this region are an important feature of the ecosystem, with the Gulf of Alaska having been compared to an estuary (Tully and Barber 1960). Large seasonal variations in the wind-stress curl in the Gulf of Alaska affect the meanders of the Alaska Stream and nearshore eddies. The variations in these nearshore flows and eddies are responsible for much of the region's biological variability.

3.2.3.2 Regime shifts

A key feature of the Bering Sea/Aleutian Islands and Gulf of Alaska ecosystems is the presence of decadal scale and naturally occurring regime shifts in a wide range of oceanographic parameters such as sea level pressure, wind, sea surface temperature, ice, and ocean currents. Such physical features are primarily driven by the winter atmospheric circulation. Changes in the Aleutian low strongly affect the nature of the regime (NMFS 2001a). There is widespread acceptance among scientists working in this system that these physical changes are associated with equally extensive changes in the makeup of biological communities (see Section 3.2.3.5).

It appears that, at least since 1890, regimes in the North Pacific have cycled back and forth at an interval of two to three decades (Minobe 1997; NMFS 2001a), most likely due to an internal oscillation in the coupled atmosphere-ocean system. This suggests that the next climatic regime shift is most likely to occur between 2000 and 2007 (NMFS 2001a). It is now widely recognized that a regime shift took place in 1976/1977, as indicated by the sudden jump in a composite index of 40 environmental variables (Francis and Hare 1994; Hare and Mantua 2000a). In addition, Hare and Mantua (2000a) have documented a more recent regime shift in 1989, particularly in the Bering Sea, based on the behavior of time series data on 31 climatic and 69 biological indices.

These alternate ecosystem states are commonly referred to as "warm" and "cold" regimes, with the Bering Sea/Aleutian Islands and Gulf of Alaska typically moving in concert, with the exception that, since the mid 1980's, the Bering Sea/Aleutian Islands has been relatively somewhat cooler than the Gulf of Alaska (NRC 1996). While temperature records in the Gulf of

Alaska do not indicate a clear regime shift, biological time series do, leading to controversy about the presence and nature of any regime shift in the Gulf of Alaska (NMFS 2001a).

3.2.3.3 Environmental influence on harvest

Hollowed *et al*. (2001) found two major time scales of climatic events that affect marine fisheries in the North Pacific: 1) El Niño-Southern Oscillation events, which occur on a two to seven year time schedule, and 2) the Pacific Decadal Oscillation, which occurs on a decadal scale. If Bering Sea pollock respond to large climatic events with predictable changes in production (especially recruitment), then abundance could fluctuate in a predictable way.

Hollowed *et al*. (2001) examined fishes from three large geographic areas for evidence of Pure Temporal Variability, that would indicate forcing on one of these two times scales. Bering Sea and Gulf of Alaska pollock recruitment demonstrated low autocorrelation, which suggests that runs of strong or weak year classes do not occur during the climatic events. Gulf of Alaska pollock showed increased abundance during El Niño North (warm) conditions. The North Pacific gadoid species did not appear to respond to the Pacific Decadal Oscillation.

Pacific Decadal Oscillations, or regime shifts, occurred in 1925, 1947, and 1977 (Mantua *et al*. 1997), and possibly again in 1989 (Hare and Mantua 2000b). Many dramatic physical and biological shifts co-occurred with these oscillations. Hare and Mantua (2000b) noted that data on salmon production collected prior to the mid-1970s is not relevant to modeling the dynamics of present-day salmon runs because of different production relationships since the 1977 regime shift, and that evaluation of optimal catch rates for the Pacific halibut fishery use regime shift models as one expression of the recruitment process. Hare and Mantua (2000b) noted increased production of Gulf of Alaska pollock following the 1977 regime shift, and lower production following the 1989 regime shift.

Most stock assessment does not explicitly take climate variability into account. Hare and Mantua (2000b) recommend adopting a more holistic view, including the incorporation of environmental forcing, to increase our understanding of fish population dynamics and to better optimize the tradeoffs between catch and sustainability.

As noted earlier, the recruitment forecast for the Gulf of Alaska pollock uses five sources, three physical and two biological (Dorn *et al*. 2000). These sources apparently do not fluctuate in a pattern consistent with either El Niño-Southern Oscillation events or Pacific Decadal Oscillations. No environmental predictors for recruitment have been found for the Eastern Bering Sea stock. But the Russian Party (2000b) noted that recruitment patterns showed a pattern of periodicity in the Far East pollock stocks, with low recruitment prior to 1975, increased recruitment from 1975 to 1989, and reduced recruitment since 1990. These periods correspond to shifts in the Pacific Decadal Oscillation.

In addition to possible environmentally induced changes to recruitment, environmental fluctuations could cause changes in pollock distribution. Bailey *et al*. (1999) suggest that adult pollock expand their range during increasing abundance and during warm periods. Pollock avoid low bottom temperatures, from zero to two degrees Celsius, which limits their northern distribution in cold years. Thus cold years would reduce the movement of Eastern Bering Sea pollock to Russian waters, if transboundary migration occurs. Conversely, if environmental conditions occurred that consistently pushed a higher than normal proportion of pollock from the Eastern Bering Sea to the Russian zone, then fishing in the Russian zone could severely impact the Eastern Bering Sea component of the stock.

3.2.3.4 Primary and secondary productivity

Detailed information on the distribution and fluctuations of phytoplankton and zooplankton, and the influence of physical oceanography on these, is generally not available. But some broad patterns are clear, and there are developing conceptual models about these connections.

The physical zonation of the continental shelf in the Bering Sea strongly controls the amount and distribution of primary productivity. The major fronts inhibit cross-shelf movement of nutrients from the deeper basin onto the shelf and the consequent slow nutrient renewal in the coastal domain leads to relatively low total production there. Primary productivity is higher in the deeper and more offshore domains (NRC 1996). This physical zonation also affects secondary production, with a much larger biomass of zooplankton found over the outer domain and decreasing biomass over the middle and coastal domains (NRC 1996). As a consequence, there is a greater shunt of primary production to the pelagic food web in the outer domains.

Primary production can vary as much as 30 to 50 percent between years in the outer domains but is apparently relatively consistent in the coastal domain (NRC 1996). Not much is known about the system-wide impacts of regime shifts on primary and secondary productivity. But there is accumulating evidence of the potential for such impacts. Francis and Hare (1994) suggest that interannual fluctuations in zooplankton abundance on the northern Gulf of Alaska shelf are related to the strength of Aleutian Low wind field. Venrick *et al.* (1987) found a significant increase in water column chlorophyll concentrations north of Hawaii after the 1976/1977 regime shift. Brodeur *et al.* (1999) documented a tenfold increase in the biomass of large medusae in bottom trawls in the 1990s, following a change around 1990 in several large-scale, winter–spring atmospheric and oceanographic variables in the Bering Sea.

The Gulf Ecosystem Monitoring Program has developed a conceptual model of how changes in the strength of the Aleutian Low related to regime shifts could strongly influence both the strength and distribution of primary and secondary productivity in the Gulf of Alaska (GEM, 2001).

When the Aleutian Low is more intense (positive Pacific Decadal Oscillation), stronger winds lead to increased upwelling of nutrient rich water offshore and a shallower, more productive mixed layer. But this set of conditions also leads to greater precipitation and terrestrial runoff, which in turn creates greater stratification in the nearshore zone and inhibits upwelling of deeper, nutrient rich water. In this set of conditions, productivity is higher offshore, leading to increases in salmon populations, while lower productivity inshore leads to decreases in forage fish and the populations of seabirds and marine mammals that depend on them.

During regimes when the Aleutian Low is less intense (negative Pacific Decadal Oscillation), the reverse of these patterns occurs, with increased productivity inshore and improved conditions for seabirds and marine mammals, but decreased productivity and salmon populations offshore.

Similarly, Francis and Hare (1994) found strong linkages between long-term patterns in the intensity of the Aleutian Low and salmon production.

3.2.3.5 Biological diversity

Pollock in the Eastern Bering Sea and Gulf of Alaska are managed together with more than a dozen species of cod, rockfish, flounders, sole and mackerel species, characterized as the "groundfish" complex (See Section 3.3.2). Pollock is the most abundant species within the Eastern Bering Sea, comprising 75-80 percent of the total catch and 60 percent of the biomass. Pollock is the second most abundant groundfish stock in the Gulf of Alaska, comprising 25-50 percent of the catch and 20 percent of the biomass (BSAI EFH Technical Team 1998).

The Bering Sea and Gulf of Alaska ecosystems also support many other commercially important species such as salmon, crab, halibut, herring, and dozens of fish and shellfish, which are managed under separate fishery management plans. There has not been a comprehensive scientific inventory of biological diversity in either of these ecosystems. But it is well known that they are also inhabited by more than 400 species of forage fish and other non-target fish species, along with molluscs, crustaceans, corals, and other marine life, ranging from micro-algae along the ice pack edge, to resident walrus, and to migrating whales (WWF 2002).

The 53-mile-wide Bering Strait that connects the Bering Sea to the Arctic Ocean is critical to marine life migrating to and from summering grounds in the Chukchi Sea and elsewhere in the Arctic Ocean. The Bering Sea supports vast populations of 50 species of seabirds, including nearly 10,000,000 murres and auklets. The Sea's Pribilof Islands, often referred to as the "Galapagos of the North" because of the exceptional abundance of marine organisms they support, are home to one of the world's largest seabird colonies, which is composed of an estimated 2,500,000 birds (WWF 2002). These Islands also support nearly 75 percent of the world's northern fur seal population during their four to six month breeding season (Angliss *et al.* 2001). The coastal fringe, including eelgrass beds, extensive coastal lagoons, deltas, wetlands and estuaries, supports an abundance and diversity of waterfowl and shorebirds (WWF/TNC 1999).

Among the 25 species of marine mammals that inhabit or migrate through the Bering Sea are the endangered bowhead, sperm, humpback, fin and northern right whales. The ice pack creates habitat for many other marine mammals, including seals, polar bears, and walruses, by providing a surface on which these animals can rest and bear their young in an isolated environment, with easy access to the food supply (WWF 2002). The region is home to ten strategic stocks[10] of marine mammals, including the northern fur seal and the Steller sea lion.

Pollock constitute an important food source for many of the fish, seabirds, and marine mammals, with which they co-occur. For example, the hatching success and fledgling survival of seabirds on the Pribilof Islands is believed to be associated with the availability of age-zero pollock to

[10] Amendments to the Marine Mammal Protection Act in 1994 define "strategic stock" as a marine mammal stock that is listed or likely to be listed under the Endangered Species Act, designated as depleted under the MMPA, or suffers human-caused mortality at a level greater than is biologically sustainable. Definition as a strategic stock triggers more aggressive conservation measures under the Act (16 U.S.C. 1362(18)). Pub.L. 103-238 (1994).

nesting birds (BSAI EFH Technical Team 1998; GOA EFH Technical Team 1998). And some hypothesize that a decrease in the availability of pollock in habitat determined to be critical to the Steller sea lion is at least partly responsible for the continued decline in the western population of that marine mammal.

The role of the pollock fisheries in the Steller sea lion decline has increasingly grown to be a subject of great controversy. Section 3.3.5 summarizes current information on the effects of fishing on Steller sea lions and other ecosystem inhabitants, as well as management measures taken to reduce fishing-related impacts on protected and non-target species.

3.3 Description of the fishery management regime

Management of the Eastern Bering Sea and Gulf of Alaska pollock fisheries, although exercised by the United States over domestic fisheries that take place within the U.S. Exclusive Economic Zone, nonetheless occurs in an international context. Not only are questions of the straddling nature of pollock stocks at issue in the Bering Sea and Gulf of Alaska. In addition, management of pollock fishing in the Donut Hole occurs under an international treaty. Finally, the United States is a party to the 1982 U.N. Convention on the Law of the Sea,[11] the U.N. Straddling Stocks Agreement, and the global Code of Conduct for Responsible Fisheries. As such, our nation observes the conventions and standards of these international agreements and has met its obligations thereunder by enacting national legislation and administrative action.

The U.S. fishery management system has been examined and analyzed thoroughly over its nearly 30-year history. Recent publications leading up to and assessing the most recent changes to and implementation of U.S. fishery management law include:

- *Sustaining Marine Fisheries* (NRC 1999);
- *Fishing Grounds: Defining A New Era for American Fisheries Management* (The Heinz Center 2000a); and
- *From Abundance to Scarcity: A History of U.S. Marine Fisheries Policy* (Weber 2001)

In addition, a variety of sources in state and federal agencies, academic research institutions, and the non-governmental community have focused on particular concerns and vulnerabilities in the system, from conflicts of interest, to ecosystem-based management approaches, to environmental compliance, to incentives and subsidies.

3.3.1 Governing authorities

3.3.1.1 International framework

Intensive pollock fishing in the area of international waters outside the exclusive economic zones of the United States and Russia gave rise to concern about the status of pollock stocks within the waters of the respective nations. Negotiations begun in 1991 led to the Convention on the Conservation and Management of Pollock Resources in the Central Bering Sea (the Pollock

[11] Third United Nations Convention on the Law of the Sea, Dec. 10, 1982, 21 ILM 1245.

Convention), concluded in June 1994 among China, South Korea, Poland, the Russian Federation, and the United States.[12]

The primary effect of the Pollock Convention was a moratorium on pollock fishing in the Donut Hole. But the Convention also contains management objectives, including restoration of pollock to levels that will produce maximum sustainable yield. Cooperation in data gathering is another principle aim, and there is a Scientific and Technical Committee that meets to exchange information and to set an allowable catch level. The convention has been described as oriented mainly to the allocation of fishing rights, rather than to conservation (Weber 1998).

The 1982 U.N. Convention on the Law of the Sea, which entered into force in November 1994, is the overarching body of law that covers every aspect of marine endeavor, from transportation, to pollution, to military issues, to scientific research. Its language related to protecting living marine resources sets out the rights and responsibilities of coastal states and flag states with regard to fishing. Article 56 of the Convention provides coastal states sovereign rights over resources out to 200 miles. Article 61 provides the authority to conserve and manage living resources within that jurisdiction.

Article 61(2) of the Convention requires that coastal nations ensure, using the best scientific information available and conservation and management measures, that the living resources of the exclusive economic zone are not threatened by overexploitation. Article 61(3) adopts maximum sustainable yield as the goal for maintaining or restoring exploited populations. Article 61(5) requires that coastal states collect, contribute, and exchange scientific information, catch, and effort statistics with other concerned states.

Article 62 of the Convention provides that foreign access to the zones of coastal states is solely within the discretion of those states, and subject to state laws and regulations, including requirements for licensing, observers, and other conservation measures. Compliance with conservation and management measures is required.

Article 63 of the Convention directs states to seek the coordinated measures necessary to conserve stocks that occur in waters adjacent to their zones, or within the zones of two or more coastal states. With regard to highly migratory species, Article 64 calls for cooperation through international organizations, and where none exists, for the establishment of such organizations "with a view to ensuring conservation and promoting the objective of optimum utilization of such species throughout the region, both within and beyond the exclusive economic zone."

The Convention even imposed new obligations on high seas fishing states. While freedom of fishing on the high seas continues in principle, the Convention can be read as imposing a dual responsibility on fishing nations - conservation and cooperation with coastal states (Sohn and Gustafson 1984).

The U.N. FAO, recognizing the need for further measures beyond those in the 1982 U.N. Convention on the Law of the Sea, "recommended the formulation of a global Code of Conduct for Responsible Fisheries which would...establish principles and standards applicable to the

[12] Senate Treaty Doc. 103-27.

conservation, management, and development of all fisheries."[13] The FAO Conference adopted the global Code of Conduct by unanimous vote on October 31, 1995. The Code covers both policy and technical matters in its 12 articles, including fishery management, fishing operations, aquaculture, coastal area development, research, and trade.

As described in Articles 1.1-1.3, the Code of Conduct is voluntary and non-binding, to be adopted by nations through national implementation and legislation. But some of its provisions are obligatory because of their relation to other legal instruments. The Code provides principles and standards for every aspect of fisheries, from aquaculture to capture, from research to fishing operations, and from processing to trade. And it is directed toward all persons concerned with conserving, managing, or developing fisheries, processing, or marketing, or any "users of the aquatic environment in relation to fisheries."

Article 6.1 of the Code of Conduct attaches, for the first time, an obligation to the freedom to fish, and calls for using living marine resources "in a responsible manner so as to ensure effective conservation and management." Article 6.2 discusses intergenerational equity in the fishery context for the first time as well, calling for maintaining the diversity of fishery resources for "present and future generations" as well as for "food security, poverty alleviation, and sustainable development."

Articles 6.3-6.8 of the Code of Conduct urge the use of effort controls, ecosystem management, the precautionary approach, selective fishing gear, habitat protection, and the best scientific information. Articles 6.10-6.12 and 6.15 call not only for monitoring and controlling flag state vessels, but also for cooperating at all levels and among jurisdictions, and for preventing disputes. Articles 6.13 and 6.16-6.18 urges states to adopt transparent decision making processes, as well as education and training programs, to provide safe and fair working conditions, and to recognize and protect the rights of subsistence, small-scale, and artisanal fishers (Weber 1998).

Articles 7-12 of the Code of Conduct provide specific guidance to states and interested parties on operational and technical matters. Many specific provisions provide further detail on the general principles set forth in the Code by describing how, for example, the precautionary approach would be applied in fishery management (see Section 4.3). A series of technical guidelines produced by the U.N. FAO provides further elaboration.

In both procedural and substantive recommendations, the global Code of Conduct is far ahead of traditional fishery agreements. Management objectives include maintaining or restoring stocks to levels that would produce the maximum sustainable yield, avoiding excess fishing capacity, protecting biodiversity and endangered species, assessing and mitigating adverse impacts from human activities, and minimizing pollution, waste, discards, ghost fishing, and bycatch. The Code recommends assessing whole ecosystems and ecological interrelationships, and directs states to consider whole stock units over their entire area of distribution.

The 1992 U.N. Conference on Environment and Development in Rio de Janeiro recognized that neither the Convention on the Law of the Sea nor the global Code of Conduct for Responsible Fisheries was slowing the depletion of fish stocks around the world. The problem of effectively

[13] FAO of the United Nations. 1995. Code of Conduct for Responsible Fisheries. Adopted 31 October 1995. Rome.

managing high seas stocks was a particular concern, resulting in a conference on straddling fish stocks and highly migratory fish stocks.

The subsequent U.N. Straddling Stocks Agreement has been recognized as the most significant outcome of the fishery management directives from Agenda 21, and a “sea change” in international fishery management. For the first time, the focus of an international fishing agreement shifted from producing maximum food for humans, to sustainable fishing, ecosystem protection, conservation of biological diversity, and the use of a precautionary approach to fishery management (Freestone 1998).

The U.N. Straddling Stocks Agreement is also the first international agreement to produce an actual methodology for the precautionary approach, and to establish reference points, targets, and limits. Most significantly, the Agreement denies (for party nations) unqualified access to fish on the high seas. It accomplishes all this without creating a new international structure, relying instead on existing regional agreements and organizations, and calling for mechanisms to strengthen them. Where such agreements or organizations do not exist, Article 8(5) directs states to create them.

Any state that ratifies the U.N. Agreement agrees to join, or to observe the conservation measures of, the relevant regional fisheries regime while fishing in the area under its jurisdiction. In a comprehensive evaluation of global fishery management regimes, Weber (1998) writes that “This provision, if observed and enforced, will address a critical problem common to fisheries regimes in all oceans: The undermining of conservation measures by the fishing activities of vessels from countries that do not belong to relevant regional regimes.” Appendix B provides a detailed description of each of the elements of the U.N. Straddling Stocks Agreement.

3.3.1.2 National regime

The North Pacific Fishery Management Council manages the U.S. pollock fishery with oversight from the NMFS under the U.S. Department of Commerce. That regional fishery management council is one of eight established by the FCMA of 1976 to develop, through a participatory process, management measures for fisheries taking place within the U.S. Exclusive Economic Zone. While regional councils are responsible for developing fishery management measures, the Act vests final authority and responsibility for federal fishery management with the U.S. Secretary of Commerce. The Act also provides ten national standards to guide fishery management decision making.

While seven of the eight regional fishery management councils are responsible for federal fisheries off the coasts of multiple states, the North Pacific Council manages fisheries in federal waters only off the State of Alaska. In addition to the fishery agency of the State of Alaska, those of the states of Oregon and Washington have voting representation on the Council, along with the NMFS, and seven public members appointed by the U.S. Secretary of Commerce.

3.3.2 Fishery management plans and goals

The Gulf of Alaska and Bering Sea/Aleutian Islands walleye pollock fisheries are managed as smaller components of two larger "groundfish" complexes under two separate fishery management plans.

The *Fishery Management Plan for Groundfish of the Gulf of Alaska* was implemented on December 1, 1978 and has been amended over fifty times (DiCosimo 1998b). According to the NMFS' most recent report to Congress on the status of U.S. fisheries, 8 of the 95 stocks managed under this groundfish plan are neither overfished, nor approaching an overfished condition.[14] The status of the remaining 87 stocks is unknown (NMFS 2001f).

The *Fishery Management Plan for the Bering Sea/Aleutian Islands Groundfish* was implemented on January 1, 1982 (Witherell 1997) and has been amended over forty times (see Appendix C for details). The NMFS (2001f) reports that, of the 121 stocks managed by the North Pacific Council under this plan, 13 are neither overfished, nor approaching an overfished condition.[15] The status of the remaining 108 stocks is unknown.

The Gulf of Alaska plan identifies as "target species" walleye pollock, Pacific cod, flounders, sablefish, and numerous species of rockfish. Atka mackerel, squid, sculpins, sharks, skates, eulachon, capelin, smelts, and octopus are described as "other species" taken in the groundfish fishery that have less commercial importance. Catches of both "target" and "other species" are limited and documented. Catches of other "non-specified species," including grenadiers, eelpouts, sea urchins, and mussels, which are taken incidental to the groundfish fishery and are not managed by other fishery management plans, are neither limited nor recorded (DiCosimo 1998b).

The Bering Sea/Aleutian Islands plan identified as "target species" walleye pollock, sablefish, Pacific cod, squid, Atka mackerel, Greenland turbot, yellowfin, flathead, and rock sole, arrowtooth flounder, Pacific ocean perch, and other flatfish and rockfish. "Other species," including sculpins, eulachon, capelin, sharks, skates, smelts, and octopus are not generally targeted, but are also taken in the groundfish fishery. Catches of both "target" and "other species" are limited and documented. Incidental catches of other "non-specified species" of fish and invertebrates, including grenadiers, eelpouts, sea urchins, and mussels, are neither limited nor recorded (Witherell 1997).

The four goals described by the North Pacific Council for all its fishery management plans are: 1) to promote conservation while providing for optimum yield,[16] 2) to promote efficient use of

[14] These include western/central walleye pollock; Pacific cod; sablefish; shortspine thornyhead; arrowtooth flounder; and western, central, and eastern Pacific Ocean perch.

[15] These include Eastern Bering Sea walleye pollock; Pacific cod; yellowfin sole; Greenland turbot; arrowtooth flounder; rock sole; flathead sole; Eastern Bering Sea and Aleutian Islands sablefish; Eastern Bering Sea and Aleutian Islands Pacific Ocean perch; Atka mackerel; and Alaska plaice.

[16] Optimum yield is defined as that which provides "the greatest overall benefit to the nation with particular reference to food production and recreational opportunities; avoiding irreversible or long-term adverse effects on fishery resources and the marine environment; and insuring availability of a multiplicity of options with respect to the future uses of these resources" (NPFMC 1999b). In the case of an overfished fishery, optimum yield provides for

fishery resources, but not solely for economic purposes, 3) to promote fair resource allocation without allowing excessive privileges, and 4) to use the best scientific data available (NPFMC 1999b). Included in a list of secondary objectives are precautionary measures, including the flexibility to respond to unpredictability, providing for a “safety margin” when the quality of information is questionable, and the design of fishing strategies that minimize the effects of fishing on the environment (NPFMC 1999b). But more important than precautionary language are the concrete management measures themselves.

3.3.3 Fishery management measures

Scientific management of Alaska groundfish fisheries developed from efforts to control foreign fisheries when little domestic groundfish fishing existed (Trumble 1998). The overfishing of groundfish by foreign fleets provided an impetus for conservative management. Bilateral and multilateral negotiations with foreign fishing nations required scientific justification for conservation measures desired by the United States. Extended jurisdiction allowed for unilateral application of conservation management, as long as scientific justification existed.

Thus, a tradition of conservative management developed in the U.S. North Pacific region before the domestic fishery developed. And, although the original goal of domestic pollock fishery management was to develop the American fishing and processing industries, this conservative philosophy continued through the transition to domestic catch and management.

Pollock fisheries in both the Bering Sea/Aleutian Islands and Gulf of Alaska management areas are controlled through permits and limited entry, catch quotas, seasons, in-season adjustments, gear restrictions, closed waters, bycatch limits and rates, allocations, and regulatory areas (Witherell 2000b; DiCosimo and Kimball 2001).

Catch specifications for the target and other species described in Section 3.3.2, and for the prohibited species identified in Section 3.3.5.2.2, are adopted by the North Pacific Council annually based on recommendations included in annual stock assessments, which are reviewed by advisors from the Council’s groundfish plan teams and its Scientific and Statistical Committee. Overfishing specifications define the unacceptable catch level. Acceptable biological catch specifications generally define the acceptable catch level. And total allowable catch specifications are essentially annual catch quotas. These quota specifications account for the total groundfish catch, including discards, with an assumed 100 percent mortality rate (NPFMC 1999c).

However allocated, the total allowable groundfish catch may not exceed an absolute cap of 2,000,000 mt for the Bering Sea/Aleutian Islands region and 800,000 mt for the Gulf of Alaska. This is true regardless of groundfish biomass and even if acceptable biological catch is much higher (NPFMC 1999c). Managers established these caps in the very first groundfish fishery management plan. In addition, they set aside 15 percent of the total allowable catch as a “reserve,” to account for unforeseen circumstances each year: “to correct operational problems in

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rebuilding to a level consistent with producing maximum sustainable yield. Optimum yield is based upon the maximum sustainable yield for a given fishery, as reduced by relevant economic, social or biological factors....” (Witherell 1997).

the fisheries, to adjust species [total allowable catch quotas] according to stock conditions" and for other purposes (Witherell 1997).

The reserve quota is made up of the total of 15 percent of each of the species specific total allowable catch quotas, which are established annually based on consideration of maximum sustainable yield, equilibrium yield, and optimum yield for the groundfish complex as a whole. Since 1992, one-half of the annual Eastern Bering Sea pollock reserve has been assigned to the CDQ program because of managers' confidence in the accuracy of the weekly catch reports (Hartley 2000). Catches are closely monitored in-season through strict reporting requirements and a comprehensive observer program. And management measures provide for cessation of the fishery when the total allowable catch quota has been taken.

3.3.4 Regulating the effects of fishing on target species

3.3.4.1 Legal requirements

The requirements for federal fishery management plans to define and remedy overfishing have gone through two distinct phases. The first phase began in 1989 with the publication of the NMFS' National Standard 1 guidelines, which required definitions of recruitment overfishing and corresponding management plans to avoid recruitment overfishing and/or to rebuild stocks that had been reduced in size as a result of recruitment overfishing.

The second phase began in October 1996 with the reauthorization and revision of the Magnuson Fishery Conservation and Management Act (MFCMA). Congress made many significant changes to the Act in 1996 but, in terms of overfishing definitions, the most significant change was just a single word. The definition of "optimum yield" was changed from "...[maximum sustainable yield] as ***modified*** by" relevant factors to "...[maximum sustainable yield] as ***reduced*** by" relevant factors (Section 3, Definitions, 104-297 28(B)).

In preparing National Standard Guidelines for the fishery management councils, the NMFS interpreted this change to mean that maximum sustainable yield or, more correctly, the fishing mortality at maximum sustainable yield (F_{MSY}) should be an upper bound (limit) on fishing mortality; i.e. that overfishing limits or thresholds should be based on F_{MSY} or relevant proxies. Thus, when the guidelines were published in 1998, the emphasis changed from avoiding recruitment overfishing to avoiding fishing mortalities higher than the fishing mortality at which maximum sustainable yield is achieved (F_{MSY}) (63 FR 24212; NMFS 1997).[17] Although not all regional fishery management councils have yet established fishing mortality rates in accordance with this stricter standard, the North Pacific Council has historically managed at a much more conservative rate, as described in the following section.

[17] By definition, recruitment overfishing must occur at higher fishing mortality than F_{MSY}. Therefore, treating F_{MSY} as an upper bound on fishing mortality should automatically avoid recruitment overfishing to the extent that parameter estimation is accurate. Effectively, the text in the 1996 Magnuson-Stevens Fishery Conservation and Management Act gave rise to a change in the limit fishing mortality from approximately $F_{20\%SPR}$-$F_{30\%SPR}$ to $F_{30\%SPR}$ - $F_{40\%SPR}$ (Pamela Mace, National Marine Fisheries Service, personal communication. 2000, quoted in Parkes (2001) Understanding SPR and its Use in U.S. Fishery Management. White Paper prepared for The Ocean Conservancy, Washington, DC.

3.3.4.2 Managing exploitation

The earliest exploitation strategies used in pollock fishery management involved monitoring changes in catch per unit effort, and adjusting catches to keep catch per unit effort within a chosen range (Trumble 1998). As population models became available, catch recommendations were generally developed through application of an exploitation rate to an estimated biomass. Analysts often developed unique approaches for determining exploitation rates and the North Pacific Council desired a consistent approach and standard methodology.

Clark (1991, 1993) determined that maintaining spawning biomass at 20-60 percent of the unfished level provides at least 75 percent of maximum sustainable yield, regardless of stock-recruitment relationships. A fishing mortality rate that reduces spawning biomass per recruit to about 35 percent of the unfished level ($F_{35\%}$) achieves this goal. Variable recruitment, especially with serial correlation, calls for a slightly lower target F ($F_{40\%}$). The North Pacific Council adopted an overfishing threshold of $F_{35\%}$ in 1995 and in 1996 (Trumble 1998). Following amendment of the MFCMA, the Council moved to adopt a threshold of $F_{40\%}$ in 1997.

The maximum allowable fishing mortality rate used to calculate acceptable biological catch and overfishing levels is defined using a set of six tiers, each corresponding to the amount and reliability of available scientific information, from the most reliable point estimates of biomass, maximum sustainable yield and probability density function, down to the least information available, which is reliable catch history from 1978 through 1995. The less information, the lower the allowable fishing mortality rate, and the more restrictive the overfishing level. Appendix D describes specific information requirements associated with each of the six tiers (NPFMC 2000).

Tightly controlled catch quotas ensure that catches are maintained within biologically acceptable levels. Since 1980, the total allowable catch of Eastern Bering Sea and Gulf of Alaska pollock has averaged only 14 percent and 7 percent of the total estimated pollock biomass, respectively (Tables 1 and 2). Figures 3 and 4 illustrate Eastern Bering Sea and Gulf of Alaska pollock catches relative to biomass and catch specifications.

3.3.4.3 Stock status, trends, and catch specifications

In contrast to the overfishing and collapse of many marine fisheries, tight restrictions on annual groundfish quotas have prevented overfishing of pollock since the implementation of the FCMA in 1977 (Shimada *et al*. 1998). Megrey and Wespestad (1990) have described the 20-year history of the fishery as a management success.

3.3.4.3.1 Eastern Bering Sea/Aleutian Islands

The stock assessment model for the Eastern Bering Sea shelf stock indicated biomass levels above B_{MSY} and above $B_{40\%}$ for the year 2000 assessment, but low recruitment in recent years may cause a future biomass decline (Ianelli *et al*. 2000).[18] Several versions of the stock assessment model, using different combinations of data or different assumptions, explored stock status. In all cases, models indicate that the Eastern Bering Sea shelf stock is not overfished and is not approaching an overfished condition through 2013 under the management rules adopted by the North Pacific Council.

Over a longer term, the Eastern Bering Sea shelf biomass rapidly increased from about 2,500,000 mt prior to 1980 to near 10,000,000 mt during the early 1980s. Since the shift to higher biomass levels, the average abundance has varied around 10,000,000 mt, although a decline to around 5,000,000 mt occurred in the late 1980s and early 1990s.

Estimates of acceptable biological catch values for 2001 are 1,842,000 mt based on $F_{40\%}$, and 2,125,000 mt based on F_{MSY} (Ianelli *et al*. 2000). The North Pacific Council set the overfishing level at 3,536,000 mt, the acceptable biological catch at 1,842,000 mt, and the total allowable catch at 1,400,000 mt. The final total allowable catch was set at a level that was 24 percent below the acceptable biological catch.[19]

Analysis of pollock from the Aleutian Islands region suggests that these fish are unlikely to represent a discreet stock and may potentially be from the Bering Sea shelf stock (Ianelli *et al*. 2000), because pollock are continuously distributed from the Eastern Bering Sea (Ianelli *et al*. 2000, 2001). Trawl survey data show that most of the biomass is located in the eastern Aleutian Islands and along the north side of Unalaska-Umnak islands in the Eastern Bering Sea region. The stock definition for “Aleutian Islands pollock” is therefore confounded with Bering Sea abundance levels and abundance in the Aleutian Basin. Pollock in the Aleutian Islands region is considered only as an “operational stock” for management, with biomass levels on the order of 100,000 to 200,000 mt (for fish age three and older). In the past two years, catch levels in this region have only been about 1,000 mt, and directed pollock fishing has been prohibited.

Ianelli *et al.* (2000) recommended using Tier 5 management applied to the trawl survey biomass, until stock structure relationships for the Aleutian Islands region are better defined. The Council set an acceptable biological catch level of 22,800 mt and a total allowable catch quota of 2,000 mt. While Ianelli *et al*. (2000) did not determine if the stock is overfished, they note that abundance has stabilized in recent years, but at a lower level than in the 1980s.

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[18] The recently released draft 2001 assessment (Ianelli *et al*. 2001) reports a 19.5 percent decrease in the bottom trawl survey estimate of abundance in 2001 compared to 2000 (4,140,000 mt, compared to 5,140,000 mt). This drop was in line with expectations based on the estimated age structure relative to the pattern of availability to the trawl survey.

[19] The recently released draft 2001 assessment (Ianelli *et al*. 2001) provides updated values for 2002. Estimates of ABC values for 2002 are 2,269,000 mt based on $F_{40\%}$, and 2,108,000 mt based on F_{msy}. The lower ABC corresponding to F_{msy} this year apparently reflects the level of uncertainty about stock size. The 2002 overfishing level alternatives for the reference model are 2,833,000 and 3,531,000 mt corresponding to $F_{35\%}$ and F_{msy} (arithmetic mean). The draft assessment report recommends maintaining the total allowable catch quota at 1,400,000 mt to account for uncertainty in stock size, and in potential changes in catch rates on the eastern Bering Sea stock outside of the U.S. Exclusive Economic Zone (particularly for pre-recruit age groups). Concern also remains over the apparent continuing declines in Steller sea lion populations.

The Bogoslof Island-Aleutian Basin stock appears distinct from those of the Eastern Bering Sea (Ianelli *et al*. 2000, see also Section 3.2.1.3). These groups have different spawning time, fecundity, and size at age. But few pollock younger than five years old have been found in the Aleutian Basin. Recruits likely come from the surrounding continental shelves in either the Russian or the U.S. Exclusive Economic Zone. In spite of five annual meetings of the members of the Pollock Convention (NMFS 2000b), the parties concluded that insufficient data exist to directly estimate the Aleutian Basin pollock biomass. The Pollock Convention did assign an "Annual Harvest Level" of zero for the Aleutian Basin, as biomass was too low to allow fishing under Convention policy.

Ianelli *et al*. (2000, 2001) note that the biomass estimates based on trawl surveys have declined from the late 1980s (2,100,000 to 2,400,000 mt) to the early 1990s (500,000 to 900,000 mt). Following a temporary increase in 1995 to 1,100,000 mt, which was at least partly caused by movement of pollock from the 1989 year-class to the Bogoslof Island area, biomass estimates have continued to decline, even in the absence of fishing. The most recent biomass estimate for 2001 is 230,000 mt.

Ianelli *et al*. (2000) calculated the acceptable biological catch level for the U.S. portion of the Aleutian Basin using 1) Tier 5 management applied to the trawl survey biomass, and 2) Tier 3 management using an assumed $B_{40\%}$. The North Pacific Council set an acceptable biological catch level of 8,470 mt and a total allowable catch quota of 1,000 mt.[20]

3.3.4.3.2 Gulf of Alaska

The Gulf of Alaska estimated biomass trend through the early 1980s (Dorn *et al*. 2000, 2001) was similar to that of the Bering Sea, showing a rapid increase from the late 1970s to a peak in 1981/1982 (over 4,000,000 mt.). In contrast to the Bering Sea, the Gulf of Alaska biomass then declined steadily up to the year 2000. Current estimated biomass levels are at their lowest levels over the period of the assessment, but the most recent assessment indicates there has been an increase in 2001 driven by higher recruitment of age-two pollock (Dorn *et al*. 1999, 2001). According to the 2001 assessment, the catch rate (the catch in biomass divided by the total biomass of age-three plus pollock at the start of the year) from 1998 to 2000 (14 percent in each of the three years) was at its highest level since 1985 (also 14 percent), and is currently at its highest sustained level over the entire period of the assessment.

The definitions of overfishing level and maximum permissible F_{ABC} under Amendment 56 of the Gulf of Alaska groundfish fishery management plan provide a buffer between the overfishing level and the intended catch rate, as required by the NMFS' national standard guidelines. The buffer between the overfishing level and the acceptable biological catch provides a margin of safety because estimates of stock biomass from assessment models are uncertain. This

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[20] Ianelli *et al*. (2001) provides an update to this assessment. Tier 5 computations use the most recent survey biomass estimate applied to an adjusted natural mortality. This gives an acceptable biological catch (2001 survey biomass _ M _ 0.75) of 34,800 mt at a biomass of 232,000 mt (with $M = 0.2$). The overfishing level is 46,400 mt. Based on the discussions of the Scientific and Statistical Committee for further reductions in acceptable biological catch based on considerations of a target stock size of 2,000,000 mt, the acceptable biological catch level for the Bogoslof region for 2001 was 4,310 mt.

assessment error should therefore not result in the overfishing level being inadvertently exceeded. For Gulf of Alaska pollock, the maximum permissible F_{ABC} catch rate is 83.5 percent of the overfishing level catch rate.

The 2001 acceptable biological catch of 100,770 mt recommended by the assessment author and the North Pacific Council's Groundfish Plan Team was based on the maximum permissible acceptable biological catch (Dorn *et al*. 2000). The total allowable catch for Gulf of Alaska pollock set by the Council and NMFS is below this level (90,690 mt) (NMFS 2001e). Two of the three surveys in 2001 indicated sharp declines in the abundance of adult pollock in the Gulf of Alaska to levels lower than projected. It now appears that, had the entire recommended acceptable biological catch been taken in 2001, the overfishing rate would have been slightly exceeded (Dorn *et al.* 2001).

Actual 2001 catches are expected to be substantially below the acceptable biological catch recommendation and also below the total allowable catch (preliminary estimates are 73,800 mt). Nevertheless, this has demonstrated a potential weakness in the assessment process. Despite the inclusion of a buffer intended to provide adequate protection against uncertainty, an acceptable biological catch was recommended that could have resulted in overfishing. The buffer was clearly insufficient, particularly because at lower stock levels (i.e., as the stock declines) the safety margin was reduced (Dorn *et al*. 2001).

The assessment team responded to this problem in the 2001 assessment by recommending to the North Pacific Council a new approach defining the $F_{40\%}$ catch rate that provides a constant buffer for assessment error regardless of stock level (Dorn *et al*. 2001). The major remaining uncertainty in the 2001 assessment is the size of the 1999-year class, on which much of the projected growth in the population after 2002 appears to be based.

3.3.4.3.3 Western Bering Sea

Stepanenko *et al*. (1999) reported on the Navarin pollock stock assessment for 2000. Echo-integration trawl surveys showed a declining abundance trend from 2,000,000 mt in 1996 to 1,300,000 mt in 1997, to 900,000 mt in 1998, and to 400,000 mt in 1999. Dense concentrations of pollock over the entire area, including the Olyutorsky stock, during the early 1990s gave way to density discontinuities and patches of pollock concentrations only in the Navarin area. These observations support the conclusion from Virtual Population Analysis models that a sharp decline of stock biomass occurred in 1993-1995 to the lowest spawning stock biomass since 1970 (Babayan *et al*. 1999).

Over a longer period, the total western Bering Sea biomass (age two plus) increased from 500,000 mt in 1970 to around 2,000,000 mt from 1980 to 1991 (Stepanenko *et al.* 1999). Subsequently, biomass dropped rapidly to about 250,000 mt in 1995, where it has stabilized. Some Russian scientists attribute the dramatic changes to oceanic regime shifts.

Wespestad (1996) (in Pautzke 1997) reported that pollock catches in the Russian Exclusive Economic Zone totaled 2,471,000 mt in 1995, of which 406,000 mt came from the western Bering Sea. Seafood Business Online (2001) reports that the 2001 Russian pollock quota will total 1,870,000 mt, but suggests that fewer fish actually exist. Stepanenko *et al*. (1999) indicate that landings from the Navarin area totaled only 50,000 to 100,000 mt per year from 1995-1998. Babayan *et al*. (1999) recommended a precautionary approach that eliminates the large-scale fishery, and a quota of 40,000 mt for the near-term fishery.

Even with conservative (weak) forecasts of recruitment, the recommended quota should result in a gradual recovery of the stock. Stepanenko *et al.* (1999) report that 1995-1997 year classes were above the long-term mean level, but also that the 1998-year class strength was weak. Russia has reduced the fleet size in its zone as the biomass decreased. The number of large-tonnage fishing vessels has decreased from 110-115 vessels in 1998, to 61 vessels in 1999, and to 40-45 vessels in 2000 (Russian Party 2000a). Landings also decreased from 680,000 mt in 1997 to 311,000 mt in 2000 (Russian Party 2000a).

It is important to note that catch (and research) data from the Russian zone cannot be independently verified, and are accepted by the United States in good faith. But catches may be higher than indicated in the official statistics. Alexey Vaisman has reported incidences of poaching and underreporting of pollock catches in the western Bering Sea (Vaisman 2001). And Russian Prime Minister Mikhail Kasyanov noted that continued poaching remains a serious problem in Russian fisheries (World Catch 2001a). Thus, some level of unreported pollock catch may occur. Pautzke (1997) reports that without some mechanism for coordinated, verifiable, and sustainable management and conservation of Bering Sea transboundary pollock stocks, their long-term outlook could be threatened.

3.3.4.3.4 Donut Hole

The Aleutian Basin pollock stock is in critical condition, and the fishery is currently under a moratorium. The Pollock Convention set a minimum biomass threshold of 1,670,000 mt for fishing to continue, a level that is substantially above recent biomass estimates of about 500,000 mt. The Convention allows member nations to conduct trial fishing, but not all members are operating trial fisheries. China's 2000 trial fishery reportedly encountered few fish (Pollock Workshop 2000).

3.3.4.4 Recruitment and year class strength

The population and fishery dynamics of walleye pollock are strongly influenced by intermittent recruitment of strong year classes (Bailey *et al.* 1999). The Eastern Bering Sea may share strong year classes (e.g., 1978) with both the Gulf of Alaska and the western Bering Sea. But strong year classes (e.g., 1982, 1984 and 1989) in the Eastern Bering Sea did not occur in the Gulf of Alaska. And strong Gulf of Alaska year classes (e.g., 1976, 1977, 1979, and 1988) did not occur in the Eastern Bering Sea (Bailey *et al*. 1999).

As discussed in Section 3.2.1.1, Eastern Bering Sea pollock exhibit extensive cannibalism – about 80 percent of the mean stomach contents of adult pollock are composed of age-zero pollock (Bailey *et al*. 1999). Cannibalism is prevalent in other areas, but is noticeably less in the Aleutian Basin and Gulf of Alaska. Pollock make up a higher proportion of all fish in the Eastern Bering Sea than in the Gulf of Alaska. And cannibalism may be higher in the Bering Sea than in the Gulf of Alaska because juvenile pollock make up a high proportion of the available prey distribution for larger pollock (Ianelli *et al*. 2000).

Using stock and recruitment data over a period of nearly 30 years, Wespestad and Quinn (1996) fitted a Ricker spawner-recruit curve indicating strong density dependence in Eastern Bering Sea pollock recruitment. The authors attributed the density dependence to cannibalism of juvenile pollock by adult pollock. According to the model, fishing has little effect on recruitment, unless density dependence is moderate, in which case it is increased by fishing. Yield is enhanced at intermediate population levels. The model further suggests that population oscillations would be greater at high levels of abundance, especially if density dependence is high.

Swartzman and Haar (1983) (in Bailey *et al*. 1999) proposed that the commercial fishery for pollock removed older, cannibalistic pollock, reducing the mortality of juveniles, thereby making them available as forage for fur seals.

Inter-annual environmental variability affects the pollock spawner-recruit relationship by increasing or decreasing the separation of adult and juvenile pollock. Increased separation reduces cannibalism (Wespestad *et al*. 2000). Wespestad *et al*. (2000) propose that passive transport by ocean currents carries eggs and larvae inshore from the spawning areas to inshore areas of low adult pollock density. Increased separation occurs during warm periods, associated with the Aleutian Low. A one-year lag indicates that the effects occur primarily in the first year.

Pacific cod, fur seals, and adult pollock are the main predators of young pollock (Livingston 1993, cited in Livingston and Methot 1997). Livingston and Methot (1997) used the stock synthesis model to incorporate mortality from the three predators in a single-species assessment of Eastern Bering Sea pollock. Cannibalism occurs on age-zero and age-one pollock. Fur seals and Pacific cod prey on age-two pollock, but these species accounted for only a small increment of mortality compared to cannibalism.

An asymptotic spawner-recruit relationship for age-one recruits and declining number of age-three recruits at high biomass highlights the importance of cannibalism on age-one pollock in reducing the number that recruit to the fishery (Livingston and Methot 1997). Factoring in climate effects on transport, as suggested by Wespestad *et al*. (2000), improved predictions. Spawner-recruit modeling with cannibalism increases the number of year-one recruits compared to modeling without cannibalism. In spite of increased age-one recruits with cannibalism, only a slight increase in exploitable biomass occurred, compared to the model without cannibalism.

The Ricker spawner-recruit curve calculated in the 2000 Bering Sea assessment (Ianelli *et al*. 2000) matched very closely to the no-predator curve of Livingston and Methot (1997), and showed a slightly declining recruitment at high abundance. The Ricker spawner-recruit curve can take cannibalism into account to some degree because it allows for density dependence. But cannibalism is not explicit in the 2000 stock assessment.

Neither the Eastern Bering Sea nor the Gulf of Alaska stock assessments use a spawner-recruit relationship in the assessment model. Instead, the assessments use proxies for recruitment. Age-one pollock data from the echo-integration trawl and bottom trawl surveys are included in the Eastern Bering Sea model as an index of recruitment (Ianelli *et al.* 2000). Regression of age-one pollock against age-three pollock indicates a linear relationship used to predict age-three pollock abundance.

The recruitment forecast for the Gulf of Alaska pollock uses five sources, three physical and two biological (Dorn *et al*. 2000). Observed precipitation at Kodiak, the first physical source, is considered a valid proxy for freshwater runoff that contributes to the density contrast between coastal and Alaska Coastal Current water. Greater contrast contributes to eddies and other secondary circulation features beneficial to larval pollock survival.

Estimated wind mixing at 57N-156W, the second physical source, reflects the nutrient mixing into the upper ocean layer. Greater winter mixing brings more nutrients, and provides a basis for a spring phytoplankton bloom. Weak spring winds provide a stable water column that better enables first feeding of pollock larvae. Week advection of ocean water in the vicinity of Shelikof Strait, the third physical source, correlates with good recruitment.

The first biological source, a larval abundance index based on counts of survey catches, correlates with recruitment. The second biological source is the estimated abundance of two-year old pollock. The probability of a weak (average) (strong) year class is calculated for following a weak (average) (strong) year class two years earlier.

3.3.5 Regulating the effects of fishing on non-target and protected species

3.3.5.1 Legal requirements

Several federal laws require fishery managers to act to reduce the adverse effects of fisheries on non-target finfish and shellfish, and on protected species. The most important of these are the M-SFCMA, ESA, and the Marine Mammal Protection Act (MMPA).

The M-SFCMA's National Standard 9 requires that fishery management measures minimize bycatch and bycatch mortality to the extent practicable, and that fishery management plans establish a standardized reporting methodology to assess the amount and type of bycatch occurring in the managed fishery.

Differences in interpretation of the term "bycatch" can result in confusion when processing data and information on incidental catch and discards. While the term is commonly used to describe the incidental take of non-target species in fishing operations, the legal definition of bycatch provided by the M-SFCMA is "fish which are harvested in a fishery, but which are not sold or kept for personal use…[including] economic discards and regulatory discards" (16 U.S.C. 1802, Sec. 3(2)).

Thus, the Act defines as bycatch only the component of targeted and non-targeted catch that is discarded. To avoid confusion here, we use the term "discards" to refer to the portion of catch that is not retained for sale or for personal use, and the term "incidental catch" to describe the take of non-target species incidental to the directed fisheries.

The ESA requires that federal agencies use their authorities to conserve endangered and threatened species, and that they ensure actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of those species or to adversely modify or destroy the habitat designated to be critical to their survival and recovery.

The MMPA prohibits, with certain exceptions, the taking of marine mammals in U.S. waters and by U.S. citizens on the high seas, and requires designated federal authorities to maintain populations of marine mammals at optimum levels, defined as "…the number of animals which will result in the maximum productivity of the population or the species, keeping in mind the carrying capacity of the habitat and the health of the ecosystem of which they form a constituent element."

The NEPA also requires decision makers, like the regional fishery management councils and NMFS, to consider the impacts of their proposed actions on the natural (and human) environment. To comply with this law, fishery managers must consider all possible alternatives to their proposed actions and analyze the consequences of a variety of alternatives. This procedure, as it applies to fisheries management, provides additional information, analysis and opportunity for comment to the public, and applies a much broader scope of consideration than does the fishery management process alone.

The NEPA requires fishery managers to determine whether a proposed action requires preparation of an environmental impact statement, and to prepare one in conjunction with a fishery management plan if needed. The intent of this Act is for decision makers to have the benefit of the environmental analysis in an environmental impact statement before concluding what their preferred alternative might be.

Appendix E provides more information on these and other federal laws affecting fishery management decision making.

3.3.5.2 Managing incidental catches and discards

Fishery managers have taken a number of actions designed to minimize incidental catches and discards in the pollock fisheries. These include placing limits on catches of prohibited species (identified in Section 3.3.5.2.2), implementing requirements for the improved retention and utilization of select species, creating no trawl zones, requiring the use of observers and catch monitoring, and making individual vessels publicly accountable for incidental catches and discards. In addition, the industry itself created cooperatives that slowed fishing substantially, thereby reducing the occurrence of incidental catches and discards.

This aggressive bycatch monitoring and reduction program is the best developed of any federal fishery (NMFS 1998). The Marine Fish Conservation Network, a coalition of conservation, fishing, environmental, and other public interest organizations, reported in a 1999 evaluation of council response to bycatch requirements that the North Pacific system "may be providing a better estimate of total catch than can be found in any other region of the country" (MFCN/CMC 1999).

In comparison, the two other major U.S. groundfish fisheries in the Northeast and Pacific regions have continued to rely on more traditional tools to manage bycatch (e.g., minimum mesh size regulations, gear and area restrictions). And the observer programs in place in the Northeast groundfish fishery and planned for the Pacific groundfish fishery have only a fraction of the coverage provided by the North Pacific's program (Cornish 2001). The failure of fishery managers to adequately manage, monitor, and account for discards in the Pacific and Northeast groundfish fisheries has resulted in lawsuits and court findings that stricter actions are needed.

3.3.5.2.1 Total pollock discards in all fisheries

Catch data on North Pacific fisheries are generally aggregated and summarized/reported by fishery managers on a species-specific basis, as the product of all fisheries operating in a defined management area. The data on pollock catches and discards contained in Tables 5 and 6 and summarized in this section are derived from such summaries. They provide an estimate of the sum total of pollock catches and discards in *all North Pacific fisheries*, including those that target pollock, as well as those that take pollock incidental to the catch of various other target species.

Table 5 provides estimates of total pollock catches and discards in all Bering Sea/Aleutian Islands fisheries from 1990 to 1999. Pollock discards averaged 7.1 percent of the total pollock catch during that ten-year period, ranging from a high of 11 percent in 1991 to a low of 1.5 percent in 1998 (Ianelli *et al.* 2000). In the Gulf of Alaska, total pollock discards as percentage of total pollock catch averaged 7.7 percent from 1991 to 1999, ranging from a high of 14.4 percent in 1992 to a low of 0.8 percent in 1998 (Table 6) (Dorn *et al.* 2000).

The higher values in 1991 and 1992 have been attributed to an increase in the abundance of juvenile pollock, resulting from the recruitment of a 1989 year-class that was the second largest on record (NFPMC 1999a). The lower values in 1998 and 1999 reflect the implementation of the North Pacific Fishery Management Council's Improved Utilization and Improved Retention program, which requires that all authorized catches of pollock be retained for processing (Ianelli *et al.* 2000). Pollock discards have been reduced considerably since the Improved Utilization and Improved Retention program was implemented in 1998. Current discards could be attributed to several different scenarios, as follows.

First, when directed fishing for a species included under the Improved Utilization and Improved Retention program is prohibited, retention of that species is required only up to any "maximum retainable bycatch amount" in effect for that species. Under this rule, vessels that are not authorized to catch pollock must retain incidental catches of pollock only up to a maximum amount defined as 20 percent of their total catch. Pollock captured in excess of this established limit must be discarded.

Second, whole fish intended for the production line may occasionally make their way into the offal produced in factory operations, resulting in unintended losses that are documented by observers as discards.

Third, also documented as discards are losses resulting from uncontrollable events routinely associated with fishing operations, such as gear failure (e.g., pollock that escape through a ruptured cod end) and other accidents (e.g., landed fish washed off the deck by waves) at sea.

Finally, non-food grade fishes, such as fish that are rotted, that contain parasites, or that are otherwise inedible, are discarded, a practice that is authorized by the discard code (personal communication, NMFS Alaska Regional Office, 12-20-01).

3.3.5.2.2 Discards in the directed pollock fisheries

Because catch data are summarized and reported by fishery scientists and managers on a species-specific basis, it is generally not possible to evaluate status and trends on a fishery-by-fishery basis using the information routinely produced in Stock Assessment Fishery Evaluation documents and other reports.

There are exceptions. For example, the Pollock Conservation Cooperative and High Seas Catchers' Cooperative detail on an annual basis both the amount and composition of catch captured and discarded by each Pollock Conservation Cooperative and High Seas Catchers' Cooperative vessel participating in the directed Bering Sea/Aleutian Islands pollock fishery.[21]

Unfortunately, such information is not routinely made available for the fishery as a whole. Consequently, the catch and discards data on the directed Bering Sea/Aleutian Islands and Gulf of Alaska pollock fisheries provided in Tables 7 and 8, respectively, were calculated from blend data provided by the NMFS, Alaska Regional Office upon special request.

While directed pollock fisheries are legally defined as those in which pollock comprise 90-95 percent of the catch (50 CFR 679), in compiling these data on catch and discards in the directed pollock fisheries, the NMFS combined discards from fisheries in which pollock comprised 90-95 percent of the catch *and* from fisheries where pollock represented the predominant species in the catch. So if, for example, the weekly reported catch taken by a vessel that is not necessarily targeting pollock is composed of 35 percent pollock, 30 percent cod, 30 percent flatfish and 5 percent crab, that catch data would be included here as data for the directed pollock fishery. Data represent all discards in these directed pollock fisheries, except those of species identified as "prohibited."

Prohibited species include Pacific halibut, Pacific herring, Pacific salmon, Steelhead trout, King crab and Tanner crab, and must be returned to the sea with a minimum of injury unless previously authorized by the NMFS (NPFMC 1999b).[22] Groundfish species and species groups for which the quotas have been achieved are treated in the same manner as prohibited species (DiCosimo 1998b; Witherell 1997).

Prohibited species catch data are recorded in different units than the above-referenced data, and so are presented separately in Tables 9 and 10. Again, in compiling these data, directed pollock fisheries were defined as those in which pollock represented the dominant species in the catch.

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[21] For more information, see Table 2 in Pollock Conservation Cooperative and High Seas Catchers' Cooperative (PCC and HSCC). 2001. Joint Report of the Pollock Conservation Cooperative and High Seas Catchers' Cooperative 2000. Presented to the North Pacific Fishery Management Council, 31 January.

[22] Participants in the Prohibited Species Donation Program may donate Pacific salmon and Pacific halibut bycatch to economically disadvantaged individuals through a NMFS authorized distributor (NPFMC 1999b).

Table 9 depicts prohibited species catch in the directed Bering Sea/Aleutian Islands pollock fishery; Table 10, prohibited species catch in the directed Gulf of Alaska pollock fishery.

3.3.5.2.2.1 Directed Bering Sea/Aleutian Islands pollock fishery catch and discards summary

Estimated discards of pollock and non-target groundfish species in the directed Bering Sea/Aleutian Islands pollock fishery ranged from 3.78 percent to 1.01 percent of total catch from 1997-2000. Discards have not exceeded 1.10 percent of total catch since the implementation of the Improved Retention/Improved Utilization program in 1998 (Table 7).

During that same period of time, this fishery captured, on average, 0.22 kg halibut per mt of groundfish, 0.025 crabs per mt of groundfish, and 0.067 salmon per mt of groundfish (Table 9). The 2000 incidental catch rate of all three of those prohibited species was either the lowest recorded rate, or tied for the lowest recorded rate, during that four-year period.

The average incidental catch rates of herring, also a prohibited species, are not included in Table 9 because herring discards are reported in a different format. To provide the evaluation team some indication of the fishery's impact on herring, the midwater pollock trawl fishery discarded 1,065 mt of herring in 1997, 750 mt of herring in 1998, 785 mt of herring in 1999, and 482 mt of herring in 2000 (NMFS 2001c).

3.3.5.2.2.2 Directed Gulf of Alaska pollock fishery catch and discards summary

Estimated discards of pollock and non-target groundfish species in the directed Gulf of Alaska pollock fishery ranged from 5.96 percent to 1.14 percent of total catch from 1997-2000 (Table 8). Discards have declined since the implementation of the Improved Retention/Improved Utilization program in 1998, but continue to represent a slightly larger proportion of the catch than do discards in the directed Bering Sea/Aleutian Islands pollock fishery. These higher values have been attributed to the continued use of bottom trawl gear in that management area. In 1999, the rate of pollock discard in the Gulf of Alaska pelagic trawl pollock fishery was 0.4 percent, compared to 0.7 percent in the Gulf of Alaska bottom trawl pollock fishery (DiCosimo and Kimball 2001).

In addition to pollock and non-target groundfish, the directed Gulf of Alaska fishery captured, on average, 0.564 kg halibut per mt of groundfish, 0.009 crabs per mt of groundfish, and 0.222 salmon per mt of groundfish from 1997-2000 (Table 10). 2000 incidental catch rates for all three of these prohibited species were the highest recorded during that four-year period. The cause of this increase has not been formally analyzed.

Herring is also captured incidental to this fishery, but average incidental catch rates for this species are not included in Table 10 because the data needed to estimate those values are not readily available. But those data do exist and may be requested from the NMFS, Alaska Regional Office.

3.3.5.3 Managing interactions with and impacts on protected species

Protected species include animals listed as depleted under the MMPA, or as endangered or threatened under the ESA (See Section 3.3.5.1; Appendix E). These listings trigger actions to reduce the effects of fishing on the recovery of affected species, for example, deterrents to prevent incidental takes of endangered albatross on longlines, or closures around walrus haul-out and rookery areas to keep vessel disturbance to a minimum.

Managers have taken numerous actions designed to minimize the adverse impacts of the Bering Sea and Gulf of Alaska groundfish fisheries on protected species. Mandated gear modifications, avoidance devices, and changes in fishing methods have focused on reducing the incidental mortality of seabirds while fishing with hook-and-line gear (DiCosimo 1998a). And seasonal closures have been implemented to protect walrus (Witherell 1997). A brief discussion of the potential impacts of the pollock fishery on the northern fur seal is provided in Section 3.3.5.3.2.

The Steller sea lion has been the primary focus of regulatory actions affecting the directed pollock fisheries and the subject of intense controversy, particularly over the last decade, culminating in 2000 in a court order enjoining "all groundfish trawl fishing within Steller sea lion critical habitat in the oceans of the BSAI and GOA…as such critical habitat is defined by regulation, until further order of this court" (*AOC v. Daley*, 7 August 2000).

The timeline illustrated in Box 1 provides an extremely simplified overview of the history and procedural status of the Steller sea lion debate. Table 1 details the full procedural history, and shows how complicated the decision process becomes once a species is listed and the requirements of the ESA are overlain upon the already complex fishery management planning process.

Protection under the ESA is triggered by 1) listing of a species as endangered or threatened with extinction, a solely biological decision, and 2) designation of critical habitat. Listing provides for immediate steps toward protection, including bans on killing and harming the animal, or trafficking in the species or products. When a federal agency is taking an action that may affect an endangered species, it must consult with the U.S. Fish and Wildlife Service or the NMFS to ensure that the proposed action will not affect the species or its critical habitat.[23] This is known as a Section 7 consultation.

In cases where the consulting agency finds a conflict between the needs of a listed species and a proposed project ("jeopardy"), that agency must provide "reasonable and prudent alternatives" to the action that will minimize its harmful effects on the protected species. The finding of whether the proposed action is likely to jeopardize the continued existence of the species, and

[23] Of the marine species, NMFS has responsibility for whales, dolphins, porpoises, seals, sea lions, marine turtles, and fishes. The U.S. Fish and Wildlife Service is responsible for seabirds, walruses, sea otters, manatees, dugongs, nesting sea turtles and their hatchlings while on land, and polar bears.

recommended alternatives, if any, are analyzed and presented in a document called a biological opinion, or BiOp.

Contributing to the difficulty of the Steller sea lion case has been the dual role of the NMFS, which finds itself in both the role of the "action agency" and the "consulting agency." The NMFS has stewardship responsibility for protected marine species including Steller sea lions, including the duty to consult with other federal agencies proposing actions that may affect Steller sea lions. In this case, the NMFS also was the agency proposing the action: a total allowable catch quota for walleye pollock, believed to be a prey species for the Steller sea lion, in a fishery occurring in critical habitat.[24]

Further confounding the situation has been the delegation of planning to the North Pacific Council, a body that is arguably advisory to the NMFS, and that had not traditionally taken on the responsibility for recovering depleted or endangered marine mammals, though it had responded in its fishery planning to agency initiatives and requirements aimed at contributing to sea lion recovery.

Beginning in 1991, lawsuits challenging agency science, decisions on catch allowances in the fishery, and compliance with the NEPA and ESA set a tone of conflict between North Pacific Council and agency decision makers, and various stakeholder groups. A large amount of scientific, legal, and regulatory activity was spawned during this period of intense scrutiny and confrontation.

Box 1. Timeline of major Steller sea lion actions

Date	Event	Action
1988	Steller sea lions decline	Listed as depleted
1989	Petition	Calls for endangered listing
1990	Decline continues	Listed as threatened
1990	Section 7 consultation	No jeopardy, TAC proposed
1991	Section 7 consultation	No jeopardy, TAC proposed
1991	Lawsuit	NMFS' no jeopardy decision upheld
1996-1998	Decline continues, reinitiate consultation	Find jeopardy, RPAs limited
1998	EIS issued for alternate TAC levels	Response to RPAs limited to TAC levels
1999	Lawsuit	NMFS overturned, alternatives insufficient
2000	Begin Programmatic Supplemental EIS, do new consultation, issue BiOp	Court finds NMFS' work inadequate, fishery closed; Find jeopardy, new RPAs enter into effect
2001	New BiOp	Find no jeopardy
2002	New RPAs reviewed, recommended, published	Protection measures in place for 2002 fishery

[24] The action also included authorization of the Pacific cod and Atka mackerel fisheries. All three were potential sources of jeopardy or adverse modification of critical habitat for sea lions. The injunction prohibited all groundfish trawling inside critical habitat.

As illustrated in Table 11, multiple versions of documents and actions created a confusing array of information, but no more or less than has resulted from similar high-profile natural resource conflicts. While the burden of responding to litigation has substantial affected the management system, the Steller sea lion controversy has also stimulated a great deal of science, and managerial actions to improve compliance with the array of mandates for which the NMFS is accountable (See Section 4.3.2.2 for a description of initiatives to improve compliance).

Although a federal district court continues its oversight of the process, the situation has stabilized somewhat in the January 2002 publication of measures to protect Steller sea lions, and the 2002 allowable catch specifications.

3.3.5.3.1 Steller sea lion status, science, and regulatory actions

The western population of Steller sea lions (west of Cape Suckling, Alaska) has declined by more than 70 percent since the 1960s and is listed as "endangered" under the ESA. The eastern population of Steller sea lions (east of Cape Suckling) is classified as "threatened," but has shown a stable or increasing trend in abundance over the last two decades (NMFS 2001b). Incidental catch, entanglement of juveniles in commercial fishing gear, intentional shooting, subsistence hunting, nutritional stress, and possibly disease and predation, have all been identified as factors contributing to the documented decline in Steller sea lion populations (NMFS 2001b).

Past regulatory actions taken to reduce the effects of fishing activity on Steller sea lions include limitations on the incidental take of Steller sea lions in commercial fisheries, area and gear closures to protect principal rookeries and haulout areas, precautionary catch limits intended to leave more fish for marine mammals and other predators, seasonal apportionments of the total allowable catch to decrease the chance of localized depletion of prey, and a prohibition on the development of a commercial directed fishery for forage fish. But a 2000 minimum population estimate indicated that the western population of Steller sea lions has continued to decline despite these restrictions. That population numbered about 34,600 sea lions in 2000, compared to 170,000-180,000 sea lions in the 1960s (NMFS 2001b).

The cause(s) of the continued decline of the western stock has been the subject of intense controversy in the past several years, with proposed explanations generally falling under one or more of the following four hypotheses:

- The regime shift hypothesis, which argues that large-scale changes in ocean climate alter the amount and distribution of productivity in ways that affect the availability of forage fish for Steller sea lions;
- The junk food hypothesis, which is an extension of the regime shift hypothesis, and argues specifically that a regime shift has led to a significant decrease in capelin and other high-lipid prey and an increase in pollock and other less nutritious prey for Steller sea lions;
- The predation hypothesis which argues that the removal of large numbers of whales from the North Pacific by whaling fleets in the decades before whaling ended in the late 1970s removed the prey for offshore populations of killer whales, which have now moved inshore and are feeding on sea otters, Steller sea lions, and other marine mammals; and

- The localized depletion hypothesis, which argues that the pollock fishery (and the Atka mackerel and cod fisheries) causes localized depressions in the prey field around Steller sea lion rookeries, haulouts, and other critical habitat.

There is some evidence for each of these hypotheses, reviewed in NRC (1996) and NMFS (2001a, d), but the evidence is either incomplete or inconsistent with other data (NMFS 2000a, 2001a). Thus, it is not possible at this point to state unequivocally that one hypothesis, or combination of hypotheses, should be favored over the others. In fact, the multispecies modeling study carried out by Trites *et al.* (1999) highlights the danger of putting too much weight on any single hypothesis, particularly relatively simple ones that depend on first-order effects.

Despite the lack of certain evidence for or against any of the four major hypotheses, the most recent biological opinion (NMFS 2001b) does restrict the spatial scope of any potential localized depletions, based on the results of recent telemetry studies that track the movement of Steller sea lions during foraging trips. The rapid evolution of knowledge about the relationships among pollock stocks, the pollock fishery, and Steller sea lions is reflected in the series of biological opinions produced by the NMFS over the last few years.

Biological opinions and consultations initiated by the NMFS in 1990, 1996, and 1997 under Section 7 of the ESA concluded that North Pacific groundfish fisheries and catch levels were unlikely to jeopardize the continued existence and recovery of the Steller sea lion or to adversely modify critical habitat (DiCosimo 1998a). The 1998 Biological Opinion concluded that, while there was “no jeopardy” for the Atka mackerel fishery, there was a jeopardy finding for pollock.

In 1999, a federal court ruled that the reasonable and prudent alternatives associated with the 1998 jeopardy finding were arbitrary and capricious because the NMFS failed to articulate a rational connection between the reasonable and prudent alternatives and how they avoided jeopardy (*AOC v. Daley*, 7 August 2000). The court ordered the agency to re-examine the issues in a more ecologically comprehensive way, and called for an expanded environmental impact statement with analysis of a broader array of alternatives than just alternate catch levels. Subsequent attempts by the NMFS to revise the Biological Opinion and reasonable and prudent alternatives for the fishery were rejected by the court, which finally granted an injunction in July 2000 to close the fishery in critical habitat areas.

The NMFS released the new court-ordered Biological Opinion in November 2000, concluding that the pollock fishery (as well as two other North Pacific fisheries) did indeed jeopardize the continued existence of Steller sea lions and adversely modify their critical habitat due to competition for prey and modification of their prey field. The Biological Opinion included recommended reasonable and prudent alternatives to mitigate these effects. In December 2000, the federal district court lifted the injunction barring trawl fishing in critical habitat areas.

Based on the finding of its Scientific and Statistical Committee that the 2000 Biological Opinion was “scientifically deficient,” the North Pacific Council rejected the conclusion that the fishery was the cause of the sea lion decline, and disagreed with the associated reasonable and prudent alternatives (NMFS 2001b). The measures associated with the opinion were considered so “sweeping” by members of the fishing industry that they sought congressional action to delay implementation of the alternatives (Seattle PI article 1/13/01).

Consequently, a congressional “rider,” an addendum to an appropriations bill, was negotiated between Senator Ted Stevens and the White House to provide support for scientific studies, to delay imposition of the reasonable and prudent alternatives for one year, and to prescribe that any reasonable and prudent alternatives would have to be reviewed and implemented via the regional council process in the course of fishery management planning, rather than imposed by the consulting agency.

The Council proposed a suite of Steller sea lion protection measures as alternatives for analysis in a June 2001 Supplemental Environmental Impact Statement. The NMFS considered the majority recommendation (identified as Alternative #4 in the Supplemental Environmental Impact Statement) as the Council’s preferred alternative, for purposes of initiating formal consultation under Section 7 of the ESA (67 FR 5:956-1024).

Informal consultations between the fisheries and protected species divisions of the NMFS concluded that all other listed species occurring in Alaska other than Steller sea lions would not be adversely affected by the implementation of actions recommended under the preferred alternative. Therefore, only the endangered and threatened populations of Steller sea lions were the subject of the formal consultation and draft Biological Opinion issued by the agency in August 2001 (67 FR 5:956-1024).

The 2001 Biological Opinion determined that Alternative #4 met the requirements of the ESA by avoiding the likelihood of jeopardy to Steller sea lions and adverse modification of their critical habitat. In a review of the draft Supplemental Environmental Impact Statement and 2001 Biological Opinion in September 2001, the Council identified Alternative #4 (with several modifications) as its preliminary preferred alternative. Although several other alternatives were considered to have similar or less adverse effects on Steller sea lions, Alternative #4 was approved by the NMFS as meeting both the ESA’s “no jeopardy” requirement and the goals of the M-SFCMA (67 FR 5:956-1024).

The final 2001 Biological Opinion issued in October of that year, after consideration of public comments, concluded that the contribution of the groundfish fisheries to the Steller sea lion decline was likely to be small under the protection measures proposed in Alternative #4. The opinion maintained the earlier finding that these measures were not likely to jeopardize the continued existence of either the eastern or western populations of Steller sea lions, or to adversely modify their critical habitat (67 FR 5:956-1024).

New protection measures proposed by the North Pacific Council under Alternative #4, approved by the NMFS, and implemented in an emergency interim rule published in the Federal Register on January 8, 2002, intend to avoid fishery-related reductions in the abundance of Steller sea lion prey in key local foraging areas. Those affecting the directed pollock fisheries include (67 FR 5:956-1024):

- Area closures for federally permitted vessels fishing between zero and three nautical miles of 39 rookery sites;

- A modified harvest control rule to prohibit directed fishing when pollock biomass reaches 20 percent of its unfished level;
- Closures within 10 or 20 nautical miles of selected haulout and rookery sites to directed fishing in the Gulf of Alaska and Bering Sea/Aleutian Islands;
- Closure of Seguam foraging area and most of the Bogoslof area to all gear types;
- A vessel monitoring system requirement;
- Closure of the Chignik area to pot, trawl and hook and line gears; and
- Modifications to the CDQ program.

Protection measures specific to pollock fishing in the Aleutian Islands area include closure of the subarea to directed fishing for pollock, and closure of the Seguam foraging area to pollock fishing by all gear types.

Protection measures specific to pollock fishing in the Bering Sea area include the establishment of two seasons (40:60 percent apportionment) for the pollock fishery with no more than 28 percent of the annual directed fishing allowance taken from the Steller sea lion conservation area before April 1, continuation of Bering Sea pollock fishery cooperatives established under the AFA, establishment of the Bering Sea Pollock Restriction Area during the A season, and closure of the Catcher Vessel Operation Area to non-CDQ pollock trawl catcher/processors during the B season.

Protection measures specific to pollock fishing in the Gulf of Alaska include distribution of pollock catch evenly over four seasons, closure of directed fishing for pollock in areas that vary from 0-20 nautical miles to 0-3 nautical miles around rookeries and haulouts, and continuation of the NMFS' Chiniak Gully research project to explore the effects of commercial fisheries on pollock abundance and distribution in the Gulf of Alaska.

These measures address competitive interactions between the groundfish fishery and Steller sea lions in several ways. First, modifying the existing harvest control rule will ensure that in the future enough prey resources exist overall and that prey densities are sufficient for Steller sea lions on a large scale. Second, distributing the catch of important prey species over zones of key importance to critical components of the Steller sea lion population and over time will reduce the effects of localized depletion (the reduction of prey resources to a level that decreases the efficiency of a foraging sea lion so that it adversely affects its health or increases its risk to predation).

Finally, prohibitions on fishing in areas immediately surrounding all rookery and many haulout sites and curtailing fishing for important prey species in significant portions of designated critical habitat will relieve competition in areas considered important to Steller sea lion survival and recovery (67 FR 5:956-1024). Figure 11 illustrates areas where pollock and Atka mackerel fishing is restricted following implementation of the emergency rule.

While the majority of these measures are in effect only through July 8, 2002, the NMFS intends to supersede this emergency interim rule implementing 2002 protection measures with proposed and final rulemaking to implement these or similar measures for the remainder of 2002 and beyond (67 FR 5:956-1024).

3.3.5.3.2 Northern fur seal status, science, and regulatory actions

Although the new regulations implemented by fishery managers to protect the Steller sea lion were not deemed to pose a threat to any other listed species, there is concern about possible effects on the northern fur seal, a depleted marine mammal. Nearly 75 percent of the world's northern fur seal population congregates around the Pribilof Islands during the four to six month breeding season. These animals spend the rest of the year in the North Pacific, migrating as far south as California, and west to the Okhotsk Sea and Honshu Island, Japan (Angliss *et al.* 2001).

The northern fur seal population, which is estimated based on pup production, was originally driven to low levels by the practice of harvesting females for pelts. The Alaska population recovered in the 1970s after this practice ceased, but decreased again in the 1980s. Pup production on St. George Island had also been decreasing since the late 1970s. And fur seals were designated as depleted under the MMPA in 1988, at which time the population was estimated at less than 50 percent of what had been observed in the 1950s. This designation means the northern fur seal is classified as a strategic stock, and incidental takes may not exceed a biologically determined level. In the case of fur seals, this level is defined as 17,905 animals (Angliss *et al.* 2001).

Pup production has been relatively stable on St. Paul Island over the last decade, but has generally continued to decline on St. George Island, with the exception of a slight increase in 1996. The current population is estimated at 983,918 animals (Angliss *et al.* 2001).

Six commercial fisheries that could have interacted with northern fur seals, including the Gulf of Alaska and Bering Sea groundfish trawl fisheries, were monitored between 1990 and 1999, with the only mortality occurring in the Bering Sea/Aleutian Islands groundfish trawl fishery. Over this nine-year observation period, the mean annual total mortality was 0.6 animals, or one animal per 1,862,573 mt of landed groundfish (NMFS 2001b). All sources of incidental mortality in fishing operations are considered insignificant (Angliss *et al.* 2001).

Habitat disturbance associated with the rapid development of a new processing plant, harbor basin, fuel tank farm, and other activities on the Pribilof Islands includes nearshore discharge of seafood processing waste, oil and contaminant spills, increased direct human disturbance, and increased levels of noise and olfactory pollution (Angliss *et al.* 2001). Other sources of mortality for fur seals include entanglement in marine debris, intentional killing by recreational or commercial fishermen, and subsistence takes.

Because northern fur seals use juvenile pollock as a prey species, the Supplemental Environmental Impact Statement analyzing Steller sea lion protection measures also evaluated the effect of the five proposed alternatives on northern fur seals, examining incidental take, entanglement in debris, fishery catch of prey species, spatial and temporal concentration of the fishery, and disturbance. The selected Alternative #4 was projected to have insignificant effects for fur seals in terms of incidental take or catch of their prey species, even though the timing of the fishery (from June to October) was expected to increase competition for prey species in fur seal foraging habitat (NMFS 2001b). Because the increased bycatch of small pollock during the breeding season is not expected to affect the fur seal population as a whole, the effect was determined to be insignificant.

Spatial and temporal concentration of the fishery under Alternative #4 was projected to have a conditionally significant negative effect on fur seals. This alternative expands the timing of the fishery from June to October, when fur seals are breeding on the Pribilof Islands. According to the Supplemental Environmental Impact Statement, "while this change slows the pace of the fishery it may also increase the likelihood of localized effects between foraging areas" (NMFS 2001b).

This is important for fur seals because studies have shown lactating females partition their foraging habitat according to their rookery areas, and that seals from one area do not forage with seals from another area (Robson 2001). The conclusion assumes that, if the Eastern Bering Sea fishery is displaced to protect Steller sea lion foraging areas, it will move into summer and fall foraging habitat of northern fur seals, where they would overlap with the fishery and perhaps compete for prey (NMFS 2001b).

3.3.6 Regulating the effects of fishing on habitat

3.3.6.1 Legal requirements

In addition to the ESA provision requiring the identification and protection of habitat determined to be critical to the survival and recovery of listed species (See Section 3.3.5.1; Appendix E), Section 303(a)(7) of the M-SFCMA, as amended October 11, 1996, requires that all federal fishery management plans describe and identify essential fish habitat for the fisheries they manage, that they minimize to the extent practicable the adverse effects on such habitat caused by fishing, and that they identify other actions to encourage the conservation and enhancement of such habitat. Essential fish habitat is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" (16 U.S.C. Sec. 3(10)).

The Final Rule published by the NMFS on 17 January 2000 to implement the essential fish habitat provision interpreted this definition as follows (67 FR 12:2343):

- "Waters" include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate;
- "Substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities;
- "Necessary" means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and
- "Spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle."

3.3.6.2 Managing habitat interactions

The North Pacific Council adopted a Habitat Policy Statement to guide its review of habitat issues as early as 1988. While most of the management measures taken by the Council over the years were intended to regulate the take of target, non-target, and protected species, and to allocate catch among competing user groups, many of those measures do provide indirect protections to habitat in the broader, ecosystem sense.

For example, the tightly controlled catch quotas described in Section 3.3.3 ensure that catches are maintained within biologically acceptable levels. The area closures and bycatch limits described in Section 3.3.5.2 minimize incidental catches and discards of non-target species. And the temporal and spatial catch allocations, as well as the prohibition on the development of a directed fishery for forage fish described in Section 3.3.5.3, reduce the potential impacts of localized depletion, and ensure that important prey species remain available to groundfish, seabirds, and marine mammals (NPFMC 1999c). But the M-SFCMA requires that fishery managers also take direct steps to minimize the adverse effects of fishing gear on habitat.

Though few studies have been conducted in the Alaska region, research conducted elsewhere indicates that several different types of fishing gear may impact the abundance and diversity of groundfish by altering, degrading, and/or destroying the habitats these and other fish depend upon for survival. For example, longline, and other types of hook and line gear, may disrupt rocks, coral, and other bottom structures important to groundfish survival. Pots (or traps), if dragged across the bottom when retrieved, can also damage benthic habitat. Finally, bottom trawls can destroy benthic organisms, damage complex habitats, and alter habitat sediment structure, in addition to smothering suspension feeders and harming larvae by suspending sediments (PFMC 2000). The National Research Council describes the current state of knowledge on the effects of bottom trawling on habitat in its March 2002 report titled *Effects of Trawling and Dredging on Seafloor Habitat*.[25]

The North Pacific Council has implemented several measures that serve to reduce the direct effects of fishing gear on habitat essential to the groundfish and other fisheries. For example, several areas of the Bering Sea and Gulf of Alaska have been closed to groundfish trawling and scallop dredging to reduce potential adverse impacts on king crabs and their habitat, as well as on other benthic organisms. The Council has prohibited the use of bottom trawl gear in the Bering Sea/Aleutian Islands directed pollock fishery. And additional restrictions regulate the size and number of dredges used in areas where scallop dredging is permitted (NPFMC 1999c).

In 1998, the NMFS was sued by a number of environmental and industry groups, including the American Oceans Campaign, the Ocean Conservancy, Oceana, the Natural Resources Defense Council, the Pacific Coast Federation of Fishermen's Associations, and the Cape Cod Commercial Hook Fishermen's Association, and others, for approving essential fish habitat amendments developed by five of the eight regional fishery management councils (including the North Pacific Council) that plaintiffs alleged failed 1) to adequately assess the effects of fishing and gear on marine habitat, 2) to adequately identify or assess potential measures to minimize

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[25] The full text of this publication is available online at http://bob.nap.edu/books/0309083400/html/.

those effects, and 3) to implement practicable measures to minimize those effects (NPFMC 2002b).

The plaintiffs argued that the essential fish habitat amendments, as developed, were arbitrary, capricious and in violation of the M-SFCMA. Additionally, they claimed that the environmental assessments that accompanied the amendments contained an inadequate evaluation of the environmental effects of the proposed actions, that they lacked justification for the agency's findings of no significant impact and, consequently, that the agency's actions were also in violation of the NEPA (NPFMC 2002b).

On 14 September 2000, the U.S. District Court for the District of Columbia rejected the plaintiffs' charge that the North Pacific Council's essential fish habitat amendment violated the M-SFCMA. The court found that the Secretary was reasonable in concluding that 1) the amendment was in compliance with the Act, based on the limited amount of scientific information available at that time, and 2) additional protective measures were not needed, considering both the lack of scientific evidence and the protective measures that had already been adopted (NPFMC 2002b).

But the Court did agree that the NMFS did not meet the requirements of the NEPA and, consequently, that the agency was in violation of the Administrative Procedures Act. As a result, the Council and the agency were prohibited from enforcing the amendment until they prepared a new, more thorough, and legally adequate environmental analysis in compliance with NEPA requirements (NPFMC 2002b).

A settlement agreement finalized almost fifteen months later provides fishery managers with a plan and schedule to improve the analyses needed to effectively meet the essential fish habitat mandate. In particular, the agreement forces managers to more thoroughly examine the impacts of fishing gear on habitat and to re-evaluate management measures that can help to mitigate those impacts (World Catch 2001b).

The NMFS is currently preparing a Supplemental Environmental Impact Statement in accordance with the NEPA for the essential fish habitat components of the Alaska groundfish fisheries. Notification of preliminary alternative approaches for essential fish habitat and habitat areas of particular concern was published in the Federal Register on 10 January 2002 (67 FR 1325).

The Alaska Fisheries Science Center's Auke Bay Laboratory[26] and Resource Assessment and Conservation Engineering Division[27] are currently conducting research to improve scientists' understanding of the direct effects of bottom trawling on habitat and to learn more about life history-habitat associations that may be affected by fishing gear. Researchers are also evaluating technology to determine gear effects and benthic habitat features, and conducting retrospective analyses of spatial and temporal patterns of bottom trawling (NMFS 2002).

[26] See http://www.afsc.noaa.gov/abl/.
[27] See http://www.afsc.noaa.gov/race/default.htm.

The short-term focus of future research will concentrate on documenting the effects of various gear types, including trawls, longlines, pots, and dredges, on a wide range of habitat types, on mapping habitat, and on examining the associations between habitat features, fish utilization, and geological processes. Long-term research will attempt to establish connections between habitat and fish production and population dynamics, and to mitigate the effects of fishing through gear design (NMFS 2002).

3.3.7 Science and data

3.3.7.1 Stock assessment modeling

During the late 1970s and early 1980s, cohort analysis and virtual population analysis became widely used in groundfish assessments, and evolved into generalized catch-at-age models (Deriso *et al*. 1985; Quinn *et al*. 1985) and stock synthesis models (Methot 1991). The synthesis model was the standard groundfish assessment technique for the North Pacific through the mid-1990s (Trumble 1998). Subsequently, stock analysts developed unique variations for pollock (Ianelli *et al*. 2000; Dorn *et al*. 2000).

Currently, stock assessment modeling for the Eastern Bering Sea pollock incorporates catch and age data, bottom trawl data, and echo integration trawl data (Ianelli *et al*. 2000; Stokes 2000). It is considered to be of the highest standard (Stokes 2000) and uses state-of-the-art modeling techniques. In this regard it assures consistency and stability of advice and credibility in science and decision making. The Gulf of Alaska pollock assessment (Dorn *et al*. 2000) is similar to that of the Eastern Bering Sea. Both assessments are updated annually.

Assessment problems in this fishery relate to the poorly understood stock structure as a whole (Bailey *et al*. 1999) (See Sections 3.2.1.3 and 4.1.1.1). Apparently unique stocks and intermingling of the stocks makes attributing catch and catch impacts to the stocks difficult. Some genetic studies indicate low levels of genetic differentiation, while another indicates high variability in the Bering Sea and Gulf of Alaska. Seasonal timing of sample collection may have allowed fish of different populations to mix (Bailey *et al.* 1999), confounding the analysis. Currently, the NMFS is collaborating with scientists at the University of Washington to use microsatellite DNA methods to evaluate the genetic composition of pollock from various regions of the Bering Sea.

3.3.7.2 Data collection

While the stock assessment modeling for the Bering Sea and Gulf of Alaska pollock assessments is acknowledged as world class, any assessment is only as good as the data on which it is based. There exists a tradeoff between the quality of the data and the concomitant level of uncertainty in key information required for the assessment, and the expression of risk in the scientific advice. Poor data and higher uncertainty mean the risk of being wrong is greater, increasing the need for precaution in setting catch quotas and other management measures. It is therefore important that the evaluation team consider in detail the processes and procedures involved in data collection and the extent and quality of the resulting data that feed into stock assessment models.

Age-length data and catch composition are derived from mandatory observer coverage of vessels greater than 60 feet in length (See Section 3.3.7.2.1.2). Age sampling results in a coefficient of variation on the catch-age reconstructions of approximately ten percent, greater than the five percent target, but excellent compared to most catch-age analyses. But there are some problems with the data collection, which are outlined in more detail in the following sections.

3.3.7.2.1 Fishery-dependent data

3.3.7.2.1.1 Catch reporting

All landings are reported, until 1986 through fish tickets, which now serve as a backup for other reporting methods. In 1986, all catcher-processor vessels and motherships were required to report their total catch to the NMFS via radio on a weekly basis. This system continued to 1990, when all processors, both at-sea and onshore, were required to report weekly totals, coinciding with the onset of observer coverage. Radio reports were replaced with faxed reports, email, and, eventually, with instant electronic reporting. Now the catcher-processor fleet reports catches daily and is voluntarily carrying vessel monitoring system units aboard each of its vessels. Regulations will take effect in June 2002 requiring all vessels fishing for cod, pollock, or Atka mackerel to carry vessel monitoring system units. All catches are weighed and counted against the total allowable catch quota.

3.3.7.2.1.2 Observer data

The use of observers on American fishing vessels began in the 1980s as programs developed to meet specific regional needs. The MMPA provides the authority to place observers on fishing vessels if a fishing operation interacts with marine mammals. Such authority is provided by the ESA if fishery management actions require monitoring as part of an incidental take statement or reasonable and prudent alternatives. The M-SFCMA also provides general authority to place observers on fishing vessels in federal waters. In 2001, there were more than 500 observers operating in 15 fisheries, with generally low levels of coverage except in the North Pacific. See Table 12 (Cornish 2001).

The fishing industry covers the $7,000,000 cost of the North Pacific’s observer program, which collects data on the age and size composition of landed catch, as well as on incidental catches and discards, and protected species interactions. Current requirements for North Pacific groundfish vessels and shoreside processing facilities are detailed in Table 13. In essence, pollock vessels have the following coverage requirements:

- Vessels 125 feet (38.1 meters) in length overall or longer must carry at least one National Marine Fisheries Service-certified observer on 100 percent of their sea days;
- Vessels equal to or greater than 60 feet (18.3 meters) in length overall, but less than 125 feet (38.1 meters) in length overall, must carry a National Marine Fisheries Service-certified observer during at least 30 percent of their fishing days; and
- Vessels less than 60 feet in length overall are not required to carry observers.

In addition to this coverage, due to the strict requirements to monitor specific quotas by the CDQ group, each catcher-processor vessel fishing under a CDQ must have motion compensated flow scales, two observers aboard to monitor 100 percent of fishing effort, and a sampling station. Observers also are required to have a minimum of 60 days prior experience and additional training. Vessels operating under the provisions of the AFA have observer requirements that are similar to those operating under the CDQ program, including 100-200 percent observer coverage in the Bering Sea.

3.3.7.2.1.3 Social and economic data

Commentators upon the fishery management system often point out that the system manages people, not fish (Mangel *et al.* 1996). In truth, many of the day-to-day regulatory challenges involve allocating catch among competing user groups who depend upon the fishery for their livelihood. The M-SFCMA recognizes this by providing fishery managers with multiple directives to assess the social, cultural, and economic status and impacts of fisheries. Social and economic data and analyses are needed to satisfy other legal requirements as well, such as those provided by the Small Business Act, NEPA, the Regulatory Flexibility Act (RFA), and Executive Order 12866: Regulatory Planning and Review. Appendix E details the requirements of these provisions.

The NMFS and several state agencies, including the Alaska Department of Fish and Game, the Department of Community and Regional Affairs, the Department of Labor, and the Department of Commerce and Economic Development, gather the data needed to meet these legal requirements. This includes data on vessels, catches, markets, participants, companies, and communities. And social scientists at the NMFS, three economists on staff at the North Pacific Council, scientific advisers, and, sometimes, independent contractors, assist in incorporating these data into the decision making process.

But it is generally widely accepted that the social, cultural, and economic aspects of fisheries and fishery management are not adequately assessed. Data deficiencies are attributed to inadequate funding for data collection and also to laws that prohibit the collection of proprietary information. In addition, the NMFS has an inadequate number of social scientists on staff to conduct impact analyses. And many important aspects such as non-market, non-use, cultural, aesthetic, and existence values are difficult to quantify (The Heinz Center 2000a).

Even so, substantial new information and profiles of fishing communities, participants, and economic returns, included in the Supplemental Environmental Impact Statement prepared for the Alaskan groundfish fisheries by Northern Economics, have improved our understanding of the human component of Alaska groundfish fisheries. And the Draft Programmatic Supplemental Environmental Impact Statement published in January 2001 (even though it has been pulled back to respond to extensive comments) has provided more detail than heretofore available on participants in the fisheries, the impact of fishing employment and income on communities, and the economic contribution of the various groundfish sectors.

3.3.7.2.2 Fishery-independent data

Surveys of demersal resources in the northeast Pacific began in the 1940s with U.S. Fish and Wildlife trawl surveys of the Bering Sea to evaluate king crab resources (Alverson *et al*. 1964). Over the next 20 years, standardized bottom trawl surveys expanded from the Chukchi Sea to waters off southern Oregon, and focused on measuring distribution and relative abundance rather than absolute abundance.

The bottom trawl survey continues to be a primary means of gathering abundance and biological data for pollock and other groundfish. The NMFS has conducted annual Bering Sea surveys on the eastern continental shelf since 1971, and triennial surveys of the outer continental shelf and upper slope since 1979 (Trumble 1998). The Eastern Bering Sea consists of a smooth, flat shelf averaging 740 km wide, and is sampled without roller gear. The rough-bottomed 39 km wide slope is sampled with roller gear.

Triennial surveys of the Gulf of Alaska began in 1984. The Gulf of Alaska has a 5-100 km wide continental shelf with many rough, foul bottom areas difficult to trawl. The untrawlable areas add uncertainty to the biological information collected, to the degree that pollock in the untrawlable areas differ from other pollock.

The Eastern Bering Sea bottom trawl survey is neither random nor stratified, but consists of a well-established standard grid of survey stations sampled using bottom trawl tows with the net on the bottom for 30 minutes. The trawl is a low headrope design used primarily for flatfish. The assessment diagnostics indicate that the survey indices of abundance are good in spite of the semi-pelagic behavior of pollock (Stokes 2000). But the trawl surveys are limited by lack of areal coverage (NPFMC 1999). Budgets and logistics prevent trawl surveys in waters deeper than about 200 fathoms. Portions of deep-water stocks – arrowtooth flounder, Greenland turbot, sablefish, Pacific Ocean perch, and pollock – are not fully sampled. The lack of coverage is partially offset by the detail available from the trawl surveys. The surveys provide an independent estimate of fishery conditions, which are often less biased than fishery-dependent estimates.

From 1984 to 2000, the NMFS' Alaska Fisheries Science Center conducted trawl surveys every three years to assess the abundance of groundfish in the Gulf of Alaska. The frequency of these surveys was increased to every two years beginning in 2001. The survey uses a stratified random design, with 49 strata based on depth, habitat, and management area (Martin 1997). The Alaska Department of Fish and Game has also conducted bottom trawl surveys of nearshore areas of the Gulf of Alaska since 1987. Although designed to monitor population trends of Tanner crab and red king crab, these surveys also sample walleye pollock and other fish. The survey is designed to sample a fixed number of stations from mostly nearshore areas from Kodiak Island to Unimak Pass, and does not cover the entire shelf area (see Blackburn and Pengilly (1994) for details).

The NMFS trawl survey is a multi-purpose survey, with lower than optimal coverage for pollock in nearshore areas that are intensively sampled by the Alaska Department of Fish and Game survey. National Marine Fisheries Service scientists are exploring various methods of integrating state survey data into the stock assessment. Preliminary results suggest that nearshore areas are not being adequately surveyed during the NMFS' bottom trawl survey, but there are many issues yet to be resolved. Since the NMFS time series begins in 1984, prior to the start of the state survey, obtaining a consistent time series of biomass estimates for population modeling may not be possible (Dorn *et al*. 2001).

Whereas bottom trawl surveys assess pollock from the bottom to the three-meter layer of the water column, echo-integration trawl surveys have been used to estimate the abundance of pollock in midwater. In the Eastern Bering Sea, echo-integration trawl surveys have been conducted approximately triennially since 1979 (Traynor and Nelson 1985). During the last decade, six echo-integration trawl summer surveys have been conducted in 1991, 1994, 1996, 1997, 1999, and 2000. In 2000 and 2001, the NMFS conducted winter echo-integration trawl surveys on the Eastern Bering Sea shelf region in addition to the Bogoslof Island region. Echo-integration trawl surveys to assess the biomass of pollock in the Shelikof Strait area have been conducted annually since 1981 (except 1982 and 1999).

In essence, the Eastern Bering Sea echo-integration surveys provide good data for midwater pollock above the range of the bottom trawl. Rather than combining these data with those from bottom trawl surveys to produce a single fishery-independent biomass estimate, the data are used independently as separate relative abundance indices within the population model.

4 ISSUES AND ANALYSIS

4.1 Principle 1: Managing exploitation of target species

Principle 1: A fishery must be conducted in a manner that does not lead to overfishing or depletion of the exploited populations and, for those populations that are depleted, the fishery must be conducted in a manner that demonstrably leads to their recovery.

Section 3.2.1 demonstrates that scientists understand a great deal about the biology and life history of walleye pollock. Thus, in terms of the information needed for traditional, single-species stock management, this fishery is relatively well positioned. The stock assessment modeling described in Section 3.3.7.1 is state-of-the-art. And the conservative exploitation strategy detailed in Section 3.3.4.2 provides fishery managers flexibility to adapt to new information as it becomes available. As a result, this fishery management system has been effective in maintaining its target species at sustainable levels. A summary of stock status and trends is provided in Section 3.3.4.3.

One issue for the evaluation team to consider under this principle relates to current uncertainties about the structure of walleye pollock stocks, and about catches and management in Russian waters (See Section 4.1.1.1). A second issue relates to the use of (or lack of use in the Gulf of Alaska) probability analyses to predict the likelihood that fishing mortality and spawning stock biomass will be maintained within threshold levels under various catch scenarios (See Section 4.1.1.2). The potential implications of the absence of an internationally adopted management strategy for the Donut Hole will also be an issue should fishing be resumed in that area in the future (See Section 4.1.2.2).

As described in the following sections, U.S. fishery managers have generally recognized and responded to the above-identified issues in a conservative way, building precautions into the management system to buffer against the potential impacts of unknowns. Consequently, none of these issues should be considered a major concern or red flag, but rather an area where management could be improved with additional information or analysis.

4.1.1 The fishery shall be conducted at catch levels that continually maintain the high productivity of the target population(s) and associated ecological community relative to its potential productivity

There are three important questions for certifiers relevant to this criterion. First, does the management system accept the criterion? Second, if a strategy to achieve the criterion is adopted, does it work on the ground? And, third, can it be enforced?

National Standard 1 of the M-SFCMA requires that "Conservation and management measures shall prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery for the United States fishing industry" (16 U.S.C. 1851). The term "optimum" is defined as "the amount of fish which a) will provide the greatest overall benefit to the nation, particularly with respect to food production and recreational opportunities, and taking into account the protection of marine ecosystems; b) is prescribed as such on the basis of maximum sustainable yield from the fishery, as reduced by any relevant economic, social, or ecological factor; and c) in the case of an overfished fishery, provides for rebuilding to a level consistent with producing the maximum sustainable yield in such fishery (16 U.S.C. 1802(28)).

The NMFS has interpreted this to mean that maximum sustainable yield is the upper bound on fishing mortality (63 FR 24212; NMFS 1997). The fact that this standard is enforceable in the courts by citizen suits actually reinforces the system. In the North Pacific walleye pollock fisheries, the standard has been implemented by setting the fishing mortality rate at a level that is projected to maintain the spawning stock biomass at a size that is capable of producing at least 75 percent of the maximum sustainable yield (See Section 3.3.4.2).

4.1.1.1 Knowledge of target stocks

Intensive studies dating back more than 20 years have provided fishery scientists and managers with valuable information on the biology and life history of walleye pollock. Extensive and fishery-independent length, weight, and age data exist for this species, as do fishery-dependent catch statistics verified by observer data.

The uncertainties about stock structure described in Section 3.2.1.3 represent the one major unknown currently recognized by fishery scientists (Ianelli *et al.* 2000). The definition and extent of separation of pollock stocks within the U.S. management area will be a topic of interest for the evaluation team. There are several issues to consider in this context.

On the one hand, there is the "real" distribution of unit stocks and other sub-units within the overall distribution of the target stock, the basic characteristics of these stocks and sub-units, and the dynamics of the interactions between them. On the other hand, there is the model of stock structure that is adopted for practical assessment and management purposes, which almost certainly represents a simplification of the real world. Finally, there is the risk to the target stock and wider ecosystem posed by the adopted management approach. There will undoubtedly be differences between the real stock dynamics and the version assumed for management purposes. But do these differences pose a threat to the achievement of management objectives, or do they err on the side of caution?

In general, if there is uncertainty whether a population in a given geographic area is a single stock, but there is evidence of putative "sub-units," then the precautionary approach is to manage those sub-units separately, each in a sustainable manner. This is because managing the aggregate of the sub-units as a single stock can hide the overfishing of a particular sub-unit (Daan 1991) (see Section 4.1.1.1.2). So in the North Pacific it is of relatively lower concern at present, at least in terms of immediate risks to sustainability, whether the Eastern Bering Sea and Aleutian Islands management units are separate stocks, since they are assessed separately, but both in a relatively precautionary manner.

As of the 2000 assessment by the NMFS, the assumed Eastern Bering Sea stock was not overfished, nor approaching an overfished condition (Ianelli *et al.* 2000). It is currently not possible to determine whether the Aleutian stock is overfished or approaching an overfished condition, due to lack of information. But determination of the level of acceptable biological catch is done on a very precautionary basis (see Section 3.3.4.2).

4.1.1.1.1 Transboundary movement

Eastern or western Bering Sea pollock that migrate across or around the Aleutian basin may be fished on both sides of the Bering Sea, thereby experiencing two independent sources of fishing mortality. The extent of exchange between pollock populations in the eastern and western parts of the Bering Sea is of some concern because of the uncertainty about both the condition of the western stock and compliance with management and reporting requirements. Alexey Vaisman has reported incidences of poaching and underreporting of pollock catches in the western Bering Sea (Vaisman 2001). And Russian Prime Minister Mikhail Kasyanov noted that continued poaching remains a serious problem in Russian fisheries (World Catch 2001a).

Catches within Russian waters might cause a reduction in the exploitable biomass and yield of populations within U.S. waters if those catches are composed of a significant number of juvenile pollock that would have recruited to the Eastern Bering Sea exploitable population. The historic level of fishing within the Navarin area (Figure 7) does not appear to have had an adverse impact on the Eastern Bering Sea stock. But the Eastern Bering Sea stock had been at high levels and then decreased to lower levels in recent years (Pautzke 1997). It is possible that the Eastern Bering Sea stock could be impacted at lower stock levels by current fishing practices in the Russian Exclusive Economic Zone.

Uncertainty over the extent of interchange between the eastern and western Bering seas makes it difficult to determine whether fishing in the Russian zone has caused the eastern stock to decline, or whether the eastern stock is perhaps more vulnerable, or both. The pollock catch in the western Bering Sea has declined recently due to overfishing. Unless there is a substantial change (increase) in the movement of pollock from the Eastern Bering Sea to the western Bering Sea, the current level of catch in the western Bering sea is unlikely to have an effect on the Eastern Bering Sea stock. In essence, while it is not a desirable indicator, the decline of the fisheries in the western Bering Sea while the Eastern Bering Sea fishery remains healthy is an indication of stock separation (see discussion of fishing effects on genetic structure below in Section 4.1.3).

Consequently, it is important for the evaluation team to consider the way in which the walleye pollock fishery is managed in Russian waters, and the extent to which this is taken into account in the assessment of total allowable catch quotas and other management measures established for the U.S. fishery. Similar questions caused the U.S. Congress in 1996 to task the North Pacific Council with preparing a report that describes the institutional structures in Russia pertaining to stock assessment, management, and enforcement for fishery catches in the Bering Sea, and that provides recommendations for improving coordination between the United States and Russia. The resulting report (Pautzke 1997) contains important information on the assessment and management of pollock in Russian waters.

Pautzke (1997) reports on differing opinions regarding the extent of interchanges between pollock populations off Cape Navarin and those in the U.S. Exclusive Economic Zone. In the past, regional Russian scientists have expressed the opinion that pollock from the Eastern Bering Sea make a significant contribution to the western Bering Sea (Fedeyev 1990; Shuntov *et al.* 1993). But they also believe that Eastern Bering Sea pollock move to the southeast Bering Sea upon reaching maturity and that the majority of large pollock captured in the northern Bering Sea (along the Convention Line) are of western Bering Sea origin (See Figure 7). Russian scientists believe that the target exploitation rate of 30 percent will prevent overfishing of the Eastern Bering Sea stock.

Wespestad (personal communication to Pautzke 1996) does not believe these assumptions are supportable. Aging techniques have been inadequate and there is a lack of clear distinction in year-class structure within the Bering Sea. Kotenev, deputy director of the Russia's Institute of Marine Fisheries and Ocean Studies in Moscow, has stated on two occasions[28] that he believes there are no Eastern Bering Sea pollock stocks intermingling with Russian stocks off Cape Navarin.

Despite these uncertainties, the precautionary approach suggests that the United States explicitly establish a management regime based on a hypothesis that fisheries in the Russian zone are at times catching pollock that have migrated west from the Eastern Bering Sea stock targeted by U.S. vessels. For example, for some years, a Russian and third party fishery has been concentrated in the northern Bering Sea just to the west of the Convention Line, and Pautzke (1997) also cites concerns over a Russian fishery off Cape Navarin that may be catching juvenile pollock from the Eastern Bering Sea stock.

The declining abundance of pollock in the Russian zone calls for catch restrictions to keep removals compatible with the productivity of the resource. If the Russian pollock management allows fishing above appropriate levels, the U.S. portion of the pollock resource could suffer. Migration of juvenile, and potentially adult, pollock from the U.S. zone to the Russian zone

[28] Personal communication to Pautzke 1997, and at the 12-13 August 1997 U.S.-Russian Bering Sea negotiating session in Washington, DC.

could put U.S.-origin pollock in jeopardy. Large Russian catches in a time of low abundance could increase the absolute amount of U.S.-origin pollock caught in Russia. Such a change in catch patterns would diminish the abundance of juvenile pollock available to migrate back to the U.S. zone. The pollock abundance in the United States could decline below levels that supported historical landings, and would require U.S. managers to significantly reduce the total allowable catch of the U.S. fishery (Pautzke 1997).

4.1.1.1.2 Donut Hole

In principle, source-sink movements of fish are less of a concern than seasonal migrations, at least from the standpoint of sustainability of the target stock. If movements to the Donut Hole are genuinely one-way overspills of adults which subsequently do not contribute to the spawning stock of the population from which they originated, they can be considered to be “surplus” fish, and could be fished intensively without affecting the source population (Wespestad 1993). But two main concerns remain regarding the spillover theories for the Donut Hole.

First, most of the support for the source-sink concept in the Aleutian Basin comes from fragmented and or anecdotal observations (Bailey *et al.* 1999), and these “spillover” theories have been contested. While juveniles are believed to be rare in the Aleutian Basin (Mulligan *et al.* 1989), spawning is known to occur in the central and southeastern parts of the basin (Hinckley 1987; Sasaki 1988; Mulligan *et al.* 1989).

Pollock in the Aleutian Basin are also known to have different length-at-age and fecundity characteristics compared to the fish on the shelf, suggesting they could come from separate spawning populations. Shuntov (1992) and Dawson (1994) have suggested that large numbers of pollock make seasonal feeding migrations from the eastern and western Bering Sea shelves to the Aleutian Basin, so they could not be considered as a sink.

Second, the idea of intensively fishing a spillover population takes into account only the effects on the target stock. Intense fishing may still have adverse effects on bycatch species, and on those species dependent on pollock and non-target species as a source of food.

Another, and perhaps more critical, question for the Eastern Bering Sea management unit is whether the fish concentrations in this area constitute a single homogenous stock, or a heterogenous collection of sub-populations. The concern in this case is that, when several genetically or geographically discrete sub-populations are grouped together within a single management unit, fishing mortality may be poorly estimated. This, in turn, could lead to inaccurate management advice and the risk of inadvertent overfishing on one or more of the sub-stocks (Daan 1991). This is particularly important in the Eastern Bering Sea where there are inter-annual fluctuations in the operation of the fishery in time and space.

4.1.1.2 Reference points

The MSC criteria call for definition of an exploitation strategy set with precautionary reference points (Principle 1, Criterion 1, Indicator 1.1.1.2). Fishery managers can use probability analyses to predict the likelihood that fishing mortality and spawning stock biomass will be maintained within threshold levels under various catch scenarios. Such analyses have been conducted for the Bering Sea fishery, but to a lesser extent for the Gulf of Alaska fishery.

The conservative, tiered approach used by the North Pacific Council to develop catch specifications for walleye pollock and other species is described in Section 3.3.4.2 and Appendix D. Pollock qualifies for Tier 1 management, the least conservative of the five tiers, which the Council uses to set the acceptable biological catch level. But the Council sets the total allowable catch level using the Tier 3 control rule.

The 2001 stock assessment for the Gulf of Alaska (Dorn *et al*. 2001) demonstrated the benefits of this more conservative approach. Low catch rates in the 2001 Gulf of Alaska trawl surveys led to biomass estimates smaller than predicted, and the 2001 assessment showed that the fishery would have exceeded the overfishing rate had total allowable catch been set equal to acceptable biological catch. In response, Dorn *et al.* (2001) proposed a new approach that increases the buffer between acceptable biological catch and total allowable catch at low biomass levels.

Pollock recruitment in recent years has been below average (though highly uncertain) in the Eastern Bering Sea, and short-term projections predict that the mean spawning stock is likely to drop below the $B_{40\%}$ and B_{MSY} levels if fishing occurs at the maximum allowable fishing mortality to set the acceptable biological catch (Ianelli *et al.* 2001). Projections through 2014 predict that mean spawning stock will increase to levels above $B_{40\%}$ and B_{MSY}. Such fluctuations are expected as a result of natural variability. But the mean biomass level does not address the full uncertainty of projected abundance trends.

Ianelli *et al.* (2001) present a cumulative probability analysis for a constant catch of 1,3000,000 mt that predicts that the 2001 abundance will be approximately 140 percent of $B_{40\%}$, with less than a 5 percent probability that abundance will fall below $B_{40\%}$. The analysis predicts that 2003 abundance will exceed 150 percent of $B_{40\%}$, with about a 25 percent chance of falling below $B_{40\%}$. For 2006, the analysis predicts an abundance about equal to $B_{40\%}$, with about a 50 percent chance of falling below that level. The annual management conducted by the North Pacific Council reduces the apparently higher future risk, as the Council annually sets the total allowable catch based on conservative interpretation of reference points.

Ianelli *et al.* (2001) make long-term projections though 2014 at two levels of fishing mortality. At $F_{40\%}$ (the maximum allowable fishing mortality for setting the acceptable biological catch), spawning biomass drops below $B_{40\%}$ and B_{MSY} for a few years. The lower bound of the 95 percent confidence interval stays well below $B_{35\%}$ for the entire projection, indicating that at least a modest probability exists that the actual abundance will fall below $B_{40\%}$. At a more conservative fishing mortality of the most recent five-year average F, the mean spawning biomass does not drop below $B_{40\%}$ at any time in the projection. The lower 95 percent confidence interval approaches $B_{35\%}$ for the entire projection, indicating a lower probability than under $F_{40\%}$ that the actual abundance will fall below $B_{40\%}$.

Dorn *et al.* (2001) provided a preliminary assessment of the probability of exceeding the overfishing level established for the Gulf of Alaska fishery, by sampling from the joint marginal likelihood of spawning biomass and fishing mortality in 2002 using a Markov Chain Monte

Carlo. Analysis of the thinned Markov Chain Monte Carlo suggests that a one-sided confidence region bounded by the current overfishing level definition would be 65 percent if 2002 catch equalled the maximum permissible acceptable biological catch, and 81 percent if the 2002 catch equalled the author's acceptable biological catch recommendation (Dorn *et al.* 2001).

If the catch in 2002 is the same as the authors' recommendation (53,490 mt), there is a 19 percent (i.e., 100-81) chance of exceeding the overfishing level, and a 35 percent chance of exceeding the overfishing level at the maximum fishing rate for 2002. While there is a 19-35 percent probability of exceeding the overfishing level for 2002, an overfishing level of F_{MSY} is conservative, and the use of $F_{40\%}$ as an estimate of F_{MSY} is even more conservative.

While the risk of exceeding the overfishing level in one or two years does not cause much concern for a stock above minimum biomass thresholds, continued fishing above the overfishing level could drive the stock below threshold values. Dorn *et al.* (2001) did not present probabilities of exceeding the overfishing level or of reducing spawning biomass below threshold values over a longer period (for example, the generation time of the pollock resource).

4.1.2 Where the exploited populations are depleted, the fishery will be executed such that recovery and rebuilding is allowed to occur to a specified level consistent with the precautionary approach and the ability of the populations to produce long-term yields within a specified time frame

4.1.2.1 Response to overfishing in U.S. fisheries

As described in Section 3.3.4.3, the Eastern Bering Sea and Gulf of Alaska pollock stocks are neither overfished, nor are they experiencing overfishing. Managers have adopted very low, precautionary total allowable catch quotas for the Aleutian Islands and Bogoslof area fisheries because they are at low levels of abundance. And the United States supports the moratorium on the Donut Hole pollock fishery.

Two groundfish species, Pacific Ocean perch and yellowfin sole, have experienced major overfishing over the course of fishing in Alaska waters. This overfishing occurred during the foreign fishing era. The North Pacific Council had no authority over these species at that time. In fact, the Council did not yet exist. But it subsequently developed a rebuilding program to recover these overfished species. This response to the overfishing of Pacific Ocean perch and yellowfin sole may suggest the type of approach the Council would take should pollock ever become overfished.

Pacific Ocean perch is common in the Gulf of Alaska and Bering Sea, and characterized by a long life span (maximum age of 90 years) and low productivity. This species was severely overfished by Japanese and Soviet fleets in the 1960s. Catches from the Gulf of Alaska increased from virtually zero in 1960 to 350,000 mt in 1965, then declined to around 50,000 mt by 1970 (Heifetz *et al*. 2000). Bering Sea/Aleutian Islands catches showed a similar pattern. The Bering Sea catch peaked at 47,000 mt in 1961; the Aleutian Islands catch, at 109,100 mt in 1965.

The North Pacific Council set conservative catch limits and closed directed catch well below the limits to allow for the incidental catch of Pacific Ocean perch in other fisheries (Heifetz *et al.*

2000). Observer data were used to account for discards. And, over time, the Pacific Ocean perch population recovered. Currently, Pacific Ocean perch in the Bering Sea/Aleutian Islands and Gulf of Alaska are neither overfished, nor are they approaching an overfished condition (Spencer *et al*. 2000). Annual landings of this species are about 15,000 mt for the Gulf of Alaska, 2,000 mt for the Bering Sea, and 10,000 mt for the Aleutian Islands.

Foreign fisheries also overfished yellowfin sole in the Bering Sea during the period 1959 to 1962. Landings dropped from an annual average of 404,000 mt in the late 1950s/early 1960s to an annual average of 50,700 mt through the 1970s (Wilderbuer and Nichol 2000). Since domestic fishing displaced foreign fishing, yellowfin sole and other flatfish have been less desirable than roundfish species. The Council set total allowable catch far below the acceptable biological catch to assure that total landings from the Bering Sea did not exceed the optimum yield. And actual yellowfin sole landings are generally less than the total allowable catch. The 2000 catch represents only 29 percent of the acceptable biological catch and 45 percent of the total allowable catch. Currently, the yellowfin sole is neither overfished, nor is it approaching an overfished condition (Wilderbuer and Nichol 2000).

While neither yellowfin sole nor Pacific Ocean perch is as commercially desirable or abundant as pollock, the recovery of these species demonstrates the conservative approach to fishery management adopted by the North Pacific Council. As previously stated in Section 4.1.1.2, the Council determines the total allowable catch quota for pollock using the Tier 3 control rule, even though adequate information exists to manage pollock as a Tier 1 species. In both cases, the catch rate would decline if the biomass continued to decrease until the biomass reaches a threshold at which the acceptable biological catch equals zero.

Both the Aleutian Islands and the Aleutian Basin pollock stocks are at lower than desired levels. In both cases, the North Pacific Council has set the total allowable catch quota substantially below the acceptable biological catch level (NMFS 2001e).

4.1.2.2 Response to overfishing in the Donut Hole

Pollock stocks have not been restored to the Donut Hole, despite a moratorium on fishing, which has been in place for almost a decade. This indicates that other factors, perhaps predator-prey interactions or oceanographic variables, are affecting the recovery of pollock in this area (Pollock Workshop 2000). A study by Hutchings (2000) reports that, in contrast to the popular perception that marine fishes are highly resilient to large population reductions, many species show little evidence for rapid recovery from prolonged declines.

U.S. fishery managers note that recovering pollock in the Donut Hole will require 1) adequate spawning biomass, 2) good oceanographic conditions, and 3) a reappearance of the pelagic pollock type. What constitutes the first and second items are not known. The Donut Hole stock may currently have a lower probability of returning to pre-harvest abundance than it did during pre-harvest years. U.S. managers hypothesize that Donut Hole pollock occur as a spillover from strong year classes on the continental shelf, consistent with the observation that few of the fish in that area are less than five years of age. Pollock fishing on the shelf will reduce the density of pollock ages five and older, and thereby reduce the probability of year classes that are large enough to result in spillover.

Bailey *et al*. (1999) suggest three sources of pollock in the Donut Hole: 1) a separate stock, 2) stocks intermingling with the shelf populations, or 3) spillover of immigrants from strong cohorts. The Russian Party (2000b) believes that pollock from the Russian zone normally contribute to the Donut Hole, but that little or no offshore movement of pollock from the Russian zone will occur at present or in the immediate future because of the low abundance of Russian pollock.

If pollock stocks in the Donut Hole recover to a level that allows fishing under Pollock Convention policies, a management strategy must be developed for the fisheries in the International Zone. The United States has proposed a management program for the Donut Hole fisheries. That program has received conceptual support. But the details are still under negotiation (personal communication, William Hines, National Marine Fisheries Service, Alaska Region). The proposal requires vessel monitoring systems for participating vessels, observers on vessels, a limitation on numbers of vessels, catches at or below specified catch rates, annual catch levels with individual national quotas, and shared catch data. Other countries will need to agree to a management program to assure precautionary fishing.

4.1.3 Fishing is conducted in a manner that does not alter the age or genetic structure or sex composition to a degree that impairs reproductive capacity

The removal of fish from a population by fishing affects the target species, as well as the ecosystem of which they are a part. The extent of these effects depends on a large number of factors, but the most important of these are the type and intensity of fishing (including exploitation rate), the biological characteristics of the fish (fecundity, growth rates, mortality rates, etc.) and the relationships between target species and dependent and related species. Fishing that targets a portion of the stock can change the demographics of that stock.

As the pollock fishery has matured, it has tended to concentrate more and more in time and space. This also has population, and possibly ecosystem level, consequences. In the Gulf of Alaska, the sea lion protection measures divide the annual pollock quota into four seasons and three large management areas to reduce the impact of fishing. These temporal and spatial allocations are based on the estimated seasonal distribution of biomass. While the goal of these measures is to reduce impacts on sea lions, other ecologically dependent species would also benefit (at least in theory). In addition, the measures would tend to conserve any sub-stock population structure that is not currently known (i.e., local spawning aggregations). A major study on the east side of Kodiak Island is currently examining whether management at this level is sufficient to prevent adverse effects of localized depletion on Gulf of Alaska fisheries. And there are plans to expand this study to the Eastern Bering Sea (Marin Dorn, personal communication, April 2002).

4.1.3.1 Age structure

Intensive fishing on pre-reproductive fish can reduce the reproductive success of a population by preventing enough fish from reaching spawning size or age. The extent to which reductions in numbers of spawning pollock affect the subsequent recruitment to the resource is one of the most important issues in the management of fisheries for sustainable catch and maintenance of ecosystem relationships. Recruitment overfishing occurs when spawning stock biomass is reduced below a threshold level that leaves too few fish to replace the population through natural reproduction.

High catch rates also tend to reduce the average age of fish populations. A shift in the age structure of the population towards younger fish could cause the reproductive success of the population to decline if the younger fish are not as successful at spawning as the older fish. Changes in mean age have been relatively slight compared to interannual variation in mean age for walleye pollock in the Gulf of Alaska (Marin Dorn, personal communication, April 2002). We recommend that the evaluation team examine whether the age structure of the Bering Sea stock has changed in response to fishing pressure.

The North Pacific Council and the NMFS restrict the allowable fishing to a conservative fishing rate (See Section 3.3.4.2). And monitoring by the observer program accounts for the total catch of all sizes of pollock. Thus, conservative management and full accounting of total catch reduce the probability that spawning biomass will fall below threshold values.

4.1.3.2 Sex composition

Female pollock are targeted for roe during the spawning season. In the extreme, targeting female pollock could seriously reduce the spawning potential of the resource. But male and female pollock mix during the spawning season, which reduces the probability that higher harvest rates would occur on females than on males. And, at other times of the year, female pollock have no special value. The North Pacific Groundfish Observer Program collects data on sex composition from the entire pollock catch (before sorting by the fishing crew occurs) so that the NMFS can monitor the sex ratios of the resource. Data do not suggest that changes in sex ratio have occurred.

4.1.3.3 Genetic structure

The U.S. system of assessing and managing pollock on a stock-specific basis reduces the probability that distinct genetic units would suffer overfishing even as the total resource experiences conservative fishing. But if distinct genetic units were smaller than fishery management units, then the genetic composition of North Pacific pollock could experience adverse changes. The relatively small size of the management units and the lack of data to suggest small-scale genetic distinctions keep this probability small.

The most danger to adverse demographic changes comes from pollock fishing in the Russian zone, where compliance with Russian management and monitoring of catches is uncertain. The Russian stocks and catches have declined in recent years. If fishery management in Russia should try to keep catches near current levels as abundance declines, fishing on juvenile pollock in Russian waters originating from the U.S. zone would likely increase.

Some Russians profess that separate Russian populations currently dominate the pollock resource in the Russian zone, and that U.S.-origin pollock contribute little to the Russian catch. To the degree that this assertion is true, Russian fisheries would have little effect on genetically-distinct U.S.-origin pollock. But, if the United States' (and some Russians') position that U.S.-

origin pollock contribute significantly to the Russian zone is true, Russian fisheries could impact U.S. origin pollock by removing pre-recruit pollock.

The U.S. catch strategy that requires a 2,000,000 mt optimum yield in the Bering Sea/Aleutian Islands area results in pollock catches that are far below a conservatively-set acceptable biological catch. This strategy, combined with the annual quota setting based on pollock biomass, minimizes the likelihood that Russian fisheries will adversely impact age, sex, or genetic composition of pollock in the U.S. zone. Enhanced data from the Russian zone made available to the U.S. analysts would help to assure that adverse impacts do not occur.

4.2 Principle 2: Managing ecosystem impacts

Principle 2: Fishing operations should allow for the maintenance of the structure, productivity, function and diversity of the ecosystem (including habitat and associated dependent and ecologically related species) on which fishery depends.

Section 3.2.3 summarizes what scientists know about the physical oceanography, environmental variability, and biological diversity of the Bering Sea/Aleutian Islands and Gulf of Alaska ecosystems. Section 3.3.5 describes the legal requirements for minimizing fishing-related impacts on non-target and protected species that co-occur with pollock, as well as regulatory actions taken by fishery managers to achieve these legal mandates. The legal requirements and actions taken to protect habitat from the adverse impacts of fishing-related activities are detailed in Section 3.3.6.

Significant issues for the evaluation team to consider under this principle relate to what scientists and managers *do not know* about the structure, productivity, and function of these two highly complex and variable ecosystems, and about the ecosystem impacts of removing such a large tonnage of biomass from the system. These knowledge gaps are important because they are directly related to the ability to understand, predict, and manage in response to environmental variability, to sustain the pollock fisheries over the long term, and to maintain the structure, productivity, function, and diversity of the ecosystems on which the fisheries depend.

The following three sections describe critical knowledge gaps and other issues associated with each of the main criteria identified under Principle 2, as well as efforts that are underway to address them. A number of research programs funded by a wide range of agencies are focused on improving knowledge of the Bering Sea/Aleutians Islands and Gulf of Alaska ecosystems, including the effects of climate variability on marine production, habitat, trophic interactions, and the status and trends of non-commercial species. These programs are conducted by universities and research institutes throughout the Pacific Northwest and Alaska, by the NMFS and other government agencies, and, in some cases, by industry.

The evaluation team should consider several key questions when reviewing the status of current scientific research. First, is current research focused adequately on closing critical knowledge gaps? If so, what is the likelihood that this research will successfully fill these information gaps? Second, is current research focused on key hypotheses? If so, are management actions designed to, among other things, help test key hypotheses? Third, what is the timeframe over which research is expected to improve knowledge and has this been factored into management strategies? For example, different management strategies should be adopted if a key uncertainty is expected to be resolved in 1-2 years versus 10–15 years. And, finally, are managers adopting strategies that will help them to decrease scientific uncertainty, and adapting programs accordingly?

4.2.1 The fishery is conducted in a way that maintains natural functional relationships among species and should not lead to trophic cascades or ecosystem state changes

As a preliminary matter, it must be understood that the Bering Sea and Gulf of Alaska are very dynamic ecosystems. Thus, fishery management may have little or nothing to do with variability, and steady state concepts may be inapplicable to ecosystem state changes. Section 3.2.3 provides detail on regime shifts and decadal change.

Fishery managers have incomplete knowledge about the full set of trophic relationships in which pollock are embedded, competition with other species for prey, and indirect effects among species. The influence of oceanographic climate on all these relationships and the patterns and sources of long-term environmental variability create even more uncertainty, as they lead to changes in carrying capacity and in competitor, predator, and prey relationships. It is most likely that such variability does not move around a stable point or mean, or a well-defined cycle, but includes large and sudden shifts in system state and surprise (Scheffer *et al.* 2001). Thus, we have a moving target syndrome in which we may never have the ability to completely characterize and predict the behavior of the system.

There are a number of ongoing efforts to apply the growing understanding of the decadal-scale regime shifts described in Section 3.2.3.2 to the dynamics of higher trophic levels and to interactions among species. These efforts attempt to organize highly variable patterns of species increases and decreases, some of which are almost certainly natural in origin (NRC 1996; NMFS 2001a). Some of their findings are summarized below (see Francis *et al.* (1998) for a review of several of these):

- Parker *et al.* (1995) document strong similarities between the lunar nodal tidal cycle and recruitment patterns of Pacific halibut.
- Hollowed and Wooster (1995), Zheng and Kruse (1998), Rosenkranz *et al.* (1998), Hollowed *et al.* (1998), and Hare and Mantua (2000a) found that recruitment strength of some stocks of marine fish and crabs is correlated with a particular climatic regime, with recruitment generally stronger during El Niño-Southern Oscillation events for gadid species such as pollock, cod and hake. In contrast, salmon and large-mouthed flatfish (e.g., arrowtooth flounder, Greenland turbot, Pacific halibut) responded more strongly to decadal-scale climate regime shifts.
- Quinn and Niebauer (1995) found that high recruitment of Bering Sea pollock populations tended to occur during years of warm ocean conditions.
- Piatt and Anderson (1996) provide evidence of possible changes in prey abundance due to decadal scale climate shifts. These authors examined relationships between significant declines in marine birds in the northern Gulf of Alaska during the past 20 years and found

that significant declines in common murre populations occurred from the mid- to late-1970s to the early 1990s.

- Piatt and Anderson (1996) found that the diet of five seabird species in the Gulf of Alaska changed from one dominated by capelin (late 1970s) to one in which capelin was virtually absent (1988-1991).
- Interdecadal shifts in the northeastern Pacific Ocean ecosystem, particularly in zooplankton biomass and salmon landings, have been of the opposite sign from those in the California Current system (McGowan *et al.* 1998, Francis and Hare 1994).
- NMFS (2001a) documents that the total biomass of commercially fished species in portions of the Gulf of Alaska has increased since 1984, in spite of considerable and concurrent increases in fishing effort, as have the abundances of other, unfished species. Pacific ocean perch, an overexploited species, also rebounded. The primary factor for these increases appears to be environmental, with increased flow around the Gulf of Alaska related to enhanced nutrient supply on the shelf and upper slope areas, and a resultant increase in productivity.
- In addition, there is growing evidence that water temperature is a fairly reliable predictor of abundance for some species, with gadids more abundant during warmer periods and crustaceans such as shrimp and crabs more abundant during colder periods (GEM 2001).

There is also evidence that such large-scale biological responses to decadal-scale climate are not unique to the Bering Sea/Aleutian Islands and Gulf of Alaska ecosystems. For example, changes in abundance in sardine stocks off Japan, California and Peru appear to be synchronized with shifts in climate (Kawasaki 1991). These cycles extend back nearly 2000 years, as documented in paleoceanographic records from deep ocean sediments (Baumgartner *et al.* 1992).

Further, Klyashtorin (1998) has linked catch patterns of Japanese sardines, California sardines, Peruvian sardines, Pacific salmon, walleye pollock, and Chilean jack mackerel with an atmospheric circulation index that similar to the Aleutian pressure index. Pacific herring and Peruvian anchovy, among other species, have a negative relationship to this index.

As a final example, McGowan *et al.* (1998) have linked a variety of long-term biological changes in communities of the California Current system to interdecadal changes in ocean climate and more frequent shifts in community patterns to El Niño occurrences.

The evidence seems clear that changes in ocean climate can have a strong influence on patterns of primary and secondary production and, through them, on higher trophic levels. But, while the broad patterns of primary and secondary production have been documented, it is not clear how these are influenced by physical oceanographic processes, or how changes in productivity impact both individual populations of consumers and larger foodwebs.

For example, it is not yet possible to choose among the plausible alternative hypotheses summarized in GEM (2001; see below) and elsewhere (e.g., Francis and Hare 1994, Francis *et al.* 1998) about the linkages that lead to large-scale shifts in ecosystem state. Nor is it yet clear if the ecosystem periodically returns to a small number of well-defined states or configurations or whether the ecosystem moves over time through a series of unique states. If the former, then it would be useful to better understand the number of states and their characteristics, as well as their return frequency and any leading indicators that could help predict their occurrence. If the latter, it would be useful to know if there are overall boundaries or limits to possible ecosystem configurations and how resilient these are to various possible forcing factors.

In addition, there is evidence that ocean climate can act directly on higher trophic levels through its effects on reproductive success and behaviors related to habitat preference (e.g., temperature). But biological communities are also structured by interspecies interactions involving competition and predation. Despite intensive research, especially over the last several years, scientists studying the Bering Sea ecosystem have not yet determined how all these influences interact.

One attempt to understand species interactions is represented by the NMFS' efforts to develop and apply multispecies models to fisheries management in the Bering Sea and Gulf of Alaska (NMFS 2001a).[29] For example, Trites *et al.* (1999) used the Ecopath and Ecosim models to describe the Eastern Bering Sea in two states: 1) the 1950s, before large-scale commercial fisheries had been established and 2) the 1980s, after many marine mammal populations had declined. They documented major changes in trophic structure and energy flow that could not be completely accounted for by commercial fishing and/or whaling. In addition, the model results suggested that adult pollock and large flatfish might compete with Steller sea lions for food.

The Gulf Ecosystem Monitoring and Research Program (GEM 2001) provides a useful overview of the set of ecological hypotheses that could be applied to efforts to explain and understand patterns of ecosystem change in the Bering Sea/Aleutians Islands and Gulf of Alaska. In brief, these include:

- The match-mismatch hypothesis, which argues that, when environmental conditions change rapidly and the responses of predator and prey populations do not track in parallel, the transfer of energy into higher trophic levels is disrupted.
- The pelagic-benthic split hypothesis, which argues that alternating periods of strong and weak inshore plankton blooms will respectively shunt productivity in the benthic or pelagic compartments of the ecosystem, with consequent changes in community structure.
- The optimum stability window hypothesis, which argues that there is an optimum degree of water column stratification that leads to maximum productivity.
- The physiological performance and limits hypothesis, which argues that changes in abundance and distribution of certain species are direct responses to changes in environmental conditions.
- The food quality hypothesis, also known as the "junk food" hypothesis, which argues that the declines of many higher trophic level species in the last few decades are due to the prevalence of forage species with relatively low energy content.

[29] See also the website of the Resource Ecology and Ecosystem Modeling division of the Alaska Fisheries Science Center at www.refm.noaa.gov/reem/default.htm.

- The fluctuating inshore and offshore production regime hypothesis, which argues that both seasonal and decadal shifts in ocean climate optimize conditions for high productivity either inshore or offshore, but not both, with resultant impacts on higher trophic levels.
- The incremental degradation hypothesis, which argues that the cumulative effects of anthropogenic contamination and habitat alteration have impacted marine populations.

Some of these hypotheses are considered explicitly in Chapter 6 of NRC 1996, Chapter 3 of NMFS 2001a, in NMFS 2001d, and in the research results supporting NMFS 2001b.

The evaluation team should consider how well regime shifts and their implications for biological communities are understood, the ability to separate the impacts of regime shifts from those due to fishing (or describe their interactions), and the ability to detect regime shifts in near real time and/or to predict their future occurrence.

4.2.2 The fishery is conducted in a manner that does not threaten biological diversity at the genetic, species or population levels and avoids or minimizes mortality of, or injuries to endangered, threatened or protected species

Knowledge is also incomplete about the influence on the ecosystem of past and present human activities, particularly whaling and fishing. More and better data are needed to improve our understanding of fishery-related impacts on the environment, particularly on the seasonal distribution and foraging requirements of key prey stocks, the effects of fishing on benthic habitat and diversity, the distribution and taxonomy of non-target species, and on how each of these is affected by natural environmental variability.

One aspect that contributes to the uncertainty about human impacts is the very real possibility that the strength of such impacts, and the ability of the ecosystem to recover from them, may shift over time and space, depending on ecosystem state. While an improved understanding of regime shifts and other sources of variability has permitted such questions to be framed more realistically, they are far from being answered.

The draft Programmatic Supplemental Environmental Impact Statement (NMFS 2001a) and comprehensive Biological Opinion (NMFS 2001d) on Alaska groundfish fisheries recently developed by the NMFS provide a comprehensive analysis of the present knowledge of the effects of Alaska groundfish fisheries on biological diversity and the environment. Although the impacts of fishing can include demographic changes and other effects, this discussion focuses on fishery-related impacts on non-target species, protected species, and essential fish habitat.

4.2.2.1 Evaluating the impacts of fishing on non-target finfish and shellfish

Section 3.3.5.2 provides data on incidental catch and discard trends in the pollock fisheries. The evaluation team should consider several important points when analyzing this information and when evaluating the known effects of pollock fishing on non-target finfish and shellfish.

First, as described in Section 3.3.5.1, the term bycatch means different things to different people. It is important not only to have a clear understanding of the legal definition of bycatch (discards), but also to be aware of how the term is defined by those using it in descriptions of catch statistics and trends. This may require contacting the author of a particular document or dataset when the term is not expressly defined.

Second, the practice of summarizing and reporting catch data on North Pacific fisheries on a species-specific basis makes it difficult to analyze the current status and trends of incidental catch and discards on a fishery-by-fishery basis using the information contained in published reports. That said, the data needed to assess status and trends at the fishery level are available through the NMFS' Alaska Regional Office.

Agency scientists are willing to share data on incidental catches and discards of non-target groundfish upon request. And online catch statistics, including data on the take of other prohibited species, date back to 1993 and, in more recent years, are detailed even down to the individual vessel level. Although not summarized at the fishery level, anyone interested in assessing trends for most prohibited species need only perform a few calculations.

Third, the North Pacific pollock fishery is a complex fishery regulated by a complex suite of management measures. Thus, great care should be taken when analyzing and interpreting both published and raw data on catch and discards. We found agency scientists to be extremely helpful in this regard and we recommend that the evaluation team contact staff at the Alaska Regional Office with any questions regarding interpretation.

Finally, the North Pacific pollock fishery operates at an exceptionally large scale and this should not be forgotten when evaluating and interpreting data on incidental catches and discards. Discard rates have declined substantially over the past decade. Even so, the directed Bering Sea/Aleutian Islands and Gulf of Alaska pollock fisheries discarded a combined total of 13,523 mt of pollock and other groundfish in 2000 (Tables 7 and 8).

On the one hand, this number is remarkably low when considered relative to the total catch of 1,182,219 mt. The directed Bering Sea/Aleutian Islands fishery has reportedly been discarding only 1.1 percent or less of its total catch of pollock and non-target groundfish since 1998. On the other hand, discards still represent about one-half of one percent of the total biomass of Alaska groundfish, which is nearly 25,000,000 mt (NMFS 2001a). The ecosystem impact of those discards remains unknown. The evaluation team should consider whether rates of biomass transfer are adequate data for considering potential food web impacts.

4.2.2.2 Evaluating the impacts of fishing on protected species

Additional uncertainties relate to the impact of pollock fisheries on protected species. The current controversy over the status of the Steller sea lion highlights conflicting views about the strength of the interactions between human activities and ecological processes, as well as the degree to which time lags of varying lengths may be involved. For example, the localized depletion and whaling hypotheses described in Section 3.3.5.3.1 can be seen in part as a distinction between the roles of short and long time lags in the dynamics of the ecosystem.

It is likely that the intensive research underway on sea lion energetics and foraging behavior, the small-scale distribution of pollock and other prey near sea lion rookeries, and the linkages to the drivers affecting larger-scale ecosystem behavior will soon improve scientists' understanding of the relative contribution of the competing hypotheses described in Section 3.3.5.3.1. We therefore recommend that the evaluation team maintain frequent contact with researchers in these areas.

In addition, recent telemetry studies on Steller sea lion foraging patterns (NMFS 2001d) suggest that any interactions with the pollock fishery are more likely to occur in state than in federal waters. To the extent practicable, the evaluation team should include the Alaska state management system in its review, as well as any interactions between nearshore and offshore portions of the stock(s).

Trites *et al.* (1999) demonstrate how research in the area of multispecies modeling can produce counter-intuitive hypotheses that otherwise might not have been considered. For example, one of their models suggests that Steller sea lion populations would be larger if adult pollock and large flatfish were lower in abundance because all three species are significant competitors for the same prey. This feature of modeling efforts is often more valuable than the quantitative predictive value they may have.

We recommend that the evaluation team use the results of this and other related multispecies modeling efforts when considering potential interactions between the pollock fishery and the endangered Steller sea lion populations. In particular, we warn against the danger of presuming that the four explanatory hypotheses outlined in Section 3.3.5.3.1 represent the complete set of viable hypotheses to be considered.

4.2.2.3 Evaluating the impacts of fishing on habitat

Section 3.3.6.1 describes the legal requirements related to regulating the effects of fishing on essential fish habitat. Actions taken by fishery managers to meet this legal mandate are described in Section 3.3.6.2. A September 2000 court opinion concluded that the existing measures implemented by the North Pacific Council are sufficiently protective given the current status of data and information, but that the NMFS violated the Administrative Procedures Act by approving the North Pacific Council's essential fish habitat amendment without an adequate NEPA analysis (NPFMC 2002b). We recommend that the evaluation team monitor the agency's progress in addressing this deficiency through the preparation of a Supplemental Environmental Impact Statement, which is currently under development.

4.2.3 Where exploited populations ("impacted populations of species other than the fishery target species") are depleted, the fishery will be executed such that recovery and rebuilding is allowed to occur to a specified level within specified time frames, consistent with the precautionary approach and considering the ability of the population to produce long-term yields

Fisheries generally have unavoidable direct (e.g., incidental catches) and/or indirect (e.g., food web impacts associated with biomass removal) impacts on non-target species that co-occur with target species. These impacts can be significant, particularly when an affected non-target population is depressed for any reason, as is currently the case with some populations of red king crab and tanner crab, salmon, and with Steller sea lions.

Section 3.3.5 describes regulatory actions implemented in the pollock fishery to minimize both direct and indirect impacts on non-target finfish and shellfish and to assist the NMFS in achieving its Steller sea lion recovery goal "to promote recovery of the Steller sea lion population to a level appropriate to justify removal from ESA listings" (NMFS 1992).

Although several other alternatives were considered to have similar or less adverse effects on Steller sea lions than the Council's preferred alternative #4, that alternative has been approved by the NMFS as meeting both the ESA's "no jeopardy" requirement and the goals of the M-SFCMA (67 FR 5:956-1024).

The alternative chosen was examined not only in relation to its ability to avoid jeopardizing the Steller sea lion and to aid in the recovery of that species, but also in relation to the effects (including cumulative) it would have on other aspects of the ecosystem, including marine mammals, seabirds, commercial and forage fish species, non-commercial shellfish and invertebrates, habitat, and ecosystem relationships. The NMFS concluded that the chosen alternative had the least negative effects on the most affected resources, though recognizing its potential to have a "conditional significant negative" effect on northern fur seals.

The purpose of an environmental impact analysis is to inform the decision maker of the alternatives and possible consequences of an array of alternatives. The choice of Alternative #4 was made with consideration of the effects on northern fur seals. The tradeoffs often made to meet the multiple statutory mandates described in Appendix E have long been a point of contention in marine fishery management. When evaluating the effectiveness of fishery management measures in fulfilling the requirements of individual statutes, the evaluation team should consider the broader context within which such regulations are developed. Meeting such a wide range of legal mandates generally necessitates a certain degree of compromise.

4.3 Principle 3: The management system

Principle 3: The fishery is subject to an effective management system that respects local, national and international laws and standards and incorporates institutional and operational frameworks that require use of the resource to be responsible and sustainable.

Section 3.3 describes a management system for Bering Sea and Gulf of Alaska pollock that, over its 20-year history, has maintained the population of the target species while providing the largest catches and income of any American fishery. The fishery operates under a management plan and regulations devised within the framework of the M-SFCMA, with its ten National Standards, the stakeholder process provided by the North Pacific Fishery Management Council, the procedural requirements of U.S. administrative law, and more than 30 years of conservation policy embodied in U.S. environmental law. These elements form the basis of a management system that fits within the global framework for fishery management and contains most of the elements called for as best practices.

Principle 3 calls for a management system that respects local, national and international laws and standards. In the context of international standards, the pollock management system compares favorably to the U.N. Convention on the Law of the Sea, the global Code of Conduct for Responsible Fisheries, and the U.N. Straddling Stocks Agreement.

For example, Articles 5 and 6 of the U.N. Straddling Stocks Agreement and Articles 6 and 7 of the global Code of Conduct call for long term measures based on the best available scientific evidence, prevention of overfishing, application of the precautionary approach, environmental impact assessment, protection of related species in the ecosystem, protection of biological diversity, consideration of artisanal and subsistence use, a transparent and accessible system and information, data collection, promotion of scientific research, and enforcement.

In an annex elaborating the precautionary approach, the U.N. Straddling Stocks Agreement calls for reference points and catch strategies of the type that are included in the pollock fishery management plan. Compare, for example, the catch specifications described in Section 3.3.4.3 with Annex II (7), which states, "The fishing mortality rate which generates maximum sustainable yield should be regarded as a minimum standard for limit reference points. For stocks which are not overfished, fishery management strategies shall ensure that fishing mortality does not exceed that which corresponds to maximum sustainable yield, and that the biomass does not fall below a pre-defined threshold."

Similarly, Article 7.6.9 of the global Code of Conduct for Responsible Fisheries calls for "appropriate measures to minimize waste, discards, catch by lost or abandoned gear, catch of non-target species, both fish and non-fish species, and negative impacts on associated or dependent species, in particular endangered species," and then proceeds to describe measures that are comparable to efforts in the pollock fisheries to reduce bycatch and discards and to avoid prey competition with Steller sea lions (see Sections 3.3.5 and 3.3.6).

Although the framework is there, the system has not operated or been implemented entirely without challenge or controversy. The Steller sea lion case history set out in Box 1 describes one example where the system was slow to respond to legal requirements provided by the NEPA and ESA, and to public interest concerns about ecosystem effects, and where the council process was not adequate for integrating multiple statutory mandates.

Significant issues for the evaluation team to examine under this principal relate to the degree of confidence in stock assessments, the availability, use, and integration of ecosystem information, the way the system deals with uncertainty, especially about ecosystem effects beyond the target species, and about fishery activity and management outside the U.S. Exclusive Economic Zone, and the vulnerability of the U.S. fishery management system to political and legal challenge.

Critical knowledge gaps that make it difficult for the management system to respond to these issues include the inherent uncertainty of stock assessments, the developing state of ecosystem-based approaches to fishery management that might provide a framework for integrating non-fishery data, and a lack of information about management, operations, and catches in Russian waters, including lack of understanding of stock structure among the various pollock stocks. Another important knowledge gap is one that does not fall in the category of scientific knowledge, but in the realm of managerial "know-how." It is in this area that many of the political and legal challenges arise because managers have not followed key procedural steps or have not engaged in the kind of communication and teamwork that would raise key issues before critical decision points in the process.

The following sections summarize these issues under the rubric of MSC sub-criteria 1-5, as published in *Bering Sea/Aleutian Islands and Gulf of Alaska Pollock Fisheries Evaluation, Revised Performance Indicators and Scoring Guideposts for MSC Principles*, February 2002.

4.3.1 The management system has a clearly defined scope capable of achieving MSC Principles and Criteria and includes short and long-term objectives, including ecosystem objectives, consistent with a well managed fishery

4.3.1.1 Objective-setting

Objective-setting is one of the most often criticized elements of the U.S. fishery management system. The National Research Council and others have cautioned that it is critical to have all stakeholders participating in the process to develop objectives for a fishery. The Heinz Center (2000a) points out that fishery management councils rarely take time to set objectives and are too burdened to do more than react to short-term problems. These and other sources advocate developing concrete, measurable objectives that go beyond biological measures, and that would incorporate the kind of planning that takes community, cultural, societal, and economic goals into account as well.

The pollock fishery management plans have included goals and objectives since the outset of the fishery (See Section 3.3.2), and those goals extend beyond just the target species and the economic benefits of their yields. Most of the biological goals, and many of the social and economic goals, have measurable objectives.

The North Pacific Council, like other councils, has only recently begun to examine goals that would accomplish alternative policies to sustainable fishing, economically viable fishing communities, and other such fishery-centric goals. For example, in recent actions to revise the Programmatic Supplemental Environmental Impact Statement (see below), the Council and the NMFS are spending time analyzing an array of objectives ranging from those that would accomplish solely ecosystem protection objectives to those that would achieve fishery maintenance targets. Fishery management council consideration of goals and objectives that are not directly related to fish, fishing, and fishing communities is a new area of endeavor, and one that recognizes a stewardship role beyond fishery management and allocation. The North Pacific Council is one of the first venturing into this arena.

Another area where objective-setting could be improved is in how planners make use of ecosystem-based approaches, and how they incorporate ecosystem objectives into fishery management plans. Several recent reports are contributing to efforts to begin this process, and ecosystem-based approaches are being tested in a few specific regional sites. An emerging consensus among scientists and managers is that moving toward ecosystem-based fishery management will require a series of incremental steps, not the least of which is refining and improving single-species management and habitat protection (Sissenwine and Fluharty 2002).

Livingston (2001) reports that the North Pacific Council has been reviewing broader, ecosystem-level information since 1994, when a new Ecosystem Considerations chapter was added to the groundfish Stock Assessment and Fishery Evaluation Report. Originally, this chapter contained summaries of recent ecosystem research, including objectives for ecosystem-based management, as well as status and trends information on protected species.

Several years ago the NMFS suggested that the content of this chapter be standardized and that it include information on the status and trends of the physical oceanography and climate, biological oceanography, habitat and effects of fishing research, marine pollution, predator-prey interactions, forage fish and other non-target species, and marine mammals and seabirds, as well as discussion of the possible factors affecting trends.

As described by Livingston (2001), the two-part purpose behind this suggestion was to "1) bring the results of ecosystem research efforts to the attention of stock assessment scientists and fishery managers in order to provide stronger links between ecosystem research and fishery management, and 2) bring together many diverse research efforts into one document, which would spur new understanding of the connections between ecosystem components and the possible role that climate, humans, or both may have on the system."

The NMFS and the North Pacific Council are currently working together to expand the chapter on Ecosystem Considerations to include ecosystem status and trends information, and management indicators. Future work will focus on developing more quantitative management objectives and ecosystem indicators that will trigger pre-defined management actions. Current scientific research in this area will be critical to the Council's ability to develop the practical means to incorporate ecosystem considerations into fishery management decision making. The Council's Ecosystem Committee has been charged with helping with this challenge (Livingston 2001).

Recommendations on principles of ecosystem management include recognition of the unpredictability of natural systems and the need to build buffers into social institutions and management plans to provide insurance against uncertainty.[30] The NMFS has convened a task force to propose guidance for fishery managers on implementing ecosystem-based approaches. That work is expected to be complete this summer (Dieter Busch, NMFS Office of Habitat Protection, personal communication, January 2002).

4.3.2 The management system recognizes applicable legislative and institutional responsibilities and coordinates implementation on a regular, integral, and explicit basis

This area is one where the management system is most vulnerable to challenge and where significant improvement can be made. The integration of multi-disciplinary scientific information, an array of legal mandates and operational deadlines, and management practices cannot be ignored as major contributing factors to recent challenges to the management of this fishery. The present shifting legal status of the groundfish fisheries, and the fact that a federal court has retained jurisdiction over resolution of issues raised in *AOC v. Daley* clearly

[30] See NMFS 1999: Ecosystem-Based Fishery Management: A Report to Congress by the Ecosystem Principles Advisory Panel. April. Available online at http://www.st.nmfs.gov/st2/Eco-bas-fis-man.pdf.

demonstrate that the management system is not "consistently in compliance with all substantive and procedural aspects of applicable domestic law." The main problems arise in the way the system is implemented, specifically within the operations of the NMFS and the North Pacific Council:

- The relationship between the NMFS and the North Pacific Council;
- Integration of information and management authority among line offices within the NMFS; and
- Communication and integration among NMFS headquarters, the Alaska Fisheries Science Center, and the Alaska Regional Office.

The General Accounting Office, the Office of Management and Budget, the Council on Environmental Quality, a Senate appropriations subcommittee, several internal National Marine Fisheries Service reports, and the National Academy of Public Administration, all have pointed out problems with the NMFS' compliance with the NEPA and with ESA consultations. Criticisms are that:

- Managers do not view conservation and procedural statutes as tools that can assist agency decision making and strengthen its ability to withstand public and legal scrutiny;
- Managers have not made NEPA analysis or ESA consultation a priority;
- Organizational structure and chain of command (science centers, line offices, regional offices) have traditionally been flat, decentralized and regionally independent, making compliance with legal mandates, cohesive policy-setting, supervision, and oversight difficult;
- The decision process and review of decisions is confusing and inconsistent and lacks concrete guidance, deadlines, and policies. Attempts to recommend improvements, such as charter and other advisory teams, remain "on the shelf;" and
- Personnel (in number and training) and fiscal resources are inadequate to the demands of multiple mandates and procedural requirements.

The controversy surrounding council and agency actions related to ESA consultation on Steller sea lions is an example of what occurs when these circumstances combine. Information on Steller sea lions was not brought into fishery management deliberations prior to decision making, nor was there any of the kind of iterative "consultation" anticipated by the ESA process, where the acting agency and consulting agency can discuss ideas and options.

When the conclusions of the review by the agency's protected resources scientists were released in the November 2000 Biological Opinion, the analysis and the proposed measures were a surprise. The conclusions contained in the opinion also raised legitimate questions, and were ultimately deemed unacceptable by the North Pacific Council and the fishing industry.

Under conventional circumstances, no federal agency proposing an action that would affect endangered species - let alone an advisory body with only quasi-regulatory authority - would be able to outright reject the advice of the consulting agency in a Section 7 situation. In this case, some constituents of the council - the fishing industry - took matters into their own hands and sought legislative relief from what they saw as onerous restrictions on the fishery.

The resultant appropriations rider bought a year of time for studies, stakeholder discussions, and collaborative development of alternative approaches to avoiding jeopardy in the fishery. But it cannot be denied that the rider circumvented the ESA by prescribing that any sea lion protection alternatives would have to be reviewed and implemented via the regional council process in the course of fishery management planning, rather than imposed by the consulting agency as reasonable and prudent alternatives under the ESA.

The NMFS is currently developing a report to Congress that will detail the agency's plans for improving compliance with the NEPA, ESA, and other substantive and procedural requirements. Support for improving performance has been forthcoming in special appropriations for additional staff, training, and special projects related to developing programmatic environmental impact statements. The North Pacific Council and agency managers in Alaska and Seattle who are working on the groundfish fisheries have undertaken offered training, and are continuing efforts to improve NEPA compliance and other means to better integrate information and conservation mandates into fishery management decision making.

4.3.2.1 Consultative Process

The North Pacific Council operates under requirements in U.S. law for public participation and stakeholder involvement. The M-SFCMA requires knowledgeable persons to serve on the councils, and provides for advisory panels, public meetings, public hearings, and minimum notice requirements. In addition, federal laws regarding open meetings, notice and comment rulemaking, and other aspects of administrative procedure assure access to information, documents, and decision making processes.

Fishery management plans are considered a major federal action that triggers preparation of an environmental assessment and potentially an environmental impact statement. Preparation of these decision analysis documents also has requirements for public scoping, notice, and comment. See *Fishing Grounds* (The Heinz Center 2000a) for a detailed discussion of the participatory process in U.S. fishery management.

The fishery management council process is open and participatory and provides a forum for all interested and affected parties. But the regional fishery management councils in general, and the North Pacific Council in particular, have been criticized for perceived conflicts of interest, voting self-interest, vote trading, and lack of diversity of members. Much of this is attributable to the statutory framework under which council members are appointed, including exemption from federal conflict of interest rules applicable to most other comparable decision making bodies, and the political nomination and selection process that creates the councils.[31] Today the North Pacific Council composition includes one federal manager, three state managers, a recreational representative, an independent environmental

[31] See *Managing U.S. Marine Fisheries: Public Interest or Conflict of Interest*, World Wildlife Fund (1995); Mhyre, W. "The Law of Unintended Consequences," in *Conserving America's Fisheries*, Proceedings of a National Symposium on the Magnuson Act, March 8-10, 1993, New Orleans, LA (1994).

consultant, a trawl and longline industry representative, an academic, a shoreside processing industry representative, a small boat representative, and an Alaska Native representative.

4.3.2.2 Responding to stakeholder concerns and legal mandates

The objectives and interest of non-fishing stakeholders are not always accounted for in the regional council process. Procedural avenues such as public hearings, comment periods, and public testimony provide opportunities for many diverse views to be expressed. But, over the history of the North Pacific Council, the views of fishery participants have generally defined issues for discussion (WWF 1994). In addition, social and economic impacts on fishing communities are by law an integral consideration in fishery management planning.

The regional councils play a major role in framing fishery management decisions, but have not historically seen their role extending to conservation or to the recovery of affected species that are not fishing targets. The NEPA, one of the procedural tools the system provides to stakeholders, is intended not only to broaden consideration of the alternatives and impacts of federal decision making, but also to engage a broader segment of the affected public.

The delegation of important policy making and decision analysis responsibilities to the regional councils was intended to get them to use the NEPA process in conjunction with the M-SFCMA to consider alternatives and impacts early on. In practice, this delegation of authority has at times constrained the NMFS' ability to respond effectively to its full range of mandates, including the protection of endangered species. Much of the litigation the agency has had to deal with in the past several years, including *AOC v. Daley's* specific challenge to the pollock fishery, has been about just such procedural infirmities in the decision making process.

Just as litigation has forced other resource agencies over the past decade to recognize the broader public interest in natural resources and to reform their decision making processes to better balance conservation and use, the current situation suggests that the public is holding the NMFS accountable for the broader set of environmental and resource values codified in the NEPA, ESA, and other statutes besides the M-SFCMA. The NMFS' institutional culture has traditionally put fishing first. The agency has not until recently made NEPA analysis or ESA consultation a priority in its scientific and policy work. But this is beginning to change.

In response to criticism by the federal district court that its environmental analysis process was inadequate and that the underlying environmental impact statement for the North Pacific fisheries was outdated, the NMFS undertook preparation of a Programmatic Supplemental Environmental Impact Statement. The document of more than 3000 pages was released in January 2001, and managers responded to stakeholder requests for additional review time, extending comment periods three times during the summer of 2001. After receiving more than 20,000 public comments on the document, which set out an array of alternatives for managing the groundfish fisheries and for protecting Steller sea lions, the agency in November 2001 withdrew the analysis for further work on proposed alternatives.

At a meeting of the North Pacific Council in early February, the agency presented a proposal for additional alternatives to be analyzed. The new approach includes examination of an array of competing goals and objectives, including goals that have only ecosystem protection or endangered species recovery objectives, goals that have fishery objectives, and goals that have combinations thereof. Discussion with council and stakeholders at the meeting resulted in modifications and a set of seven very different policy goals, with measurable objectives. Alternatives and consequences under each of the scenarios will be analyzed in the revised Programmatic Supplemental Environmental Impact Statement.

4.3.3 The management system includes a rational and effective process for acquisition, analysis, and incorporation of new scientific, social, cultural, economic, and institutional information

4.3.3.1 Biological data

Various independent trawl and acoustic survey programs collect biological data in the Bering Sea and Gulf of Alaska (see Section 3.3.7.2.2). These are supplemented with data collected through the fishery observer program.

The North Pacific Council requires observers on large- and medium-sized vessels that fish for groundfish in waters off Alaska (See Section 3.3.7.2.1.2; Table 13). Vessels longer than 125 feet must carry observers during all fishing operations, and vessels from 60 to 125 feet must carry observers 30 percent of the time. This observer program is the only one of its kind in any U.S. fishery (see Table 12). But improvements could be made related to coverage and the hiring process.

Under North Pacific Council requirements, vessels obtain observers directly from private observer companies. While the NMFS certifies observers that have passed training, it has no role in selecting or distributing observers to vessels. Direct contracting of observers by vessels presents an opportunity for vessels and observer companies to select observers “satisfactory” to a vessel. In the extreme, this could result in observers benefiting the vessels by not performing all duties with due diligence.

Observer coverage of vessels in the 30 percent coverage category is not random at the vessel level. An independent review carried out in 1999/2000 (MRAG Americas 2000) indicated that this has the potential to introduce unknown bias into the dataset. The review cited a high likelihood of differences in vessel behavior between observed and non-observed vessel days, both in terms of fishing patterns and compliance with management measures.

In addition, while the 30 percent coverage level may provide sufficient coverage for routine sampling, it may not provide enough spatial and/or temporal coverage for special scientific programs (e.g., otoliths, stomach contents sampling for ecosystem studies). A further problem may be that less observer coverage may result if there is increased participation in the fishery by smaller vessels (i.e. those not requiring 100 percent coverage) as a result of the AFA.

The review recommended the development of a mechanism under which the NMFS has direct control over coverage levels, timing, and placement of observers, to ensure that bias is not introduced through non-random selection of vessels and periods for observer coverage. To date, this recommendation has not been implemented.

An important function of the observer program is to collect data on discards. Significant quantities of pollock are discarded (See Section 3.3.5.2.1; Tables 5 and 6) and must be taken into account in estimation of population size and forecasts of yield. Observer length frequency observations indicate that discarded pollock include both large and small pollock. Since observers usually sample the catch prior to discarding, the size distribution of pollock sampled closely reflects that of the actual *total* catch. Discard data compiled by the NMFS Alaska Regional Office have been included in estimates of total catch since 1990 (Ianelli *et al.* 2001).

4.3.3.2 Social and economic data

The paucity of social, cultural, and economic information available to fishery managers is as well recognized as the critical need for such information. The two bodies chartered under the Federal Advisory Committee Act to provide advice to the National Oceanic and Atmospheric Administration (the Marine Fisheries Advisory Committee and the Science Advisory Board) called for increased capacity in the social sciences in separate reports to the U.S. Secretary of Commerce in 2000.

Of the approximately 2,680 people employed by the NMFS in 2000, just 34 were economists, and only three were non-economist social scientists (i.e., anthropologists) (McCay 2001). Yet much of the decision analysis required in fishery management planning by the M-SFCMA, NEPA, and Executive Orders - and in devising reasonable and prudent alternatives under the ESA - requires assessing and balancing environmental considerations with social and economic considerations.

In addition to the lack of assessment and analysis, it is difficult to acquire many types of economic information, including sales and income information. For example, statistical information on U.S. fisheries does not include proprietary economic information because laws protecting business interests restrict collection of such data. Data on non-market, non-use, cultural, aesthetic, and existence values are generally a low priority, and these social aspects of fisheries are difficult to measure (The Heinz Center 2000a).

One of the most difficult continuing issues for the North Pacific Council and managers of the Bering Sea/Aleutian Islands and Gulf of Alaska groundfisheries is the question of effort reduction, an issue driven entirely by social and economic concerns. As described in Section 3.1, government support to develop U.S. fishing and processing capacity contributed to rapid growth. By the time the fishery was completely Americanized, it was already overbuilt. The excess capacity manifested itself in the historical rivalry between onshore processors in Alaska and offshore processors. This geographic/political conflict played itself out in the onshore/offshore allocation battle, which eventually divided the total catch, but left both sectors with more catching and processing capacity than necessary to take the total allowable catch.

A license limitation put in place in 1995 did stop new entrants from coming in the fishery, but did little to reduce the fishing power already in the Bering Sea and Gulf of Alaska, or to stabilize ownership.

The advent of cooperatives and the passage of the AFA have changed the trawl sector of the pollock fishery considerably (See Section 3.1). Other sectors, such as the crab fleet and the groundfish fleet in the Gulf of Alaska, are examining cooperatives for their fisheries. Inshore cooperatives are authorized by the AFA, but have only been organized or operating less than a year.

Another legislative initiative to craft a similar buy-out for crab vessels in the Bering Sea is a response to the continuing moratorium on the development of individual fishing quota programs. Although originally set to expire in 2000, Congress has yet to act on legislation that would specifically amend the M-SFCMA to address the parameters under which quota programs would be allowed. This limits the tools available to fishery participants and managers to address capitalization problems.

4.3.4 <u>The management system applies information through implementation of measures and strategies (by rule or by voluntary action of fishery) that demonstrably control the degree of exploitation of the resource in the light of the natural variation in ecosystems</u>

Management measures in the Alaska groundfish fisheries track three of the five elements of the 100 percent scoring guidepost and all elements of the 80 percent scoring guidepost for this criterion. Fishery managers have taken actions to control the catch of target species (Section 3.3.4.2), to reduce bycatch and minimize waste (Section 3.3.5.2), to minimize habitat damage (Section 3.3.6.2), and to improve monitoring and compliance (Section 3.3.7.2.1.2).

Catch levels are set and limited by target species population goals, including goals for population subcomponents. The management system applies the precautionary approach. And there is no evidence that the productivity of pollock is declining as a consequence of the catch level. Catch levels are also set considering available information on predator-prey dynamics, prey abundance, essential fish habitat needs, and ecosystem-based considerations.

The policies and management measures devised by the North Pacific Council are implemented in the fishery through regulations promulgated by the NMFS. Season openings, closures, identified areas for fishing as well as areas where trawling is prohibited, catch limits, prohibited species caps, gear types, sizes, and configuration all are specified in the regulations. Enforcement is performed cooperatively by the U.S. Coast Guard, the NMFS, and the Alaska Department of Fish and Game.

The Alaska Commercial Fisheries Entry Commission keeps track of licenses, limited entry, and other permits. In-season management occurs through daily electronic reporting by the fleet. Electronic information on catch and bycatch is used not only for closures when participants in the groundfish fisheries near their respective total allowable catch quota or prohibited species caps, but also to avoid areas where bycatch occurs.

Various sectors of the fleet have instituted voluntary actions to improve data collection, to enhance compliance through electronic communication and peer pressure, and to reduce excess capacity. By conventional fishery management standards, the system and fishery operation are models.

That is not to say that "conventional standards" are good enough, or that there is not room for improvement. Given the near certainty of ecosystem-wide changes of some kind in the future, we recommend that the evaluation team consider the extent to which the management system, and the fishery itself, can adapt to potentially rapid and severe changes in stock structure, abundance, and distribution. Any serious failure in the ability of the fishery and the management system to successfully adapt to the variability and uncertainty inherent in these ecosystems will create pressures, both economic and biological, that will undermine the potential for sustainability of both the human and biological aspects of the fishery.

In particular, we recommend that the evaluation team assess the degree to which the management system takes advantage of opportunities to build into its decisions experiments that will reduce key elements of uncertainty and/or elucidate the costs and benefits of alternative management options.

The temporal and spatial scales of the processes that structure the Bering Sea/Aleutian Islands and Gulf of Alaska ecosystems probably exceed the span of control of the existing management system, especially with regard to the temporal scale.[32] Managers have improved the appropriateness of spatial scale by considering catches and management actions throughout the Bering Sea. This is consistent with the size of the ecosystem. But temporal scale span of control is much more difficult to achieve.

For example, in responding to declines in Steller sea lion populations, the initial models were designed to assume that the removal of a fish made prey immediately unavailable to sea lions, without recognizing the time lags that occur as a natural component of ecosystem function. We recommend that the evaluation team consider the ability of the management system to operate over the spatial and temporal scales relevant to the Gulf of Alaska and Bering Sea ecosystems.

4.3.5 <u>The performance of the management system is regularly and candidly evaluated and adapted as needed to improve</u>

The M-SFCMA and implementing regulations promote a fair amount of evaluation through specific provisions, as does the NEPA and other laws. But the crisis-atmosphere that drives fishery management decision making rarely affords the opportunity to evaluate the success of past actions and to adapt management accordingly.

Fishery managers at the national and regional level maintain that they do not have the staff, time, or funding needed to adequately evaluate all aspects of fishery performance, particularly the social aspects. Not only does this divert resources, it can also dictate institutional priorities. In addition, the vagueness or just the sheer number of established goals and objectives can make it impossible to quantify their impact in any meaningful way. The Heinz Center (2000a) provides

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[32] Cybernetics literature posits in the law of requisite variety that, given a system and some regulator of that system, the amount of regulation attainable is absolutely limited by the variety of the regulator. Therefore, regulations and management actions must operate at the same scale as the ecosystem. See Clemson, B. 1984. Cybernetics: a new management tool. Kent, UK: Abacus Press.

more background on these and other related issues in the chapter titled *Evaluating Fishery Performance*.

The continuous stream of notices, rules and regulations published in the Federal Register may provide the impression that Alaska pollock fisheries are indeed adaptive and responsive to change. And, to a large degree, they are. For example, new theories, concepts, and data are incorporated into stock assessment modeling to improve knowledge and understanding of target stocks (Section 3.3.7.1). A flexible six-tier framework allows managers to calculate catch specifications using different formulas, depending on the amount and reliability of available scientific information (Section 3.3.4.2). And a comprehensive monitoring program enables managers to close fisheries or fishing areas ahead of schedule when in-season catch reports and/or observer data indicate that the total allowable catch has been taken, or that prohibited species caps have been achieved (Sections 3.3.3 and 3.3.5.2).

But most of the day-to-day changes proposed by the Council appear to be driven largely by external pressures associated with meeting the needs of fishery participants, rather than by information derived from routine internal assessments conducted to determine whether the fishery is meeting its stated goals and objectives. Managing fisheries to achieve competing biological, social, and economic goals and objectives leaves managers increasingly vulnerable to stakeholder pressure, as well as to litigation, which is another important external force driving changes in the fishery management system, as managers are required to adapt rules and regulations to comply with the orders and findings of the Court.

5 CONCLUSIONS AND RECOMMENDATIONS

The ten main issues we have identified under the three MSC principles are summarized below. They relate to how managers use alternatives to single species models, how they integrate information from disciplines outside fishery management, how they promote, test and evaluate ecosystem-based approaches, and how they apply environmental risk and impacts analysis and other integrative decision processes.

Each numbered issue is followed by a description of the problem, the specific performance indicator(s) under which the issues arise, and how the point relates to a fishery's performance for the specified indicator. The information supporting each point is referenced to the relevant issue subsection, with citations to data or other documentation. In some cases we have recommended areas where the certification team should concentrate its inquiry. In others, we have made specific recommendations about how management could be improved. We have not drawn conclusions or made specific recommendations on scoring, though it can be assumed that in areas where we have raised no concerns, it is our view that management meets the MSC standard for that indicator.

1. **Stock assessment modeling is state-of-the-art, but assessments could be improved with additional calculations predicting the probability of overfishing under current control rules.**

Sections 3.3.4 and 3.3.7 detail assessment processes and exploitation strategies for Bering Sea/Aleutian Islands and Gulf of Alaska pollock fisheries that meet standards set by U.S. law and best practices described in international conventions. But, as described in Section 4.1.1.2, more precaution could be built into assessments used by fishery managers to determine catch specifications in the Gulf of Alaska if probability analyses were used to predict the likelihood that fishing mortality and spawning stock biomass will be maintained within threshold levels under various catch scenarios. This issue relates to Principle 1 indicator 1.1.2.3.1.

According to a preliminary assessment conducted by Dorn *et al.* (2001), there is a 19-35 percent probability of exceeding the 2002 overfishing level established for the Gulf of Alaska fishery for 2002. While the risk of exceeding the overfishing level in one or two years does not cause much concern for a stock above minimum biomass thresholds, continued fishing above the overfishing level could drive the stock below threshold values. But it is important to note that the conservative approach used by fishery managers to define overfishing and to establish annual catch specifications makes this an unlikely scenario.

The use of F_{MSY}, and of $F_{40\%}$ as an estimate of F_{MSY}, creates a precautionary buffer that would probably prevent biomass from declining below threshold levels, even if the overfishing level were exceeded. Thus, only if managers were consistently overestimating would this pose a problem. And there is little risk that will occur, as the catch specification process allows overestimations to be corrected on an annual basis. For these reasons, the costs of conducting additional analyses might not outweigh the benefits.

We recommend that managers consider the benefits of adding an additional step to Gulf of Alaska assessments that would calculate the probability that various catch scenarios would be capable of maintaining fishing mortality and spawning stock biomass within threshold levels. The length of these projections should be determined by fishery analysts, but, at minimum, should equal the life span of the fish.

2. **Incomplete knowledge about the effects of fishing on population and ecosystem structure, and about the structure of Bering Sea pollock and fishing mortality in Russian waters, creates uncertainty about appropriate exploitation rates.**

As the walleye pollock fishery has matured, it has tended to concentrate more and more in time and space. The effect of this concentration on population and ecosystem structures and relationships is not well understood. As discussed in Section 4.1.3, the reproductive capacity of a stock may be affected by such changes in fishing patterns. This relates to Principle 1 Criterion 3.

In addition, existing uncertainties about the exchange between pollock populations in the eastern and western parts of the Bering Sea described in Section 3.2.1.3 make it difficult to determine with accuracy the appropriate level of fishing mortality on what is currently defined as the Eastern Bering Sea stock. As discussed in Section 4.1.1.1, it is possible that the Eastern Bering

Sea stock could be impacted at lower stock levels by current fishing practices in Russian waters. This issue relates to Principle 1 indicators 1.1.2.3.4.2 and 1.1.2.3.5.1.

It is important to note that fishery managers have been cautious in dealing with incomplete knowledge of stock structure and Russian catches. The U.S. management regime conservatively assumes that pollock targeted in the western and Eastern Bering Sea are of the same stock. And Russian fishing mortality is accounted for in the assessment of total allowable catch quotas and other management measures established for the U.S. fishery. Thus, the only real danger associated with this uncertainty lies in the highly unlikely scenario that environmental conditions consistently pushed a higher than normal population of pollock from the Eastern Bering Sea into Russian waters.

We recommend that the evaluation team and managers examine the effect on population structure of the concentration of pollock fishing in time and space. Changes in mean age have been relatively slight compared to interannual variation in mean age for walleye pollock in the Gulf of Alaska. The evaluation team should examine whether the age structure of the Bering Sea stock has changed in response to fishing pressure. More research is needed on the reproductive biology of pollock to improve understanding of the effects of fishing on reproductive capacity. And managers should pursue ongoing work with Russian scientists to define stock structure and to improve understanding of genetic variations of pollock throughout the Bering Sea.

3. **The observer system currently used in the Alaska pollock fishery is one of the best in the world. But improvements could be made in several areas.**

The observer program described in Section 3.3.7.2.1.2 is the only one of its kind in any U.S. fishery (see Table 12). But, as described in Section 4.3.3.1, improvements could be made related to coverage and the hiring process. This issue relates to Principle 1 indicators 1.1.2.3.4.5 and 1.1.2.3.5.2.

First, observer coverage of vessels in the 30 percent coverage category is not random at the vessel level. According to MRAG Americas (2000), this has the potential to introduce unknown bias into the dataset. Second, the use of independent contract observers could potentially result in biased reporting.

We recommend that the NMFS develop a mechanism under which the agency has direct control over the coverage levels, timing, and placement of observers, to ensure that bias is not introduced through non-random selection of vessels and periods for observer coverage.

4. **Incomplete knowledge of environmental influences on stock dynamics and of the effects of fishing on ecosystem structure makes it difficult for managers to clearly distinguish the relative effects of natural and anthropogenic factors on stock dynamics and ecosystems, or to predict how changes in ocean climate will affect stocks and ecosystems in the future.**

Section 3.2.3.3 describes the current level of uncertainty regarding the effects of longer-term and larger-scale shifts in oceanic climate regimes on the ecosystem in general and the pollock stock(s) in particular. These knowledge gaps make it difficult to distinguish between the effects of human and environmental impacts and to predict changes in production (particularly in recruitment) that could result from changing environmental conditions. This issue relates to Principle 1 indicator 1.1.2.3.4.6.

In addition, although many areas have been closed to fishing, managers have yet to designate specific no fishing areas as control, or "test," areas that can be used to scientifically evaluate the effects of fishing on ecosystem structure and function. This issue relates to Principle 1 indicators 1.2 and 1.4.1.

It is important to note that there is no large ecosystem in the world for which definitive knowledge exists on the relative effects of natural and anthropogenic factors. And research to improve our understanding of the effects of environmental variability on productivity is actively underway.

We recommend that researchers continue to focus on better understanding the effects of environmental variability on stock dynamics, and that they designate no fishing areas that can be used to study the effects of fishing on ecosystem structure and to evaluate the impact of conservation measures on marine ecosystems, particularly on the predators of pollock. We also recommend that managers incorporate new information derived from these studies into stock assessments and ecological analyses.

Recognizing, however, that no amount of money or research will eliminate all uncertainty, the management system should move away from an emphasis on predicting the most likely outcome. Instead, the management system should make much more use of scenario planning and other well-developed tools that aid in developing management strategies that are robust under several possible futures. Though the draft Programmatic Environmental Impact Statement does define alternative management approaches, these are considered independently and do not incorporate the more fully developed planning methods used in business, the military, crisis planning, and policy analysis.

5. **Bycatch reduction and monitoring programs are effective. But bycatch reporting could be improved.**

Section 3.3.5.1 describes the legal requirements to minimize bycatch and bycatch mortality in fisheries managed under federal fishery management plans, and to establish a standardized reporting methodology to assess the amount and type of bycatch occurring in managed fisheries. Section 3.3.5.2 outlines the aggressive actions fishery managers have taken to accomplish this in the Gulf of Alaska and Bering Sea pollock fisheries. As noted in that discussion, the North Pacific Council's bycatch monitoring and reduction program is the best developed of any U.S. fishery.

Sections 3.3.4.2.1 and 3.3.5.2.2 describe the status and trends of pollock discards in all Alaska groundfish fisheries, as well as the status and trends of discards in the "directed" Gulf of Alaska and Bering Sea pollock fisheries, based on data provided in Tables 5-10. These data indicate that the North Pacific Council's Improved Retention Improved Utilization program has been successful in reducing total pollock discards in all groundfish fisheries to the lowest levels observed in ten years, that discards in the "directed" BSAI and Gulf of Alaska pollock fisheries have been reduced to about one percent and two percent of total catch, respectively, and that the discard rates of prohibited species are also remarkably low. Therefore, we believe that the bycatch program has been effective. The only improvements we suggest in this area relate to how bycatch data are summarized and reported to the public. This issue relates to Principle 2 indicator 1.2.1.

We note in Section 4.2.2.1 that the current practice of summarizing and reporting catch data on North Pacific fisheries on a species-specific basis makes it difficult to analyze the current status and trends of incidental catch and discards on a fishery-by-fishery basis using the information contained in published reports. Again, there are exceptions, such as the annual report of the Pollock Conservation Cooperative and High Seas Catchers' Cooperative, which details both the amount and composition of catch captured and discarded by each cooperative vessel participating in the directed Bering Sea/Aleutian Islands pollock fishery. Additionally, the data needed to assess status and trends at the fishery level can be obtained through the NMFS' Alaska Regional Office. And data on the take of other prohibited species dating back to 1993 are available online.

We recommend that managers continue efforts to minimize bycatch, and that they consider summarizing and publishing incidental catch and discards data at the fishery, as well as single-species, level to help the public better understand the impacts of individual fisheries on non-target species. We recommend that scientists continue efforts to determine, through research, the impact of bycatch on the integrity of marine food webs.

6. **Incomplete knowledge about the trophic relationships among pollock and other species in the Bering Sea and Gulf of Alaska ecosystems makes it difficult to determine management strategies that are optimal for preserving critical relationships.**

As described in Section 4.2.1, managers have incomplete knowledge about the trophic relationships among pollock and other species in the Bering Sea and Gulf of Alaska ecosystems, and about how these relationships may be affected by large-scale climatic and oceanographic changes. These knowledge gaps make it difficult to predict and manage the impacts of the pollock fishery on other target and non-target species. This issue relates to Principle 2 indicator 1.2.3.

The evaluation team should examine the extent to which managers are employing alternate analytical concepts to take into account the potential effects of ecosystem changes. Multispecies modeling could be a way to promote alternative thinking, counter-intuitive hypotheses and steps away from single-species models. Another approach is a recommendation for fishery ecosystem planning. The North Pacific Fishery Management Council and National Marine Fisheries Service managers in that region are exploring means to integrate ecosystem information and approaches. To the degree that there is a plan and a timetable for applying these new methods, this concern could be addressed.

We recommend that the evaluation team consider current efforts to investigate concerns related to the impacts of the pollock fishery on the pelagic food web through multispecies and

ecosystem modeling, and to incorporate in the Stock Assessment and Fishery Evaluation report's Ecosystem Considerations chapter a set of indicators of ecosystem status and trends that could eventually provide an early warning of adverse changes in the ecosystem.

7. **Uncertainties regarding the impact of the pollock fishery on the protected Steller sea lion have made it difficult to implement regulatory measures that are certain to protect this listed species and that comply with U.S. environmental laws.**

Section 3.3.5.3 provides an overview of issues surrounding the controversial Steller sea lion debate. Until ongoing studies on sea lion energetics, foraging behavior, and other issues are completed, the impact of pollock fisheries on protected species will continue to be subject to disagreement regarding which (if any) of the four competing hypotheses that are commonly used to explain the reasons behind the continued decline of the western stock is correct. This issue relates to Principle 2 indicators 2.1, 2.2.1, 2.2.2, 2.3.1, 2.3.3, 2.3.4, 2.4.1, 2.4.2, 2.4.3, and 3.1.3.

It is important to note that Steller sea lion protection measures have been implemented in the pollock fishery for more than a decade, despite uncertainty regarding the impacts of the pollock fishery on this listed species. Past and current measures are detailed in Section 3.3.5.3.1.

We recommend that the evaluation team keep abreast of research developments that provide improved understanding of the impact of the pollock fishery on the protected Steller sea lion, and that fishery managers adapt regulations to address new information as it becomes available. We also believe it would benefit the management system to be more "adaptive" and less "reactive." Providing scientists and managers greater flexibility to experiment and test different hypotheses could help to resolve current uncertainties. While the fisheries management system has become more flexible and responsive to new information, the concept of actively and intentionally probing the system has, for the most part, been lost.

In some cases, this may mean pursuing incidental take permits for scientific purposes, or using other tools in the ESA to allow carefully controlled takes of protected species at risk in local situations (e.g., by fishing near some sea lion rookeries and not others). Where the knowledge payoff would be great, leading to better conservation and management of the ecosystem, ways should be found to carry out meaningful field experiments using the fishery.

8. **In setting objectives for the fishery, managers have not until recently incorporated ecosystem objectives that encompass species and habitats beyond the target stock.**

Section 3.3.2 describes the overall goals and objectives adopted for the Bering Sea/Aleutian Islands and Gulf of Alaska groundfish fisheries. As discussed in Section 4.3.1.1, public interest in fishery management and conservation of biological diversity in the marine environment demands that managers take more recognition of elements of the system beyond those directly related to commercially targeted species. This issue relates to Principle 3 indicators 1.2 and 1.3.

The North Pacific Council has built a framework into its planning since the inception of the fishery, but has not until recently done much to hang concrete measures on that framework. For example, a primary plan objective is to promote "the efficient use of fishery resources, but not solely for economic purposes," and a secondary objective is to minimize the impacts of fishing on the environment. Yet, a review of the history of fishery management plan amendments illustrates that, with the exception of Steller sea lion protection responses, the majority of the council's actions in the past have related directly to the fishery and its economic effects. Recent actions to examine an array of competing goals and objectives in a thorough Programmatic Environmental Impact Statement is indicative of a change in thinking.

Sections 3.3.6 and 4.2.2.3 describe the current status of fishery managers' efforts to better achieve legal mandates to designate and protect essential fish habitat. As noted in these sections, the Supplemental Environmental Impact Statement needed to accomplish this goal is still under development.

We recommend that the evaluation team examine plans and timetables for the new Programmatic Environmental Impact Statement, and inquire of managers and of the applicants how the performance of new conservation approaches will be evaluated. The team should also take into consideration the actions of managers over the past several years to protect forage species and habitat, and to reduce the take of non-target species.

The evaluation team should also keep abreast of efforts to complete the Supplemental Environmental Impact Statement required to comply with legal mandates to designate essential fish habitat and to minimize the impacts of fishing on essential fish habitat. Managers should examine, under the framework that provides for the designation of habitat areas of particular concern, the potential for marine protected areas in the Bering Sea and Gulf of Alaska to conserve marine biodiversity.

9. **Traditional fishery management approaches, along with constraints on resources and unclear guidance, have weakened compliance with administrative procedures and environmental protection laws other than the M-SFCMA.**

As described in Sections 3.3.5.3 and 4.3.2.2, managers have been vulnerable to challenge that they have not complied with all applicable law and policy. Not only does failure to touch procedural bases open the system to legal challenge and all its attendant costs, but it also deprives Council and agency decision makers, as well as stakeholders, of the best possible information and alternatives analysis on which to base their decisions. This issue relates to Principle 3 indicators 2.1 and 2.2.

The NMFS has sought and received substantial resources from Congress to improve its compliance with the NEPA and other statutes. The head of the agency has made consistent public statements about his commitment to better environmental impact analyses and informed decision making. Though a plan describing the agency's actions to realize this commitment was not delivered to Congress on its December deadline, many elements of that plan are clearly underway. Improving compliance with the agency's multiple legal mandates will likely require significant changes in the structure, resources, and institutional framework of the agency that will allow managers to be responsive to this new way of doing business.

We recommend that the evaluation team find out when the NMFS' report to Congress on actions underway to improve compliance with the NEPA and other laws will be released, and

that it evaluate the adequacy of proposed improvements, and the timetable for implementing those improvements.

10. **The fishery management system responds to stakeholder concerns on an ad-hoc basis, rather than considering them in the context of the goals and values of all stakeholders over the long term.**

The current council process is very receptive and responsive to fishery participants' concerns about emerging issues. But dealing with social, cultural, economic, and ecological issues in the short term and on an ad-hoc basis often creates further problems down the road. This issue relates to Principle 3 indicators 1.3, 1.4.3, 3.1, and 3.2.

Without a framework that incorporates goal-setting for long-term social, cultural, and economic, as well as ecological objectives, fishery decision making may solve the concerns of one group while creating a very different set of problems for another stakeholder group. For example, as described in Section 3.1, concerns about the allocation of groundfish between onshore and offshore processing sectors in the 1990s led to a series of year-by-year council responses in an attempt to address the split of fishery resources between competing sectors. Inability to tackle the root of the problem - excess capacity - led to continuing economic difficulties and eventual bankruptcies. One group of stakeholders finally went to Congress to find a legislative solution for a problem that could not be addressed within the system.

Stakeholders in the groundfish fisheries have had to seek solutions outside the council process on more than one occasion. CDQs were legislated to provide access to Alaska Native communities. Cooperatives were legislated to help to reduce capacity in the offshore catcher-processor and catcher boat sectors. And alternatives for avoiding jeopardy for endangered Steller sea lions were judicially prompted. While these solutions are still within the "system" as defined by the evaluation team, they add instability and surprise to an institutional system already grappling with an unpredictable ecosystem.

The North Pacific Council employs sociologists, economists, and anthropologists, and incorporates these disciplines in its Scientific and Statistical Committee, along with natural scientists. But they look at management proposals as they arise in the biological context - how many fish in the total allowable catch in a given year. The fishery management planning system does not provide stakeholders an opportunity to articulate their values and long-term goals.

Not only would this type of planning help managers to envision a sustainable fishery that provides a constant stream of catch that does not drive the stock to low levels or harm the ecosystem. It would also help stakeholders to articulate community and cultural goals, and to be flexible enough to respond to major environmental change.

For example, sardine, anchovy, salmon, and crab fisheries have illustrated that stocks may come and go in radical ways as the result of large-scale natural variability. Whether this can happen with pollock is open to question. In any case, in the unpredictable natural world, sustainability of both the stock and the fishery may require conscious planning that allows fishermen to switch among stocks as the leading indicators of ecosystem change start flashing.

Physical oceanographers are beginning to identify the "on-off" switches that signal when regime shifts are happening. This kind of flexibility will require rethinking the permit system, boat design, and the capital structure of the fishing industry. For example, boats may need to be designed to readily accommodate several different kinds of gear instead of for maximum efficiency at catching one target stock. This could help to reduce boom and bust cycles and to lessen the economic pressures that have led to situations in many other fisheries where quotas are set at levels that are too high to sustain the fisheries over the long term.

The increased use of social and economic analysis at the Council and in the NMFS is a sign that managers are integrating these disciplines into fishery management. The proposed approach to analyze seven different competing goal sets in a new Programmatic Supplemental Environmental Impact Statement is indicative of a wider scope of inquiry than has historically been applied to the pollock fisheries.

There also are signs that the moratorium on quota regimes will be considered during reauthorization of the M-SFCMA, providing fishery managers with yet another tool that might assist them in achieving social and/or economic objectives. The Bush administration has endorsed the use of individual transferable quotas, and William Hogarth, acting assistant administrator for fisheries, said the current moratorium should be allowed to expire with little other action by Congress.

We recommend that the evaluation team assess how the fishery management system as a whole builds in mechanisms to articulate the social, cultural, and economic values and goals of diverse fishery stakeholders, and to provide for flexibility to respond to large-scale ecological change.

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TABLES AND FIGURES

Table 1: Age 3+ biomass (mt, hindcast from 2000 Model 1 analysis), pre-season catch specifications (mt), and total catches (mt, including discards) of walleye pollock in the Eastern Bering Sea, 1980-2001.

Year	Biomass	ABC	TAC	Catch
1980	3,723,000	1,300,000	1,000,000	958,279
1981	7,834,000	1,300,000	1,000,000	973,505
1982	9,021,000	1,300,000	1,000,000	955,964
1983	9,958,000	1,300,000	1,000,000	982,363
1984	9,518,000	1,300,000	1,200,000	1,098,783
1985	11,182,000	1,300,000	1,200,000	1,179,759
1986	10,277,000	1,300,000	1,200,000	1,188,449
1987	10,636,000	1,300,000	1,200,000	1,237,597
1988	9,910,000	1,500,000	1,300,000	1,228,000
1989	8,251,000	1,340,000	1,340,000	1,230,000
1990	6,473,000	1,450,000	1,280,000	1,353,000
1991	4,859,000	1,676,000	1,300,000	1,268,360
1992	7,920,000	1,490,000	1,300,000	1,384,376
1993	10,233,000	1,340,000	1,300,000	1,301,574
1994	9,285,000	1,330,000	1,330,000	1,362,694
1995	10,267,000	1,250,000	1,250,000	1,264,578
1996	8,556,000	1,190,000	1,190,000	1,189,296
1997	7,057,000	1,130,000	1,130,000	1,124,593
1998	7,448,000	1,110,000	1,110,000	1,101,165
1999	10,772,000	992,000	992,000	988,674
2000	10,490,000	1,139,000	1,139,000	1,112,100
2001	10,060,000	1,842,000	1,400,000	

Source: Witherell 2000b.

Table 2: Exploitable biomass (from stock synthesis model), catch specifications and total catches (including discards) of age 2+ walleye pollock in the Gulf of Alaska, 1978-2001 (in mt).

Year	Biomass	ABC	TAC	Catch
1978	2,264,000			90,820
1979	2,739,000			98,510
1980	3,195,000			110,100
1981	3,854,000			139,170
1982	3,987,000			168,690
1983	3,364,000			215,570
1984	2,719,000		234,960	307,400
1985	2,004,000		293,250	284,820
1986	1,615,000	116,600	133,280	93,570
1987	1,697,000	112,000	108,000	69,540
1988	1,614,000	93,000	93,000	65,625
1989	1,465,000	75,375	72,200	78,220
1990	1,250,000	73,400	73,400	90,490
1991	1,381,000	133,400	133,400	107,500
1992	1,728,000	99,400	87,400	93,900
1993	1,582,000	160,400	114,400	108,600
1994	1,338,000	109,300	109,300	110,890
1995	1,128,000	65,360	65,360	73,250
1996	941,000	54,810	54,810	50,200
1997	1,000,000	79,980	79,980	89,800
1998	964,000	130,000	124,730	125,471
1999	767,000	100,920	100,920	93,380
2000	577,000	100,000	100,000	71,877
2001	699,000	105,810	95,875	

Source: DiCosimo and Kimball 2001.

Table 3. Geographic distribution of walleye pollock stocks.

Stock	Characteristics
Southeast Alaska-Canada	Small stock, minor fisheries
Western-Central Gulf of Alaska (GOA)	Variable stock, 50-200 thousand mt catch
Eastern Bering Sea (EBS)	Large stock, 1-2 million mt catch
Aleutian Basin	Variable stock (0.1-1.4 million mt catch)
Aleutian Islands	Small stock, minor fisheries

Source: Bailey *et al.* 1999, modified from Wespestad 1996.

Table 4. Summary status of pollock stocks in the U.S. Exclusive Economic Zone.

Stock	Characteristics
Eastern Bering Sea	Estimated biomass in 2000 age 3+ = 7.7 million mt U.S. and Russian EIT surveys indicate that the EBS stock goes into the Russian EEZ. Russians indicate 5% of EBS stock in the Navarin shelf region. NMFS and UW collaborating on DNA study (Ianelli *et al.* 2000, 1.8.3.). ABC basis Tier 1
Aleutian Islands	Estimated biomass in 2000 age 3+ = 106,000 mt No directed fishing for several years? Stock definition confounded with EBS - unlikely to represent a discreet stock (Ianelli *et al.* 2000, 1.15.); ABC basis Tier 5
Aleutian Basin-Bogoslof Island	Biomass in 2000 age 3+ 301,000 mt Closed since 1991; ABC basis Tier 5 current ABC 8,470 mt; more likely than the Aleutian Islands to be discreet from EBS stock, but still may not be - very few young fish, maybe recruiting from elsewhere (Ianelli *et al.* 2000, 1.16.). Contiguous with the Donut Hole
Gulf of Alaska	Biomass in 2000 age 3+ 616,710 mt; this is an all time low ABC = 100,000 mt

Table 5. Estimated pollock catch retained and discarded, as percent of total pollock catch in all BSAI fisheries from 1990-1999 (mt).

Year	Total Pollock Catch	Retained	Discarded	Discards as % of Total Catch
1990	1,534,218	1,416,711	117,507	7.7%
1991	1,482,061	1,318,966	163,095	11%
1992	1,213,185	1,091,919	121,266	10%
1993	1,383,732	1,271,914	111,819	8.1%
1994	1,422,094	1,312,892	109,202	7.7%
1995	1,339,728	1,228,654	98,542	7.4%
1996	1,222,339	1,145,133	77,206	6.3%
1997	1,150,533	1,056,316	94,217	8.2%
1998	1,124,987	1,108,106	16,881	1.5%
1999	990,855	961,362	29,492	3.0%

Source: Ianelli *et al.* 2000.

Table 6. Estimated pollock catch retained and discarded, as percent of total pollock catch in all Gulf of Alaska fisheries from 1991-1999 (mt).

Year	Total Pollock Catch	Retained	Discarded	Discards as % of Total Catch
1991	100,488	91,181	9,308	9.3%
1992	90,857	77,812	13,045	14.4%
1993	108,908	100,645	8,264	7.6%
1994	107,355	101,028	6,306	5.9%
1995	72,618	64,759	7,859	10.8%
1996	51,263	46,107	5,156	10.1%
1997	90,130	82,888	7,242	8.0%
1998	125,098	124,077	1,022	0.8%
1999	95,590	93,643	1,947	2.0%

Source: Dorn *et al.* 2000.

Table 7. Estimated pollock and non-target groundfish catch retained and discarded in directed BSAI pollock fisheries from 1997-2000 (mt).

Year	Total Catch	Retained			Discarded			Discards as % of Total Catch
		Pollock	Non-Target Groundfish	Total Retained	Pollock	Non-Target Groundfish	Total Discarded	
1997	1,097,657	1,050,833	5,318	1,056,152	28,712	12,794	41,505	3.78
1998	1,022,374	1,002,485	9,417	1,011,902	4,258	6,214	10,472	1.02
1999	957,713	942,761	5,249	948,010	5,999	3,705	9,704	1.01
2000	1,109,250	1,090,029	7,040	1,097,069	1,424	10,757	12,181	1.10

*This table represents discards of pollock and non-target groundfish only. See Table 5 for data on prohibited species.
*Directed pollock fishery defined by catch composition, not reported gear type.
*Numbers may not sum perfectly due to rounding.

Source: National Marine Fisheries Service, Alaska Fishery Science Center, December 2001.

Table 8. Estimated pollock and non-target groundfish catch retained and discarded in directed Gulf of Alaska pollock fisheries from 1997-2000 (mt).

Year	Total Catch	Retained			Discarded			Discards as % of Total Catch
		Pollock	Non-Target Groundfish	Total Retained	Pollock	Non-Target Groundfish	Total Discarded	
1997	88,284	82,089	936	83,025	4,322	936	5,258	5.96
1998	125,924	123,413	1,073	124,486	833	604	1,438	1.14
1999	96,688	92,805	1,825	94,630	1,197	861	2,058	2.13
2000	72,969	69,853	1,774	71,627	626	716	1,342	1.84

*This table represents discards of pollock and non-target groundfish only. See Table 5 for data on prohibited species.
*Directed pollock fishery defined by catch composition, not reported gear type.
*Numbers may not sum perfectly due to rounding.

Source: National Marine Fisheries Service, Alaska Fishery Science Center, December 2001.

Table 9. Average rate of incidental catch of halibut, crab and salmon in the directed BSAI pollock fishery (1997-2000).

Year	kg halibut / mt groundfish**	# crab / mt groundfish			# salmon / mt groundfish**		
		Red king	Tanner	Total crab	Chinook	Other	Total salmon
1997	0.243	0.000	0.026	0.026	0.002	0.061	0.062
1998	0.345	0.014	0.056	0.070	0.004	0.063	0.066
1999	0.180	0.000	0.003	0.003	0.008	0.069	0.077
2000	0.112	0.000	0.001	0.001	0.004	0.057	0.062

*Directed pollock fishery defined by catch composition, not reported gear type.
**Data do not distinguish between catch discarded and catch donated to disadvantaged individuals through the Prohibited Species Donation Program.

Source: NMFS 2001.

Table 10. Average rate of incidental catch of halibut, crab and salmon in the directed Gulf of Alaska pollock fishery (1997-2000).

Year	kg halibut / mt groundfish**	# crab / mt groundfish			# salmon / mt groundfish**		
		Red king	Tanner	Total crab	Chinook	Other	Total salmon
1997	0.463	0.000	0.008	0.008	0.109	0.027	0.135
1998	0.359	0.000	0.003	0.003	0.080	0.026	0.106
1999	0.347	0.000	0.001	0.001	0.273	0.021	0.295
2000	1.087	0.000	0.025	0.025	0.251	0.101	0.352

*Directed pollock fishery defined by catch composition, not reported gear type.
**Data do not distinguish between catch discarded and catch donated to disadvantaged individuals through the Prohibited Species Donation Program.

Source: NMFS 2001.

Table 11. Procedural history of the Steller sea lion debate.

Date	Action
Late 1970s	NMFS obtains first reliable data on counts of Steller sea lions (SSL); report total of approximately 109,000 animals.
1978, 1981	NMFS approves and implements the North Pacific Fishery Management Council's Fishery Management Plans (FMP) for the Gulf of Alaska (GOA) and Bering Sea Aleutian Islands (BSAI) Groundfish Fisheries; Environmental Impact Statements (EIS) for the FMPs are prepared and approved.
1980s	NMFS data indicate precipitous decline of sea lions.
5/1988	NMFS publishes an advanced notice of proposed rulemaking to designate the SSL in Alaska as "depleted" under the MMPA based on the 1988 Status Report.
10/1988	Congress amends the MMPA; includes a provision directing NMFS to follow the recommendation of the Marine Mammal Commission that it designate the SSL as "depleted" and prepare a conservation plan by 12/31/1990.
11/1989	Environmental Defense Fund and 17 other environmental organizations petition NMFS for emergency rule listing all SSL populations in Alaska as endangered. Population estimated for Kenai to Kiska area to be 25,000.
4/1990	NMFS designates the SSL as a threatened species on an emergency basis under the ESA, following severe declines at rookeries throughout much of the GOA and Aleutian Islands region.
6/1990	NMFS initiates ESA Section 7 Consultation on all federally-managed fisheries within the SSL's range. No jeopardy or adverse modification is found.
Fall 1990	NMFS and the North Pacific Council propose to increase 1990 catch levels for BSAI and GOA groundfish fisheries by 80 percent for 1991.
11/1990	NMFS publishes final listing of SSL as a threatened species (50 FR 49204). Western population of sea lions estimated at 28,000 animals.
6/1991	NMFS completes Section 7 Consultation on the 1991 GOA Pollock total allowable catch (TAC) specification and concludes that the fishery, if operated outside of 10 nautical mile no-trawl zones around GOA rookeries and with spatial and temporal TAC allocations to prevent localized depletions, was not likely to jeopardize or adversely modify habitat.
7/1991	Greenpeace sues NMFS alleging violations of the NEPA and Section 7 of the ESA in approving a revised pollock TAC for 1991 that was 41 percent higher than the 1990 TAC based on an environmental assessment (EA) finding no significant impact and a biological opinion (BiOp) concluding no jeopardy.
10/1991	Federal district court concludes nothing in administrative record shows NMFS violated duties under either ESA or NEPA; decisions not to prepare an EIS or undertake further studies before issuing "no jeopardy" finding not arbitrary or capricious; NMFS adequately assessed environmental impact of action approving the TAC. Greenpeace appeals.
1/1992	NMFS publishes final rules implementing Amendments 20 and 25 to the GOA and BSAI groundfish FMPs, including as SSL protective measures buffer zones, 10-nautical miles.

Date	Action
12/1992	Federal Court of Appeals upholds lower court decision in *Greenpeace v. Franklin*. NMFS decision not to prepare an EIS in setting the pollock TAC was based on adequate scientific data.
3/1993	NMFS issues final rule implementing an FMP regulatory amendment to expand 20-nautical mile the trawl fishery closure around the Ugamak Island SSL rookery in the eastern Aleutian Islands during the pollock roe fishery season to better protect the foraging zone of sea lion pups as indicated by satellite tracking data.
8/1993	NMFS publishes final rules defining SSL critical habitat, including the marine areas within 20 nautical miles of approximately 40 rookeries and 82 haulouts west of 144 degrees W longitude as well as three special at-sea foraging areas (58 FR 45269).
1996	NMFS observes that SSL population has declined by 80 percent from the late 1970s. National Research Council publishes "The Bering Sea Ecosystem," concluding that the "cascade hypothesis" is the most likely explanation of events observed in the Bering Sea ecosystem since 1945, causing pollock to dominate the ecosystem and making forage fish with higher nutritional value relatively scarce, leading to the declines of marine mammals in the system.
5/1997	NMFS publishes final rule recognizing two separate populations ("distinct population segments") of SSL under the ESA and reclassifying the western population (west of 144 degrees W longitude) as endangered, based on continued population declines.
5/1998	NMFS approves FMP amendment and EA for BSAI FMP to reapportion total allowable catch of Atka mackerel and reduce fishery effects on SSLs.
12/1998	NMFS Office of Protected Resources prepares BiOp 1 on BSAI and GOA groundfish fisheries and concludes that the BSAI and GOA pollock trawl fisheries, as projected for 1999 through 2002, were likely to jeopardize the endangered western population of SSLs and adversely modify critical habitat. NMFS also prepares and issues a final supplemental EIS (SEIS) for the federally-managed groundfish fisheries off Alaska, evaluating the environmental effects of alternative TAC levels. NMFS prepares an additional BiOp on the effects of the 1999 groundfish fisheries on endangered species and habitat (1998 - 2 BiOp). Greenpeace *et al.* challenge the opinion as too narrow in scope.
5/1999	U.S. Congress, House Subcommittee on Fisheries Conservation, Wildlife and Oceans holds oversight hearing on SSL research.
7/1999	Federal district court judge Zilly rules that the 1998 SEIS on Alaska groundfish fisheries was too narrow in scope and failed to consider cumulative effects and dramatic changes in the North Pacific ecosystem and was therefore legally inadequate; orders NMFS to prepare EIS that includes a reasonable set of programmatic management alternatives, not just alternative harvesting levels. The revised programmatic EIS is to incorporate results from the consultations under Section 7 of the ESA on the likely effect of the authorized fisheries on listed species and their habitats.
8/1999	Judge Zilly remands the 1998 BiOp to NMFS to prepare and issue revised final reasonable and prudent alternatives, which NMFS issues in 10/1999. Greenpeace and the other plaintiffs challenge the revised reasonable and prudent alternatives (RPA).

Date	Action
10/1999	NMFS publishes notice of intent for scoping meetings on developing a programmatic SEIS (64 FR 53305). Comment period through 11/15/1999.
11/1999	NMFS issues notification of draft alternatives for the SEIS and extends the scoping and comment period through 12/15/1999 (64 FR 59730).
12/1999	NMFS prepares BiOp on TAC specifications for BSAI and GOA groundfish.
1/2000	Judge Zilly finds NMFS is in continuing violation of the ESA. The 1998-2 BiOp was not comprehensive and failed to analyze the full scope of the FMPs and all the potential cumulative effects of the fisheries.
4/2000	NMFS publishes report on Alaska groundfish fisheries SEIS scoping with a comment period through 5/1/2000 (65 FR 18074).
7/2000	Judge Zilly issues an injunction prohibiting fishing for groundfish with trawl gear in federal waters within SSL critical habitat west of 144 degrees W longitude until NMFS issues a legally adequate comprehensive BiOp analyzing the full scope of the FMP including measures determining where and when fishing will take place.
11/2000	NMFS issues court-ordered comprehensive BiOp, incidental take statement and RPA, concluding that the Alaska groundfish fisheries under existing FMP management framework jeopardize the SSL and adversely modify its critical habitat due to competition for prey and through disruption of its prey field. The North Pacific Council reviews the BiOp at its meeting and rejects the findings, asking its scientific committee to review the opinion and prepare a full report by 2/2001.
12/2000	Congress uses appropriations bill to require support for SSL scientific studies and outline a three-step phase-in process for implementation of the comprehensive BiOp's RPA, including a requirement that the restrictions are implemented as fishery management provisions through the regional council process.
1/2001	NMFS publishes emergency rules (66 FR 7275) establishing SSL protection measures for the 2001 Alaska groundfish fisheries including a one-year phase-in of the RPA in the comprehensive BiOp. NMFS releases draft programmatic SEIS on federal groundfish fisheries off Alaska, evaluating all activities authorized and managed under the FMPs, including significant cumulative effects of environmental and management changes in the groundfish fisheries, and an analysis of reasonable management alternatives and their impacts (66 FR 8788).
2/2001	North Pacific Council's Scientific and Statistical Committee releases a review of the comprehensive BiOp, concluding it is scientifically deficient, unduly negative towards fisheries, and based on unsubstantiated opinions and facts, lacking scientific balance. North Pacific Council appoints RPA Committee to recommend SSL conservation measures for summer 2001.

Date	Action
3/2001	NMFS extends comment period on draft SEIS to 6/25/2001 (66 FR 16226). NMFS publishes corrections to emergency interim rule on SSL protection measures (66 FR 15656). NMFS publishes amendments to emergency interim rule, relaxing restrictions on vessels fishing for groundfish off Alaska with jig gear and on vessels less than 60 ft length overall fishing for Pacific cod with hook-and-line or pot gear in the BSAI (66 FR 17083, March 29, 2001).
4/2001	North Pacific Council adopts RPA recommendations and requests emergency rule for SSL protection measures by June.
5/2001	NMFS extends comment period on the draft SEIS to 7/25/2001 (66 FR 22551).
6/2001	NMFS publishes amendments to emergency interim rule implementing 2001 SSL protection measures and harvest specifications for the groundfish fisheries off Alaska. These modifications prohibit directed fishing for Pacific cod by specified vessels until 7/17/2001. Effective 6/10/2001 (66 FR 31845).
7/2001	NMFS receives more than 20,000 comments on draft programmatic SEIS, including many from environmental group plaintiffs who claim the list of alternatives does not provide specific protections for the ecosystem. NMFS publishes correction to emergency interim rule; Final 2001 Harvest Specifications (66 FR 34852). NMFS amends and corrects the emergency interim rule that implements the 2001 SSL protection measures and 2001 harvest specifications and extends through 12/2001 (66 FR 37167).
8/2001	NMFS releases revised draft BiOp regarding the impact of the groundfish harvest on endangered SSLs, with comment period through 9/2001. NMFS publishes draft SEIS on SSL protective measures.
9/2001	Correction to the 7/17/2001 emergency interim rule and its 8/22/2001 correction by correcting SSL protection areas for the Pacific cod directed fishery (66 FR 48371).
11/2001	NMFS publishes notice of intent to revise the draft programmatic SEIS, and pushes off original intent to complete document until 9/2003 at the earliest. NMFS publishes final SEIS on SSL protection measures.
1/2002	Emergency Rule for SSL protection measures and TAC specifications. Comment period through 2/7/2002 (67 FR 956).

Source: The material in this box was updated and adapted from a timeline provided in “The Best Available Science: Proceedings from a workshop on the role of science in marine conservation law,” Honolulu, Hawaii March 9-10, 2001. Sponsored by Marine Law Institute, University of Maine School of Law. Available online at http://www.usm.maine.edu/~rieser/ SSL/SSL_chronology.html.

Table 12. U.S. Fisheries Observer Coverage.

Fishery	Authority	Coverage	Funding
New England Sink Gillnet	MMPA	<5%	Federal
New England Scallop Dredge	M-SFCMA	20%	Industry
Mid-Atlantic Midwater Trawl	MMPA	<1%	Federal
Mid-Atlantic Coastal Gillnet	MMPA	<5%	Federal
South Atlantic Shark Driftnet	MMPA/MSA/ESA*	50-100%	Federal
Atlantic Pelagic Longline	M-SFCMA/ESA*	3-5%	Federal
Gulf of Mexico Shark Longline	M-SFCMA	2%	Federal
Gulf of Mexico Otter Trawl	Voluntary	<1%	Federal
Pacific Whiting Trawl	Voluntary	100%	Industry
West Coast Groundfish	(planned)	(10%)	Federal
Monterey Bay Halibut Setnet	MMPA	25%	Federal
Swordfish and Thresher Shark Drift Gillnet	MMPA	25%	Federal
Hawai’i Swordfish and Tuna Longline	M-SFCMA/ESA*	20%	Federal
Bering Sea Groundfish	M-SFCMA	30-100%	Industry
Aleutian Islands Groundfish	M-SFCMA	30-100%	Industry
Gulf of Alaska Groundfish	M-SFCMA	30-100%	Industry
Salmon Setnet and Driftnet	MMPA	1%	Federal

*Observers authorized to monitor interactions with ESA-listed species.

Source: Presentation to Marine Federal Fisheries Advisory Committee, April 24, 2001, Victoria R. Cornish, National Observer Program, National Marine Fisheries Service.

Table 13. Current requirements for observer coverage in the North Pacific groundfish fishery.

Fleet/Industry Component		Coverage
Catcher / processor or catcher vessel	125 feet (38.1 meters) in length overall (LOA) or longer	Must carry a NMFS-certified observer at all times while fishing for groundfish, except for vessels fishing for groundfish with pot gear as provided for below.
	Equal to or greater than 60 feet (18.3 meters) LOA but less than 125 feet (38.1 meters) LOA	Must carry a NMFS-certified observer during at least 30% of its fishing days in each calendar quarter in which the vessel participates for more than 3 fishing days in a directed fishery for groundfish. Each vessel that participates for more than 3 fishing days in a directed fishery for groundfish in a calendar quarter must carry a NMFS-certified observer during at least one fishing trip during that calendar quarter for each of the groundfish fishery categories defined in regulations 50 CFR part 627.27(c)(1)(iv) in which the vessel participates.
Catcher / processor or catcher vessel fishing with hook-and-line gear	Equal to or greater than 60 feet (18.3 meters) LOA but less than 125 feet (38.1 meters) LOA	Must carry a NMFS-certified observer during at least one fishing trip in the Eastern Regulatory Area of the Gulf of Alaska during each calendar quarter in which the vessel participates in a directed fishery for groundfish in the Eastern Regulatory Area.
Catcher / processor or catcher vessel fishing with pot gear	Equal to or greater than 60 feet (18.3 meters) LOA	Must carry a NMFS-certified observer during at least 30% of its fishing days in each calendar quarter in which the vessel participates for more than 3 fishing days in a directed fishery for groundfish. Each vessel that participates for more than 3 fishing days in a directed fishery for groundfish in a calendar quarter using pot gear, must carry a NMFS-certified observer during at least one fishing trip during that calendar quarter for each of the groundfish fishery categories defined in regulations 50 CFR part 627.27(c)(1)(iv) in which the vessel participates.
Mothership processor vessels of any length	Processes 1,000 mt or more, calculated in round weight equivalents, of groundfish during a calendar month	Must have a NMFS-certified observer on board the vessel each day it receives or processes groundfish during that month.

Fleet/Industry Component		Coverage
	Processes from 500 mt to 1,000 mt, calculated in round weight equivalents, of groundfish during a calendar month	Must have a NMFS-certified observer on board the vessel at least 30% of the days it receives or processes groundfish during that month.
Shoreside processing facilities	Processes 1,000 mt or more, calculated in round weight equivalents, of groundfish during a calendar month	Must have a NMFS-certified observer present at the facility each day it receives or processes groundfish during that month.
	Processes 500 mt to 1,000 mt, calculated in round weight equivalents, of groundfish during a calendar month	Must have a NMFS-certified observer present at the facility at least 30% of the days it receives or processes groundfish during that month.

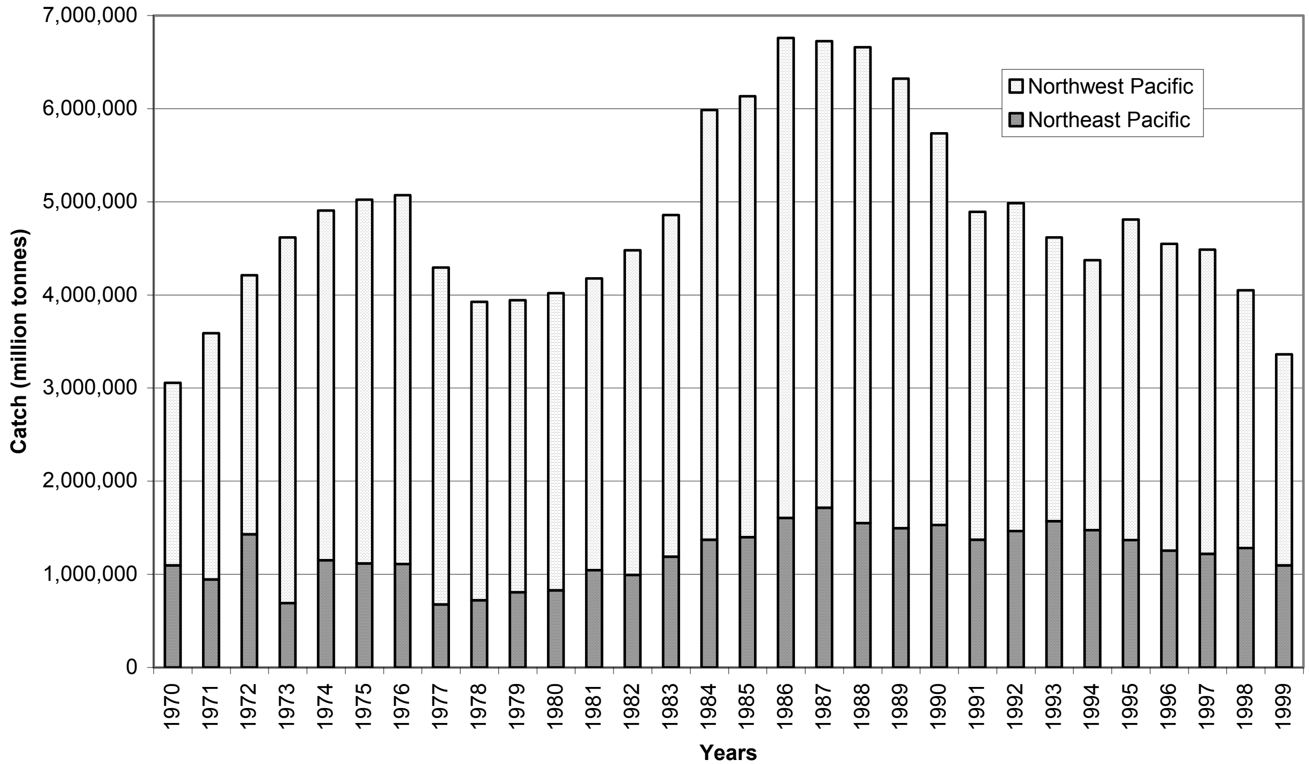

Figure 1. Total walleye pollock catch in the northwest and northeast Pacific, 1970-1999.

Source: Froese and Pauly 2001.

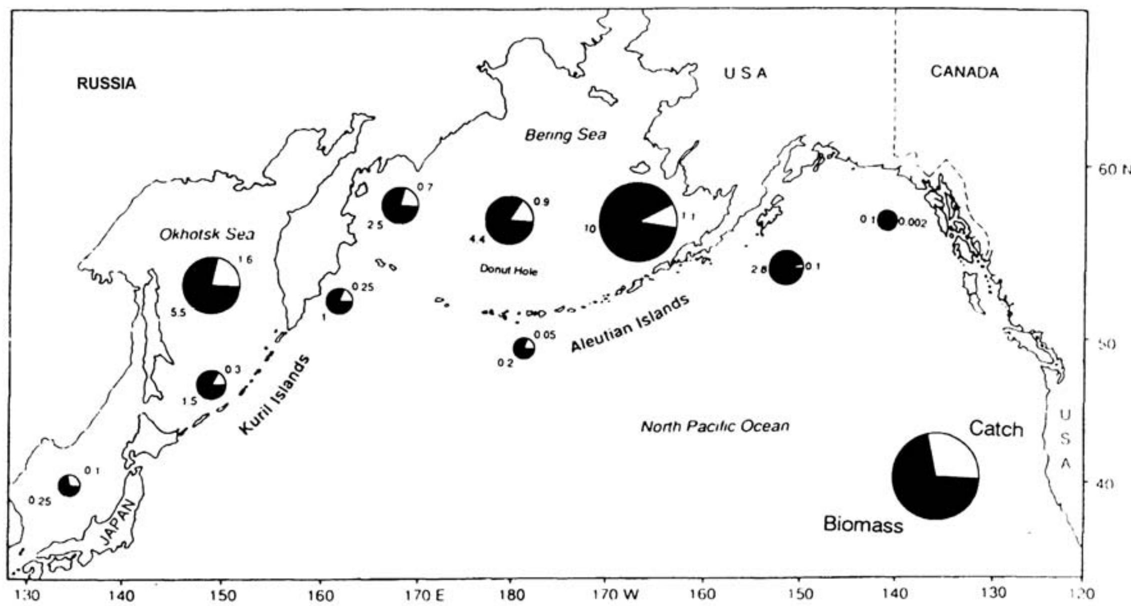

Figure 2. Historical average catches and estimated biomass of walleye pollock in million mt by stock or major fishing areas.

Source: After Wespestad 1993, sources cited include Asian catch and biomass data, N. Fedeev, TINRO, Vladivostok, personal communication; Bering Sea-Aleutian Islands, Wespestad and Dawson (1992); West central Gulf of Alaska and eastern Gulf of Alaska-Washington, A. Hollowed, Alaska Fisheries Center, personal communication.

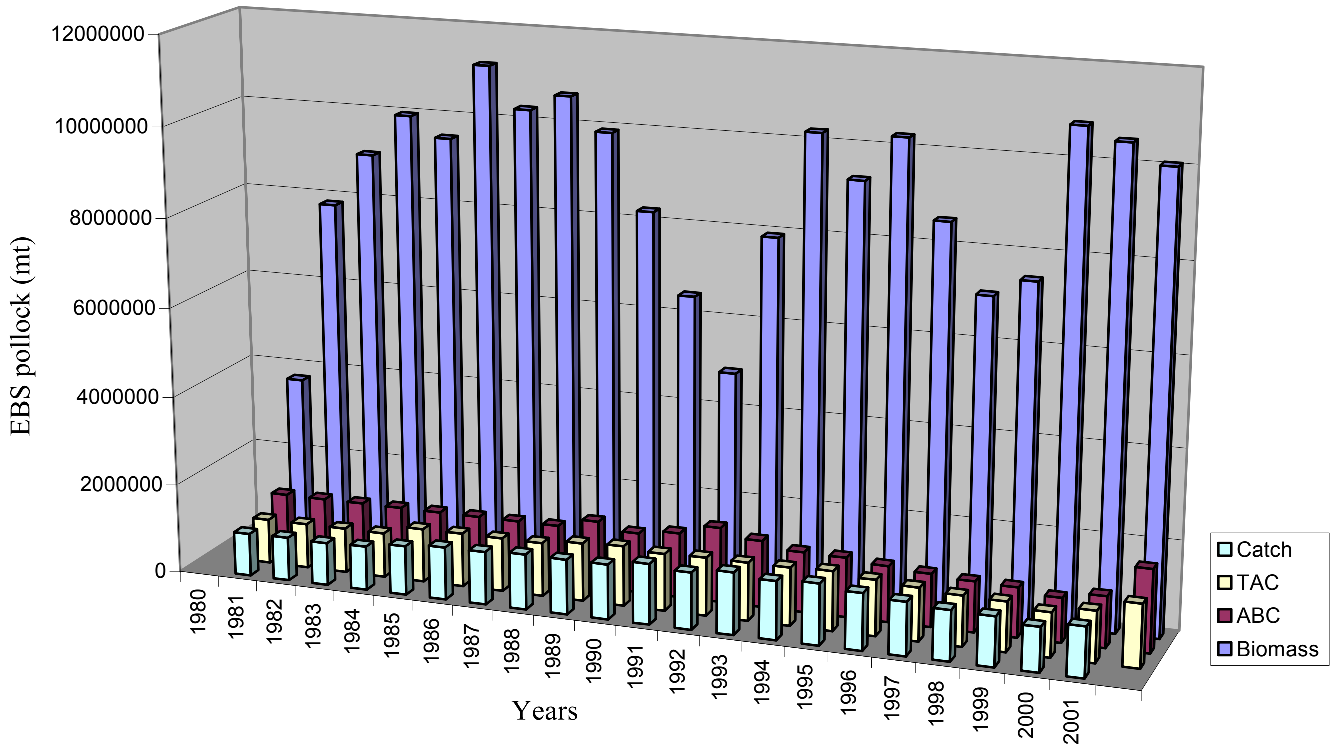

Figure 3. Age 3+ biomass (hindcast from 2000 Model 1 analysis), pre-season catch specifications, and total catches (including discards) of walleye pollock in the Eastern Bering Sea, 1980-2001.

Source: Adapted from Witherell 2000b, p. 1.

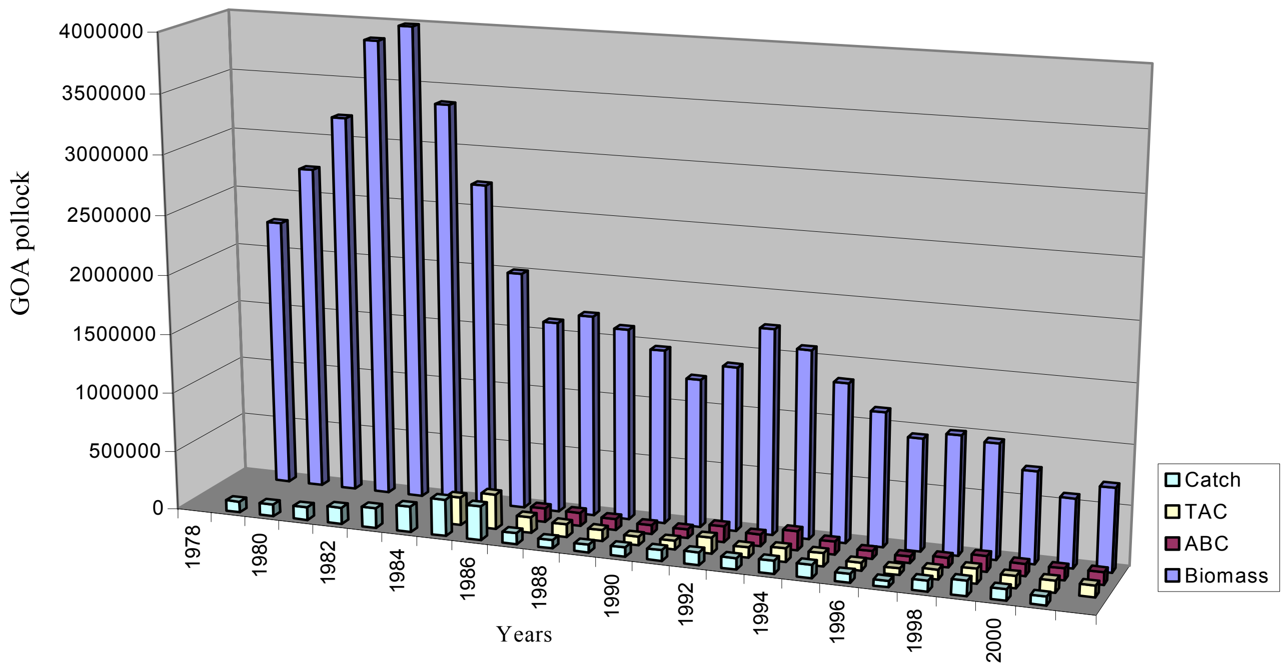

Figure 4. Exploitable biomass (from stock synthesis model), catch specifications and total catches (including discards) of age 2+ walleye pollock in the Gulf of Alaska, 1978-2001.

Source: Adapted from DiCosimo and Kimball 2001, p. 1.

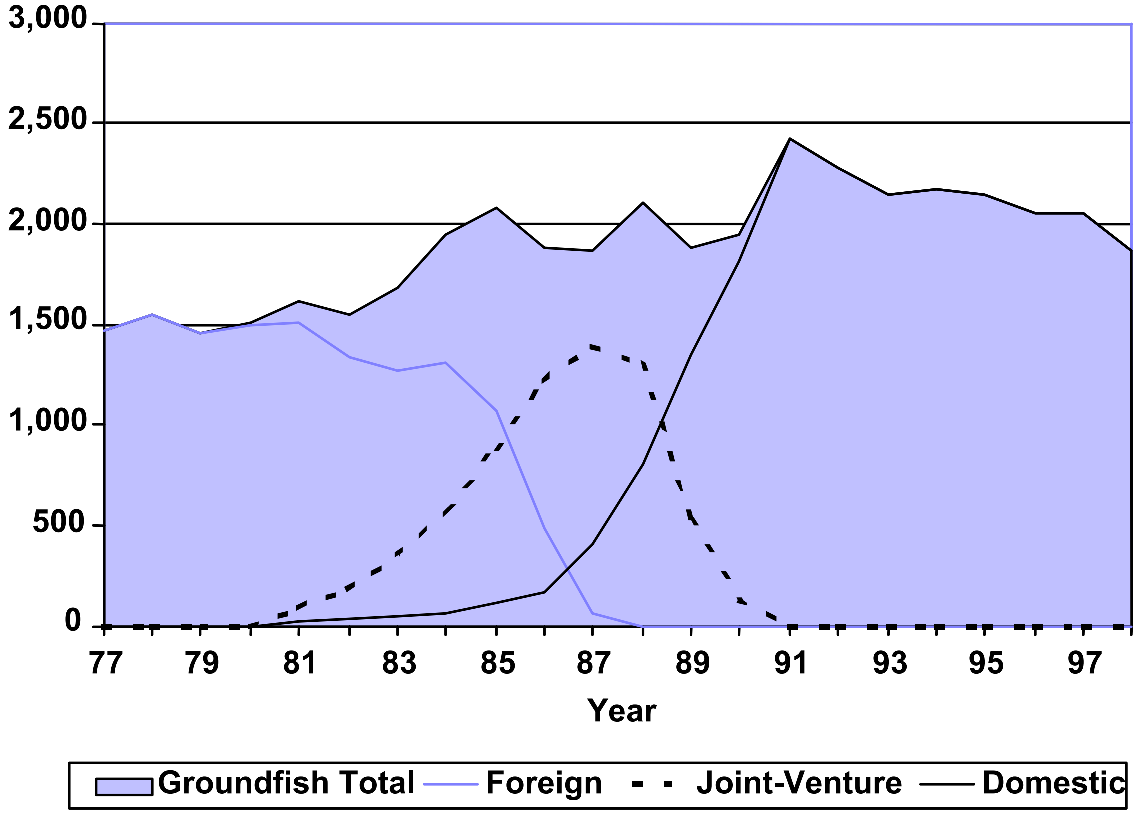

Figure 5. Foreign, joint venture and domestic groundfishing and processing 1977-1988.

Source: From Northern Economics Sector and Regional Profiles of the North Pacific Groundfish Fisheries. Economic Status of the Groundfish Fisheries off Alaska, 1991 and 1995, R.K. Kinoshita, et al, April 1997; and NMFS and NMFS Blend Data, June 2000.

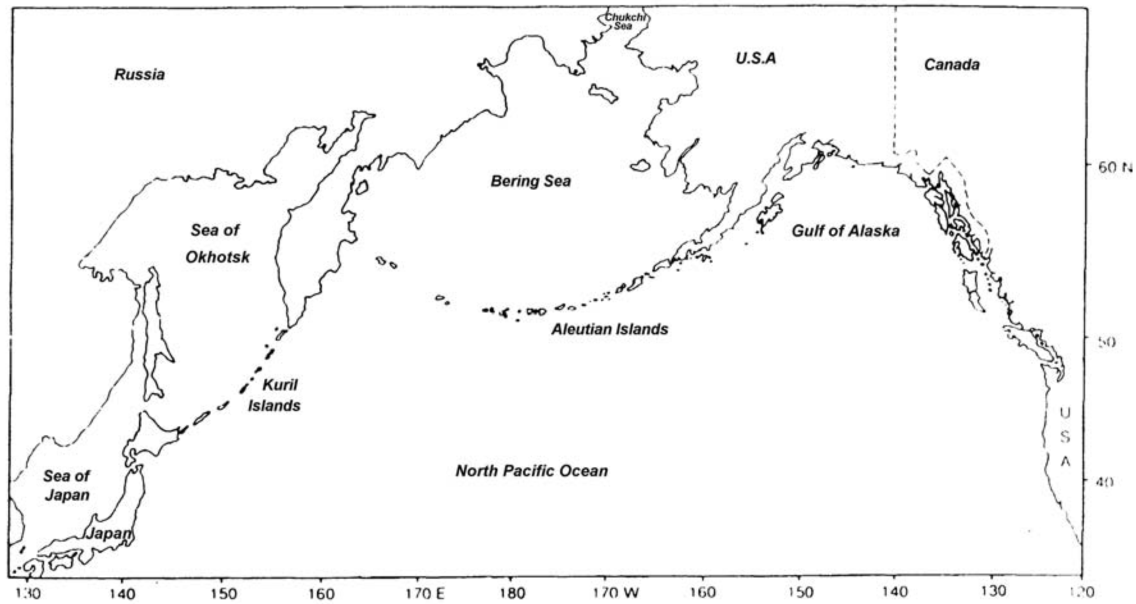

Figure 6. The North Pacific.

Source: Modified from Wespestad (1993).

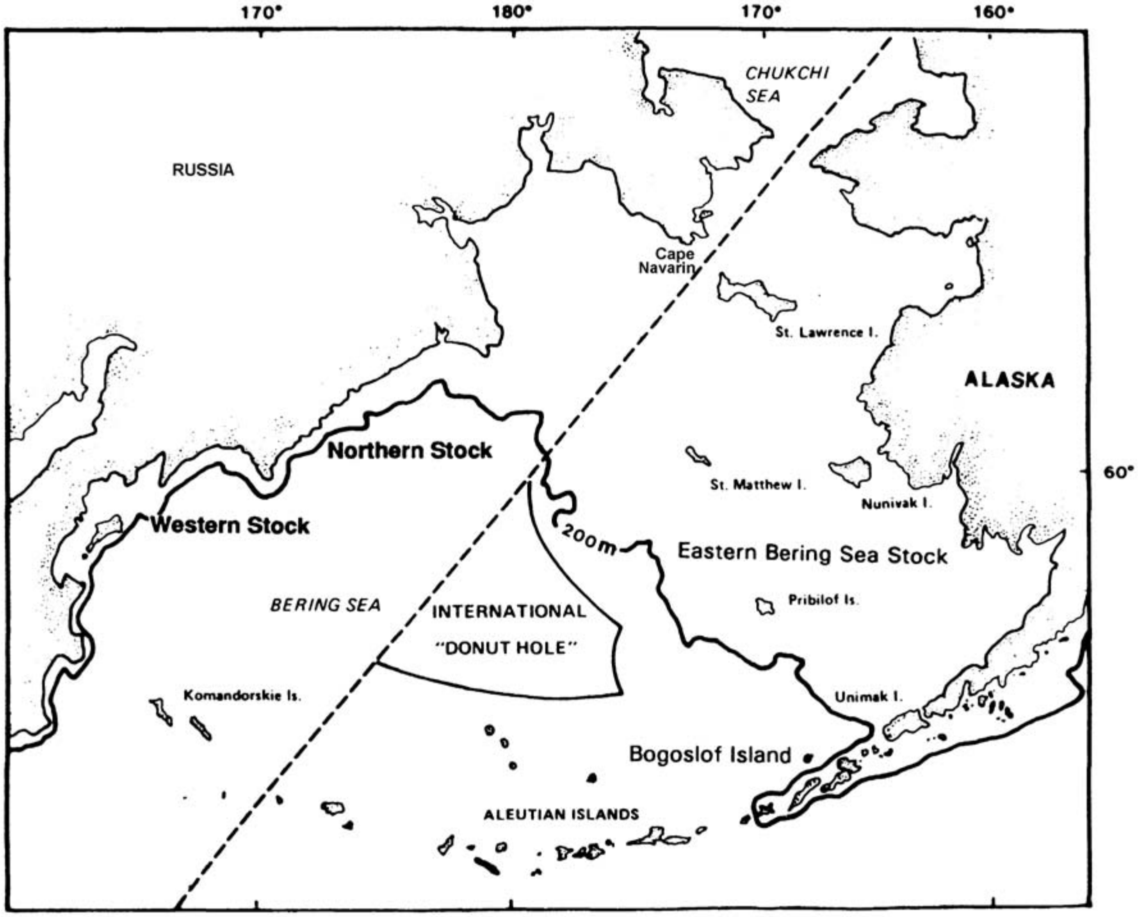

Figure 7. Major features of the Bering Sea and walleye pollock stocks.

Source: Modified from Wespestad 1993.

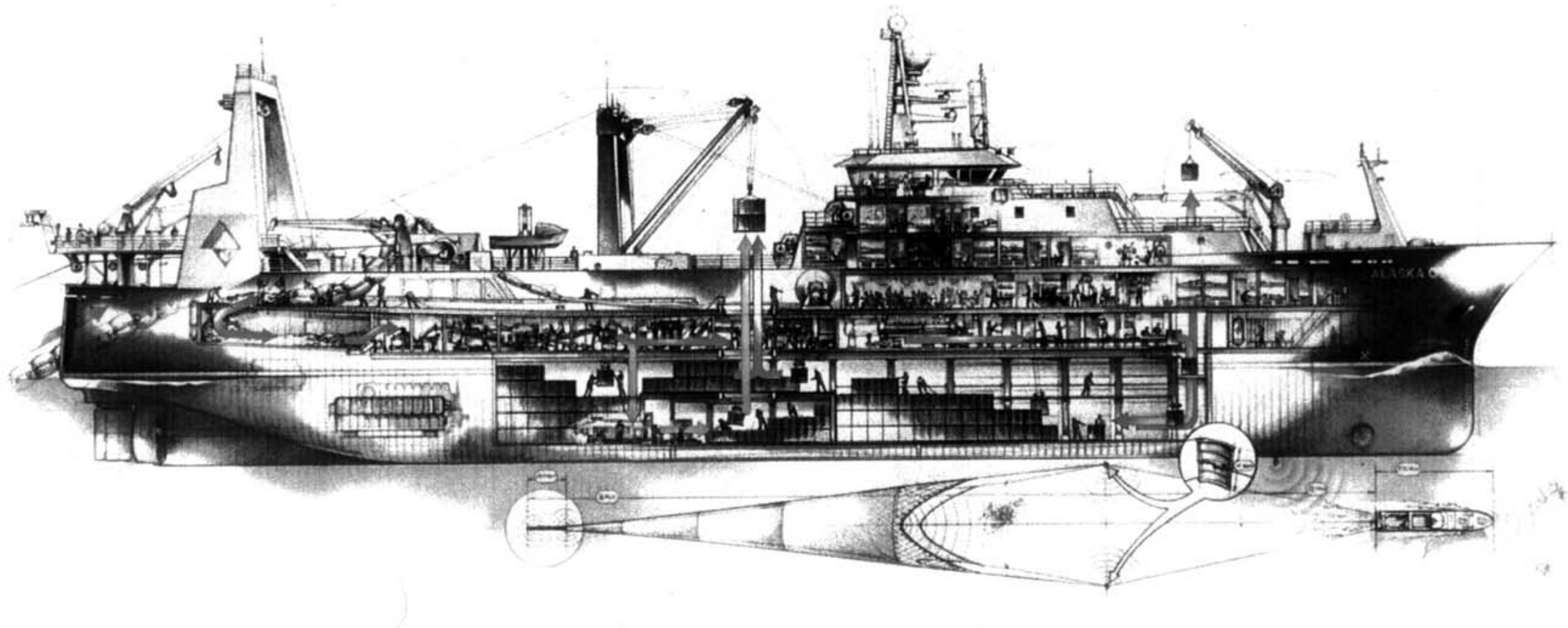

Figure 8. Schematic of a Catcher-Processor Vessel

At the far left, the trawl is winched aboard up the open stern ramp. The catch is dumped out of the cod end into a refrigerated seawater hold. Fish are then pulled out of the hold into the factory line where they are either filleted or minced for surimi. Freezer storage in the hold of the ship keeps blocks of product until it is offloaded by cranes. The inset drawing shows the deployment of the net behind the vessel as it is towed. Trawl doors designed like airplane wings to provide lift keep the net open. Electronics detect not only schools of fish, but monitor fish in the opening of the net, and also the behavior of the net as it is towed.

Source: At-Sea Processors Association 1998

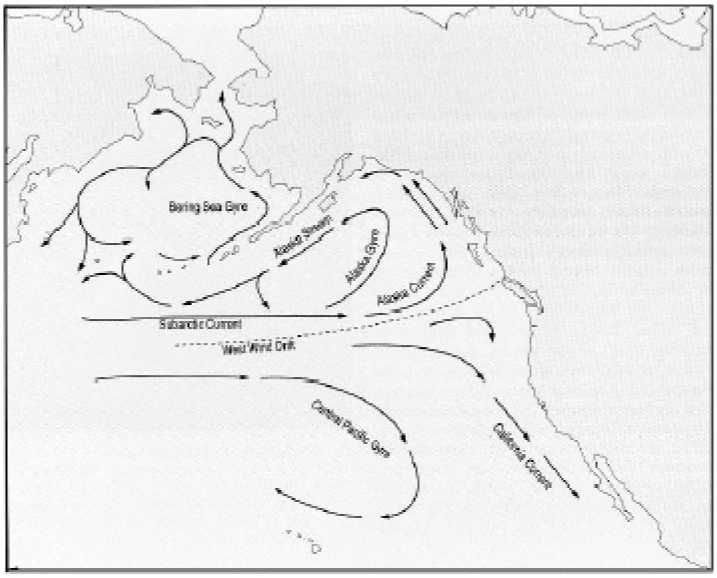

Figure 9. General surface circulation and major current systems of the North Pacific Ocean.

Source: NMFS 2001a.

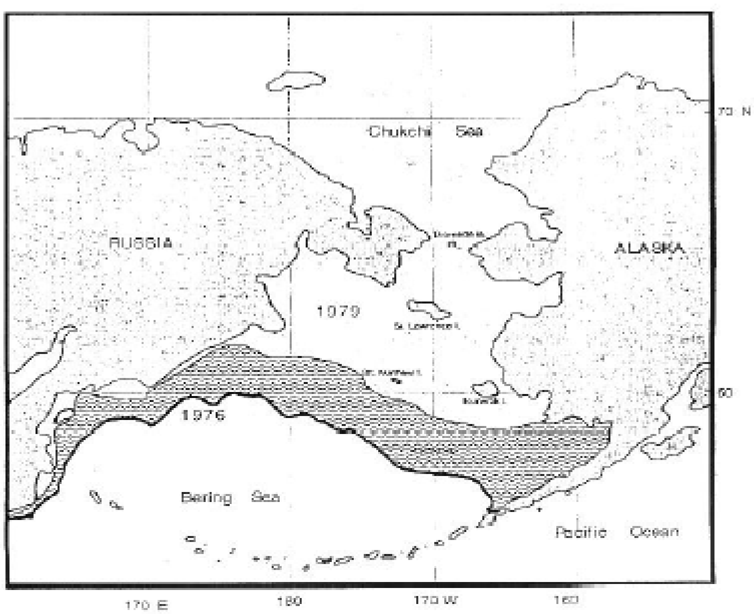

Figure 10. Maximum (1976) and minimum (1979) extent of sea ice in the Bering Sea in recent years.

Source: NMFS 2001a.

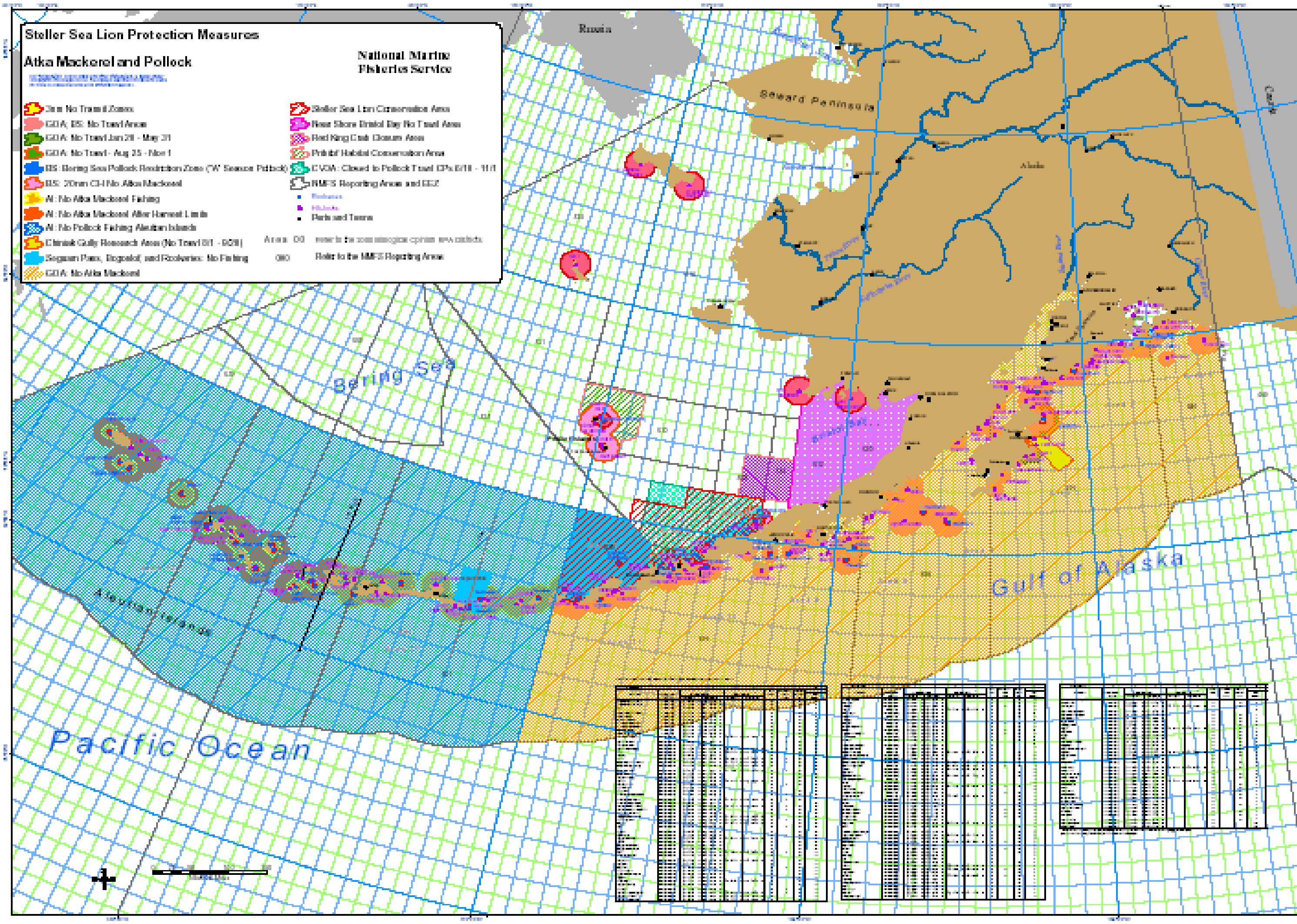

Figure 11. Map of areas where pollock and Atka mackerel fishing is restricted to protect Steller sea lions.

Source: NMFS 2001d.
*The original (and larger) version of this map is available online at http://www.fakr.noaa.gov/protectedresources/stellers/maps/Atka_Pollock.pdf. A comprehensive list of the mapped areas (including lat. and long. boundaries) is available online at http://www.fakr.noaa.gov/sustainablefisheries/sslertables/2002table22.pdf.

APPENDICES

Appendix A: Comments to Scott Burns and Chet Chaffee, November 2001

M E M O R A N D U M

TO: Scott Burns, WWF
FR: Suzanne Iudicello Martley
RE: Pollock Certification Performance Indicators

9 November 2001

Following this cover are comments related to the "advisory" sent on October 21 by Chet Chaffee of Scientific Certification Systems regarding the certification process for pollock. These comments have been prepared by Graeme Parkes, Brock Bernstein and myself. We are continuing to work on the overall comments, now in light of these performance indicators.

Comments on Performance Indicators and Scoring Guidelines for MSC Evaluation of Pollock Fisheries in the Bering Sea and Gulf of Alaska

A general comment: Under the MSC, the certifiers are given some latitude to develop performance indicators and scoring guidelines for the fishery being certified. This is presumably a reflection of the relative infancy of the certification standard. One would hope that the MSC is working towards a standard set of indicators and scoring guidelines that are comprehensive, robust, yet flexible enough to be applied to all fisheries seeking certification with little or preferably no modification between applications. Otherwise the certification tends to lose its "standard" and it becomes increasingly difficult to compare performance across certified fisheries and accredited certifying organisations.

Also in general, the indicators should have unique numbers. As it is, there are multiple indicators with the same number, which makes it confusing when referring to individual indicators. This could be accomplished by including the Principle number in the indicator number.

Principle 1.

Criterion 1 Catch levels

According to the team's stated interpretation, under MSC criterion 1 they intend to focus on "1) management of the target species and 2) management of by-product species (retained commercial species that are not the prime target of the fishery). Other aspects of "associated ecological community" are dealt with under Principle 2."

It would be better if the management procedure itself included explicit consideration of the "ecological community" rather than it being looked at as something outside the assessment of catch limits for the target species. Example measures arising from this approach include explicit catch limits for non-target, retained and discarded species (which can affect the catch limits for the target species), and a target escapement of the target species that takes into account the needs of predators (e.g. the CCAMLR assessment of krill).

Sub-criteria listings

The nesting of sub-criteria is quite well done and, once you can visualise the hierarchy (which is rather difficult at first glance), it makes reasonable sense (noting as above that I disagree with the interpretation under Criterion 1 that the "associated ecological community" should be dealt with separately). This nested structure highlights the much greater emphasis being placed on the target species compared to the retained by-catch. Pollock is a pretty clean fishery, but given the volume of the catch, it only takes a small percentage of by-catch to add up to a lot in absolute terms. There perhaps ought to be more of a balance in detail between the standards being set for the knowledge, assessment and management of the target species and those of the by-catch (both retained and discarded) species.

Sub-criteria 1.1.1 (catch control rules) and 1.1.2 (stocks are not depleted)

There needs to be a more explicit link between these indicators and their scoring guideposts and those under Criterion 2 (strategies to promote recovery of depleted stocks). Indicator 2.1 refers to threshold stock levels, but there is little mention of "target" stock sizes or fishing mortality rates under sub-criterion 1.1.1 and how the two levels (target and threshold) might operate in a management procedure incorporating decision rules. Indicators under sub-criterion 1.1.2 refer to limit reference points, which are presumably thresholds? There needs to be some clarification of the terminology (see attached discussion from a recent MRAG paper on SPR).

Indicator 1.1.1.1

Attempts to develop multispecies models and include their results in the stock assessment means that "assessment methods can vary from year to year" as improved models are incorporated into stock assessment procedures. While a strict interpretation of the 80 percent scoring guidepost ("assessment methods vary from year to year") would lead to a lower score, it would be unfortunate to downgrade the management system for its attempts to improve assessment methods.

Indicator 1.1.1.3 - uncertainty

The wording here is not very clear and may be misleading. The important point about uncertainty is that it is included in the parameters of the projection model in appropriate places and in appropriate amounts. This should then affect the output in terms of probabilities of achieving management targets. If uncertainty in inputs is high, it become harder to predict outcomes and the probability of achieving a target (or avoiding going below a threshold) at a given level of harvest falls. The result is that the harvest level must be reduced to maintain the desired probability of success. Whether "major" reductions in harvest level are needed depends upon the nature of the uncertainty and the sensitivity of the model to it.

Noting the comment below about rare events, this highlights why they should also be looked at more closely. One of the important issues here is regular reality checks (assessments) to make sure nothing unexpected, or unexplained has happened to drive the harvest strategy off track. The projection may look at the effects of a harvest strategy over several years, but that does not mean you can then go out and harvest as planned without checking back regularly to see how the system is responding in practice.

This also affects the other scoring criteria. There is quite a bit of language in the scoring guideposts requiring that this or that parameter is well known or accurate, and if this is not the case, then the score drops. The more important issue, however, is how the assessment and the projection respond to uncertainties in the parameters that are not well known. It is quite possible to manage sustainably a fishery on a stock about which little is known providing it is done in a precautionary way pending the collection of necessary information.

Indicator 1.1.2.3.1 Assessment models

It should be reasonable to expect that even at the 80 percent level of scoring, the assessment should include all sources of mortality (not just fishing mortality), but one might expect that non-fishing mortality would be lumped together into a single estimate of natural mortality. At the 100 percent level one might be looking for some examination of inter-annual and age specific components of M, and what sources of M (e.g. predation) might be most important.

Indicator 1.1.2.3.4 Adequate knowledge about the target stocks

This sub-criterion does not include indicators covering the knowledge of the geographical range of the target species (e.g. Burry Inlet cockles certification indicators 1A.1 and 1A.3). Nor does it seem to cover knowledge of stocks outside the management area of the fishery, which may be linked to those inside the management area. Stock structure, the extent and nature of exchanges between stocks inside and outside the management area, and the influence of fisheries outside the management area (e.g. in the western Bering Sea) are clearly important topics for the certification of pollock fisheries in the U.S. EEZ. This last point is apparently covered under Indicator 1.1.2.3.5.1 but the importance of this will depend on knowledge of the exchanges between stocks. Regarding scoring criteria for indicators dealing with stock identity (1.1.2.3.4.2 and 1.1.2.3.4.3), what will be important is not so much whether information on stock separation is unequivocal (which it rarely is and certainly isn't in the case of the pollock), but whether the separation of the fishery into management units is precautionary in the face of uncertainty. For example, is it possible that more than one stock has been lumped together into one management unit (not good)?

Indicator 1.1.2.3.4.5 fishery independent surveys

Regarding the 80 percent scoring criteria under this indicator, it may not be necessary for the surveys to cover "all significant components of the population" to provide "adequate information to measure trends in the abundance of stocks". Pre-recruit and/or adult stock surveys may be adequate by themselves, depending on how the information is used. It is very rare to find surveys of abundance covering "all significant components of the population".

Sub-criterion 1.1.2.3.5, Indicator 1.1.2.3.5.1

There are several issues to be covered here regarding the component of the fishing fleet that is being certified (the current action is for the At-sea Processors' Association) and the extent to which the effects of this component of the fleet are separable from the effects of other components. Are the components of the fleet operating on the target stock that are not subject to certification as well documented as those that are? What differences in selectivity might there be, for example between inshore and offshore components, and between different gears? Also, should the certification be considering the activities of the fleet subject to certification on stocks and species that are not subject to certification? If profits from the pollock fishery allow these vessels to operate elsewhere at other times of the year, should those activities come under some level of scrutiny?

Regarding the observer program, there are major issues of "statistical coverage" to be considered. Large vessels have 100 percent coverage (at least one observer per vessel covering all sea days, but not necessarily observing all hauls). Vessels less than 124ft and greater than 60ft have 30 percent coverage (by vessel days), but vessel/time allocation is not random. Vessels <60ft have no coverage. The allocation of observers and the level of coverage has historic antecedents in statutory provisions related to observation of marine mammal takes. It would be reasonable to re-examine whether the same observer coverage strategies are relevant for statistically valid observations of catch, whether observers have tasks that cover a span of information collection from fisheries to protected species, and whether either objective is adequately served by the amount of coverage.

Indicator 1.1.1.4

The underlying assumption for the scoring guideposts is that outcomes can and should be defined in terms of probability distributions. This may not always be appropriate. For example, in many complex systems, the potentially catastrophic failures are rare enough that they cannot be defined probabilistically. I recommend the certification team review the organizational literature on industrial accidents and the behavior of high-reliability organizations for alternative models.

Criterion 2. Recovery of depleted populations

(See comments under Criterion 1, sub-criteria 1.1.1 and 1.1.2)

How does the scoring under this criterion link with scoring under sub-criterion 1.1.2? Even if the fishery passes under indicators 1.1.2.1 and 1.1.2.2, there still needs to be a "well defined and effective" strategy for promoting recovery of stocks that become depleted.

Criterion 3. Reproductive capacity

More indicators are needed here to be more explicit. For example the NZ hoki certification has three sub-criteria and ten indicators (see below). Some of these are repetitive, but there are several issues that will not be covered adequately by the three indicators currently listed for pollock.

1. There is adequate knowledge about the age, genetic structure, sex composition and reproductive capacity of the target stock being fished

- There is adequate knowledge of the age, genetic structure, sex composition and reproductive capacity of the stock (NZ hoki 1F.1)
- There is adequate knowledge about the reproductive capacity (fecundity, spawning aggregations, age structure) of the target species (NZ hoki 1F.2)
- There is adequate spatial and temporal information on trends in abundance of the spawning stock (NZ hoki 1F.3)

2. There is adequate knowledge about the fishery to evaluate the impact of fishing on the reproductive capacity of the target species

- There is adequate spatial and temporal monitoring of catch, effort, age and sex composition (NZ hoki 1G.1)
- There is adequate spatial and temporal information on fishing patterns (NZ hoki 1G.2)
- There is adequate spatial and temporal information on fishing methods (gear selectivity, changes in catchability) (NZ hoki 1G.3)

3. There is a well-defined and effective strategy to manage the target stocks to ensure the effects of the fishery on the genetic structure, age and sex composition of the fish population do not impair reproductive capacity

- Age, sex and genetic structure are involved in the stock assessment (NZ hoki 1H.1)
- Reproductive capacity and spawning stock are involved in the stock assessment (NZ hoki 1H.2)
- Management tools (input and/or output controls) are specified and appropriate (NZ hoki 1H.3)
- The current status of the reproductive capacity of the population is known (NZ hoki 1H.4)

Principle 2.

Criterion 1.

The lists under the scoring guideposts are far longer here than those under Principle 1. This may be a reflection of the greater complexity of assessing the effects of fishing on the ecosystem, so the detail has migrated down to a lower level, but it might provide a more robust scoring structure if the indicators (1.2.1 to 1.2.4) were subdivided further. For example, how would you score a fishery that does well on 5 out of the 6 100 percent guidepost elements under indicator 1.2.1, compared to one that does well on only 3 out of the 6? By contrast, most of the guideposts under Principle 1 have only one element.

Indicator 1.2.1

Is the concern about impacts on benthic habitats and corals relevant for this fishery, since it is a midwater trawl fishery? Are you trying to pick up the small portion of the fishery using pots?

Third guidepost under 100 percent, should be “affect” not “effect”

Indicator 1.2.2

The scoring guidelines ignore food chain impacts. Not all impacts on vertebrate and invertebrate communities will occur through bycatch, discard, and direct impacts on habitat. What about the fact that removal of pollock may increase abundance of pollock prey, thereby increasing/decreasing relative population sizes of the prey’s planktonic food species?

Indicators 1.2.2 – 1.2.4

It is not clear what the difference is among these three indicators. They all focus on impacts on invertebrate or vertebrate communities or biodiversity, and the wording from one to the next is not different enough to seem significant.

Subcriterion 1.3

This seems at odds with subcriterion 1.2. If knowledge is adequate, this reduces the need for research; conversely, if knowledge is inadequate, this would tend to increase the need for research. It therefore seems unlikely that a well-managed fishery would be able to simultaneously achieve the highest score on both sets of indicators. If ultimately the total score received will be compared against the theoretical maximum possible on all indicators, then there's a glitch here.

Indicator 1.3.1

Simply measuring abundances, productivity, etc. over many years and calculating their variability (100 percent scoring guidepost) should not be the requirement for receiving a 100 percent score on this indicator. It's not the measurements that are important but the synthesis of those into a set of internally consistent explanatory hypotheses that can provide the basis for making predictions about future system states and/or explaining them well enough when they occur that an intelligent choice can be made among alternative management actions. As written, a routine monitoring program that collected data for years and never analyzed or synthesized it could receive a maximum score on this indicator.

Indicator 1.3.2

The scoring guidelines for this indicator may reflect an underlying assumption that habitats are sites that are fixed in space. While that is true in many instances, it is also true that key habitats for organisms in the Bering Sea and Gulf of Alaska ecosystems are defined by specific oceanographic features that move around somewhat in space. Simply tying a monitoring program to a "large number of sites across the geographic range of the fishery" may or may not capture such features. I recommend that more thought be given to incorporating the dynamic nature of this ecosystem in the scoring guidelines.

Criterion 2.

Criterion 2 mentions biological diversity at the genetic, species and population levels, but there is no mention of this in the indicators and scoring guideposts. Biodiversity is mentioned in the sub-criteria and indicators under Criterion 1, although it is not mentioned explicitly in the Criterion – it is in the Certifier's interpretation however. It is unclear how this should be handled, but in any event, the following sub-criteria and indicators might be helpful:

Sub-criteria

The fishery is conducted in a manner which does not have unacceptable impacts on biological diversity at the genetic, species or population levels

An ecological risk assessment has been conducted to determine the potential impacts of the fishery on the genetic, species and population level biodiversity

Indicators:

- There is information available on biological diversity at the genetic, species or population levels
- The effects of the fishery on biological diversity at the genetic, species or population levels have been adequately determined
- Information is available on the extent and significance of such effects

Regarding Subcriteria 2.2 and 2.3 and Indicators 2.2.1 through 2.3.3 thereunder, activities such as assessments, permitting, monitoring, and research related to endangered, threatened, protected or icon species occur in or are conducted by management authorities outside the fishery management regime. It would be useful to have a performance indicator that examines the management system's ability to integrate information and authorities outside the fishery realm. Although Subcriteria 2 and 3 under Principle 3 deal with many of these coordination and integration issues, there is no mention there of protected species. The following might be helpful additions to Subcriteria 2.2 and 2.3:

Indicators:

- The management system includes provisions for acquiring, integrating and synthesizing new scientific information from protected species research, management and recovery programs outside fishery management
- The management system recognizes applicable legislative and institutional responsibilities outside fishery management
- The management system has established mechanisms to conduct integrated and synthetic environmental assessment

<u>Criterion 3.</u>

I agree with the interpretation of "exploited populations" indicated by the certifiers. In fact, the language under this Criterion is more or less identical to that under Criterion 2 of Principle 1. This may be a mistake in the original drafting of the Ps and Cs, since under Principle 2 the focus is clearly on the ecosystem, including non-target species affected by the fishery. There needs to be some specific provision which covers strategies for the recovery and rebuilding of non-target species affected by the fishery, including endangered, threatened or protected species. I recognise that we are not at liberty to change the wording of the criteria, however, to illustrate the point, I suggest that the term "exploited populations" in the criterion should be replaced by "populations affected by the fishery", and the words "and considering the ability of the population to produce long-term potential yields" should be deleted. This criterion would therefore become

"Where populations affected by the fishery are depleted, the fishery will be executed such that recovery and rebuilding is allowed to occur to a specified level within specified time frames, consistent with the precautionary approach".

As stated in the comments under Criterion 1, the protection of dependent and related species (e.g. major predators) should, to the extent possible, be integrated into the decision rules used to determine catch limits and other restrictions on the fishery.

Principle 3

Indicator 1.2

The idea that a fishery management plan **must** include significant and representative areas set aside as no-take zones to achieve the 100 percent scoring guidepost is unrealistic. It is important to specify here what these are intended to accomplish. No take zones are more or less effective depending on the life histories of the species involved, their habitats, the nature of the fishery management regime, and the current status of the stock. Simply requiring that every management plan include no take zones begs these and other significant issues. The indicator itself refers to "Application of zone-based management, where appropriate" – i.e. not in every case. The guidepost at the 80 percent level "No-take zones are used where appropriate" is much better and should be used at the 100 percent level. See the language under indicator 4.1.8 for more effective wording.

Indicator 1.3

Re the scoring guideline that "all environmental and social externalities of fishery are identified, documented and internalized by the fishery," the "all" part of this seems unrealistic and unachievable. I would wager that there is no industry, or industry segment, anywhere in the world that internalizes "all" externalities. Achieving such a goal in this fishery would require substantial changes to nationally accepted accounting practices, state and federal laws, and assumptions about the role of government in society. This seems beyond the scope of the fishery management system.

Re the scoring guideline that "economic rent is shared … by all communities historically dependent…," the definition of the word "historically" is important. The certification team should be aware that the pollock fishery is a relatively new one, without the lengthy history of participation typical of fisheries in other, more accessible regions.

Re the scoring guideline that "fishery management system provides for long-term predictability needed for investment," long-term predictability is not needed for investment. Investment decisions, many of them very large, are made all the time by other industries in the face of large uncertainties. What is important is that, if long-term predictability is not available or possible, that parties have access to the tools needed to hedge uncertainty and manage risk. I recommend expanding the scoring guidelines to include the concept of risk management and hedging, and the ability and willingness of the management system to accommodate such concepts. Given the nature of this ecosystem, long-term predictability may never be possible and it may be a waste of time to keep trying to achieve it.

Overall, the 100 percent scoring guidelines under this indicator seem overly unrealistic. For example:

"All aspects of fishery free from subsidies that promote overfishing or ecosystem degradation". From experience in other areas, we expect that this will be impossible to show.

"All participants in fishery have access to short- and long-term economic incentives to prevent overfishing and ecosystem degradation". There are plenty of ways of avoiding overfishing and ecosystem degradation without the need to provide access to economic incentives (limited entry for example).

"New entrants into the fishery can be accommodated without unduly disrupting other participants or undermining fishery and ecosystem management goals." I don't understand why this is required. No fishery can continue to accommodate new entrants *ad infinitum*. Many fisheries are over-subscribed in terms of the demand for access and entry is limited through a licensing system. Why would such a fishery be scored lower than one that is sufficiently under-subscribed that it can accept new entrants?

What might make more sense is for the social and economic indicators to mirror the stock and ecological ones. For example, rather than set arbitrary—and probably unachievable—performance measures for aspects such as incentives, investment and so forth, why not require the system to set long-term social and economic objectives just as it would for the target stock and the ecosystem? For example, does the system have a mechanism for the kind of long-range planning where stakeholders can describe their "vision" for the future of what they want the fishery to look like? Are there collaborative and rational ways to define objectives for the fleet composition geographically, by community, by size, gear and so forth? Is there a mechanism for stakeholders to determine how to accommodate new entrants? Or are these issues resolved de facto in the hurly-burly of allocation disputes? Most of the hard and fast requirements defined under the 100 percent scoring guidepost could be described in the plan's objectives, if it were required to define some related to people, communities, and social and economic issues.

Sub-criterion 2

Under this criterion it would seem to be important to take up the issue raised under the MSC criterion "The management system shall incorporate an appropriate mechanism for the resolution of disputes arising within the system". Here there is a footnote that states: *"Outstanding disputes of substantial magnitude involving a significant number of interests will normally disqualify a fishery from certification."* A suitable indicator would be:

- There are no outstanding disputes of substantial magnitude involving a significant number of interests

Indicator 2.1 provides an example of the problem stemming from the duplicative numbering scheme. Is the reference to MSC Criterion 3.1 to Criterion 3.1 under Principle 1 or under Principle 2? Also, all the references under the indicators in Principle 3 to other Criteria (e.g., 3.10) actually appear to be references to other indicators. Whatever the case, avoid confusion by being clear which Principle is being referred to.

Indicator 2.2

The requirement in the 100 percent scoring guidepost that "the management system, including its component institutional entities, has not been found at any time to be in violation of any order of any domestic court of jurisdiction on any matter related to performance of any statutory duty" sets the bar quite high. This is especially true if one considers the courts to be part of the dispute resolution system (see comment on Indicator 3.4 below). Active stakeholder participation often results in litigious advocacy as a means to improve the performance of a system. Nevertheless, as an indicator of ideal performance, we concur in this choice.

Indicator 3.4

It will be important for the evaluation team to decide if they consider the courts to be part of the management system or not. If they are, then lawsuits are just a part of the dispute resolution procedures provided for in law and regulation. If they are not, then lawsuits represent a breakdown in the management system.

Annex: Extract from MRAG paper on SPR
Levels of risk: targets, limits and thresholds

There are two risks involved in implementing National Standard 1. Firstly, there is the biological risk that the stock will become overfished, with the subsequent negative consequences for the fishery. As the level of catch (yield) gets closer to the estimate of maximum sustainable yield, uncertainty and variability dictate that the risk that the stock will become overfished increases (i.e. the catch will overshoot the maximum sustainable yield on a regular basis). Secondly, there is the risk that catches will be too low to achieve social and economic objectives and the potential of the fishery will not be realized (Mace 1994).

Part of the role of fishery managers is to determine or define acceptable levels of risk, and hence what values should be used for reference points to meet the objective of OY, incorporating biological, economic and social considerations in their assessment. As we have seen, text in the 1996 Magnuson-Stevens Act requires that OY cannot be higher than MSY. Management using reference points based on OY should therefore reduce the risk of overfishing compared to simply using MSY. In this context it is important to clarify the terminology used in defining reference points, including *targets*, *thresholds* and *limits* (see Fig. 2).

A *target* reference point usually indicates a desirable state of a fishery, which should be the goal of management action, whether during fishery development, operation of the fishery at near-optimal conditions, or rebuilding from an overfished state. The term *threshold* has been used in the US to indicate a state of the fishery that is undesirable, which management action should avoid (e.g. Rosenberg *et al.* 1994, Restrepo *et al.* 1998). This corresponds to the use of the term *limit* reference point in much of the rest of the fisheries management community around the world (e.g. Garcia 1995). The Food and Agriculture Organization of the United Nations (FAO), and much of the international literature, uses the term threshold to define an "early warning" reference point. Reaching a threshold indicates that a certain type of action (usually agreed beforehand) needs to be taken to reduce the probability that a target or limit point would be exceeded, due to uncertainty in estimates of stock status, or slow management reaction.[33]

[33] This is analogous to the "interim thresholds" referred to in the preamble of the final rule issuing the NSGs.

To avoid confusion in this paper, we will use only two terms for reference points; target and limit. The use of these terms corresponds to that adopted by the international community. For those familiar with terminology used routinely in the U.S., our use of the term limit can be assumed to mean the same as threshold as it is used in the NSGs and some other fisheries literature in the U.S.

By definition in the Magnuson-Stevens Act, the target reference point is represented by OY. This is based on biological, economic, social and other relevant factors, and is always less than or equal to MSY. Due to uncertainty and variability, the target may be exceeded sometimes. Target reference points should be specified so that this is not a problem, providing the level is not exceeded more than 50% of the time, nor on average.

A limit reference point defines the level at which a fish stock becomes overfished. It is therefore defined on the basis of biological considerations only and should be expressed in quantities related to the MSY management objective, for example, as a particular level of adult biomass (a minimum) or fishing mortality (a maximum). The NSGs indicate that in all cases, criteria for determining the status of fished populations must specify both a maximum fishing mortality limit (threshold), or reasonable proxy, and a minimum stock size (biomass) limit (threshold), or reasonable proxy. In terms of our two goals listed in Section 2.3.2, the first is an indicator of overfishing and the second is an indicator of the overfished condition.

In some fishery management plans, the limit (threshold) and target reference points are specified at the same level. Specifying any type of reference point is a step in the right direction, but due to uncertainty in our understanding of the dynamics of most fisheries, it is dangerous to specify the target and the limit as the same. The probability of exceeding the limit year after year, and consequently overfishing the stock is too high. In essence, the limit should *not* be set up as the target, because the chances of missing the target are too great. Put another way, one cannot achieve a goal (the target) while at the same time trying to avoid it (the limit). The specification and use of a target reference point should ensure there is a buffer zone into which the status of the fishery may dip from time to time without crossing the limit and becoming overfished.[34]

Having said that, in considering a fish stock which is recovering from an already depleted state, Powers (1999) emphasized that the highest priority is to determine the limit (threshold) measure, rather than planning the transition of the stock to produce optimum yield (i.e. the target). He considered that, particularly if the recovery trajectory is lengthy, the debate associated with defining the target criteria is not as important as the initiation of recovery itself. As recovery approaches the limit (threshold) level, then questions concerning optimum yield (the target) and how quickly it should be achieved rise in priority (see also Section 6.3).

[34] This, and the specification of control rules associated with threshold and target reference points, is one of the corner stones of the precautionary approach to fisheries management, which advocates the implementation of conservation measures even in the absence of scientific certainty that fish stocks are being overexploited.

Appendix B: Elements of the U.N. Agreement on Straddling Fish Stocks and Highly Migratory Fish Stocks

Management Goal: The management goal of the U.N. Straddling Stocks Agreement, expressed in Article 2, is “to ensure the long-term conservation and sustainable use" of straddling fish stocks and highly migratory fish stocks.

Precautionary Approach: Article 6 and Annex II describe the precautionary approach. The core of the precautionary approach is to act cautiously but expeditiously when information is “uncertain, unreliable, or inadequate,” in the words of the U.N. Agreement. The Agreement describes a process for applying this approach that includes the following general features:

A) Identifying precautionary reference points for each stock of fish;

B) Identifying in advance management measures that will be adopted if reference points are exceeded;

C) Adopting “cautious” management measures for developing fisheries, until information allows setting reference points;

D) Monitoring the impact of fishing on non-target species and developing plans to conserve them; and

E) Adopting emergency measures if continued fishing would increase the risk of depletion caused by a natural event.

Compatibility of Measures: Article 7 requires compatibility between conservation measures on the high seas and those in the exclusive economic zones of coastal States. Among other considerations in determining compatibility, States are to take into account the biological unity of stocks and the distribution of the stocks, the fisheries, and the geography of the region. If compatible measures are not achieved, States are to use the procedures for dispute resolution identified in the U.N. Agreement.

Elements of Regional Agreements: According to Article 9, regional arrangements are to identify the stocks under management, the area of application, and the way in which a regional regime will obtain scientific advice.

Functions of Regional Regimes: Article 10 identifies 13 specific functions, which may be summarized as follows:

A) Developing conservation measures in a timely manner;

B) Obtaining scientific advice;

C) Collecting, analyzing, and disseminating fisheries data;

D) Monitoring and enforcing conservation measures;

E) Insuring full cooperation of national agencies in implementation;

F) Identifying how new members will be accommodated; and

G) Promoting peaceful settlement of disputes.

Transparency: Article 12 calls for transparency in decision making by regional regimes and for the participation of intergovernmental and nongovernmental organizations, subject to procedural rules that are not “unduly restrictive.”

Membership: Article 17 calls upon State members of regional regimes to request that non-participating States join the regime and to take action to deter activities that undermine the effectiveness of regional conservation regimes.

Flag State Responsibilities: Article 18 enumerates eight obligations of flag States, including maintaining an accessible registry of vessels authorized to fish on the high seas, requirements for vessel and gear marking and for timely reporting of catch and other information, national inspection and observer schemes, and measures to insure transhipment at sea does not undermine conservation measures.

Enforcement: Article 19 enumerates five obligations of flag States in enforcing regional conservation measures. Articles 20-23 describe procedures by which Flag States and other States should collaborate in enforcing regional conservation measures, and provides authority for States to board fishing vessels of other States. Article 21 identifies eight specific activities that qualify as serious violations, including failing to maintain accurate records of catch, fishing in closed areas or seasons, or using prohibited fishing gear. Regional regimes may identify other serious violations.

Developing States: Articles 24-26 of the U.N. Agreement call for providing financial and technical assistance to developing States for management under the Agreement. Conservation measures are not to place an undue burden on developing States.

Dispute Resolution: Articles 27-32 call for States to settle disputes through peaceful means of their choice, and describe procedures for settling disputes.

Information Collection and Analysis: Article 14 describes five principal obligations of States for collecting and providing information and cooperating in scientific research. Annex I provides specific types of data that should be collected on fisheries and vessels, and describes obligations for frequent reporting by vessels, verification of data, and data exchange.

Other Obligations: Article 5 briefly describes 12 general tasks, some of which are described in greater detail elsewhere in the UN Agreement. Tasks that do not receive significant additional treatment in the U.N. Agreement include:

A) Assess the impacts of fishing and other factors on target, associated, or dependent stocks;

B) Adopt measures to maintain or restore associated or dependent species above levels “at which their reproduction may become seriously threatened;”

C) Minimize pollution, waste, discards, catch by lost or discarded gear, and bycatch;

D) Protect biodiversity;

E) Adopt measures to prevent or eliminate overfishing and overcapitalization; and

F) Consider the interests of artisanal and subsistence fishermen.

Source: Weber 1998.

Appendix C: History of the Bering Sea/Aleutian Islands Fishery Management Plan

Year	Amendment	Regulatory Action(s)
2001	69	Allows vessels to lease their pollock quota to AFA qualified vessels outside their co-ops.
2001	68	Pot cod split CV/CP analysis; split the 18.3% of pot gear Pacific cod TAC among pot catcher/processors and pot catcher vessels according to historical catch.
2001	67	Stabilizes the fully utilized fixed gear Pacific cod fishery in the BSAI using endorsements for exclusive access to long-time participants.
2000	66	Removes the squid allocation to the Western Alaska CDQ program. Prevents incidental catch of squid in pollock fisheries.
2000	65	Prohibits a commercial fishery for HAPC biota (corals, sponges, kelp, rockweed, and mussels).
2000	64	Apportions hook-and-line or pot gear (fixed gear) allocation of TAC of Pacific cod in BSAI among hook-and-line catcher-processor vessels and hook-and-line catcher vessels and pot-gear vessels.
1999/2001	63	Revises management of sharks, skates, squid, octopi, and sculpins into "other species."
	62	See 61.
2000	61	Incorporates the provisions of the AFA into the FMPs and their implementing regulations (formerly Plan Amendment 62).
2001	60	Makes changes to the License Limitation Program.
1998	59	Extends the Vessel Moratorium Program for qualified vessels.
1999	58	Establishes a framework to allow NMFS to reduce the annual trawl bycatch limit for Chinook salmon and revises the Chinook Salmon Savings Area in the BSAI to reduce bycatch of Chinook salmon by trawl fisheries in the BSAI.
1999	57	(1) Prohibits the use of nonpelagic trawl gear in the directed pollock fisheries of the BSAI; (2) revises the existing performance standard for pelagic trawl gear; and (3) reduces crab and halibut bycatch limits established for the BSAI groundfish trawl fisheries to address bycatch reduction objectives.
1999	56	Defines ABC and OFL for the BSAI groundfish fisheries.
1999	55	Delineates EFH ("…those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity") for all managed species.
2001	54	Makes three changes to the Individual Fishing Quota program for fixed gear Pacific halibut and sablefish fisheries off Alaska: (1) allows a QS holder's indirect ownership of a vessel; (2) defines "a change in the corporation or partnership" to prevent estates; and (3) standardizes use limits for the two IFQ species.
1998	53	Allocates shortraker rockfish and rougheye rockfish (SR/RE) in the Aleutian Islands subarea between vessels using trawl gear and vessels using non-trawl gear to prevent the incidental catch of SR/RE in trawl fisheries from closing non-trawl fisheries.

Year	Amendment	Regulatory Action(s)
	52	Implements advance registration requirements for vessels participating in certain fisheries at risk of TAC overages; implementation of sideboard measures under the AFA alleviates the need for this measure
1998	51	Re-establishes the catcher vessel operational area in the Bering Sea and the allocations of TACs of pollock and Pacific cod between inshore and offshore components through 2001. Recommended changing the pollock allocations from 65% offshore and 35% onshore to 61% offshore and 39% onshore for 1999-2001. Partially approved/disapproved.
	50	Authorizes the retention and processing of halibut taken as bycatch up to a limit of 50,000 pounds, for donation to economically disadvantaged individuals (halibut donation program).
1997	49	Requires all vessels fishing for groundfish in the BSAI management area to retain all pollock and Pacific cod beginning January 1, 1998, and all rock sole and yellowfin sole beginning January 1, 2003. Establishes a 15% minimum utilization standard for all at-sea processors; for pollock and Pacific cod beginning January 1, 1998 and for rock sole and yellowfin sole, beginning January 1, 2003.
1998	48	Streamlines the Council's annual groundfish harvest specification process. Identifies legal and technical problems. Concept of this amendment was tabled in mid-1999.
1996	47	Repeals regulations implementing the North Pacific Fisheries Research Plan. Establishes an Interim Groundfish Observer Program until a long-term program that addresses concerns about observer data integrity, equitable distribution of observer coverage costs, and observer compensation and working conditions is recommended by the Council and implemented by NMFS.
1996	46	Authorizes the continued allocation of Pacific cod TAC among vessels using different gear types and the further allocation of the portion of the Pacific cod TAC to vessels using trawl gear between catcher vessels and catcher-processor vessels.
1998	45	Reauthorizes the allocation of 7.5% of the pollock TAC to the Western Alaska CDQ program.
1996	44	Adopts new definitions for ABC and overfishing levels.
1996	43	Increases the consolidation ("sweep-up") levels for small quota share blocks for Pacific halibut and sablefish managed under the IFQ program.
1996	42	Allows quota shares and IFQ assigned to vessels in larger size categories to be used on smaller vessels. Provides small boat fishermen with more opportunities to improve the profitability of their operations.
1996	41	Authorizes the annual specification of *C. bairdi* PSC limits in Zones 1 and 2 based on abundance of crab estimated from data collected during the annual NMFS trawl survey.
1997	40	Establishes a PSC limit for *C. opilio* crab in a new Bycatch Limitation Zone of the Bering Sea. Upon attainment of a *C. opilio*

Year	Amendment	Regulatory Action(s)
		bycatch allowance apportioned to a particular trawl fishery category, the *C. opilio* Bycatch Limitation Zone would be closed to directed fishing for species in that trawl fishery category.
1997	39	Establishes a 7.5% CDQ reserve for each groundfish species TAC and PSC limit, and a license limitation program.
1995	38	Amends #18 with two changes: (1) decreases size of the catcher vessel operational area by moving the western boundary of the area 30 minutes to the east; and (2) allows catcher processors to engage in directed fishing for pollock inside the catcher vessel operational area if the inshore component pollock allocation was closed to directed fishing and the offshore component allocation was still open to directed fishing.
1996	37	Authorizes the annual specification of the red king crab bycatch limit based on the abundance of Bristol Bay red king crab.
1997	36	Defines a forage fish species category and implements associated management measures.
1995	35	Requires a second NMFS-certified observer at shoreside processing facilities that (1) offload fish at more than one location on the same dock; (2) have distinct and separate equipment at each location to process those fish; and (3) that receive Bering Sea pollock harvested by catcher vessels in the catcher vessel operational area, during the second pollock season.
1997	34	Requires that up to 2% of the TAC for Atka mackerel in the eastern Aleutian Islands district and the Bering Sea subarea be allocated to the jig gear fleet.
1995	32	Achieves full utilization by relieving transfer restrictions on CDQ compensation quota shares, thereby allowing transfers to persons who could use the resulting IFQ to harvest the resource.
1994	24	Allocates on a temporary basis the BSAI Pacific cod TAC among vessels using trawl gear (54%), fixed gear (hook-and-line and pot) (44%) and jig gear (2%). The allocations, which were scheduled to expire at the end of 1996, represented roughly the existing harvest percentages of the two major sectors (trawl and hook-and-line), while specifically allocating 2% to jig gear. The 2% allocation to jig gear exceeded the existing harvest percentage taken by that gear type and was intended to allow for growth in the jig sector.
	23	Adopts vessel replacement restrictions (moratorium).
1991	18	Establishes a CDQ program and sets aside one-half of the pollock reserve (7.5% of the BSAI pollock TAC) for CDQ harvest; allocates 35% of the remaining BSAI pollock TAC to vessels catching pollock for processing by the inshore component and 65% of the remaining BSAI pollock TAC to vessels catching pollock for processing by the offshore component in the first year of the allocation, with the inshore allocation increasing to 40% in the second year and to 45% in the third and fourth years of the amendment, respectively. Also establishes a catcher vessel operational area from which catcher processors and motherships

Year	Amendment	Regulatory Action(s)
		would be excluded throughout the fishing year when operating in a directed fishery for pollock.
	1	Provides the framework to manage the groundfish resources as a complex.

Appendix D: Tiered System for Determining Overfishing Levels in the Bering Sea/Aleutian Islands and Gulf of Alaska groundfish fisheries

1) Information available: Reliable point estimates of B and B_{MSY} and reliable pdf of F_{MSY}.

1a) Stock status: $B/B_{MSY} > 1$

$F_{OFL} = \mu_A$, the arithmetic mean of the pdf

$F_{ABC} \leq \mu_H$, the harmonic mean of the pdf

1b) Stock status: $\alpha < B/B_{MSY} \leq 1$

$F_{OFL} = \mu_A \times (B/B_{MSY} - \alpha)/(1 - \alpha)$

$F_{ABC} \leq \mu_H \times (B/B_{MSY} - \alpha)/(1 - \alpha)$

1c) Stock status: $B/B_{MSY} \leq \alpha$

$F_{OFL} = 0$

$F_{ABC} = 0$

2) Information available: Reliable point estimates of B, B_{MSY} , F_{MSY} , $F_{35\%}$, and $F_{40\%}$.

2a) Stock status: $B/B_{MSY} > 1$

$F_{OFL} = F_{MSY}$

$F_{ABC} \leq F_{MSY} \times (F_{40\%}/F_{35\%})$

2b) Stock status: $\alpha < B/B_{MSY} \leq 1$

$F_{OFL} = F_{MSY} \times (B/B_{MSY} - \alpha)/(1 - \alpha)$

$F_{ABC} \leq F_{MSY} \times (F_{40\%}/F_{35\%}) \times (B/B_{MSY} - \alpha)/(1 - \alpha)$

2c) Stock status: $B/B_{MSY} \leq \alpha$

$F_{OFL} = 0$

$F_{ABC} = 0$

3) Information available: Reliable point estimates of B, $B_{40\%}$, $F_{35\%}$, and $F_{40\%}$.

3a) Stock status: $B/B_{40\%} > 1$

$F_{OFL} = F_{35\%}$

$F_{ABC} \leq F_{40\%}$

3b) Stock status: $\alpha < B/B_{40\%} \leq 1$

$F_{OFL} = F_{35\%} \times (B/B_{40\%} - \alpha)/(1 - \alpha)$

$F_{ABC} \leq F_{40\%} \times (B/B_{40\%} - \alpha)/(1 - \alpha)$

3c) Stock status: $B/B_{40\%} \leq \alpha$

$F_{OFL} = 0$

$F_{ABC} = 0$

4) Information available: Reliable point estimates of B, $F_{35\%}$, and $F_{40\%}$.

$F_{OFL} = F_{35\%}$

$F_{ABC} \leq F_{40\%}$

5) Information available: Reliable point estimates of B and natural mortality rate M.

$F_{OFL} = M$

$F_{ABC} \leq 0.75 \times M$

6) Information available: Reliable catch history from 1978 through 1995.

OFL = the average catch from 1978 through 1995, unless an alternative value is established by the SSC on the basis of the best available scientific information.

ABC ≤ 0.75 × OFL.

Sources: NPFMC 2000a; 2000b.

Appendix E: Regulatory Framework

Management of North Pacific pollock in the high seas area of the Bering Sea is governed by the **Convention on the Conservation and Management of Pollock Resources in the Central Bering Sea** (Senate Treaty Doc. 103-27), adopted in 1994. In addition to allocation, observer coverage and other provisions, the Convention includes a prohibition on fishing in the Donut Hole until the biomass of the Aleutian Basin stock is determined to exceed a threshold of 1,670,000 mt. China, Korea, Russia, the United States, Japan and Poland are all party to the agreement.

Management of the North Pacific pollock fishery in the U.S. EEZ is governed by a number of federal statutes designed to protect the biological and human components of U.S. fisheries, as well as the ecosystems within which those fisheries are conducted. Major laws affecting federal fishery management decision making are summarized below.

The **Magnuson-Stevens Fishery Conservation and Management Act** (M-SFCMA) (16 U.S.C. 1801 et seq.) (originally enacted in 1976 as the Fishery Conservation and Management Act) claims sovereign rights and exclusive fishery management authority over most fishery resources within the U.S. EEZ, an area extending 200 nautical miles from the seaward boundary of each of the coastal states, and authority over U.S. anadromous species and continental shelf resources that occur beyond the U.S. EEZ. Responsibility for federal fishery management decision making is divided between the U.S. Secretary of Commerce and eight regional fishery management councils that represent the expertise and interests of constituent states. Regional councils are responsible for preparing, monitoring, and revising management plans for fisheries needing management within their jurisdiction. The Secretary is responsible for promulgating regulations to implement proposed plans and amendments after ensuring they are consistent with ten national standards set forth in the statute, as well as with other provisions of the M-SFCMA, regulations governing international fisheries in which the United States participates, and other applicable laws. This responsibility has been delegated to the National Marine Fisheries Service under the National Oceanic and Atmospheric Administration.

The **American Fisheries Act** (AFA) of 1998, located within the Omnibus Consolidated and Emergency Supplemental Appropriations Bill for Fiscal Year 1999, provides for the allocation of pollock quota among the catcher-processor, mothership, and inshore processing sectors.

The **Coastal Zone Management Act** (CZMA) of 1972 (16 U.S.C. 1451 et seq.) encourages state and federal cooperation in the development of plans that manage the use of natural coastal habitats, as well as the fish and wildlife those habitats support. When proposing an action determined to directly affect coastal resources managed under an approved coastal zone management program, NMFS is required to provide the relevant state agency with a determination that the proposed action is consistent with the enforceable policies of the approved program to the maximum extent practicable at least 90 days before taking final action.

The **National Environmental Policy Act** (NEPA) of 1969 (42 U.S.C. 4321 et seq.) requires federal agencies to consider the environmental and social consequences of proposed major actions, as well as alternatives to those actions, and to provide this information for public consideration and comment before selecting a final course of action. Under NEPA and its implementing regulations, NMFS is required to prepare environmental impact statements for major fishery actions that significantly affect the quality of the human environment and to prepare an environmental assessment for those actions that are determined to not significantly affect the human environment. Social considerations are to be accounted for through the development of social impact assessments.

The **Endangered Species Act** (ESA) of 1973 (16 U.S.C. Section 1531 et seq.) requires that federal agencies use their authorities to conserve endangered and threatened species and that they ensure actions they authorize, fund, or carry out are not likely to harm the continued existence of those species or the habitat designated to be critical to their survival and recovery. The ESA requires NMFS, when proposing a fishery action that "may affect" critical habitat or endangered or threatened species, to consult with the appropriate administrative agency (itself for most marine species, the U.S. Fish and Wildlife Service for all remaining species) to determine the potential impacts of the proposed action. Informal consultations are conducted for proposed actions determined to "may affect," but "not likely to adversely affect" critical habitat or endangered or threatened species. Formal consultations, including a biological opinion, are completed for proposed actions determined to "likely to adversely affect" critical habitat or endangered or threatened species. If jeopardy or adverse modification is found, the agency is required to suggest reasonable and prudent alternatives.

The **Marine Mammal Protection Act** (MMPA) (16 U.S.C. 1361 et seq.), originally enacted in 1972, established a moratorium, with certain exceptions, on the taking of marine mammals in U.S. waters and by U.S. citizens on the high seas, and on the importing of marine mammals and marine mammal products into the United States. The Secretary of Commerce is responsible for the conservation and management of all pinnipeds, other than walruses; the Secretary of the Interior for all other marine mammals. This responsibility includes maintaining populations of marine mammals at optimum levels, defined as "…the number of animals which will result in the maximum productivity of the population or the species, keeping in mind the carrying capacity of the habitat and the health of the ecosystem of which they form a constituent element," and developing conservation plans for populations that fall below this threshold level. Marine mammal stock assessments, take reduction plans for stocks reduced or depleted as a consequence of interacting with commercial fisheries, and studies of pinniped-fishery interactions are all components of a new system established by the 1994 amendments to the MMPA to control marine mammal mortality in commercial fisheries. Under this new system, all U.S. commercial fishing operations are characterized as one of three types based on their levels of incidental and serious injury of marine mammals. At a minimum, vessel owners must register for an Authorization Certificate and may also be required to carry fishery observers.

The **Regulatory Flexibility Act** (RFA) of 1980 (5 U.S.C. 601 et seq.) requires federal agencies to assess the impacts of regulatory actions implemented through notice and comment rulemaking procedures on small businesses, small organizations, and small governmental entities, with the goal of minimizing adverse impacts of burdensome regulations and record-keeping requirements on those entities. Under the RFA, NMFS must determine whether a proposed fishery regulation will have a significant economic impact on a substantial number of small entities. If not, a certification to this effect must be prepared and submitted to the Chief Counsel for Advocacy of the Small Business Administration. Alternatively, if a regulation is determined to significantly impact a substantial number of small entities, the act requires the agency to prepare an initial and final Regulatory Flexibility Analyses to accompany the proposed and final rule, respectively. These analyses, which describe the type and number of small businesses affected, the nature and size of the impacts, and alternatives that minimize these impacts while accomplishing stated objectives, must be published in the Federal Register in full or in summary for public comment and submitted to the chief counsel for advocacy of the Small Business Administration. Changes to the RFA in June 1996 enable small entities to seek court review of an agency's compliance with the Act's provisions.

Executive Order 12866: Regulatory Planning and Review, signed in 1993, requires federal agencies to assess the costs and benefits of their proposed regulations, including distributional impacts, and to select alternatives that maximize net benefits to society. To comply with E.O. 12866, NMFS prepares a Regulatory Impact Review (RIR) for all fishery regulatory actions that either implement a new fishery management plan or significantly amend an existing plan. RIRs provide a comprehensive analysis of the costs and benefits to society associated with proposed regulatory actions, the problems and policy objectives prompting the regulatory proposals, and the major alternatives that could be used to solve the problems. The reviews also serve as the basis for the agency's determinations as to whether proposed regulations are a "significant regulatory action" under the criteria provided in E.O. 12866 and whether proposed regulations will have a significant economic impact on a substantial number of small entities in compliance with the RFA. A regulation is significant if it is likely to result in an annual effect on the economy of at least $100,000,000 or has other major economic effects.

All federal rulemaking is governed under the provisions of the **Administrative Procedure Act** (APA) (5 U.S.C. Subchapter II), which establishes a "notice and comment" procedure to enable public participation in the rulemaking process. Under the APA, NMFS is required to publish notification of proposed rules in the *Federal Register* and to solicit, consider and respond to public comment on those rules before they are finalized. The APA also establishes a 30-day wait period from the time a final rule is published until it takes effect.

The **Paperwork Reduction Act** of 1995 (44 U.S.C. 3501 et seq.) regulates the collection of public information by federal agencies to ensure that the public is not overburdened with information requests, that the federal government's information collection procedures are efficient, and that federal agencies adhere to appropriate rules governing the confidentiality of such information. The PRA requires NMFS to obtain approval from the Office of Management and Budget before requesting most types of fishery information from the public.