Before the U.S. Commission on Ocean Policy
Anchorage, Alaska
August 21, 2002

Testimony of
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"North to the Future: The North Pacific as a Model of Fisheries Management"

Admiral Watkins, members of the Commission, honored guests, I am Ron Clarke, the Executive Director of the Marine Conservation Alliance. Thank you for coming to Alaska and for inviting our group's testimony. I am honored to participate in this meeting with you.

The MCA is a new organization, established by fishing associations, communities, CDQ groups, harvesters, processors, and support sector businesses, to promote the sustainable use of North Pacific marine resources by present and future generations, based on sound science, prudent management, and a transparent, open public process. We seek practical solutions to resource use questions to both protect the marine environment and minimize impacts on the North Pacific fishing community. We support research and public education about the fishery resources of the North Pacific.

No one is more concerned with the long-term health of the North Pacific and its vast and diverse resources than the people whose lives and livelihoods depend on them. They want and believe we can have clean water, sustainable fisheries, good jobs, and prosperous, livable coastal communities. The MCA is proud to represent those interests.

You've already heard how this region's groundfish fishery went from a foreign-dominated, inadequately-regulated system in the 1970s to what is now widely regarded as the best-managed fishery in the world.

You've also heard how the National Research Council's ecosystem-based management principles are already a fact of life in the North Pacific – some of these model practices have been in place for more than two decades.

As a result, no groundfish species are overfished, Americans derive greatest benefit from the area's natural wealth, and catches are monitored closely through an industry-funded observer program. Through diligent, responsible management -- and cooperation between government and the fishing industry -- the North Pacific has been spared some of the difficulties and outright tragedies experienced elsewhere.

The governance system most likely to succeed is the one closest to the people, the region, and the fishery being governed. National standards and goals are appropriate, and clearly, this Commission has important nationwide perspectives. Still, we hasten to emphasize how well our region has demonstrated that local and regional fishery management systems can be effective.

Regions where the existing system is working should not be penalized by shortcomings in other regions, nor should the system be dismantled or significantly altered if some areas have difficulty employing all the features the system has to offer.

We have several specific recommendations.

1. Replicate North Pacific Successes.

Use successful practices in this region as benchmarks by which to measure management regimes in other parts of the country.

We encourage you to recognize the indispensability of:

1. **Science- based management decisions;**
2. **Conservative fishing quotas;**
3. **Effective monitoring and enforcement;**
4. **Rationalization of effort;**
5. **Protection of fisheries-dependent communities;**
6. **Incorporation of ecosystem-based management principles into Fishery Management Plans;**
7. **An open, transparent public process where all stakeholders can participate; and**
8. **A wholesome, sustainable source of nutritious, high-quality seafood.**

That's not to say the North Pacific management regime is perfect. There is room for improvement. Bycatch reduction is a case in point.

Although Council bycatch reduction measures already implemented have succeeded in reducing the overall bycatch level in the Alaska groundfish fisheries to about eight percent – one-fourth the national average – we can do better. Indeed, the Council, with full industry support and cooperation, is aggressively pursuing a new bycatch reduction initiative using bycatch management co-ops. Although the final details remain to be resolved, we're confident this innovative arrangement can reduce bycatch even further.

2. Support More and Better Science.

The single best thing we can do to improve our management of the North Pacific ecosystem is to expand our base of reliable information about how that ecosystem works. To better understand marine habitats and the life they support, we need continued, expanded, and ongoing basic peer-reviewed research.

MCA members presently support a wide variety of research efforts and plan to do more. Over the past three years, the seven member companies of the Pollock Conservation Cooperative have collectively contributed over $4 million to sponsor 25 marine research projects at the University of Alaska, Alaska Pacific University, and Sheldon Jackson College – according to UA President Mark Hamilton, the largest privately-funded research program in Alaska's history. Other MCA members support initiatives such as the North Pacific Marine Research Foundation, which has helped fund important new research into the nature and cause of the decline of Steller sea lions in the North Pacific.

Whatever the Commission can do to advocate expanded research is worthwhile, whether in the form of government-funded research programs, tax incentives for donors, or any creative mechanism to steer more resources into science.

We support applied, cooperative research involving partnerships between resource user groups and government managers. This includes a continued and expanded observer program, making vessels available as research platforms, and industry-sponsored programs for collection and use of real-time data from the fisheries. An example of the latter is the Bering Sea pollock fleet's Salmon Reduction and Avoidance program, whereby real-time salmon bycatch "hotspot" information is collected and distributed to the active fleet on the fishing grounds.

3. Reduce Bycatch and Bycatch Mortality.

Eliminating the "race for fish" through rationalization reduces bycatch, improves safety, and results in delivery of higher quality products. Generally, the MCA supports quota-based rationalized fishing systems because they bring significant conservation and other benefits. We strongly believe the authority to create and implement such systems should reside with the regional Councils.

Other steps can reduce incidental catch. One notable example began in 1995, when the North Pacific Longline Association undertook a study of seabird avoidance techniques around the world. It drafted a set of seabird avoidance regulations for longliners and presented them to the North Pacific Council, which promptly recommended their implementation. The U.S. Coast Guard volunteered to enforce the regulations.

The industry and the University of Washington's Sea Grant Program spent two years aboard commercial fishing vessels, studying the effectiveness of seabird avoidance techniques. Funding came from the Saltonstall - Kennedy Program and the U.S. Fish and Wildlife Service. The waterproof field guide you have before you is an offshoot of that program – 11,000 such guides were distributed to the fishing fleet.

Results were significant. Avoidance techniques initially aimed at Short-tailed Albatrosses proved effective for all seabird species. Freezer-longliners, responsible for 80–85% of all incidental seabird take off Alaska, reduced that take by 90%.

This industry initiative, in partnership with the Council, government, and academia, is an excellent example of the teamwork and practical approaches to problem solving supported by the MCA. The Commission could encourage similar advances by recommending ongoing funding for conservation efforts, and experimental approaches to solving both nationwide and regional challenges.

4. Manage Fisheries Through Science, Not Litigation.

As Chairman Benton explained, the increasing prevalence of litigation hampers the ability of government agencies to do their regular work, and creates a massive drain on energy and resources of all parties. One subject likely to inspire further litigation is the Marine Protected Area (MPA).

MPAs can serve legitimate management objectives if they are scientifically justified, have clearly articulated goals, and incorporate provisions for continued monitoring to ensure those goals are being achieved. Importantly, the regional Councils already enjoy ample authority to designate MPAs; we encourage you to help preserve that authority.

This Commission could help by encouraging clear definitions and goals for MPAs. Any definition should be broad enough to include fishery management actions that close an area permanently or seasonally, and/or otherwise restrict certain fishing gear types in order to achieve conservation and management objectives – not just no-take marine reserves. Meanwhile, federal MPA activities affecting fisheries should be placed on hold until MPAs are properly defined and specific goals identified.

By whatever name they are known, MPAs have long been a fact of life in the North Pacific. Tens of thousands of square nautical miles are already closed or otherwise restricted to fishing to protect habitat or otherwise conserve sensitive species, including the following:

- **Bottom Trawl Restrictions in State Waters, State Critical Habitat Areas, and State Marine Parks**
- **Catcher Vessel Operational Area**
- **Pribilof Islands Savings Area**
- **Herring Savings Areas**
- **Prohibited Species Bycatch Limitation Zones**
- **Crab and Halibut Protection Zones**
- **Chum Salmon Savings Area**
- **Pribilof Islands Habitat Conservation Area**
- **Steller Sea Lion Critical Habitat Protection Areas**
- **3 Nautical Mile No Transit Zones Around Steller Sea Lion Rookeries**
- **Pollock and Cod No Trawl Zones**
- **Atka Mackerel No Trawl Zones**
- **Nearshore Bristol Bay Closure Area**
- **Bristol Bay Red King Crab Savings Area**
- **Walrus Islands Closures**
- **Chinook Salmon Savings Areas**
- **Cape Edgecumbe Pinnacles Reserve**
- **Bogoslof Groundfish Closure Area**

- **Alaska Coastal Management Plan Areas Meriting Special Attention**
- **Southeast Alaska Dive Fishery Closures**
- **Southeast Trawl Closure in the Gulf of Alaska (not on map)**

As you can see, the North Pacific already has a substantial network of protected areas already in place.

We encourage the Commission to recommend the establishment of MPA guidelines with the same transparent, public, science-driven process central to Council decisions. Since half of all fish and shellfish landings in the U.S. come from federal and state waters off Alaska, we trust the North Pacific fishing community will be well-represented in those deliberations.

5. Minimize Pollution and Contaminants.

This important topic will be addressed more fully tomorrow, but we would be remiss if we failed to mention the inextricable relationship between pure water, healthy ecosystems, wholesome seafood, steady jobs, and livable communities.

Luckily, here in the North Pacific, we haven't faced as many of the acute threats so pervasive around the world, but it is certainly relevant to the long term health of our fisheries that we work to minimize pollution and contaminant threats. We must remain vigilant

to the individual and cumulative effects of industrial and commercial activities, port development, navigation threats, agriculture, silviculture, aquaculture, urban and suburban development, erosion, mining, logging, dumping, natural events and a host of other potential threats.

6. Remove Marine Debris.

The MCA is building a new, cooperative program to identify, collect, transport, and dispose of marine debris, including derelict fishing gear. We hope that our growing network of people in the field and on the fishing grounds can begin to alleviate this long-standing problem. As we develop overall plans and customize strategies for specific locations, there will be plenty of room for all interested stakeholders to lend a hand, and all are welcome.

For more information, see www.marineconservationalliance.org.

Thank you for your time and attention, and especially for your dedication and leadership.

Successful Ecosystem-based Management

The North Pacific Groundfish Fishery

The National Research Council, an arm of the National Academy of Sciences, identified a number of management strategies that fishery managers should employ to help ensure a sustainable ecosystem. In every instance, the North Pacific Groundfish Fishery meets or exceeds the recommended measures.

National Research Council Recommendations	North Pacific Groundfish Management
Adopt Conservative Catch Limits	For 25 years, annual catch limits for the fishery have been set at or below the acceptable biological catch (ABC) level recommended by fishery scientists.
Set Annual Catch Limits	Annual catch limits are set for each groundfish species, and fisheries close when catch limits are reached. All fish caught, whether retained or discarded, count against the catch limit.
Incorporate Ecosystem-based Goals into Management	From conservative catch quotas, to habitat protections, to bycatch controls, to comprehensive monitoring and enforcement, ecosystem considerations are a key component of management decisions.
Provide for Adequate Monitoring and Enforcement Through a Comprehensive Federal Fishery Observer Program	Federally trained observers record and report catch amounts. All groundfish vessels longer than 125 feet carry an observer at all times and pollock catcher/processors carry two observers. Smaller vessels carry observers 30 percent of the time.
Adopt a Precautionary Approach to Deal with Uncertainty	Since the 1970s, managers have adhered to a precautionary, risk averse, approach in estimating fish population abundance and setting catch levels. Decisions are based on the “best scientific information available.”

Conduct Scientific Research to Improve Understanding of Fish Stocks	NMFS conducts annual research surveys to collect information necessary to estimate fish population abundance. NMFS has research survey data over several decades, enhancing the accuracy of annual estimates.
Reduce Excess Fishing Capacity	The establishment of the Pollock Conservation Cooperative within the catcher/processor sector has effectively ended the race for fish and reduced the fleet alone by nearly 25 percent.
Establish Marine Protected Areas	Managers have established a comprehensive habitat protection policy. Tens of thousands of square miles of productive fishing grounds are closed permanently or seasonally to some or all fishing to protect marine resources and sensitive habitat.
Include Bycatch and Discard Mortality in Catch Accounting	Managers have implemented numerous measures to reduce bycatch and to ensure an accurate accounting of bycatch that does occur. In all cases, bycatch-related mortality is included in catch accounting.
Increase Use of Technology to Improve Conservation	Observers file catch reports electronically, which allows for real-time catch accounting to ensure that catch limits are not exceeded. Many vessels are equipped with Vessel Monitoring System (VMS) units that allow NMFS to track vessel locations on a real-time basis.
Encourage Voluntary Conservation Efforts by the Fishing Industry	The fishing industry works with a private company, Sea State, Inc., that reviews observer data, identifies areas of high bycatch, and advises vessels on the grounds to avoid such areas.
Allow for Stakeholder Participation in the Fishery Management Process	Members of the environmental community, the commercial and sport fishing sectors and Alaska natives serve on the North Pacific Fishery Management Council as well as the Council's advisory panel. All meetings are open to the public and public comment is solicited on all proposed management measures.

Pollock Conservation Cooperative Research Center

Projects Funded in 2000

Markets for Alaska Pollock Products
Gunnar Knapp

The Quality of Commercial Fish Species in Steller Sea Lion Habitat Units
Robert Foy and Kate Wynne

Analysis of Hydrographic Data Collected by the Pollock Conservation Cooperative in the Bering Sea
David Musgrave

Thyroid Hormones and Plasma Leptin Concentrations During Food Deprivation and Satiety: Use as an Index of Metabolic Condition in Free-ranging Steller Sea Lions
Shannon Atkinson

Capture and Holding of Transient Juvenile Sea Lions
Shannon Atkinson and Michael Castellini

Validating the Use of Satellite-linked Mortality Transmitters in Rehabilitated California Sea Lions and Juvenile Steller Sea Lions
Markus Horning

Do Steller Sea Lions at the Pribilofs Have Enough to Eat? Evidence From Diet and Stress Hormones
Alan Springer and Alexander Kitaysky

Interactions Among Steller Sea Lions, Pollock and Herring and an Examination of Variability Associated With Acoustic Surveys of Pollock
Richard Thorne, Gary Thomas and John Goering

Instruction in Fisheries Management
Margaret Merritt

Projects Funded in 2001

Pollock Market Data Acquisition: Future Russian Pollock Supply
Gunnar Knapp

Sinking Particles and Pelagic Food Webs in the SE Bering Sea: 2001
Susan Henrichs

DNA Analysis of the Origins of Chinook Salmon Bycatch in Alaskan Trawl Fisheries
Anthony Gharrett

Distribution of Age-1 and Age-2 Walleye Pollock in the Bering Sea: Sources of Variation, Implications for Higher Trophic Levels, and Climate Change

Alan Springer, Kevin Bailey, Taina Honkalehto and Janet Duffy-Anderson

Deployment of an Acoustic Data Logger on Commercial Fishing Vessels to Evaluate the Potential of Fishing-induced Declines in Local Pollock Abundance
Terrance Quinn II

Factors Affecting Nearshore Survival and Production of Juvenile Sockeye Salmon from Kvichak Bay – Phase I: Important Habitat, Migration Routes and Food Resources
Stephen Jewett and Paul Rusanowski

Assessing the Extent of Competition Between Steller Sea Lions and Commercial Fisheries
Alan Springer and Andrew Trites

An Investigation Into the Possible Relationship Between Killer Whale (*Orcinus orca*) Predation and the Continuing Decline of the Steller Sea Lion (*Eumetopias jubatus*)
Markus Horning

Projects Funded in 2002

Continuation: Deployment of an Acoustic Data Logger on Commercial Fishing Vessels to Evaluate the Potential of Fishing-induced Declines in Local Pollock Abundance
Terrance Quinn II

Continuation: DNA Analysis of the Origins of Chinook Salmon Bycatch in Alaskan Trawl Fisheries
Anthony Gharrett

Keeping Mooring 2 Alive: Continuing Long-term Biophysical Measurements over the Southeastern Bering Sea Shelf
Terry Whitledge

Keeping Mooring 2 Alive: Sinking Particles and Pelagic Food Webs in the SE Bering Sea 2002
Susan Henrichs

An Examination of the Maturation of Walleye Pollock in the Eastern Bering Sea in Relation to Temporal and Spatial Factors
Gordon Kruse

Stock Assessment of Nearshore Fishes in the Aleutian Archipelago
Brenda Konar

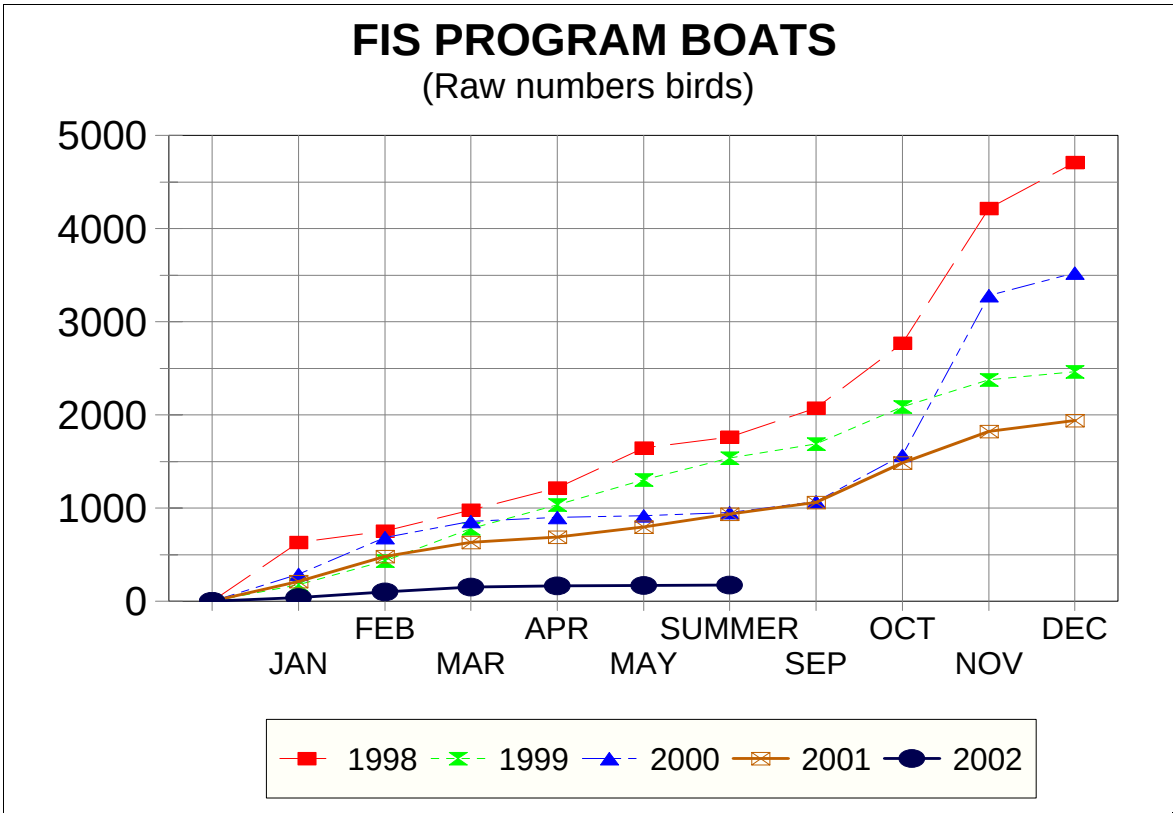
Jellyfish Impact on Food Web Production and Ecosystem Structure in the Southeastern Bering Sea
Alan Springer

Producer Cooperative and Producer Organizations
Gunnar Knapp

07-Aug-02

FIS **OBSERVED BIRDS (UNEXTRAPOLATED)**

	1998		1999		2000		2001		2002	
	month	CML	month	CML	month	CML	month	CML	month	CML
JAN	630	630	177	177	290	290	210	210	40	40
FEB	123	753	255	432	394	684	272	482	58	98
MAR	224	977	347	779	175	859	150	632	53	151
APR	238	1215	254	1033	40	899	58	690	14	165
MAY	429	1644	272	1305	20	919	106	796	2	167
SUMMER	117	1761	231	1536	34	953	138	934	8	175
SEP	314	2075	154	1690	118	1071	127	1061		
OCT	694	2769	395	2085	451	1568	423	1484		
NOV	1447	4216	292	2377	1343	3280	340	1824		
DEC	492	4708	86	2463	227	3524	114	1938		



[Draft Manuscript submitted to ICES Journal of Marine Science -- A special issue on the proceedings of the ICES/SCOR Symposium on the Ecosystem Effects of Fishing. March 1999.]

Integrating Ecosystem Considerations into Groundfish Fisheries Management off Alaska, USA

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Abstract -- Ecosystem considerations factor into the management of groundfish fisheries in the North Pacific Ocean off Alaska, USA. The Council's ecosystem-based management approach involves public participation, reliance on scientific research and advice, conservative catch quotas, comprehensive monitoring and enforcement, bycatch controls, gear restrictions, temporal and spatial distribution of fisheries, habitat conservation areas, and other biological and socioeconomic considerations. The most basic ecosystem consideration employed is a precautionary approach to extraction of fish resources. Off Alaska, all groundfish stocks are considered healthy, while providing sustained yields of about two million metric tons annually. Management measures are also taken to minimize potential impacts of fishing on seafloor habitat and other ecosystem components such as marine mammals and seabirds.

Ecosystem-based management strategies have been widely adopted throughout the United States for terrestrial and freshwater aquatic systems, but are just beginning to be applied to marine ecosystems (National Research Council, 1999). Fisheries can impact ecosystems in numerous ways. Populations of fish and other ecosystem components can be affected by the selectivity, magnitude, timing, location, and methods of fish removals. Fisheries can also impact ecosystems by vessel disturbance, nutrient cycling, introduction of exotic species, pollution, unobserved mortality, and habitat alteration. An ecosystem-based management strategy for marine fisheries would be to minimize potential impacts while at the same time allowing the extraction of fish resources at levels sustainable for both the fish stock and the ecosystem. Management measures consistent with an ecosystem-based strategy include conservative and precautionary catch limits, comprehensive monitoring and enforcement, bycatch controls, gear restrictions, temporal and spatial distribution of fisheries, marine protected areas, and other considerations.

The North Pacific Fishery Management Council has been developing an ecosystem-based management approach for management of North Pacific groundfish (e.g., pollock, cod, flatfish) fisheries. The Council is a regional organization established by the Magnuson-Stevens Fishery Conservation and Management Act in 1976 when the United States extended its fisheries jurisdiction out to 200 nautical miles (371 km). The Council, together with the National Marine Fisheries Service, has primary responsibility for groundfish management in the Gulf of Alaska, Bering Sea, and Aleutian Islands area, encompassing about 900,000 square nautical miles (2,680,000 km^2). Conservative management policies, such as catch limits and marine protection areas, were implemented with adoption of the first fishery management plans. The goals of the fishery management plans include conserving fishery resources for optimum yield, maintaining productive fish habitats, and minimizing interactions with other elements of the ecosystem.

The Council's goals and policies, which are consistent with a precautionary approach and ecosystem-based management, have resulted in sustainable fisheries. All groundfish stocks are considered relatively healthy after 20 years of sustained annual harvests of about 2 million mt. No fish stocks have been deemed overfished in a recent evaluation of the status of U.S. fisheries (National Marine Fisheries Service, 1998a).

When revised overfishing definitions were implemented in 1999, only one fishery resource in the region (Bering Sea Tanner crab) was determined to be below its minimum stock size threshold, and an aggressive rebuilding plan is being developed for this stock.

Although fish stocks remain healthy, concerns about the impacts of fish removals on other components of the ecosystem have motivated the Council to continue development of a more ecosystem-based management strategy. This paper reviews the Council's approach to date, and explores further progress towards integrating ecosystem considerations into management of groundfish fisheries.

Precautionary and Conservative Catch Limits

Total removals of groundfish are controlled by annual catch limits established for each stock. For each target stock, three harvest levels are set, corresponding to the overfishing level (OFL), the acceptable biological catch (ABC) and total allowable catch (TAC). TACs are essentially annual catch limits for the fishery, and are established at or below the ABC. ABCs define acceptable harvest levels from a biological perspective, and OFL defines the unacceptable harvest level. Specification of harvest limits is done in a precautionary manner, due to a number of reasons as explained below.

Harvest rate specifications are more conservative when less information is available. The maximum allowable rates are prescribed in descending order of preference, corresponding to descending order of information availability (Thompson, 1996). Additionally, maximum sustainable yield (MSY) is treated as a limit, rather than a target. For most stocks, ABC is based on a rate less than or equal to $F_{40\%}$, which is the fishing mortality rate associated with an equilibrium level of spawning per recruit equal to *40%* of the equilibrium level of spawning per recruit in the absence of any fishing. In other cases where less information is available about the stock, ABC is generally based on the three-fourths of the natural mortality rate (M). Both the $F_{40\%}$ and 0.75M rates are considered to be conservative harvest rates for most groundfish stocks (Clark, 1993; Rosenberg and Restrepo, 1995). To further minimize the possibility of catches jeopardizing a stock's long term productivity, there is a buffer established between ABC and OFL. For most stocks OFL is defined based on a $F_{35\%}$ rate.

Harvest rates used to establish ABCs are reduced at lower than average stock size levels, thereby allowing rebuilding of less abundant stocks. If the biomass of any stock falls below Bmsy or $B_{40\%}$ (the long-term average biomass that would be expected under average recruitment and $F=F_{40\%}$), the fishing mortality rate is adjusted relative to stock status. This serves as an implicit rebuilding plan should a stock fall below a reasonable abundance level. Conservative harvest policies have helped to restore yellowfin sole (Pleuronectes asper) and Pacific Ocean perch (Sebastes alutus) stocks that were depleted by foreign fleets in the 1960's. For other stocks, such as Greenland turbot, Reinhardtius hippoglossoides, even very conservative harvest rates have not resulted in increased recruitment.

As a result of these definitions, specified harvest rates for groundfish stocks are very low. Actual harvest rates are significantly lower for many species, as the TAC may be set much lower than ABC, and harvests may be less than TAC due to regulatory closures. All fish caught in any fishery (including bycatch), whether landed or discarded, are counted towards the TAC for that stock. Based on comprehensive onboard observer data and reports provided by the fleet, directed fisheries for each species or complex are closed before the TAC is reached, so that catches are maintained within biologically acceptable levels. Observer data provides for accurate and precise estimation of Alaska groundfish catch (Volstad et al., 1997). Because 100% mortality for all discards is assumed (some fish likely survive), actual removals may be lower than catch numbers indicate.

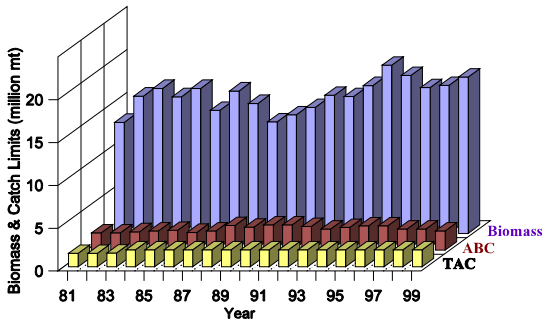

Figure 1. Catch specifications (TAC and ABC in mt) and exploitable biomass (mt) of Bering Sea and Aleutian Islands groundfish stocks, 1981-1999.

Additional precaution is incorporated at the catch specification level for Bering Sea/Aleutian Islands groundfish. Since 1981, the total annual allowable catch of groundfish for this region must fall within an optimum yield range of 1.4 to 2.0 million mt. This has limited the sum of TAC's for all species to 2 million mt per year, which has been considerably less than the sum of all ABCs (Figure 1). In some years, ABC's have totaled more than 2.8 million mt. As a result, many groundfish stocks, particularly flatfish stocks, have been exploited well below sustainable levels (Witherell, 1995).

Limits on bycatch and discards

The issues of bycatch, discard, and waste of fish resources stems from social, economic, and conservation concerns. From an ecosystem perspective, mortality of unwanted and prohibited species may reduce spawning potential, reduce biodiversity, alter regular paths of energy flow and balance, enhance the growth of scavenger populations, and add uncertainty to estimates of total removals. Fish are discarded for two reasons, either they are required to be thrown back due to regulations (prohibited species), or they are unwanted by that fishing vessel. In the North Pacific, discards of unwanted groundfish (so-called economic discards) result when fishermen do not have markets, sufficient equipment, time, or economic return to retain and process the catch (Queirolo et al., 1995). In the 1997 Bering Sea/Aleutian Islands fisheries, a total of 258,000 mt of groundfish was discarded, equating to about 15% of the total groundfish catch. Although this discard rate is much lower than most of the world's groundfish fisheries, which average about 19.9% discards (Alverson et al., 1994), the sheer volume of discards is troublesome to many people who consider economic discards as waste of food and as having an impact to the ecosystem.

Bycatch management measures implemented for groundfish fisheries of the eastern Bering Sea have focused on reducing the incidental capture and injury of species traditionally harvested by other fisheries. These species include king crab, Paralithodes and Lithodes spp.; Tanner crab, Chionoecetes spp.; Pacific herring, Clupea harengus pallasi; Pacific halibut, Hippoglossus stenolepis; and Pacific salmon and steelhead trout, Oncorhynchus spp. Collectively, these species are called "prohibited species," as they cannot be retained as bycatch in groundfish fisheries and must be discarded with a minimum of injury.

Bycatch controls were instituted on foreign groundfish fisheries prior to passage of the Magnuson Stevens Act in 1976 and have become more restrictive in recent years (Witherell and Pautzke, 1998). Bycatch limits are apportioned to specific groundfish target fisheries, and attainment of any apportionment closes that groundfish target fishery for the remainder of the season. Bycatch limits for 1998 Bering Sea and Aleutian Island groundfish trawl fisheries included 3,775 mt of halibut mortality, 1,697 mt of herring, 100,000 red king crabs, 2,850,000 C. bairdi crab, 4,654,000 C. opilio crab, 48,000 chinook salmon, and 42,000 other salmon. These limits equated to about 0.1% of the red king crab and C. opilio crab populations, 1.8% of the C. bairdi crab population, 1% of the herring biomass, and 1.3% of the halibut biomass. The impact of salmon bycatch on Alaska salmon populations remains unknown, but is thought to be <1% of the chum salmon population, and in the order of 2% to 4% of the adult chinook salmon population (NPFMC, 1999). To reduce the impact of bycatch on chinook salmon population, bycatch limits will be incrementally reduced to 29,000 salmon by the year 2003.

In addition to bycatch limits, gear restrictions

and other regulatory changes have also been implemented to reduce bycatch and waste. Biodegradable panels are required for pot gear to minimize waste associated with so-called ghost fishing of lost gear. Tunnel openings for pot gear are limited in size to reduce incidental catch of halibut and crabs. Gillnets for groundfish have been prohibited to prevent ghost fishing and reduce bycatch of non-target species. With the implementation of an individual fishing quota system for halibut and sablefish longline fisheries in 1995, bycatch and waste were reduced because the race for fish was eliminated, allowing for more selective fishing practices (Adams, 1995). The Council recently approved a measure to prohibit the use of non-pelagic trawl gear for vessels targeting pollock in the Bering Sea, and made a concomitant reduction of allowable prohibited species bycatch.

To reduce discards, the Council adopted an improved retention and utilization program for all groundfish target fisheries. Beginning in 1998, 100% retention of pollock (Theragra chalcogramma) and Pacific cod (Gadus macrocephalus) was required, regardless of how or where it was caught. Only fish not fit for human consumption can be legally discarded. This measure has dramatically reduced overall discard of groundfish (Figure 2). For example in 1997, about 22,100 mt of cod (8.6% of the cod catch) and 94,800 mt of pollock (8.2% of the pollock catch) were discarded. In 1998, discard amounted to only 4,300 mt of cod (2.2%) and 16,200 mt of pollock (1.6%). A regulation requiring full retention of all demersal shelf rockfish species (e.g, yelloweye rockfish, Sebastes ruberrimus) was adopted in 1999. Rock sole (Lepidopsetta bilineata) and yellowfin sole retention will be required beginning in 2003; the delay will allow for development of new markets and gear technological responses by the vessels engaged in these fisheries. These retention requirements are expected to reduce overall discard rates (all species) from about 15% to about 5%.

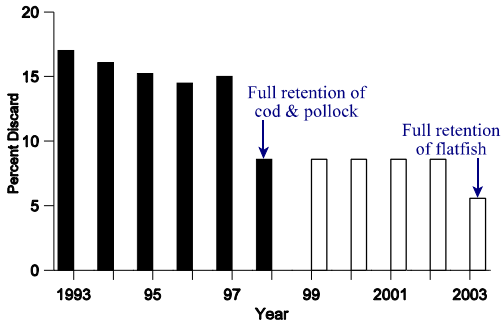

Figure 2. Total discard rates of Alaska groundfish, all areas and species combined, 1993-1998, with projections through 2003.

Marine Protected Areas

Several marine protected areas have been established to protect habitat for fish, crabs, and marine mammals (Figure 3). Adequate habitat is essential for maintaining productivity of fishery resources, and some species or life stages require particular habitats for food, reproduction, and shelter from predators. In the Bering Sea, three large areas have been closed to groundfish trawling and scallop dredging to reduce potential adverse impacts on vulnerable and essential habitat for crab and other resources. A limited amount of longlining for Pacific cod and halibut, as well as pot fishing for Pacific cod and crabs occurs within all three of these marine protected areas. In the Gulf of Alaska, several discrete trawl closure areas have been established around Kodiak Island to protect crab habitat. A very large no trawling area was established off Southeast Alaska, an area containing extensive coral distribution and other high relief habitat. Closure of Cook Inlet to bottom trawling has also been proposed to further protect crab habitat. One small area, a nearshore pinnacle off Cape Edgecumbe in southeast Alaska, has been closed to bottom fishing with all gear types.

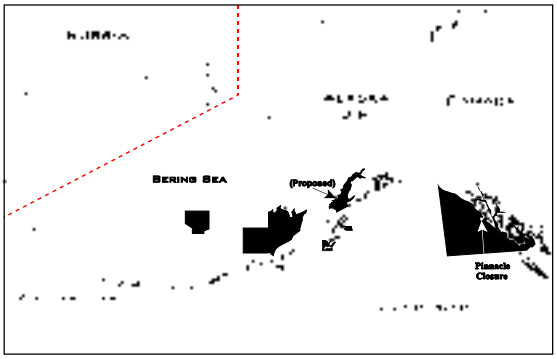

Figure 3. Location of marine protected areas off Alaska where trawling is prohibited year-round to protect fish and crab habitat.

These marine protected areas comprise a relatively large portion of the continental shelf, and in many respects, serve as marine reserves. In total, the three Bering Sea area closures encompass about 30,000 square nautical miles (89,500 km^2). To put this in perspective, this is an area more than twice the size of Georges Bank off the east coast of the United States. The Gulf of Alaska closures encompass about 47,000 square nautical miles (140,200 km^2), but a vast majority (80% - 90%) of this area is off the continental shelf (> 200 m). Lauck et al. (1998) recently suggested that marine reserves should be at least 20% of available habitat in order to be effective. The Bering Sea marine protection areas exceed this threshold by encompassing about 25% of the Bering Sea shelf where commercial quantities of groundfish can be taken with bottom trawl gear, based on interpolation of fishery location data from Fritz et al. (1997). Existing Gulf of Alaska closure areas encompass less than 10% of the trawlable shelf area.

The Magnuson-Stevens Act recently required that all fishery management plans include a description and identification of essential fish habitat, adverse impacts, and actions to conserve and enhance habitat In 1998, the Council defined essential fish habitat based on general fish distribution. Maps of these areas will be useful for understanding potential threats from proposed development and other activities. The next step is to identify habitat areas of particular concern based on ecological function and vulnerability to anthropogenic impacts. An example would include areas with slow growing corals that are extremely sensitive to impacts. Once these areas have been identified, potential threats due to fishing activities can be evaluated and additional measures implemented as needed. Because the Council has found marine protected areas to be a useful tool in managing bycatch and habitat protection, it is likely that additional areas will be established.

Marine Mammal and Seabird Considerations

Measures have been implemented to reduce potential impacts of localized depletion of prey for higher trophic levels. For example, because pollock is a primary prey item for endangered Steller sea lions (Eumetopias jubatus), it was determined that pollock fisheries could potentially jeopardize the continuing existence of the sea lions and impact their recovery (National Marine Fisheries Service, 1998b). To address these concerns, a number of precautionary management measures have been implemented. The TACs for pollock, and Atka mackerel, Pleugrammus monopterygius, (both important prey for sea lions) were spatially and seasonally apportioned into smaller sub-TACs to prevent prey removals from occurring all at once, and in localized areas. In 1999, all pollock fishing was prohibited in the Aleutian Islands region to eliminate any potential competition with sea lions.

Area closures have also been implemented to prevent disrupting marine mammals at rookeries and haulouts, and to reduce competition from fisheries. To protect Pacific walrus (Odobenus rosmarus), fishing vessels are prohibited in that part of the Bering Sea within twelve miles of Round Island, the Twins and Cape Pierce in northern Bristol Bay during the summer. To protect Steller sea lions, no trawling is allowed year round within 10 nautical miles (18.5 km) of numerous Steller sea lion rookeries and haulouts (Figure 4). In addition, a number of these no trawl zones extend out to 20 nautical miles (37 km) on a seasonal basis.

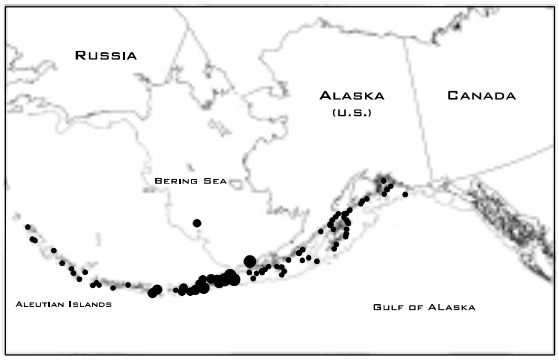

Figure 4. Location of the zones around Steller sea lion rookeries and haulouts where trawling is prohibited to reduce competition for prey.

In 1997, the Council adopted a regulation that prohibits directed fishing for forage fish, which are prey for groundfish, seabirds, and marine mammals. Under this amendment, protection is provided for forage fish species such as capelin (Mallotus villosus) and a host of other forage species including euphausiids (krill). Limited commercial fisheries for Pacific herring have traditionally been prosecuted in State waters, so herring was the only forage fish species exempted from the regulation. The Council took this proactive approach by preventing fisheries for important forage species from expanding or developing.

Regulations have also been established to reduce direct mortality of mammals and seabirds. Incidental catch limits have been established for Steller sea lions and the endangered short-tailed albatross, Diomedea albatrus. Concern for the incidental bycatch of seabirds led to regulations requiring deterrent devices be employed on groundfish longline vessels beginning in 1997. Approximately 9,600 seabirds (including about 1 albatross per year) are incidentally killed in Alaska groundfish fisheries each year (Wohl et al., 1995). It is hoped that these deterrent devices, which are actively being developed and improved upon by fishermen, will significantly reduce incidental mortality.

Continued Progress Towards Ecosystem-Based Management

Although fish stocks remain healthy, concerns about the impacts of fish removals on other components of the ecosystem have motivated the Council to continue development of a more ecosystem-based management strategy. This development has progressed at all levels, from science to policy making. Since 1995, the groundfish plan teams have prepared an Ecosystem Considerations section to supplement the annual Stock Assessment and Fishery Evaluation report (e.g., NPFMC, 1998). This chapter provides an annual assessment of the ecosystem, a review of recent ecosystem-based management literature, updates of ongoing ecosystem research, local observations from coastal people and fishermen, and new information on the status of seabirds, marine

Table 1. Draft ecosystem-based management policy of the North Pacific Fishery Management Council.

Definition: Ecosystem-based management, as defined by the NPFMC, is a strategy to regulate human activity towards maintaining long-term system sustainability (within the range of natural variability as we understand it) of the North Pacific, covering the Gulf of Alaska, the Eastern and Western Bering Sea, and the Aleutian Islands region.

Objective: Provide future generations the opportunities and resources we enjoy today.

Goals:

1. Maintain biodiversity consistent with natural evolutionary and ecological processes, including dynamic change and variability.
2. Maintain and restore habitats essential for fish and their prey.
3. Maintain system sustainability and sustainable yields of resources for human consumption and non-extractive uses.
4. Maintain the concept that humans are components of the ecosystem.

Guidelines:

1. Integrate ecosystem-based management through interactive partnerships with other agencies, stakeholders, and public.
2. Utilize sound ecological models as an aid in understanding the structure, function, and dynamics of the ecosystem.
3. Utilize research and monitoring to test ecosystem approaches.
4. Use precaution when faced with uncertainties to minimize risk; management decisions should err on the side of resource conservation.

Understanding:

1. Uncontrolled human population growth and consequent demand for resources are inconsistent with resource sustainability.
2. Ecosystem-based management requires time scales that transcend human lifetimes.
3. Ecosystems are open, interconnected, complex, and dynamic; they transcend management boundaries.

mammals, habitat and other components of the North Pacific ecosystem. Future Ecosystem Considerations chapters will include more data analysis, such as standardized ecosystem status and trend indicators.

In 1996, the Council established an Ecosystem Committee to discuss possible approaches to incorporating ecosystem concerns into the fishery management process. The committee has held workshops on ecosystem research, held several meetings to discuss essential fish habitat, and has hosted numerous informal discussions on ecosystem-based management and habitat concerns. A major role of this committee has been to provide the Council and stakeholders with information on ecosystem-based management in the North Pacific. The committee identified primary principles and elements of ecosystem management from scientific literature (e.g, Grumbine, 1994; Mangle et al., 1995; Christiansen et al., 1996) to serve as draft policy for ecosystem-based management of North Pacific fisheries (Table 1). The committee also provides feedback to scientists regarding research needs.

Discussion

The Council has made significant progress towards incorporating ecosystem considerations into management of groundfish fisheries. Steps have been taken to lessen human impacts on the environment due to fishing, while at the same time providing sustained yields of fishery resources. Unlike many groundfish stocks in other areas of the world, stocks off Alaska remain relatively abundant. Catches of groundfish have been sustained at about 2 million mt over the past 20 years, despite many restrictions implemented to reduce fishing impacts on other ecosytem components.

The most basic ecosystem consideration employed by the Council is a precautionary approach to extraction of fish resources. The precautionary principle was developed over the past 10 years as a policy measure to address sustainability of natural resources in the face of uncertainty. Because precise impacts caused by human activity cannot be known with certainty, a more cautious approach is required (Dovers and Handmer, 1995), particularly when there is a high level of uncertainty and there are large (potentially irreversible) costs if a mistake is made (Garcia, 1995). Fisheries management around the world has traditionally been based on a preventative and trial-and-error approach, yet the collapse of some fisheries indicates that a more precautionary approach should have been applied. New national and international fishery legislation is pushing fishery management towards a new paradigm whereby MSY is treated as a limit to be avoided, rather than a target that can be exceeded. Mace (1999) refers to this system as one of conscious under-exploitation of natural marine resources so that marine ecosystems are preserved in perpetuity while still contributing to food production, recreation, and other human uses. If fisheries are managed sustainably using a precautionary approach, it is likely that the overall ecosystem processes, ecosystem integrity, and biodiversity are also protected to some degree.

Although measures implemented to date have been successful at achieving their objectives, ecosystem-based management is an adaptive process. Effective ecosystem-based management of fisheries will require periodic evaluation and modification to incorporate new scientific information as it becomes available. Additionally, ecosystems are not static, and human impacts also change with technology and continued population growth. Ocean conditions can cause significant, rapid, and sometimes unexpected changes in ecosystem components. Because so little is known about marine ecosystems, an adaptive and precautionary approach should be used for all fishery management policies.

Acknowledgments

We thank Linda Roberts for preparing the figures.

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