Marine Protected Areas in Alaska: Recommendations for a Public Process

REPORT TO THE ALASKA BOARD OF FISHERIES

By

The Alaska Department of Fish and Game
Marine Protected Areas Task Force

Doug Woodby (chair),
Scott Meyer,
Kristin Mabry,
Victoria O'Connell,
Charlie Trowbridge,
Janet Hall Schempf,
Earl Krygier, and
Denby Lloyd

Regional Information Report 5J02-08

Alaska Department of Fish and Game
Division of Commercial Fisheries
Juneau, Alaska

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FOREWORD

The Alaska Department of Fish and Game is pleased to present this report of recommendations for a marine protected area program to the Alaska Board of Fisheries and to the people of Alaska. This report was prepared at the urging of the Board of Fisheries to provide them guidance in responding to public proposals for creation of marine protected areas. The charge from the Board is included as Appendix A.

Commissioner Frank Rue of the Department of Fish and Game appointed a task force in November 2001 to develop a strategy for developing a marine protected areas program for the state. This report was prepared by the task force, whose members represent the department's divisions as follows:

Commercial Fisheries Division – Earl Krygier, Denby Lloyd, Kristin Mabry, Tory O'Connell, Charlie Trowbridge, Doug Woodby (chair)
Sport Fish Division – Scott Meyer
Habitat and Restoration Division – Janet Hall-Schempf
Wildlife Conservation Division – Bob Small
Commissioner's Office, also representing the Subsistence Division – Rob Bosworth

The task force was established with only department personnel in a deliberate attempt to enlighten ourselves about this complex issue prior to making recommendations. The task force met six times prior to publication of this report: in 2001 on November 1 and 29, and in 2002 on February 1, March 11, May 14, and June 25. Public presentations describing the department's program were made by the task force chair at four meetings in Anchorage in 2002: the Exxon Valdez Oil Spill Workshop on January 22, the joint Board of Fisheries and North Pacific Management Council meeting on February 5, the Board of Fisheries on March 14, and the Native American Fish and Wildlife Society on May 1.

INTRODUCTION

This document provides a set of recommendations for a public process for establishing marine protected areas (MPAs) in Alaska. These recommendations were developed by a ten-member task force of Department of Fish and Game personnel (see Foreword) as guidance for development of an MPA policy by the Alaska Board of Fisheries.

The Alaska Department of Fish and Game is taking the initiative to develop a public process for an MPA program for several reasons. First, there is growing recognition that marine protected areas may be important tools for fishery management, for habitat protection, and for conserving biodiversity (NRC 2001). Globally, traditional fishery management has often been inadequate to provide sustained fishery yields, with as many as 25 to 30% of the world's fish stocks classified as overfished despite management efforts (FAO 1999). Nationally, concerns about overfishing and marine habitat degradation resulted in Presidential Executive Order 13158, issued in May, 2000, directing federal agencies to work with the states and other entities to develop a national system of marine protected areas. And in Alaska, individuals and conservation organizations have recently submitted a variety of proposals to the North Pacific Fishery Management Council and the Alaska Board of Fisheries calling for creation of marine reserves and for additional regulations to protect habitats.

Second, the primary goals of the Alaska Department of Fish and Game are to ensure that Alaska's renewable fish resources and their habitats are conserved and managed on the sustained yield principle, and the use and development of these resources are in the best interest of the economy and well-being of the people of the state. Based on recommendations by the National Research Council (2001), the department views marine protected areas as worthy of serious consideration to achieve those goals.

The report and recommendations focus on marine reserves (areas closed to fishing), as this is the type of MPA of greatest concern to the public and for which the Board has only limited precedent and policies to address. The Board has extensive experience with proposals and regulations for less restrictive closures involving single species and various gear types. The task force also addressed recommendations specifically directed at protection of marine habitats, particularly those subject to damage by bottom contact fishing gear.

Despite this report's focus on fishing, the department recognizes a larger context and need for marine protected areas. This larger context includes protection for other marine life, such as marine mammals and seabirds, protection from pollution, protections from adverse impacts of mineral extraction, protection of culturally important sites, and maintenance of pristine ecosystem structure and function. Where appropriate, the department recommends taking these larger issues into consideration as additional factors when evaluating MPAs proposed for fishery related purposes.

The approach taken in this report is to review the existing information on MPAs and to make recommendations based on the reviews for the benefit of the Board and the public.

The review materials were of three types: the scientific basis, the experience with MPA processes in other west coast jurisdictions, and the legal process for designating MPAs in Alaska. The review of the scientific literature (Appendix B) summarizes results on benefits within reserves and benefits to fishery yields outside of reserves, with a focus on results pertinent to Alaska. The review of MPA processes in other jurisdictions (Appendix C) focuses on what we can learn from the successes and failures made in ongoing public processes in California, Oregon, Washington, British Columbia, and elsewhere, and provides a review of the national MPA process. The review of the legal process (Appendix D) provides guidance and sideboards on how designation of MPAs may proceed in both the state (Board of Fisheries) and federal (NPFMC) arenas.

A preliminary inventory of MPAs in Alaska is included as Appendix E. The maps and information presented there are examples of an MPA information system that the department is proposing to develop as a decision-making tool for both MPA issues as well as general fishery management issues. As shown in the inventory, some fairly extensive MPAs have already been established in Alaska, primarily to reduce bycatch and to protect habitats. These include large offshore areas closed to trawling on the eastern Bering Sea shelf, in the eastern Gulf of Alaska, and in state waters from Kodiak westward to Bristol Bay (Witherell et al. 2000).

YOUR FEEDBACK IS REQUESTED

The task force hopes that this report will help to achieve an effective public process on marine protected areas in Alaska. To this end, we request your comments on all aspects of this report. Comments should be sent by September 18, 2002 to:

MPA Task Force, attention Doug Woodby
Alaska Department of Fish and Game
Commercial Fisheries Division
P.O. Box 25526
Juneau, AK 99801

or:

MPA_program@fishgame.state.ak.us

Comments will be compiled, summarized, and submitted to the Alaska Board of Fisheries for review prior to their October, 2002 work session in Anchorage. It is anticipated that the Board will make decisions regarding a public process in the fall or winter of 2002/03.

This report has been submitted to the Department of Law for a parallel review of statutory and regulatory authorities, with anticipated completion of review by October 17, 2002.

TIMELINE

The following timeline for the remainder of 2002 provides our expectations for the sequence of events in the public process. Subsequent activities will be determined by the Board of Fisheries.

July 18, 2002	Publication of this report and beginning of public comment period.
September 18, 2002	Last date for submission of written comments to ADF&G.
October 1, 2002	Comments and summary of comments presented by ADF&G to the Board of Fisheries.
October 17–21, 2002	Board of Fisheries work session in Anchorage. Board to discuss recommendations and to consider adoption of a policy and timeline for further actions and decisions on marine protected areas.

RECOMMENDATIONS

DEFINITIONS

The following definitions apply throughout these recommendations:

1. Marine protected area (MPA) – a geographically defined area designated with special protections to enhance the management of marine resources. MPAs include the following three types.
2. Marine reserve – a geographically defined area where extraction of living resources and disturbance or destruction of habitats is prohibited.
3. Marine fishery reserve – a geographically defined area may be identified as a marine fishery reserve where extraction of specified fishery resources is prohibited. These should be named for the protected resource, e.g., rockfish reserve for a rockfish closure area. To date, the Board of Fisheries routinely designates closures of this type for single species; this designation would also apply to multiple species.
4. Protected marine habitat – a geographically defined area where habitat disturbance, including use of bottom contact fishing gear of specified types, is prohibited.
5. Alaskan waters – those marine waters of Alaska including waters under state jurisdiction within 3 nautical miles of shore and those under federal jurisdiction out to 200 miles offshore.

Definitions 1 and 2 are similar to those presented by the National Research Council (2001). The addition of a definition of marine fishery reserves fills the need to clarify the intention of reserves that are targeted for protection of specific fish resources.

GOALS OF MARINE RESERVES IN ALASKA

- To reduce risk of stock collapse. Reserves may serve as precautionary controls on fishing mortality rates, as well as insurance against uncertainty, management errors, human caused disturbances, and natural catastrophes.
- To rebuild overfished populations or stocks. When marine species are depleted or threatened, reserves can provide undisturbed habitat to allow populations to rebuild.
- To provide research controls. Control areas without fishing are important for understanding the effects of fishing, and allow differentiating fishing effects from environmental changes, including large scale climatic effects.
- To conserve biodiversity. Elimination of fishing in specific areas may encourage higher species diversity through indirect community level effects of competition and predation. Genetic diversity within species may be preserved by eliminating the selective effects of fishing for traits such as size or growth rate
- To enhance fishery yields. In combination with other fishery management measures, reserves may enhance yields of overfished populations through a variety of means, including larval dispersal, adult and juvenile spillover, and protection of spawning and nursery areas.

GOAL FOR PROTECTION OF MARINE HABITATS

- To protect sensitive and important marine habitats. Sensitive marine habitats should receive substantial protection from disturbance by fishing gear to ensure their continued contribution to marine ecosystems.

SPECIFIC RECOMMENDATIONS FOR MARINE RESERVES AND PROTECTED MARINE HABITATS IN ALASKAN WATERS

Although there are huge gaps in our knowledge regarding marine species and fisheries, there is a sufficient scientific basis (See Appendix B) to justify some use of marine reserves to achieve the goals listed above. Specific actions to achieve those goals are given below. These are based in part on recommendations by the National Research Council (2001) and on recommendations by ADF&G staff.

Policy

The department recommends that the Board consider adopting a policy for establishment of marine protected areas as outlined in this set of recommendations, with due consideration to realistic timeframes and staff commitments.

Public Involvement Process

1. Establish a public process to involve stakeholders in providing advice and recommendations to the Board of Fisheries on all key elements of this report at the earliest reasonable opportunity and with the following guidelines:
    a. identify stakeholder groups and solicit their involvement; provide opportunities for individuals to participate as well;
    b. establish a statewide advisory group or panel to allow stakeholders to be well and faithfully represented; this group will consider the need for and structure of regional advisory panels;
    c. establish a timeline that is realistic, allowing full participation and full development and dissemination of information;
    d. assess needs and concerns of stakeholders and communities; and
    e. ensure that the process is clear and readily accessible to the public;

2. This report with recommendations should be subjected to full public review, with comments and criticisms reported on and summarized for the Board of Fisheries to assist the Board in policy development.

3. Determine if MPA proposals should be considered on a Board regulatory review cycle separate from, and possibly longer period than the current three-year cycle. This option would allow for more comprehensive statewide implementation of MPAs, as appropriate. This option would be in contrast to the status quo, in which individual proposals may be submitted each year, depending on the region and fishery affected.

Evaluate Needs for Reserves and Habitat Protection

1. The recommended approach is a needs analysis to identify the fisheries and stocks for which reserves would be an important management tool, and to identify specific marine habitats that warrant protection from damage caused by bottom contact fishing gear. The analysis is expected to be a significant effort requiring additional funding and potentially conducted under contract. The proposed MPA information system (Appendix E) would be a useful tool for this analysis. The analysis should address:
    a. depleted stocks needing rebuilding;
    b. overfished stocks where fisheries occur on spawning and nursery grounds;
    c. highly exploited stocks with uncertainty in stock assessments;
    d. highly exploited stocks with uncertainties or difficulties in controlling exploitation rates;
    e. fisheries and non-target species for which bycatch and ghost fishing (by derelict gear) remains a significant issue;
    f. known and probable locations of sensitive, important habitats, and their overlap with bottom contact fisheries;
    g. emerging or other fisheries for which management plans have not been developed and for which there is a substantial risk of overfishing;
    h. the need for reserves as experimental controls (see below);
    i. the existence of biogeographical regions; and
    j. the historical distributions of commercial fisheries, especially "hot-spots," and how those relate to (b.) above and to representative habitat types as discussed below.

    The analysis should be conducted in phases with periodic public involvement and review.

2. Fishery populations and marine habitats that emerge in the needs analysis as candidates for special protections should be considered by the department, the stakeholders, and the Board for appropriate measures. Options include:
    a. taking a statewide approach or a regional approach;
    b. taking an incremental approach to provide protection to the most vulnerable and valuable areas and habitats with the highest conservation needs first, but proceeding with a view to a more comprehensive system of protected areas;
    c. taking an adaptive approach, allowing for shifting boundaries, expansion, contraction, or possibly termination of a reserve or protected habitats, depending on the results of ongoing evaluations (see below); and
    d. the establishment of a network, or system of reserves and protected habitats that provides for connectivity (via larval transport or migration) and for full representation and protection of the types of marine habitats in each region of the state's marine waters.

    Although selection of a set percentage of fishing grounds (e.g., 20% or more) has merit and is a potential option, it would be best to base the actual coverages for any

particular area on the actual needs, including the amount and quality of habitat and an evaluation of how well current management systems are working.

This recommended process should not hinder the Board or the department from taking emergency action as warranted.

Reserve Site Selection

1. Site selection should be done in a process that is objective and transparent to all stakeholders, so that stakeholders are included and decisions are well justified.
2. The department and/or advisory panel will facilitate evaluations of specific site proposals in an interdisciplinary forum with scientists, specialists, and stakeholders.
3. Sites should be selected in the context of the needs analysis, such that sites will be complementary and in a network when possible.
4. Sites should meet threshold ecological criteria. This will ensure the highest chance of success over the long-term. A minimal set of recommended ecological criteria (adapted from Roberts and Hawkins 2000) are:
    a. exploited species should be present, preferably in areas important to one or more vulnerable life stages, such as spawning or rearing; and
    b. site size should be large enough to meet the objectives of the proposed site.
5. Additional ecological criteria include:
    a. inclusion of high quality habitats or unique bathymetric features;
    b. inclusion of vulnerable habitats;
    c. inclusion of vulnerable or rare species, including marine mammals or birds;
    d. high biodiversity and/or high productivity;
    e. level of disturbance (less is better); and
    f. vulnerability to extraction of non-living resources, such as oil, gas, and minerals;
6. The full suite of criteria, including social and economic criteria, should be developed in a public process. A comprehensive list of criteria may be gleaned from the several schemes reviewed by the National Research Council (2001). These criteria should include:
    a. social and economic stability for coastal communities,
    b. magnitude of existing fisheries and their values;
    c. anticipated effect of displaced fishing effort;
    d. cultural values of area;
    e. potential for tourism and non-consumptive recreational use;
    f. potential for monitoring and evaluation;
    g. social and political acceptability;
    h. ease of enforcement;
    i. ease of management; and
    j. compatibility with existing and adjacent uses.

Buffer Zones

The establishment of buffer zones around reserves may be beneficial to meeting reserve objectives. These zones may have varying levels of fishing restrictions to meet the goals of

the reserve. For example, a no-take reserve might be established within a larger MPA having seasonal, gear, or individual species closures.

Experimental Controls

No-take reserves should be established as experimental controls where assessments can be conducted to evaluate whether population changes in fished areas are due to fishing or to environmental changes. Size of control areas is dependent in part on home range sizes of the fished population, but to be practical, the size should not be larger than the area that can be sampled in a statistically valid manner with acceptable precision for testing for differences. Controls should be created in replicate, preferably at least three.

Sensitive Marine Habitats

Fragile habitats that are subject to damage should receive priority for expedited review for potential designation as protected marine habitats. Eliminating use of some or all bottom contact gear types may, in some situations prevent damage to fragile habitats, including deep sea corals and sponges, which structurally enhance the diversity of habitats and promote greater biodiversity.

Coordination with Federal Efforts and with other State Agencies

Coordination of this program with federal entities, especially the North Pacific Fishery Management Council, and also the appropriate divisions of NOAA (NMFS and the National Ocean Survey–NOS), is important to the overall success of marine resource management in Alaskan waters. A consideration of the use of marine reserves and protected areas is expected to take place as part of the ongoing federal process to identify essential fish habitat (EFH) and habitat areas of particular concern (HAPC), as mandated by the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA). The Alaska Board of Fisheries participates in this process through joint Board/Council consultations, meetings, and actions.

The public, including conservation organizations, have recently shown heightened interest in developing proposals for MPAs in both the Board and Council arenas. The public would be best served if these issues could be addressed in a coordinated manner. As both state and federal programs move forward, it is recommended that the Board seek increased opportunities for coordination with the Council, specifically to coordinate the public process as well as the regulatory decision process. It is also recommended that the department coordinate closely with Council staff and NMFS on both the fishery analysis and the public process.

Designation of marine reserves and protected habitats should also be integrated and coordinated with existing and planned programs for protected areas with other agencies, including the Alaska Departments of Environmental Conservation, Community and Economic Development, and Natural Resources, as well as various federal departments having jurisdiction over marine waters.

Management Plans for Reserves

The Board should consider the need for management plans for designated marine reserves. Management plans should have the following features:

1. identification of reserve goals and objectives, specifically identifying whether the reserve is for fishery management purposes and/or biodiversity protection;
2. a description of the preferred management measures;
3. an evaluation of effects of closure on existing uses;
4. a plan for monitoring and evaluation (see below), including benchmarks for performance;
5. an enforcement plan; and
6. a plan for cross-jurisdictional coordination.

The management plan should be flexible, allowing for adaptation to changing circumstances. It will be important to identify who is responsible for development of the plan, as well as approving and modifying it.

Monitoring and Evaluation

It is important to monitor and evaluate reserve effectiveness to determine if objectives are being met and to learn how better to design and locate reserves. A plan for monitoring and evaluation would require a determination of (1) who would do it, (2) who would coordinate it, (3) and who would pay for it.

Monitoring should:

1. begin early in the process to establish a baseline;
2. be long-term;
3. include exploited and unexploited species, assessed with readily obtained measures:
    a. size/age and sex composition;
    b. abundance indices (densities);
4. include habitat measures:
    a. cover types;
    b. structural complexity; and
    c. measures of damage;
5. use independent scientific personnel where possible (e.g., university researchers).

Evaluation should:

1. include specific objectives and measurable benchmarks to gauge progress toward stated goals and objectives;
2. be completed at regular intervals with a public input and information distribution component; and
3. have decision analysis criteria in place for decision-making about the future management of the closure, allowing for adaptive management.

APPENDIX A: ALASKA BOARD OF FISHERIES CHARGE TO COMMITTEE

ALASKA BOARD OF FISHERIES
CHARGE TO COMMITTEE:
MARINE PROTECTED AREAS
2001-207-FB

The Board of Fisheries' authority for marine protected areas (MPAs) is found in AS 16.05.251(a)(1): setting apart fish reserve areas, refuges, and sanctuaries, in waters of the state over which it has jurisdiction, subject to approval of the legislature;..." Within this charge, "marine protected areas" is meant to generally describe these areas. The board and department seek to develop a process by which marine protected areas might be established and evaluated, including coordination with other agencies and other organizations.

The department is beginning a process to organize its approach to MPAs. A multi-divisional committee will inventory the current protected areas, no-take zones, etc. in Alaska; perform literature searches; review other programs; outline how to coordinate current efforts with other jurisdictions such as Western Association of Fish and Wildlife Agencies, National Marine Fisheries Service, North Pacific Fishery Management Council; define use of MPAs as a management tool; identify criteria under which MPAs will be established and evaluated; define terms, etc.

For the current meeting cycle (2001/2002), the board included in its Call for Proposals an opportunity for the public to submit proposals concerning MPAs, and received three proposals. In order to coordinate with state (and national) programs and initiatives, the board shall appoint a committee to design a process that the board may utilize for evaluating MPAs, including opportunities to involve the public. It is important to include the Department of Law to clarify the authority the board has in this area.

The committee shall consist of: Ed Dersham, Grant Miller, and Dr. John White. Staff will include the Deputy Commissioner, the Executive Director, and the Interjurisdictional Coordinator, and an Assistant Attorney General. The committee shall report to the full board in March 2002.

The calendar of events is as follows:

<u>NOVEMBER 2001 – February 2002</u>
Department committee meets to continue its work
Board MPA Committee is formed

<u>JANUARY 2002</u>
Joint BOF/NPFMC Protocol Committee meets and identifies coordination issues

<u>FEBRUARY 2002</u>
A white paper is provided to the board (and public) describing:
- Progress of department committee
- Recommendations on a board process for establishing an MPA

MARCH 2002
Board MPA Committee brings recommendation for process to full board
Board reviews white paper and decides on its process and timeline

Adopted: Nov 17, 2001
Anchorage, Alaska

Vote: 7-0

Ed Dersham, Chair

APPENDIX B: THE SCIENTIFIC BASIS FOR RESERVES

The department task force prepared this review of the scientific basis for marine reserves with the intent of providing a summary of results relevant to Alaska. This review focuses on research addressing potential benefits marine reserves might offer to fish populations and to fisheries to conserve populations and promote sustainable fishing. Benefits may be classed as either 1) those occurring within reserves, and 2) those observed outside reserves where fisheries may benefit directly. We also examine reserve design, including issues of location and size, and we consider costs associated with reserves

Research on MPAs and reserves has mushroomed in the last ten years (Conover et al. 2000). In response to the heightened interest in MPAs, the National Research Council (NRC) conducted a comprehensive review of the scientific basis for MPAs as tools for fishery management, and published a book with its findings (NRC 2001). Our task force has drawn extensively on the NRC publication in preparation of this review, as well as a variety of other review materials (Roberts and Polunin 1991, Rowley 1994, Agardy 1997, Allison et al. 1998).

BENEFITS AND COSTS TO FISH, FISHERIES, AND ECOSYSTEMS

Benefits Within Reserves

The immediate benefits to fish populations within reserves have typically been dramatic, but not surprising in hindsight. Closing areas to fishing generally allows individual fish to grow larger and their populations to increase, particularly for sedentary species in reef systems (review in NRC 2001, Halpern in press). The propensity of fish populations to replenish may be attributed in part to the exponential increase in egg production of most fish (and invertebrates) as they grow larger. This intrinsic increase in fecundity is one of the foundations for support for reserves among marine scientists, albeit with the tenuous proviso that increased egg production leads to increased recruitment (larval survival may sometimes be a more critical factor regulating recruitment).

World Wars I and II provided two of the earliest experiments on the effects of marine reserves on fisheries (Cushing 1981, Smith 1988). Due to wartime activities, the North Sea was virtually closed to fishing for plaice (*Pleuronectes platessa*, a heavily fished flounder) from 1914 to 1918. Immediately after the war, catch rates of plaice doubled and the average size was markedly larger. When this closure “experiment” was repeated from 1939 to 1945, the stock density more than tripled by war’s end.

Research on reserve effects has been more deliberate and focused in the past several decades, albeit often over periods of just a few years. Despite the short time frames, the results for changes in size and abundance within reserves are compelling. In a recent review of 89 studies by Halpern (in press), overall changes due to reserve creation were a doubling of densities, a near tripling of biomass, a 31% increase in average size, and a 23% increase in species richness. These increases are averages from a variety of studies for which the percentage of studies showing increases in densities, biomass, size, and species

richness were 63%, 90%, 80% and 59%, respectively. The implication is that the majority of reserves in the review showed increases in those four measures, and despite the inclusion of reserves that did not show increases, the average change was large. Given the short duration of most studies, it is likely that even greater increases, particularly in biomass, would come about over longer closed periods (NRC 2001), with potentially impressive increases in spawning biomass.

These are persuasive results, but are they applicable to Alaska? Virtually all of the studies reviewed by Halpern (in press) were from reef systems, mostly tropical coral reefs (59%) and to a lesser extent from temperate rocky reefs (41%), including four reserves in Puget Sound, Washington. To the extent that our exploited species share life history traits with the studied species, it is plausible that results would be similar here. Many of our invertebrates as well as our rocky habitat associated species (e.g., rockfish) are relatively sedentary as adults, which is a key life history trait of many reef species in the review. Moreover, several species studied in the Puget Sound reserves are also common in the Gulf of Alaska, including copper rockfish (*Sebastes caurinus*) and lingcod (*Ophiodon elongatus*), both of which showed significant increases in abundance in the reserves (Palsson and Pacunski 1995). Northern abalone (*Haliotis kamtschatkana*), though not included in Halpern's review, was found to increase substantially in body size and density in reserves in southern British Columbia (Wallace 1999). This species is closed to commercial harvest in Southeast Alaska due to low abundance (Woodby et al. 2000).

Eliminating Bycatch

In addition to effects on target species, non-target species may benefit from reserves in several ways. One of these is the elimination of bycatch, which may be substantial in some fisheries and for certain gear types, including trawls. For example, an examination of observer data for trawl, longline, and pot fisheries indicates that substantial bycatch of deep sea corals has occurred in the western Aleutian Islands region as well as other Alaskan waters (Heifitz 2002 in press, Witherell and Coon 2002 in press). Direct observations suggest that deep sea corals such as *Primnoa* spp. are important habitat for sea stars, nudibranchs, snails, rockfishes, shrimps, and crabs and other deep water species (Krieger and Wing 2002 in press), suggesting that prevention of bycatch for deep water corals may have significant ecosystem effects.

Conditional area closures in the Bering Sea for the trawl fisheries include areas where salmon bycatch was high (e.g., Chinook Salmon Savings area, see Appendix E: Inventory).It is possible, and in some cases probable, that displacement of effort away from prime fishing grounds for a target species may result in higher bycatch if fishing effort increases in less desirable grounds as fishers strive to maintain historical harvest levels.

Indirect Benefits

Non-target species may benefit indirectly through community level effects. Research closures beginning in the mid 1970s in nearshore reef habitats in the Phillipines (Russ and Alcala 1996), New Zealand (Walls 1998, Babcock et al. 1999), and Chile (Castilla 1999) led to incidental observations that, in addition to size and density changes, biological diversity increased with time. For example, at Leigh Reserve in New Zealand, large

predatory fish flourished and significantly reduced the population of sea urchins, which are highly effective grazers. Consequently, kelp and other algae became more abundant, providing greater structural habitat complexity for the nearshore community (Babcock et al. 1999). A similar ecological story played out in the Aleutian Islands, except in this case the "fish" were sea otters. After otter hunting ceased in 1911, following near total extirpation, otters eventually repopulated much of their former range, preying heavily on the urchin populations that had flourished in the near absence of otters (Estes and Palmisano 1974). With removal of urchins, the kelp communities grew to dominate the nearshore environment, sheltering a biological community rich in kelp-associated species.

Genetic Benefits

Fishing is often size selective, and is therefore a potential agent for evolutionary change towards slower growth and smaller size at maturity (Policansky 1993). Reserves may remove this pressure from a segment of a population, allowing a return, if only partial, to original size related life history characteristics. Reserves may allow this provided that sufficient genetic variation remains and that gene flow out of the reserve is adequate, conditions that were predicted to be true for red snapper (*Lutjanus campechanus*) in the Gulf of Mexico (Trexler and Travis 2000). These changes, if they are to occur, may not be immediately or readily apparent, and hopes for a marine reserve to provide these benefits is possibly better directed towards other management changes (e.g., size restrictions) if size selection driven evolution is a significant issue (Trexler and Travis 2000).

Benefits Outside of Reserves

Given the large potential increases in reproductive output associated with increases in spawning biomass observed in many reserves, it might be reasonable to expect a spillover of larvae, juveniles, and adults to adjacent areas open to fishing. From a fishery perspective, reserves would be beneficial if total yield were to increase on a sustained basis due to dispersal from reserves. Notably few published studies have addressed this issue through either observation or experimentation. Because effects on yield are an important issue for fishery management, we review most of the available empirical studies pertinent to Alaskan fisheries, including for example, research in north temperate areas with groundfish and invertebrate species. A summary of the selected research is given in Table B1. Due to the scarcity of temperate and high latitude examples, we also review some tropical studies and some pertinent modeling results.

Some impressive conservation benefits were seen following closures to bottom trawling of three large areas totaling 17,000 km^2 on Georges Bank, in the Northwest Atlantic (Murawski et al. 2000). The trawl closures were put in place as year-round in 1994 to protect groundfish species, including yellowtail flounder, haddock, and cod that were experiencing declining abundance and high exploitation rates. In 2000, after six years of closure, spawning stock biomass of yellowtail, haddock, and cod increased by 800, 400, and 50%, respectively. Scallops, which were not the focus of the closure, increased in biomass by 16-fold (Paul Rago, NMFS Woods Hole, personal communication). These increases are the totals across both closed and open areas of Georges Bank, indicating significant stock benefits outside the closed areas. It would be incorrect to attribute the

impressive gains solely to the closures, as effort restrictions and other fishery management actions were also involved. Further, the gains were large in percentage terms, but all four species were overfished, and so each had considerable recovery potential.

Despite the several caveats, the results from Georges Bank offer several lessons. First, closure location is important. The closures were placed to coincide with spawning aggregations, particularly for haddock and yellowtail flounder. Water circulation patterns in the area have been likened to a washer spin cycle, distributing eggs, larvae, and pelagic juveniles outward to nearby areas (P. Rago, personal communication). Second, the most sedentary species, including scallops and yellowtail flounder, experienced the greatest increases in biomass. The more migratory species, including haddock and cod, were more vulnerable to fishing elsewhere; hence, the effectiveness of the closures for these species also depends on fishery management in adjacent open areas (Murawski et al. 2000).

In contrast to the Georges Bank results, a nearby closure on the Scotian Shelf to protect haddock has failed (Frank et al. 2000). The closure (circa 13,700 km^2) was put in place in 1987 to protect juvenile haddock in their nursery habitat. Reasons given for failure are varied and suppositional, but the primary reason given is deterioration in growth and condition of the haddock stock due to historic over-exploitation and large-scale oceanographic cooling, such that reproductive output, measured in terms of recruitment, has fallen.

One other temperate Atlantic area closure merits mention: the “plaice box” in the North Sea adjacent to the Danish, German, and Dutch coasts, where trawling was restricted in 1989 to reduce exploitation and bycatch mortality of juvenile plaice. The closed area, 38,000 km^2, was open 6 months of the year, and when closed, only certain large, high horsepower trawlers were prohibited (Piet and Rijnsdorp 1998). Projections of the contributions to fisheries outside the “box” indicate that biomass of landings would fall by 8% if the restrictions were removed (Horwood 2000). This closure at best might be considered a moderate success, which has been limited by continued exploitation of the stock outside the “box” and by continued fishing for other species, including shrimp, in the “box” (Horwood 2000).

Yield from an overfished stock of snow crabs (*Chionoecetes opilio*) in Japan was improved following creation of a 14 km^2 reserve in 1983 (Yamasaki and Kuwahara 1989). Sublegal and newly molted (soft shell) crabs were apparently protected by the preserve from becoming discard mortalities in crab seine and other fisheries. Out migration from the preserve of legal-sized male crabs was demonstrated by recaptures of tagged crabs; in fact, highest catch rates in the fishery were recorded within 3 miles of the preserve boundaries.

Several tropical studies merit consideration in part because they are among the very few examining fishery yield effects. One of the earliest studies compared yields before and after removal of fishing restrictions at a small (0.5 km^2) coral reef reserve at Sumilon Island in the Philippines (Alcala and Russ 1990). Prohibitions on fishing in the reserve were lifted in 1984 after 10 years of protection. Eighteen months afterward, yield had dropped by 54% for the entire reef, whereas effort was relatively unchanged. These results suggest that the

presence of the reserve, covering 25% of the reef, supported a higher yield for the entire reef (36.9 tonnes/km^2), which the authors postulate was due to movements by adult fish out of the reserve. The authors also note that fisheries are more likely to benefit in coral reef systems when only parts of reefs are closed, allowing spillover of adults to increase yield in adjacent fished parts of reefs.

Negative effects on yield were found in a second tropical reef study at Mombasa Reserve in Kenya (McClanahan and Kaunda-Arara 1996), a 10 km^2 reserve created in 1987. Catch per unit effort in the open areas adjacent to the reserve increased in the first two years following closure for a reduced number of fishers, but then returned to pre-closure levels. By the end of the seven year study, yield had decreased by 35%, which was about one-half of the reduction in area open to fishing (65%). The authors give several explanations for the drop in yield, including new gear restrictions and park boundary effects. They suggest that 1) fishing effort, which became concentrated along the reserve edge, acted as a barrier to dispersal of fish out to the remainder of the open areas, and 2) a low edge to reserve area ratio limited the opportunity for spillover. The authors suggest that smaller parks (< 6 km^2), with higher edge to area ratios would allow for greater spillover. This result supports the conclusions of the Sumilon Island study (above).

More recently, Roberts et al. (2001) describe improved yield in artisanal coral reef fisheries at St. Lucia in the Caribbean, coming 5 years after creation of reserves covering 35% of the reef area. Catch of reef fish per trip in the non-reserve areas increased between 46 and 90%, depending on trap size. Although not a controlled experiment, the authors contend that the improvements were due to reserve creation and not to external (e.g., environmental) effects.

In the same report the authors describe improvements in a sport fishery in waters adjacent to the Cape Canaveral launch facility at Merritt Island National Wildlife Refuge in Florida. Refuge waters were closed to fishing in 1962. The authors report that a disproportionately large percentage of world record-sized fish of four popular sport caught species have come from adjacent waters, presumably due to movement of large fish from the refuge. The authors attribute the success of the reserves for both the artisanal and sport fisheries to the large proportion of area put into reserve status and to strong enforcement. They also attribute the success in the Florida sport fishery to the long period of closure (over 30 years), allowing individual fish to grow into the larger size classes.

The reality of the recreational fishery effects at Merritt Island has been strongly criticized on several grounds: the study ignored the effect of commercial gillnetting and a recent ban on their use, no tagging evidence was given for claims that fish migrated out of the reserve, and the trophy catch records were completely distorted (Olander 2002).

Creation of a reserve to protect shrimp nursery grounds had no obvious affect on yield in the Tortugas shrimp fishery off the Florida Keys in the Gulf of Mexico (Klima et al. 1986). The reserve was set aside specifically to allow export of small shrimp to the commercial fishery, with a projected enhancement of 10% to the average yield of 10 million lbs. The reserve was in place for two years (May, 1981 to April, 1983), and in the first year of

closure yield was relatively high. Yield in the second year was lower than in any of the previous 22 years for which the authors present data; the authors attribute this to low recruitment. Illegal fishing in the reserve was common during the closures, with only 65% compliance, making evaluation of the effectiveness of the reserve difficult.

Models

Given the scarcity of real world examples, scientists have made extensive use of population models to predict if marine reserves might benefit fisheries. These models are generally of two types: 1) adult spillover models, where adults of the target species move outside the reserve and 2) larval transport models, where larvae are well dispersed outside the boundaries but adults are sedentary.

In general, models of reserves show the greatest long-term yield benefits when adults are sedentary and larvae are well distributed, especially when a population is overfished (Beverton and Holt 1957, Polacheck 1990, Sladek Nowlis and Roberts 1999). Yield increases are most substantial for highly overfished populations and for those with low population growth rates (Sladek Nowlis and Roberts 1999). This prediction, based on four larval transport models for coral reef species, is potentially applicable to many other species having sedentary adults (many invertebrates and reef fishes); however, the predictions require that larvae are well dispersed and that they have adequate survival both within the reserve areas and outside. The problem with these assumptions is that the extent of larval transport and survival after settlement is poorly known for marine species in general. Bearing those caveats in mind, there are a number of exploited Alaskan stocks with mostly sedentary adults, including various rockfish species (*Sebastes*), clams such as geoducks (*Panopea abrupta*), weathervane scallops (*Patinopecten caurinus*), sea cucumbers (*Parastichopus californicus*), and sea urchins (*Stongylocentrotus* spp.).

Hastings and Botsford (1999) used a simplified larval transport model to examine in a general sense when reserves would prove beneficial. They demonstrated that a roughly equivalent yield is expected under traditional fishery management (fixed harvest rate) as compared to a no-take reserve, even though they made the conservative assumption that fecundity did not increase for fish protected by reserves. They showed that the fraction of habitat to remain open to fishing is always at least as great as the optimal proportion of adults harvested under traditional fishery management. For example, if the optimal harvest rate is 25% of the adults, then at least 25% of an area can remain open, and the yield should be the same as with harvest rate management. When the authors allowed for harvest rate management outside of the reserve(s), the proportion of open areas could be larger and still provide equivalent yield. This result suggests that reserves could be either a cost-effective alternative or a supplement to more traditional measures used to achieve a harvest rate. In addition to assuming that adults don’t migrate, their model also assumes that larvae are widely dispersed and that the number of larvae surviving to adulthood depends only on the density of settling larvae. If larvae somehow benefit from settling near adults (as may occur with red urchins and other species) then reserves would not produce as much yield as harvest rate management without reserves.

Clearly, models are simplifications of reality, and the life history of red urchins provides an illustration of the importance of considering the details. For example, urchin spawning success diminishes rapidly below a threshold density of adults (Levitan et al. 1992), whose sperm and eggs must find each other once released into the water. This type of density dependence, known as an Allee effect, also plays out for survival of small urchins, which are more likely to escape predation if they are sheltered under the spine canopy of large adults (Tegner and Dayton 1977). When these Allee effects were incorporated in a spatial model for red urchins, reserves were found to be necessary to sustain a heavily exploited population (Quinn et al. 1993).

A recurring conclusion in the scientific literature has been that adult spillover models predict small or no yield benefits to fisheries, and usually only where exploitation rates are high (Beverton and Holt 1957, Polacheck 1990, Sladek Nowlis and Roberts 1999). This conclusion has been well challenged in a detailed model by Apostolaki et al. (2002) that distinguished between spawning and nursery areas for seasonally migratory species, and between fisheries targeting mature and immature fish. In that model, increases in yield were substantial for migratory species, provided that the targeted segment (adults or immatures) received seasonal protection in the reserve, and that harvest rates were relatively high. The greatest improvements in yield were found for reserves protecting nursery habitat when immature fish were targeted, and these were predicted to occur even at moderately low exploitation rates. In keeping with the simpler adult spillover models, improvements in yield were predicted to fall off as the mobility of the target species increased.

Reserves may be beneficial to even highly migratory species, as shown in a retrospective model of the northern cod (*Gadus morhua*) fishery off Newfoundland. Due to the wide ranging migratory nature of cod, the majority of the cod grounds (80%) would have to have been placed in reserves to prevent the now famous collapse of the stock in the early 1990s (Guénette et al. 2000). With such an extensive closure, the authors predict that the displaced effort would then have concentrated on the few remaining grounds, especially along the reserve boundaries, leading to extreme local depletion and lower catch rates. Also, given the local economics at the time, fishers would likely have increased their capitalization in boats and gear, exacerbating the problem. The solution posed by the authors was to combine a smaller reserve (20% coverage) with effort reductions (imposed as temporal closures for trawls and gill nets), and they predict that this would have been sufficient to prevent stock collapse and allow rebuilding. In fact, given the severely depleted state of the cod stock at the time, effort reduction was considered necessary to prevent stock collapse in their simulated populations.

Martell et al. (2000) incorporated information on movement of lingcod (*Ophiodon elongatus*) in a spatial model to evaluate the effectiveness of several small reserves in British Columbia, where lingcod populations have been reduced to less than 10% of pre-fishing abundance. Commercial fishing for lingcod there has been closed since 1990, whereas a sport fishery continues. The authors concluded that the three existing reserves are too small (0.01 to 0.05 km^2) to protect legal-sized adults in the reserves, assuming average movements of 750 meters per day. They examined several management options,

and found that increasing the area in reserves from less than 1% to 10% of the lingcod grounds doubled the annual yield, as compared to the status quo. This option had the lowest risk of overharvest, with an annual exploitation rate less than one-fifth of the status quo (circa 20%). Alternatively, halving the season to 2 months was predicted to more than quadruple the yield with less than half the annual exploitation rate. Increasing the size limit from 65 to 75 cm was predicted to increase yield by three times but with a higher risk of overharvest. Other management options, including smaller increases in reserve area, smaller reductions in fishing time, and smaller increases in the size limit, were less effective at increasing yield or reducing risk of overharvest.

Rockfish Models

Various Gulf of Alaska rockfish species may benefit from reserves because most are non-migratory as adults and have low population growth rates, making them prone to overfishing and serial depletion. Interest in halting the depletion of rockfish on the U.S. west coast and in Alaska have resulted in several research efforts using models to examine the benefits of harvest refugia.

Using a larval transport model for bocaccio rockfish (*Sebastes paucispinus*) in fisheries off central and northern California, Sladek Nowlis and Yaklovich (1998) found that reserves enhanced yields whenever the fishery was overfished. Also, the optimum size of reserve increased as fishing mortality increased.

In a model for Pacific ocean perch (POP, *Sebastes alutus*), Foran and Fujita (1999) demonstrated that the effect of reserves on yield depends on the interplay between the stock recruitment relationship and the extent of migration that occurs out of the reserve. Their model incorporates deep water reserves for adult POP, which tend to be more migratory than many other rockfish in the genus. If recruitment is “optimistic” (authors’ definition: high recruitment occurs without having high populations of adults) movement out of the reserve improves yield, whereas if recruitment is “pessimistic” (author’s definition: high levels of recruitment only occur with high population levels of adults), reserves produce higher yields when adults do not move out of the reserve. In that case, reserves shield adults from harvest, and these adults fuel higher long-term catches via higher egg output. In all cases, POP fisheries with no-take reserves are predicted to provide yields equal to or greater than fisheries without reserves. Further, exploitation rates could be higher with reserves and still achieve higher long-term yields, suggesting that reserves act as buffers against management errors in controlling fishing mortality rates.

In a notably Alaskan application, Soh et al. (2000) used a larval transport model (larval but not adult dispersal) with detailed population dynamics to demonstrate several potential conservation benefits of reserves for shortraker and rougheye rockfish (*Sebastes borealis* and *aleutianus*) in the Gulf of Alaska. These species are legally taken only as bycatch in hook and line fisheries for other species (typically halibut and sablefish), and the season for shortraker and rougheye rockfish closes when the bycatch allowance is taken. The authors found that placing reserves over hotspots would have two conservation benefits. First, serial depletion of high density areas would be prevented. Second, “topping-off” to the bycatch allowance would be more difficult because the fleet would be displaced to lower

density areas where they could not as efficiently target these species to reach their bycatch limits. The predicted effect would be to prolong the bycatch-only season, hence shortening the subsequent season after the total allowable catch has been taken when all specimens of these species must be discarded[2]. Reducing discard mortality (most rockfish die when brought to the surface because their swim bladders rupture) reduces total mortality without reducing total landings, effectively increasing the biomass of the unharvested stock. The authors note that topping-off is done to maximize economic returns. Without this opportunity, albeit an unintended benefit of the existing fishery management system, some harvesters would suffer a near-term economic loss. Lacking sufficient information on dispersal, the authors did not assess the contribution of productivity in the model reserves to overall fishery yield and sustainability.

Costs

Costs of implementing marine reserves may be born by a variety of individuals or groups, including commercial, recreational, and subsistence fishers, as well as society at large. A complete analysis of such costs is far beyond the scope of this review and would be mostly conjectural. A fairly complete review of the larger economic issues, examining both costs and benefits for market and non-market values is provided by the NRC (2001).

The immediate costs include lost opportunities to fish in traditional areas, which for commercial fishermen include loss of fishing income from the reserve. There may be increased travel costs to fish in more distant, possibly unfamiliar grounds, providing other areas and opportunities are available. If fishing is displaced to less productive grounds, there may be heightened competition for fewer fish, and bycatch may increase as effort increases to maintain catch and income expectations. Even though marine reserves may eventually provide for increased yields for overfished fisheries, the general expectation is that yields will be decreased during a transition phase (e.g., Roberts and Hawkins 2000, NRC 2001) lasting perhaps several years or more.

Losses to subsistence and recreational harvesters may be great, particularly if no viable substitute area is available to meet subsistence and other personal needs. The seafood processing industry may bear costs, including lost wages and jobs if total yield decreases in the short or long-term due to reserve designation. Costs to society include enforcement costs, which will depend on logistical constraints, such as remoteness, as well as the likelihood for violations. Additional societal costs include any governmental compensation to persons adversely affected by reserve creation, and any new costs of research and management associated with the reserve.

Example: Glacier Bay

The recent closure of Glacier Bay to most commercial fishing, notably for Dungeness crabs, provides an example of costs; however, this is not an example of a marine reserve

[2] As of 2000, all rockfish bycatch in state waters must be landed, (proceeds going to the state) in an attempt to account for all mortality. A decision on similar restrictions in federal waters is pending.

created as a fishery management tool. Rather, the closure was put in place based on the public's desire to exclude commercial extractive activities from a National Park.

A worst-case assessment of economic losses due to the fishery closures ranged from $28.6 million to $51.6 million (present day value of future losses, McDowell Group 2000). These "losses" do not include costs incurred by the Park Service to enforce new restrictions, conduct new research, or for the Park Service to participate in new responsibilities for commercial fishery management.

Actual costs have been included in a federal compensation package. Qualifying permit holders in the Glacier Bay Dungeness crab fishery were eligible for a minimum of $400,000 compensation for their permits, gear and vessels. Nine permit holders participated in the buyout totaling $5.5 million. To meet expectations for additional compensation, Congress appropriated $23 million for any persons, businesses, and communities adversely affected by the new commercial fishing restrictions in the bay. This includes permit holders in other fisheries, crew members, processors and their employees, other fishing related businesses, and communities that may lose fish tax revenues.

The compensation package for Glacier Bay is probably not a good example of what commercial fishers should expect if marine reserves are created elsewhere in Alaskan waters. Commercial fishing permits allow harvest and sale of particular species, but do not grant rights to fish everywhere, and the Board's authority to close fishing areas is specifically used to benefit the resource, for the future benefit of permit holders and the public.

Table B1. Closed area effects on fishery yield: results of selected case studies and predictions of models.

Area and type	Species group	Reserve size	Effect	Reference
N. Atlantic shelf – Georges Bank	Scallops and groundfish	17,000 km2	16x, 8x, 4x, and 0.5x increase in scallops, yellowtail flounder, haddock, and cod, resp.	(Murawski et al. 2000)
N. Atlantic shelf – Scotian Shelf	Haddock	13,700 km2	Failed to result in increases in juvenile haddock, but appears to have increased abundance of plaice and winter flounder (*Psuedopleuronectes americanus)*	(Frank et al. 2000)
North Sea, Plaice Box	Plaice	38,000 km^2	Moderate, but limited improvement in yield due to continued fishing in "box"	(Piet and Rijnsdorp 1998, Horwood 2000)
British Columbia	Lingcod	3 sites: 0.048 km^2, 0.047 km^2, 0.018 km^2	Densities of large spawners was greater in reserves than out; substantial movement across boundaries is suspected; reserves are probably too small.	(Martell et al. 2000)
Japan Sea	Snow crab	14 km^2	Yield increased; sublegal and soft shell crab were protected; export of legal crab demonstrated by tagging.	(Yamasaki and Kuwahara 1989)
Florida keys, Tortugas Reserve	Shrimp	Not given	No obvious affect. Reduced yield in 1 of 2 closed years possibly due to poor recruitment. Only 65% compliance.	(Klima et al. 1986)
Philippines; coral reefs; Sumillon I.	Reef fish	0.5 km^2	Higher yields with reserve: yield dropped 54% when reserve opened to fishing.	(Alcala and Russ 1990)
Kenya; coral reef; Mombasa Reserve	Reef fish	10 km^2	Yield dropped 35% after 7 years	(McClanahan and Kaunda-Arara 1996)
Caribbean: coral reefs; St. Lucia	Reef fish	Not given; 35% of reef fishing area	Catch/trip increased 46–90% depending on trap size.	(Roberts et al. 2001)
Florida; Merritt I.	Sport fish	40 km^2 in 2 sections	Large percentages of world record-sized trophy fish of 3 species.	(Roberts et al. 2001)

RESERVE DESIGN

The primary elements of reserve design include location, size, configuration, and coverage (the proportion of an area with reserve status). Although these elements are so closely related as to be inseparable when reserves are designated, we treat them separately here to highlight concerns unique to each.

Location

Selecting specific locations for no-take reserves may be the most contentious stage in the process of reserve designation because there are few marine waters that are not harvested by someone. To date, most existing reserves, including those in Alaska, were set aside given the opportunity to protect pristine areas (e.g., wilderness waters of Glacier Bay) or known areas of unusual biological importance (Round Island for Walrus, the Sitka Pinnacles, primarily for lingcod). As public interest in designating reserves has grown worldwide, various authors have proposed objective criteria for site selection that are expected to provide well justified choices in the full public arena (summary in NRC 2001). These criteria span social, economic, and ecological issues, and are summarized in Table B2.

Possibly the most elaborate procedure, titled COMPARE (Criteria and Objectives for Marine Protected Area Evaluation) was developed for evaluating proposed and existing MPAs in South Africa (Hockey and Branch 1997). COMPARE is a matrix approach in which 17 criteria are numerically scored against a list of 14 objectives in three categories: biotic protection, fishery management, and provision of human uses (Table B3). The method is information rich and designed to allow quantitative evaluation of alternatives. If anything, COMPARE is possibly too elaborate for the Alaskan program, with many required scorings for which information may not be available, and a differentiation between objectives and criteria that may be too arcane for a broad-based stakeholder process. As such, COMPARE may serve well as an example from which a reduced set of criteria and objectives may be selected.

Table B2. Summary list of social and economic site selection criteria from various authors (summarized by Roberts et al. in review b).

Economic value
Number of fishers dependent on the area
Value for tourism
Potential contribution of protection to enhancing or maintaining economic value
Social value
Ease of access
Maintenance of traditional fishing methods
Presence of cultural artifacts/wrecks
Heritage value
Recreational value
Educational value
Aesthetic appeal
Scientific value
Amount of previous scientific work undertaken
Regularity of survey or monitoring work
Presence of current research projects
Educational value
Feasibility/Practicality
Social/Political acceptability
Access for education/tourism
Compatible with existing uses
Ease of management
Ease of enforcement

Table B3. Site selection criteria and objectives used in the COMPARE procedure in South Africa (adapted from Hockey and Branch 1997).

	Criteria		**Objectives**
1	Regionally representative	1	Biogeography
2	Not conserved elsewhere	2	Habitat diversity
3	High habitat diversity	3	Rare or endemic species
4	Includes fragile habitats	4	Vulnerable stages (all species)
5	Houses vulnerable species	5	Reduced fishing mortality
6	Protects rare or vulnerable species	6	Vulnerable stages (exploited species)
7	Pristine or restorable	7	Adjacent yield
8	Special natural features	8	Spawner biomass
9	Supports exploited species	9	Research
10	Supplies adjacent areas	10	Monitoring
11	Large enough	11	Ecotourism
12	Adjacent terrestrial reserve	12	Low-impact recreation
13	Aesthetically appealing	13	Education
14	Accessible to public	14	Exploitation
15	Effective management		
16	Satisfies social needs		
17	Preserves historical sites		

In their review of previously published site selection procedures (Roberts et al. in review a) developed a suite of purely ecological criteria for single sites as well as for networks of reserves. The rationale for using ecological criteria first is that reserves will only have lasting economic and social value if they are biologically effective. The criteria are in four categories: representation, excluding, screening, and modifying (Table B4).

It would be a mistake to assume that, just because these are scientific criteria, only scientists should be evaluating sites by the ecological criteria. This was the approach taken in coastal California by the California Department of Fish and Game in late 2001, and the plan was roundly criticized and soon dropped, primarily because most stakeholders were not involved in the initial site selection process. Instead, Roberts et al. (in review b) suggest that stakeholders be involved based on their knowledge of the resources and for stakeholders to be apprised of the importance of biological attributes for achieving the objectives.

A difficulty with each of these criteria schemes is the need to assign weights to each factor, given that some criteria may be more important than others and should receive more emphasis in the final tally. The NRC (2001) recommends involving stakeholders in this step of the process as well.

Table B4. Ecological criteria for selection of marine reserves and reserve networks (summarized from (Roberts et al. in review b).

Representation criteria: to include full biodiversity spectrum	
	Biogeographic representation – include all bioregions; replicate reserves in each if a network
	Habitat representation and heterogeneity – a proxy for species diversity requiring less data
Excluding criteria	
	Level of human threat – high threats eliminate a site unless threat can be mitigated
	Level of threat from natural catastrophes – high threats eliminate a site
Screening criteria	
	Size of site – large enough to support viable populations
	Connectivity – network of sites should be connected via dispersal and migration of organisms
Modifying criteria	
	Presence of vulnerable habitats – e.g., corals
	Presence of vulnerable life stages – e.g., spawning sites and nursery grounds
	Presence of exploitable species – required if purpose is to support fisheries
	Presence of species or populations of special interest – e.g., endangered or rare species
	Ecosystem functioning and linkages – e.g., areas that export nutrients
	Provision of ecological services for people – e.g., coastal protection, water purification

RESERVE SIZE

Despite a number of theoretical attempts to determine optimal reserve size, the eventual determination of size is subject to a host of concerns ranging from biological to political and practical. For this reason, this review seeks only to identify the issues, and a few relevant results from the scientific literature are presented.

Ecologically, larger reserves are preferred because they will typically include more habitats, hence more species. Also, population sizes are likely to be larger for species in a larger reserve, and therefore more likely to persist given natural disturbances and disasters, such as El Niño events or oils spills, and more likely to retain genetic diversity. The down side of larger reserves is that they will be more disruptive to fisheries and other human activities.

Reserves can't be too small. If too small, the populations within may not be viable, and there may be too much edge relative to the interior, making them "leaky" and unable to accumulate significant spawning biomass (Roberts and Hawkins 2000). Roberts et al. (2001) argue that the proper size to optimize spillover to fisheries is a few to a few tens of kilometers across, and that these sizes will be a practical result of human constraints of population pressure and other uses of the area.

A surprising result of Halpern's (in press) review of benefits within existing reserves (see above) is that size isn't everything; that is, small reserves are just as likely as a large reserves to have a doubling in fish densities or a near tripling in biomass. Again, his review is mostly of reef reserves, and especially tropical coral reef reserves where species are relatively sedentary. In that review, reserve sizes varied from 0.002 km^2 to 846 km^2, with the mode between 1 km^2 and 10 km^2.

For reserves created to conserve particular species, the home range is an important criterion in determining reserve size. Home range can be defined as the area an animal uses repeatedly. Some fish, including some pelagic and highly migratory species, may not have home ranges, but for the many that do, reserve size should be at least as large as the longest dimension of the home range, if not several multiples of home range size to limit exposure to an adjacent fishery (Kramer and Chapman 1999). For example, a theoretical calculation of exposure to fishing (time outside of the reserve) is 10% for a reserve length of 2.5 times the home range length, and 2% for a reserve of 12.5 home range lengths (Kramer and Chapman 1999). The length and position of the boundary with respect to habitat types will affect this estimate.

Finally, there are inherent risks of fishery failure using almost any management tools, including reserves, and the degree of tolerance for risk affects the selection of reserve size (Mangel 2000). For example, a larger reserve may be needed if it is extremely important that the reserve meets its objectives, say for protecting the remaining population of an endangered species as opposed to protecting one of several viable populations of a rare species. Given that unlikely events become more likely as time passes, reserve size will also need to be larger if the planning horizon is 100 years instead of say, 10 years.

Configuration: Reserve Networks

An alternative to large reserves is a network of smaller reserves. Various authors (Murray et al. 1999, Roberts and Hawkins 2000, Roberts et al. 2001) have argued strongly for creation of reserve networks, as opposed to single reserves, based on several expected benefits: 1) a network is likely to cover more types of habitats than a single large reserve of

the same total coverage, 2) a network will distribute and reduce the risk of negative effects from disturbances and catastrophes, and 3) networks are better matched to the dispersal and metapopulation characteristics of many marine populations.

The last point requires clarification and some analysis. Marine species vary greatly in their dispersal abilities. Some have short dispersal distances of a few meters while others, including many marine fish and invertebrates, have a pelagic larval phase that promotes long distance dispersal from spawning sites. Dispersal distances depend greatly on residence time in the water column, which, depending on the species and environmental conditions, can range from a few days to months (Brothers et al. 1983, Strathmann 1987, Moser and Boehlert 1991), suggesting that dispersal distances can be well over 100s of kilometers, presumably with prevailing currents[3]. Species with minimal dispersal distances may be self-sustaining in small reserves, whereas large distance dispersers will need external sources of propagules to persist.

A common view is that the external source will often need to be another reserve (Roberts et al. 2001), and hence that there needs to be a network of reserves connected by dispersal of the resident organisms. This view has been developed for coral reefs where metapopulations, comprised of individual reef populations, interact by way of dispersal across habitat inhospitable to adults (Man et al. 1995) and more importantly, where fishing pressure has or is expected to become so intense that some species will be unable to persist outside of reserves (Roberts et al. 2001).

In the Alaskan realm, this view might apply to particular species, including rockfish in patchy rock or kelp habitats; however, the applicability of this view is debatable for the broad expanses of continental shelf habitat where much of the industrial fishing for groundfish and crabs occurs, and where exploitation rates are explicitly controlled to allow for population replenishment. In this and similar cases, the concept of a reserve network requires careful consideration.

Where reserve networks are to be created, Roberts et al. (2001) make the following recommendations for reserve size and spacing (abbreviated here):

1. sizes of individual reserves in the network should range from a few kilometers to 10s of kilometers across so as to optimize spillover,
2. spacing should be variable, ranging from a few kilometers to a few tens of kilometers,
3. include representatives of every habitat in several different reserves,
4. include 20–50% of habitat,
5. offshore reserves should be larger than inshore,
6. every biogeographic region should have a reserve network that spans the region, and
7. reserves in the region should be physically and ecologically connected.

[3] Some species may move vertically in the water column, effectively controlling their exposure to currents or tidal movements that vary with depth, and may disperse in directions other than the prevailing current.

Coverage

Less than one-half of 1% of the world's oceans are now in any protected status, with much less off limits to fishing (Roberts and Hawkins 2000). Comparing these tiny percentages to the much larger fractions on land, conservationists and marine scientists have suggested placing anywhere from 10 to 70% of the seas into protected status free from fishing. Justifications for these levels include ethical considerations, as well as quantitative, largely theoretical analyses focused on precautionary management, yield enhancement, and biodiversity protection (readers are encouraged to see the full reviews in NRC 2001 and in Roberts and Hawkins 2000). Given that these suggested coverages would significantly alter marine resource use patterns, it is appropriate to ask if the concerns are relevant to Alaskan waters.

The ethical argument holds that some areas should be unexploited, and 10% should be the minimum, line-in-the-sand amount given the remaining 90% available for exploitation. This is not an argument that can be evaluated from a purely scientific perspective, but is more of a subjective, societal decision.

The precautionary approach seeks to reduce the risk of stock collapse that might occur for a variety of reasons, including recurrent recruitment failures, inadequate stock information, management errors, and human-caused or environmental disturbances. The precautionary method seeks to maintain anywhere from 20 to 75% of the unexploited stock size to ensure that there will nearly always be adequate reproduction to sustain the population. The simple approach to achieve these stock sizes, absent fishery controls, and absent reliable estimates of unexploited stock sizes, is to close large proportions of areas to fishing, with most estimates ranging from 20 to 50% (Roberts and Hawkins 2000). Where fishing is controlled, for example by effort and gear restrictions or by harvest limits, total reserve coverage may be reduced and provide adequate risk protection. For example, and as described previously, the early 1990s collapse of Newfoundland cod stocks might have been averted if as much as 80% of the fishing grounds for this highly migratory species had been closed, or alternatively, if a 20% closure had been accompanied by temporal closures to trawls and gill nets (Guenette et al. 2000).

The argument to close large proportions of the sea to enhance yields comes largely from modeling results that predict increased yields when stocks are overfished (see Models, above). These studies largely assume few or no other fishery controls, and lacking these, prescribe closed areas totaling 20 to 40% of the fishing grounds (summary in Roberts and Hawkins 2000).

SUMMARY AND CONCLUSIONS

- Effects within reserves: Marine reserves have proven effective in promoting rebuilding of overfished populations within reserves, particularly for relatively sedentary species associated with reefs. In a recent review of 89 studies by Halpern (in press), reserve creation appears to have resulted in a doubling of densities and a near tripling of biomass. These results are despite short time research frames.

- Effects on fisheries are largely theoretical, but there are examples of significant positive effects:
    - The build-up of spawning biomass within reserves has enormous theoretical potential to improve fishery yields outside of reserves because of the geometric increase in egg production associated with increased body size.
    - Most research on reserve effects comes from reef systems, especially tropical coral reefs; however, several temperate latitude studies point to significant positive benefits for fisheries that have been overfished. One of the most compelling cases is that of scallops on Georges Bank, where spawning biomass increased 16-fold across closed and open areas.
    - Fishery models of reserves strongly suggest that reserves for relatively sedentary species will lead to increased yields whenever the population is overfished, despite reductions in area open to fishing. The explanation for increased yields is that spawning biomass increases, leading to very large increases in larvae output to areas outside of the reserve.
    - Reserves for more mobile species are expected to reduce the risk of overfishing and allow higher yields when spawning and nursery areas are included in the reserve, and as long as management measures effectively control total exploitation rates.
    - Reserves may be useful in controlling bycatch reduction, e.g., for rockfish where other fishery controls are inadequate.
    - Marine reserves are not a panacea for overfishing, but provide a hedge against uncertainty to promote long-term sustainability in conjunction with other fishing restrictions, including effort controls.
- Costs to the fishing industry due to reserve creation are projected to be greatest in the first few years, after which enhancements to yield would be expected to kick in. Of the few analyses of costs, the Glacier Bay closure provides a worse case scenario for the Dungeness crab fishery, with minimum societal costs of $29 million.
- Published site selection criteria are available to assist agencies and the public to choose between options. These include biological, social, and economic criteria. Reserve sites are not likely to be successful if they do not meet biological criteria, and they are unlikely to be acceptable if they do not meet socioeconomic criteria.
- Optimal reserve size is difficult to know; however, home range of the target species is an important criterion to consider. Larger is better, and networks of reserves are probably best for achieving general reserve objectives of fishery yield enhancement and maintenance of biological diversity.
- Total reserve coverage has been recommended to be in the range of 20 to 50% of the fishing grounds to enhance yield and to reduce the risk of stock collapse. These proportions are notably large compared to the existing coverage in no-take reserves of 1% of the world's oceans.

APPENDIX C: MPA PROCESSES IN OTHER JURISDICTIONS

INTRODUCTION

The state of Alaska is in an enviable position to learn from the successes and mistakes of other jurisdictions that have broken trail in establishing marine protected area programs. This section provides a review of processes in the United States in general, in each of the three other Pacific coastal states, and in British Columbia. These reviews emphasize the legal basis for the programs, the types of MPAs under consideration, the public process, and the current status. Web links and contact information are provided as well. Anyone considering being fully involved in the Alaska process is urged to not only read the materials presented here but to browse the internet links to catch the full flavor of the processes in nearby jurisdictions. Some highlights of these programs are:

> The national program is best characterized as gearing up. Executive Order 13158 issued by President Clinton in 2000 calling for a national MPA program was reaffirmed by President Bush in 2001. A national MPA center and two regional centers have been recently established and staffed, a national inventory is underway, a national advisory committee is being formed, and there is a comprehensive website (www.mpa.gov).
>
> The state of California has a clear mandate in the Marine Life Protection Act of 1999, directing the California Department of Fish and Game to develop a master plan, to improve the existing MPA program, and incorporate reserves. The process was on a fairly fast track through 2001, but the master plan presented to the public that year, complete with maps of proposed closures, was scrapped in January, 2002 by the Department of Fish and Game due to overwhelming opposition, especially from recreational fishing interests. It proved to be an ill-fated process to have agency staffers and scientists primarily responsible for selecting proposed closure boundaries without effective stakeholder involvement. The revised process is based on stakeholder representation on seven regional advisory groups.
>
> The MPA program in Oregon is under the jurisdiction of the Ocean Policy Advisory Council (OPAC), which is following a principle of maximum inclusion of stakeholders, particularly in light of the recent California experience. OPAC has prepared a draft proposal calling for a limited set of reserves to test their effectiveness in meeting conservation goals.
>
> Washington's MPA program might be described as a complex patchwork of protected areas under a variety of jurisdictions (federal, state, county, and other) without a coordinated master plan. An important feature of the Washington process is the need for coordination with tribal governments, which by law have been allocated 50% of the allowable resources.

British Columbia is proceeding under a clear and strong mandate from their federal government under the 1997 Oceans Act to develop an MPA system. Their commitment is for shared responsibility between the province and the federal government, a shared decision-making process with the public, and to have a comprehensive system of protected areas in place by 2010. Four proposed reserves are in various stages on their way to becoming the first designated sites under this program.

Based on the reviews presented in this appendix, there are some clear lessons for Alaska. First, make the process inclusive, providing stakeholders meaningful opportunities for effective participation. Second, develop a coordinated master plan and establish principles for carrying it out. Third, start with a blank slate for specific recommendations for sites. Fourth, allow adequate time for the process to unfold, without predetermined endpoints.

U.S. FEDERAL MARINE PROTECTED AREA PROGRAMS

Current status, Definition, and Legislation

Executive Order 13158 (EO) resulted in a National Marine Protected Area (MPA) initiative (http://mpa.gov/). It directed the Departments of Commerce and the Interior to coordinate development, under existing laws and statutes, a nationwide system of MPAs. This included facilitation of MPA development by other entities, including "state, territorial, local, and tribal governments as well as other stakeholders". The EO assigned a broad definition to MPAs, "any area of the marine environment that has been reserved by Federal, State, territorial, tribal, or local laws or regulations to provide lasting protection for part or all of the natural and cultural resources therein". This has been defined as meaning areas with year-round protection.

The MPA initiative relies upon existing legislation and agency jurisdiction in creating MPAs but when fully developed will coordinate as well as provide support and guidance among areas. Another mandate of the EO was the creation of a comprehensive list of MPAs within the United States. An MPA list has not yet been created. However, a Marine Managed Areas (MMAs) Inventory, comprised of areas that (currently) meet the EO definition of an MPA, has been developed. Not all sites listed in the MMA Inventory will meet all of the criteria for designation as MPA List sites. In its current form, the inventory has developed a set of working criteria based upon five words in the MPA definition: "area, reserved, marine, lasting, and protection".

Federal sites currently listed in the MPA Inventory include:

Department of Commerce, National Oceanic and Atmospheric Administration (NOAA)
- National Marine Sanctuaries (14)
- National Marine Fisheries Service (36)
- National Estuarine Research Reserves (joint state/federal) (25)

Department of the Interior
National Park Service (39)
Fish and Wildlife Service (162)

Other government entities that may either create or partner with states on MPAs include the Environmental Protection Agency (EPA), the Department of Agriculture – United States Forest Service (USFS), and the NOAA-Coastal Zone Management Program (CZMP).

Numerous pieces of federal legislation provide the basis for establishing and managing MPAs. These include:

1) Title III of the Marine Protection, Research, and Sanctuaries Act of 1972 (renamed The National Marine Sanctuaries Act in 1992).
2) Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA)
3) Endangered Species Act (ESA)
4) Marine Mammal Protection Act (MMPA)
5) 1916 National Park Service Organic Act (Organic Act)
6) General Authorities Act of 1970
7) 1978 Redwood National Park Act
8) Refuge System Administration Act of 1966, as amended.
9) Migratory Bird Conservation Act
10) Fish and Wildlife Act of 1956
11) Emergency Wetlands Resources Act of 1986
12) Alaska National Interest Lands Conservation Act (ANILCA)
13) Clean Water Act, as amended in 1987
14) National Environmental Policy Act (NEPA)
15) Outer Continental Shelf Lands Act (OCS)
16) Wilderness Act
17) Coastal Zone Management Act (CZMA)

Legal Basis

Because the federal MPA program fulfills a coordination and support function and does not create MPAs, the legal basis for establishing MPAs lies in the aforementioned legislation. Specific MPA system components currently represented in the federal MPA/MMA Inventory include National Marine Sanctuaries, National Wildlife Refuges, Ecosystem Reserves, fishing (gear and species) closures, habitat closures, and ESA and MMPA critical habitat and protected areas. Other components that are joint federal/state entities include National Estuarine Research Reserves and the National Estuary Program under EPA.

The rationale for MPA sites is developed within the legislation for the applicable unit, however the EO also provided guidance for support and encouragement of protections afforded by MPAs. Section 4 (a) lists the following:

1) science-based identification and prioritization of natural and cultural resources for additional protections;

2) integrated assessments of ecological linkages among MPAs, including ecological reserves in which consumptive uses of resources are prohibited, to provide synergistic benefits;
3) a biological assessment of the minimum area where consumptive uses would be prohibited that is necessary to preserve representative habitats in different geographic areas of the marine environment;
4) an assessment of threats and gaps in levels of protection currently afforded to natural and cultural resources, as appropriate;
5) practical, science-based criteria and protocols for monitoring and evaluating the effectiveness of MPAs;
6) identification of emerging threats and user conflicts affecting MPAs and appropriate, practical, and equitable management solutions, including effective enforcement strategies, to eliminate or reduce such threats and conflicts;
7) assessment of the economic effects of the preferred management solutions; and
8) identification of opportunities to improve linkages with, and technical assistance to, international marine protected area programs.

Process

Federal regulations outline the methods to establish MPAs under the various programs. Most include both an administrative and a legislative avenue.

National Marine Sanctuary Program (NMS)
NOAA/NMFS
Regulations for implementing the National Marine Sanctuary Program are subparts A through E of Title 15, Chapter IX, Part 922 of the Code of Federal Regulations. Sanctuaries may be established either, through an administrative process under the NMS program, or via an Act of Congress. Under the administrative process, locations that have been assigned to the Site Evaluation List may progress to Active Candidate status. Active Candidate sites are chosen for their conservation, ecological, recreational, or aesthetic values. These may be selected for publication in the Federal Register under a notice of intent for consideration as a sanctuary. At this point, a draft environmental impact statement (EIS) is prepared (per NEPA) as well as a draft management plan and draft regulations. The draft EIS is then made public and at least one public meeting is held in the affected area. The Secretary also provides the affected state, federal Regional Fishery Management Council, or other agency an opportunity to develop regulations on fishing activities within the proposed sanctuary. The MPA/MMA inventory lists all 14 NMS sites covering more than 18,000 square miles.

Coastal Zone Management Program (CZMP)
NOAA/NOS
The Coastal Programs Division (CPD) administers the U.S. CZMP. The CPD is responsible for advancing national coastal management objectives and maintaining and strengthening state and territorial coastal management capabilities. While the program does not directly manage coastal areas, it supports states through financial assistance, mediation, technical services and information, and participation in priority state, regional, and local forums. In Alaska, this joint federal/state program is managed by the State of Alaska, Division of Governmental Coordination.

National Marine Fisheries Service (NMFS)
NOAA
National Marine Fisheries Service has responsibility for sustainable management of living marine resources within the exclusive economic zone (EEZ). Under the MSFCMA, ESA and the MMPA, NMFS has established MPAs to protect resources and manage fisheries, and has designated critical habitat to protect endangered species. NMFS jurisdiction is within all waters from 3–200 miles offshore known as the Exclusive Economic Zone (EEZ). Most NMFS closures involve restrictions in the form of gear prohibitions, for partial-year or year-round periods, designed to protect habitats, important life stages, fish stocks or species assemblages as well as to promote the recovery of threatened or endangered species. Closure areas are established via a public process through the eight Regional Fishery Management Councils established under MSFCMA. Although they lack the authority to designate MPAs, the council's make recommendations to the Secretary of Commerce through the development of Fishery Management Plans (FMPs). Apart from fisheries management actions, MSFCMA requirements such as identification of essential fish habitat (EFH) and habitat areas of particular concern (HAPC) could result in recommendations to the Secretary that fall within the definition of MPAs. Recent closures to protect critical habitats of endangered Steller sea lions were adopted under ESA and MMPA as Federal Threatened and Endangered Species Protected Areas and Critical Habitats.

National Park Service (NPS)
Department of the Interior (DOI)
Authorities for administration of the system include the 1916 National Park Service Organic Act (Organic Act), the General Authorities Act of 1970, and the 1978 Redwood National Park Act. This legislation defines or expands the NPS authority and mission. Units within the system are designated by an act of Congress or Presidential Proclamation under the Antiquities Act of 1906. Each type of designation within the National Park System, which includes parks, preserves, recreation areas, lakeshores, seashores, battlefields, and others, have equal legal standing in the national system.

National Wildlife Refuge (NWR)
DOI
Legal authority for the NWR system comes from the Refuge system Administration Act of 1966, as amended. Other legislation, including the ESA, Migratory Bird Conservation Act, Fish and Wildlife Act of 1956, Emergency Wetlands Resources Act of 1986, and the Alaska National Interest Lands Conservation Act (ANILCA) also provide authority for refuge development and management. Refuges have been designated via "Executive Order, Secretarial Orders and decrees, and direct Congressional legislation" e.g., ANILCA. Additional acquisitions are made by donation, transfer, agreements, or purchase. Regulations for refuges are found in CFR Title 50.

National Estuary Program (NEP)
Environmental Protection Agency (EPA)
The governor of any state may nominate an estuary within that state (either whole or in part) as an "estuary of national significance" and request a conference with the EPA as the

first step toward designation. To determine the need for such a conference the EPA is required to coordinate and implement, through the National Marine Pollution Program Office and the NMFS a program of ecosystem assessment and monitoring, and water quality for the proposed area. Each NEP designate must develop and implement a Comprehensive Conservation and Management Plan designed by a stakeholder group, composed of federal, state, and local government agencies as well as community members, that identifies problems, develops specific actions to address those problems. The Program gives priority consideration to numerous areas specifically named in the legislation including Long Island Sound, Narragansett Bay, Buzzards Bay, Puget Sound, New York-New Jersey Harbor, Delaware Bay, Delaware Inland Bays, Albemarle Sound, Sarasota Bay, San Francisco Bay, and Galveston Bay.

United States Forest Service (USFS)
Department of Agriculture
The USFS manages extensive coastal lands, primarily in the western U.S. However, thus far USFS authority has not extended into the adjacent marine waters. It is possible that the USFS could join with other state or federal entities to develop management approaches that complement existing forest plans for the uplands. Sites designated as Research Natural Areas would be candidates for a cooperative approach such as this.

History

Although federal programs designating marine waters have been in place since the 1920s, in most areas existing uses were allowed to continue. Designations that include a marine fisheries protection element are relatively recent. The recent Executive Order is the first focused effort to coordinate the development of an interconnected MPA system.

Inventory of Current MPAs

The MPA List and MMA Inventory that are being developed by the Departments of Commerce and Interior provide the most current and comprehensive listing of federal MPAs in the U.S.

Case Studies

Florida Keys National Marine Sanctuary
Now the largest no-take marine reserve off of North America, the Dry Tortugas Ecological Reserve (DTER) was established in a process that was at first highly contentious, but that ended in consensus. The reserve is part of the larger Florida Keys National Marine Sanctuary, which extends the entire length of the keys in a system created in 1990 to reverse decades of environmental degradation of our nation's only barrier coral reef.

The Sanctuary was originally proposed by NOAA to be zoned to include 20% as no-take reserves, but strong opposition from sport and commercial fishing interests caused that plan to be scrapped. Seeking a better solution, NOAA took a comprehensive approach involving all stakeholders in a project dubbed "Tortugas 2000" focusing on the Dry Tortugas area as

a world class coral reef reserve. The scientific basis for choosing the Dry Tortugas area included current patterns, in that the area is upstream and hence a potential source area for larvae to supply reefs down current, to the east. The Dry Tortugas are also relatively undisturbed, with high water quality and rich marine species diversity (Roberts and Hawkins 2000).

A 25-member working group was formed, including commercial and recreational fishermen, divers, scientists, citizens-at-large, and resource managers. This group agreed to adopt an ecosystem approach and to draw boundary lines based on what made sense ecologically and economically, ignoring jurisdictional boundaries.

Maps showing use patterns, including fishing areas for the various species as well as recreational dive sites, were combined with benthic habitat maps and bathymetry and other ecological data in a GIS. From the GIS and through a series of meetings, the group created a variety of alternatives, with parts falling outside of Sanctuary boundaries involving three jurisdictions – NOAA, the National Park Service, and the state of Florida. The group reached consensus on the preferred alternative in May of 1999, and the plan was eventually approved at the three jurisdictional levels, with final protected status declared in July, 2001.

The result is a 196 square mile ecological reserve in two parts. A rectangular northern area protects a range of habitats with both seagrass beds and highly productive coral reef areas. A rectangular southern area protects mainly mid-level and deep water habitats. Final regulations prohibit consumptive activities and place restrictions on activities such as diving, anchoring, and research. Lessons from the Tortugas experience include the importance of involving all stakeholders, the importance of developing trust among the users, and the need for all sides to make compromises (Roberts and Hawkins 2000).

Others

The Bristol Bay Red King Crab Savings Area, with a year-round bottom trawl gear prohibition, is one example of a NMFS gear closure under MSFCMA (50 C.F.R. 679.22(a)(3)). Initially implemented as an emergency rule in 1995 and formally adopted by amendment 37 to the BSAI Crab Management Plan in 1996, the closure was designed to protect the red king crab population and habitat.

Contacts for the federal MPA Inventory

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Internet Sites

Federal MPA program
http://www.mpa.gov/

Florida Keys National Marine Sanctuary
http://www.fknms.nos.noaa.gov/tortugas/studyarea/welcome.html

CALIFORNIA MARINE PROTECTED AREAS

The California coast is peppered with what has been called a "regulatory crazy quilt" of marine managed areas. A 1997 inventory listed 103 MPAs, including four National Marine Sanctuaries, three National Estuaries, two National Estuarine Research Reserves, two National Parks, one National Seashore, and numerous other federal and state marine management classifications (McArdle 1997). A recent review by the Resources Agency of California (RAC) listed 261 state marine managed areas (not necessarily MPAs) in 18 classifications, many of which overlap. Examples of these classifications include Fish Refuges, Clam Refuges, Marine Life Refuges, Reserves, Ecological Reserves, Natural Preserves, Areas of Special Biological Significance, and others. The review also concluded that "there is no overall mission, policy goal, or comprehensive program in place to guide the development of a logical and unified organizational system" and that the "lack of purpose and direction has resulted in inconsistent terminology and site selection, lack of standardized criteria for designation, research, and evaluation, and an inability to evaluate the effectiveness of the system…" (RAC 2000).

Recent legislation has focused California's approach to management of marine fishery and other marine resources, including implementation of MPAs. California is now fully engaged in a process of revising and designating MPAs and marine reserves. This section will focus on California's state management authority and the development and implementation of policies and actions called for in this recent legislation.

Legal Basis

The California Ocean Resources Management Act mandates that the State of California develop and maintain an ocean resources planning and management program to promote and ensure coordinated management of federal and state resources, and to coordinate management with adjacent states. Amendments to the act in 1991 assigned authority for the California Ocean Resources Management Program to the California Resources Agency, an umbrella agency that oversees 7 state departments and 17 boards and commissions with responsibilities for resource planning, management, and coordination. The Department of Fish and Game, the Fish and Game Commission, the Department of Parks and Recreation, Department of Conservation, and the Department of Water Resources have the most direct line of responsibility for managing marine fisheries and marine managed areas.

In January 1999 the California legislature passed the Marine Life Management Act (MLMA), the first of two major acts effectively reigning in a new era of management and conservation of living marine resources. The MLMA includes a number of innovative features. It applies to all marine wildlife, not just to fish and shellfish. It requires an ecosystem, rather than single-species perspective. It shifts the burden of proof from demonstrating harm toward demonstrating that a fishery or other activity is sustainable. It emphasizes science-based management and requires that fishery management plans form the primary basis for managing the state's marine fisheries. State regulations pertaining to the MLMA are in the Department of Fish and Game code, Part 1.7, Conservation and Management of Marine Living Resources, sections 7050–7090.

Because of the state's large number and diversity of fishery resources, Fish and Game code requires an overall master plan to establish guidelines and set priorities for development of fishery-specific plans. The state released the MLMA Master Plan for public review in April 2001. The Master Plan identified over 375 marine fisheries managed by the state and identified three approaches to prioritizing development of fishery management plans (FMPs). The first plans to be developed are for white sea bass and nearshore finfish. Once they are complete, the next highest priority is to develop FMPs for sea urchins, California halibut, and nearshore sharks and rays. The Master Plan also describes the Department of Fish and Game's preferred methods and activities for public involvement and how the public can be involved in the FMP development process.

The second major piece of legislation was the Marine Life Protection Act (MLPA), introduced in February 1999 and chaptered in October 1999. The legislation was sponsored by the Natural Resources Defense Council, and supported by conservation, diving, scientific, and educational groups. The purpose of the MLPA is to improve the existing system of marine protected areas through adoption of a Marine Life Protection Program and comprehensive master plan. The act specifically ensures that no-take areas (marine reserves) are incorporated and that they are designed and managed with clear, conservation-based goals and guidelines. The California Department of Fish and Game was designated the lead agency charged with implementing provisions of the MLPA, including development of a master plan (see **Process** section).

Immediately following passage of the MLPA, the California Resources Agency conducted a review of state marine managed areas (RAC 2000). The review, discussed above, found 18 classifications of marine managed areas and recommended a more cohesive system of 6 classifications that provide for prohibition or limitation of extraction of living marine resources, protection or enhancement of water quality, preservation of cultural resources, and enhancement or restriction of recreational opportunities. The Marine Managed Areas Improvement Act, passed in January 2002 requires that any marine managed areas in existence on January 1, 2002 shall be reclassified under the new system based upon the existing management purpose and level of resource protection at each site. A state interagency committee is responsible for the reclassification process and all areas must be reclassified by January 1, 2003. The six classifications and a general description of restrictions are as follows:

Classification	**Restrictions (italics added for clarification)**
State Marine Reserve	Unlawful to injure, damage, take, or possess any living, geological, or cultural resource (except under terms of a permit)
State Marine Park	Unlawful to injure, damage, take, or possess any living or nonliving marine resource *for commercial exploitation purposes.*
State Marine Conservation Area	Unlawful to injure, damage, take, or possess any specified living, geological, or cultural resource for *certain commercial, recreational, or a combination of commercial and recreational purposes.*
State Marine Cultural Preservation Area	Unlawful to damage, take, or possess any cultural marine resource.

Classification	Restrictions (italics added for clarification)
State Marine Regional Management Area	Any activities that compromise the recreational values for which the area was designated are prohibited.
State Water Quality Protection Area	Point source waste and thermal discharges are prohibited or limited by special conditions. Nonpoint source pollution controlled to the extent practicable.

Of the six classifications, the first three are the primary classifications to be used to develop MPAs under the Marine Life Protection Act.

Process

The MLPA requires the Department of Fish and Game (DFG) to develop a master plan for MPAs in California. The primary focus of the plan is to re-design and improve the state's haphazard system of marine managed areas into a cohesive network of MPAs under the new classification system. By regulation, a MLPA Master Plan Team was convened, consisting of state agency staff from several departments, scientists from other agencies and educational institutions (including at least one with expertise in the economics and culture of California coastal communities), and a member nominated by the California Sea Grant Marine advisors. The Master Plan Team appointments were made by the Department of Fish and Game Director in April 2000. On April 1, 2001 the DFG sent over 7,000 letters on behalf of the Master Plan Team to commercial fishermen, charter boat owners and operators, dive boat owners and operators, and recreational fishermen and divers, explaining the MLPA goals and approach, and seeking input and information regarding the most important geographic areas of use by each user group. In June the DFG released a document outlining Initial Draft Concepts for MPAs, addressing MLPA goals and requirements. The Initial Draft Concepts were meant to be a starting point for public discussions. The department also set up a web site containing background information on the MLPA, minutes of Master Plan Team meetings, and information and schedules for workshops.

In July 2001 a series of ten public workshops were held up and down the coast to obtain more public input on the MLPA Master Plan. More than 2,500 people attended the workshops and more than 3,000 written comments were received on the Master Plan. Despite the mailings and workshops held along the coast, the public commented frequently that the Master Plan process was moving too quickly and without adequate opportunities for public input on specific areas to be recommended for marine reserves. The legislature had already extended the time limit for development of the master plan by 16 months.

Following complaints by commercial and recreational users, environmental groups, and scientists, the DFG Director recognized that the public process had been flawed, and publicly scrapped the plan in January 2002, and announced that the public process for development of the Master Plan was to be revised to allow more public input, particularly in the earlier planning stages. In particular, the complaints from the public were that they had little effective involvement in developing the maps, which was a job left to agency staff and scientists.

The revised steps for development of the Master Plan are as follows:

1. Establish Working Groups
2. Review MLPA guidelines and establish a schedule
3. Discuss alternatives
4. Determine an initial range of alternatives
5. Socioeconomic and scientific review
6. Discussion of Reviews and alternatives
7. Draft Master Plan Presentation and Review (Jan 1, 2003)

Seven Working Groups of 14–18 members each were formed representing regions along the coast, and a series of facilitated workshops will be held to discuss and review alternatives for the Master Plan. Working Groups include commercial and recreational resource users, scientists, non-consumptive users, coastal communities, environmental groups, and the US Department of Defense. Representatives were nominated by the public and selected by the Director of the Department of Fish and Game in June 2002 based on established criteria. Representatives of state and federal agencies, such as the DFG, Coastal Commission, Department of Parks and Recreation, Pacific Fishery Management Council, National Marine Fisheries Service, etc. will either be represented on the working groups or will act as consultants.

In developing final recommendations, the Working Groups must follow certain guidelines in Fish and Game code (regulations). For example, Fish and Game Code Section 2856 (a)(2)(A) states that "the master plan shall include recommendations for the extent and types of habitat that should be represented in the MPA system and in marine reserves." In addition, Section 2856 (a)(2)(D) states that "the preferred siting alternative shall include MPA networks with an improved marine life reserve component, and shall be designed according to each of the following guidelines:

1. Each MPA shall have identified goals and objectives. Individual MPAs may serve varied primary purposes while collectively achieving the overall goals and guidelines of this chapter.
2. Marine life reserves in each bioregion shall encompass a representative variety of marine habitat types and communities, across a range of depths and environmental conditions.
3. Similar types of marine habitats and communities shall be replicated, to the extent possible, in more than one marine life reserve in each biogeographical region.
4. Marine life reserves shall be designed, to the extent practicable, to ensure that activities that upset the natural ecological functions of the area are avoided.
5. The MPA network and individual MPAs shall be of adequate size, number, type of protection, and location to ensure that each MPA meets its objectives and that the network as a whole meets the goals and guidelines of this chapter."

History

January 1999	Marine Life Management Act became law, requiring ecosystem approach and development of fishery management plans.
October 1999	Marine Life Protection Act became law, requiring development of master plan for development of a coordinated network of MPAs and marine reserves.
January 2000	Review of California's system of marine managed areas released with recommendations for reclassification.
January 2002	Marine Managed Areas Improvement Act establishes six new classifications for marine managed areas, including three for MPAs.
January 2002	The State of California revised public process for development of MLMA Master Plan.

Inventory of Current MPAs

McArdle (1997) conducted the first inventory of California's haphazard collection of MPAs. The work identified 103 MPAs of various federal and state designations. Information was presented for each site on designation, date established, agencies responsible for management, overlapping boundaries, and the regulations governing fishing, kelp harvesting, and aircraft use. Maps were constructed using GIS boundary information developed by the Remote Sensing Research Unit of the University of California, Santa Barbara, Department of Geography. The work was funded by the David and Lucile Packard Foundation and published by the California Sea Grant College Program.

As described at the beginning of this chapter, the Resources Agency of California completed a comprehensive review of *state* marine managed areas in 2000. The report was the culmination of an 18-month process involving 11 state agencies, and listed 261 marine managed areas in 18 classifications (RAC 2000). Recommendations for a simpler classification system were eventually incorporated with minor changes into the Marine Managed Areas Improvement Act.

Resource Assessments in California MPAs

A number of agencies and other scientists have been involved in resource assessment in California. Addressing information needs for the MLMA, The Resources Agency of California compiled a 592 page document called California Living Marine Resources: A Status Report (RAC 2001). The report inventories and describes the entire marine coastal environment and all important living resources, including climatic and oceanographic processes, water quality issues and implications, human use (commercial, recreational, subsistence, and aquaculture), enforcement, coastal bays and estuaries, marine plants, marine birds and mammals, and detailed reviews of all important nearshore and offshore fisheries.

A substantial amount of information on California marine resources is available through the California Environmental Resources Evaluation System (CERES). CERES is a web-based information clearinghouse developed by the California Resources Agency to facilitate access to a variety of electronic data describing California's environments. The California Ocean and Coastal Environmental Access Network (CalOCEAN) is a component of CERES specializing in ocean and coastal data and information from a wide variety of sources and in a range of types and formats. The goal of Cal OCEAN is to provide the information and tools to support ocean and coastal resource management, planning, research and education via the Internet.

The MPLA Working Group web site contains links and information on a number of scientific reports or journal articles relating directly to marine reserves and their potential application or effectiveness in California or on species found in California. These articles were reviewed by the Working Group in preparation of the Master Plan.

The Pacific Fishery Management Council also conducts periodic stock assessments for major fisheries off the California coast, but the assessments are not necessarily related to evaluation or inventory of MPAs.

Case Study: Channel Islands National Marine Sanctuary

In a process completely separate from the MLMA and MLPA, the federal government, state government, and interested stakeholders have been working on a joint process to consider designation of marine reserves within the Channel Islands National Marine Sanctuary (CINMS). The CINMS is centered about approximately 70 miles west of Los Angeles. The joint process is needed because of overlapping and complimentary state and federal jurisdiction.

The Channel Islands National Marine Sanctuary Advisory Council (SAC) is considered to be the "heart of the process." The SAC was formed in December 1998 to provide stakeholder-balanced, regionally-based forum for advice to the sanctuary manager. The SAC consists of 20 members and 20 alternates representing a wide variety of regional interests. A Marine Reserve Marine Reserve Working Group (or "Working Group") was formed under oversight of the SAC, and a Marine Reserve Science Panel and Socio-Economic Panel were convened to support the Working Group. The Working Group is composed of commercial and recreational stakeholders, state and federal agency staff, and scientists. Facilitators were employed to efficiently guide the process.

The SAC and Working Group have used a bottom-up approach with extensive involvement to develop alternatives for implementing a network of marine reserves within the CINMS. The Working Group adopted a problem statement that notes a burgeoning coastal population adjacent to the sanctuary and associated effects from pollution and increasing harvest, and large scale natural phenomena that have destabilized marine populations. The problem statement led to a list of goals and objectives that were adopted by consensus in December 2000.

In June of 2001 the SAC forwarded a recommendation for the establishment of a reserve network to the sanctuary manager. The SAC recommendation called for setting aside 25% of the sanctuary in 11 State Marine reserves, one State Marine Park, and one State Marine Conservation Area. The SAC advised the sanctuary manager to work with the Department of Fish and Game to forward a proposal to the Fish and Game Commission in August and to the Pacific Fishery Management Council in October. The recommendation followed two years of work by the Working Group, including 24 meetings, public forums, input from the Science and Socio-Economic Panels, and more than 10,000 comments from the public. Despite the unprecedented level of involvement of the public and stakeholders, the recommendation is highly controversial.

The recommendation was presented to the Fish and Game Commission in August 2001 by the Department of Fish and Game and CINMS staff. Approximately 450 people attended the meeting, including representatives of commercial, recreational, and conservation user groups. Many people provided comment on the recommendation. The Commission requested that the DFG prepare a range of options for consideration, including proposals to designate 12–34% of the sanctuary, status quo, and an alternative to include the proposed Channel Islands reserves as part of the MLPA coastwide process for designating reserves.

In November 2001 the DFG and CINMS staff presented the range of alternatives to the Pacific Fishery Management Council for consideration. The Council then asked the Fish and Game Commission to delay taking final action on the proposal until it had a chance to thoroughly review aspects of the recommendation dealing with reserve size. The Commission delayed action and the DFG continued work on the recommendation.

The proposal has been refined by the DFG to a list of six alternatives. The Fish and Game Commission heard public testimony on the alternatives in February and March of 2002. In May the Department of Fish and Game released a draft Environmental Document, which is open for public review through July 12.

Expectations for Future Status

California has solid planning foundations for management and protection of coastal marine resources and is steadily progressing on the development and incorporation of marine reserves into their coastal system of managed areas. The draft MLMA Master Plan (for development of management plans) has been submitted for public review and is scheduled for adoption hearings in August 2002. The draft MLPA Master Plan (for MPAs and marine reserves) must be finalized and presented to the Fish and Game Commission by April 1, 2003, and the Commission is scheduled to adopt the Master Plan by December 1, 2003.

The draft study listing alternatives for establishing Marine Reserves at Channel Islands is open for public review through mid-July 2002. The Fish and Game Commission is scheduled to take final action in December 2002.

Internet Sites

California Marine Protected Areas Inventory (McArdle 1997):

http://www.csgc.ucsd.edu/PUBLICATIONS/announce039.html

Geographic database: http://www.geog.ucsb.edu/~jeff/projects/mpa/

Channel Islands National Marine Sanctuary Home Page: http://www.cinms.nos.noaa.gov/

Joint federal-state process to consider marine reserves:
http://www.cinms.nos.noaa.gov/nmpreserves.html

Sanctuary Advisory Council (SAC) home page:
http://www.cinms.nos.noaa.gov/sacmemb.html

OREGON MARINE PROTECTED AREAS

The entire Oregon coast is included in a comprehensive system of state protection, and qualifies as a marine protected area under the two definitions listed in Executive Order 13158.

Specific state marine protected area designations include 17 areas listed under Oregon Department of Fish and Wildlife (ODFW) regulations as Marine Gardens, Shellfish Reserves, or Research Reserves. The Oregon Fish and Wildlife Commission, a body analogous to the Alaska Board of Fisheries, established these areas in regulation. Most of the areas are closed to shellfish or invertebrate harvest, but one area (Whale Cove Habitat Refuge) is a no-take area, closed year-round to harvest of all marine fish, shellfish, and invertebrates. Another state regulation, implemented by the Oregon Marine Board (boating safety agency), consists of a seasonal closure to boat traffic within 500 feet of Three Arch Rocks in the National Wildlife Refuge of the same name. Federal areas qualifying as MPAs include four National Wildlife Refuges in estuarine waters, but there are no National Marine Sanctuaries or National Parks along the Oregon coast. There is one National Estuarine Research Reserve (South Slough).

Legal Basis

Oregon laws (ORS 196 and Statewide Planning Goal 19) establish a legal management regime, known as the Ocean Resources Management Program (ORMP), that is as protective as the National Marine Sanctuary Program. The ORMP was created in 1991 through the Oregon Ocean Resources Management Act (ORS 196.415). The program is linked directly to the Office of the Governor and is administered by the Department of Land Conservation and Development (DLCD), created in 1973 to coordinate coastal planning goals. The Land Conservation and Development Commission (LCDC) has adopted planning goals for Ocean Resources (Goal 19), Estuarine Resources, Coastal Shorelands, and Beaches and Dunes.

The ORMP consists of the following elements:

1. Oregon Ocean Policy Advisory Council (OPAC): created in 1991 to coordinate policy advice to the Governor, state agencies, and others to prepare a plan for the territorial sea. The Council is chaired by a Governor's appointee and there are 23 members, including directors of seven state departments (Agriculture, Environmental Quality, Fish & Wildlife, Geology and Mineral Industries, Land Conservation and Development, Parks and Recreation, and State Lands) and 16 other members appointed by the Governor. OPAC has no authority to regulate activities, manage resources, or enforce its plans or policies, but if policies are approved by the LCDC then agencies are required to follow or carry out policies.
2. Oregon Ocean Resources Management Plan ("the Ocean Plan"): Prepared by the 1987 Ocean Resources Task Force. Recommended future policies for a variety of existing and potential resource management issues. The legislature in 1991 recognized the Ocean Plan as a starting point for species plans and policies.
3. Oregon Territorial Sea Plan: Applies to state and federal programs and activities that occur in the Oregon territorial sea (3 miles). Adopted in 1994 by OPAC, approved as part of the state's Coastal Management Plan, amended in late 2000.
4. State Agency Coordination Requirements: LCDC given authority to ensure that state agencies adhere to policies adopted by OPAC.
5. Department of Land Conservation and Development (DLCD) Ocean Program Activities and Meetings: This department administers the Oregon Coastal Management Program. The department provides staff support to OPAC, coordinates with the Governor and other state and federal agencies, applies for and administers grants, and reviews "consistency" determinations under the federal Coastal Zone Management Act.

The Oregon Resources Management Program lays the legal foundation for marine policy in the state. All state agencies are bound to policies established by OPAC. The rationale for establishing MPAs, reserves, or specific no-take areas is rooted in the goals established in the Ocean Resources Planning Goal (Goal 19) and the Territorial Sea Plan. Goal 19 outlines state stewardship of state and federal waters off the coast of Oregon, and calls for the maintenance and restoration of living marine resources, biological diversity, habitat, and areas important to fisheries. Management measures called for in the document include adaptive management, intergovernmental coordination, public involvement, and a precautionary approach.

Oregon, like many other jurisdictions, is viewing MPAs as another tool to address long term management and rebuilding of fish stocks. Lingcod and four rockfishes have been declared overfished, and three other rockfishes are listed as experiencing overfishing (NMFS 2001). The Secretary of Commerce declared a fishery disaster in 1999, and the Pacific Fishery Management Council Groundfish Strategic Plan is calling for a 50% reduction in fleet size, delegation of nearshore species assessment and management to the states, improved quality of information, and simplified management.

Process

OPAC meets every four to six months and all meetings are open to the public. At least four meetings have been held to date, in October 1999, January 2000, October 2000, and April 2001. Meetings have included presentations from and dialogue with "marine experts" (fishery and habitat scientists). OPAC developed and distributed guidelines for the dialogue that included expectations of each party, stressing dialog rather than debate, active listening with an open mind, etc. Meeting summaries and narratives are available online.

OPAC convened the Marine Protected Areas Working Group (MPAWG), consisting of 8 OPAC members. They were appointed to gather information and ideas and assist the full OPAC in preparing a report and recommendations. The MPAWG meets about once a month to hear from a variety of resource management speakers and have informational dialogues with scientists, other experts, and the public. The MPAWG will use this information to prepare a report to OPAC of findings and conclusions in March or April 2002, and a draft report for public review by May. OPAC is scheduled to submit a full report to the Governor in August 2002.

The MPAWG has a web site to keep track of meetings, read meeting summaries, review staff papers and draft reports, provide comments and feedback, and link to related web sites. The MPAWG has prepared three study papers to guide their planning. The first outlines definitions of terms, the second is an inventory of goals and policies guiding Oregon and other jurisdictions, and the third explicitly relates Goal 19 and the Territorial Sea Plan to policy choices with respect to marine reserves.

History

Oregon has an extensive history of coastal marine planning and protection. Since the 1960s the legislature has adopted numerous statutes in response to threats on coastal resources from uncontrolled development, including the Oregon Beach Bill and the Removal/Fill Law. The Oregon legislature created the Land Conservation and Development Commission in 1973, and passed the Oregon Ocean Resources Management Act in 1991. The state has only recently begun the coordinated planning effort to establish marine reserves.

Inventory of Current MPAs

Didier (1998) lists 18 state-administered MPAs, mostly intertidal. Seventeen are implemented under ODFW regulations as Marine Gardens, Shellfish Reserves, or Research Reserves. One implements a seasonal closure to boat traffic within 500 feet of rocks and is implemented by the Oregon Marine Board (boating safety agency).

OPAC (Bailey 2001) has recently assembled an inventory of MPAs for Oregon, using the definitions in Executive Order 13158 as criteria for listing. It lists four National Wildlife Refuges in estuarine waters. Under the Statewide Planning Program and Planning Goal for Estuarine Resources, every estuary on the coast is protected under comprehensive state authority. Twenty-two major and several minor estuaries are listed as protected under a

variety of designations. There is one National Estuarine Research Reserve (South Slough). The inventory lists the same 18 special marine fish and wildlife MPAs managed by ODF&W as listed in Didier (1998). The inventory also lists numerous de facto MPAs, mostly undersea cables or areas assumed to be unfishable with small footrope trawl gear.

Resource Assessments in Oregon MPAs

ODFW conducts the Marine Habitat Project as part of its Marine Resources Program. Project staffs participate in the OPAC process and represent the state on the Habitat Committee and Marine Reserves Committee of the Pacific Fishery Management Council. The project focuses on inventory of marine habitat and providing habitat-related information for policy decisions and management. Current research includes an inventory of rocky reefs, developing techniques for fishery-independent assessment of nearshore reef rockfish, and development of coastal GIS. These objectives are intended to address two high-priority management needs: (1) assessing fish stocks, and (2) developing marine protected area policy. A description of the project and reports are available online.

Case Study: Red Sea Urchins

Oregon is only now in the process of developing an MPA policy and no sites have yet been established under the Ocean Resources Management Program. A recent study, however, compared red sea urchin biomass and population age structure in two areas closed to urchin harvest in 1967 and 1993 with two adjacent areas still open to commercial harvest (Montano-Moctezuma 2002). Urchin biomass density was highest in the area closed in 1967, intermediate in the closed area recovering from high harvest and in one of the areas open to harvest, and lowest in the other area open to harvest. Older urchins made up a smaller proportion of the population in heavily fished areas. Examination of currents and larval development times indicated that Oregon's refuges probably act more as a colonization source for northern California and southern Washington than as a source of replenishment for the Oregon coast. This suggests that sea urchin populations need to be managed coastwide as a metapopulation structure to sustain urchin fisheries because sources and sinks may be far apart. The study also explored kelp forest community interactions and stability, and concluded that stability of community structure was less likely under higher fishing rates.

Expectations for Future Status

The State of Oregon appears to be fully committed to determining how marine reserves (no-take areas) could strengthen its ocean resource management program. The Marine Protected Area Working Group has established goals or purposes for establishing marine reserves that are consistent with the statewide Ocean Resources Planning Goal, the Territorial Sea Plan, and the Rocky Shores goals and policies. OPAC is scheduled to submit a full report to the Governor in August 2002. Development of a marine reserve system will require close coordination between the state and the Pacific Fishery Management Council.

In April 2002, OPAC released a draft of their proposed recommendation to the governor for public review. The proposal was the result of study and discussions of the Marine Protected Area Working Group. It contains recommendations for policy and process. The major policy recommendation is that Oregon establish a limited system of reserves to test their effectiveness in achieving marine conservation goals and to provide baseline information on the marine ecosystem. Another policy recommendation is that further consideration of reserves in addressing conservation goals be left to state and federal fishery managers. OPAC did not define a "limited system" but established guidelines on design, monitoring, and enforcement. The primary recommendation for process was that implementation occur in two steps: first develop a coast-side framework design, including overall system goals and objectives, and second, choose local sites and implement them. Both steps include involvement of the public, scientists, commercial and recreational fishermen, resource managers, port officials, interest groups, etc. Process recommendations also address agency implementation, inventory and evaluation, mitigation for effects on fishermen and coastal communities, and funding.

Internet Sites

Oregon Ocean Policy Advisory Council (OPAC): http://www.oregonocean.org

Draft Recommendation to the Governor (April 2002): http://www.oregonocean.org/upload/DRAFTOPAC_MR_May7.pdf

Marine Protected Areas Work Group: http://oregonocean.org/resources.shtml

Oregon ocean management goals and policies, Territorial Sea Plan: http://www.oregonocean.org/upload/GoalsPoliciesTSP.htm

Oregon Department of Fish and Wildlife: http://www.dfw.state.or.us/

ODFW Marine Habitat Project: http://www.hmsc.orst.edu/odfw/habitat/index.html

WASHINGTON STATE MARINE PROTECTED AREAS

There has been strong interest in establishing MPAs in Washington since the early-1990s. In 1992 an agreement was signed between British Columbia and the State of Washington to address biological concerns in shared waters. A joint British Columbia/Washington Marine Science Panel was formed and it identified marine habitat destruction and declines in finfish and shellfish as priority issues. The panel recommended establishment of MPAs including each major type of habitat to "protect against further human encroachment, permit recovery of depleted fish stocks, and provide refuge areas for marine mammals and birds."

A report done for the Puget Sound/Georgia Basin International Task Force identified 13 marine species as having undergone substantial declines in regional abundance (West 1997). The American Fisheries Society has declared Puget Sound to be one of four areas in North America with the most threatened marine fish stocks (Koenings, 2000). A little more

than half of the groundfish stocks in Puget Sound are in either a critical or depressed status, including lingcod, cabezon, and several rockfishes.

There is no one policy, standard, or process to coordinate development of MPAs or reserves in Washington. Instead, the MPA landscape is a complex patchwork of federal, state, county, and private-sector designations that provide a variety of protections for a wide range of marine resources. Primary federal MPAs include ten National Wildlife Refuges, two National Estuaries, a National Marine Sanctuary, and two National Estuarine Research Reserves. The Pacific Fishery Management Council is also considering establishment of marine preserves. This chapter will focus on state and local measures aimed at protecting and conserving fishery or subtidal resources. Federal programs will be covered in another chapter.

Legal Basis

Primary authority for management of non-tribal fish and wildlife in Washington state waters rests with the Washington Department of Fish and Wildlife (WDFW) and Fish and Wildlife Commission (FWC). Their authority is outlined in Chapters 43.300 and 77.04 of the Revised Code of Washington (RCW). The FWC received its authority from the legislature upon passage of a public referendum in 1995. The relationship of these two agencies is similar to that of ADF&G and the Alaska Board of Fisheries.

The FWC makes regulations closing or restricting fishing for various species at various times. Many areas with fishing restrictions have not been given any special designations but essentially serve in the broad sense as MPAs. Examples include commercial salmon closures around stream mouths, commercial salmon exclusion zones, and areas closed to sea cucumber harvest. The WDFW and FWC have also designated at least 15 Marine Preserves and Conservation Areas ranging from 3 to 454 acres in size, all in Puget Sound. These units protect bottomfish, shellfish, or intertidal invertebrates from non-tribal harvest. The term “Marine Preserve” does not have an explicit definition; rather the regulations vary among areas and are contained in the area definitions in Washington Administrative Code (WAC). Generally speaking, marine preserves are areas where harvest of most species is prohibited. The term “Conservation Area” is explicitly defined in WAC 220-20-010(19) as an area where it is “unlawful to fish for or possess food fish or shellfish” (no-take reserve).

In 1974, the case of U.S. vs. Washington (the “Boldt Decision”) allocated 50% of the allowable catch of fish to fifteen treaty tribes that were granted fishing rights in the mid-1800s. The individual tribes manage tribal fisheries, while non-tribal fisheries are managed by the state. Until recently, this was done primarily by circulating proposed rules to the tribes for consideration. Recently, WDFW has made an effort to co-manage with the tribes, developing policies and plans jointly for the mutual benefit of tribal and non-tribal users. Tribal fisheries have focused primarily on salmon and shellfish, with most of the groundfish harvest taken in non-tribal fisheries.

The Washington Department of Natural Resources (DNR) manages 2.5 million acres of aquatic lands. DNR has broad authority under RCW 79.70 to preserve natural areas of land

or waters, and specific authority under WAC 332-30-151 to create scientific, environmental, and educational aquatic reserves. In 2000, DNR designated six areas of submerged state lands as aquatic reserves, or areas withdrawn from leasing to protect habitat and "embedded resources" such as clams, oysters, and mussels. Following designation of these areas, the state recognized that many questions regarding an aquatic reserves program were left unanswered, such as allowable activities, differences between types of reserves (e.g., educational versus scientific), and how they will be managed. DNR is now soliciting public participation through the State Environmental Policy Act (SEPA) to consider the impacts of establishing an aquatic reserve program.

The Washington State Parks and Recreation Commission has legal authority to restrict fishing in State Parks, and has system-wide prohibitions on the harvest of algae and unclassified marine invertebrates. There is an extensive system of intertidal marine state park areas in Puget Sound but they are not designed to function specifically to control or enhance commercial or recreational fisheries. The commission is making progress developing an underwater park program.

The University of Washington, Friday Harbor Laboratories worked with the WDFW and WFWC to establish five marine protected areas in 1991, known collectively as the San Juan Islands Marine Preserve Areas. The preserve areas were proposed to address escalating harvest and poaching of sea urchins and sea cucumbers and are to be managed by Friday Harbor Lab primarily for research and education. All areas have restrictions on harvest of shellfish, bottomfish or food fish, and salmon.

Congress authorized the Northwest Straits Marine Conservation Initiative in 1998 following public opposition and discontinuation of a feasibility study examining creation of a new National Marine Sanctuary in northern Puget Sound, the Strait of Juan de Fuca, and the San Juan Islands. The program takes a "bottom-up" approach by using locally driven strategies to protect and restore marine resources in northwest Washington. The Northwest Straits Commission was formed to coordinate and offer planning resources to seven county-level Marine Resource Committees (MRCs). These MRCs are made up of scientists, local and tribal government representatives, resource users, business owners, and the public at large. MRCs coordinate development of marine resource protections at the county level. San Juan County has led the MPA effort by establishing eight voluntary no-take zones in 1997 as elements of their Bottomfish Recovery Program. Other counties are following with programs aimed at inventory and mapping of fish and vegetation, identification of candidate protected areas, and encouragement of grass-roots involvement in planning.

Non-governmental organizations, citizens, and landowners have also been involved in protection of marine resources. The Edmonds Underwater Park was established through the joint efforts of local divers, the City of Edmonds, and WDFW. This no-take zone was established primarily to enhance fish viewing for divers. Approximately 61% of the state's tidelands have been sold to private interests, providing opportunities for the private sector to become involved in managing and protecting intertidal areas. As of 1998, the Nature

Conservancy of Washington had established seven preserves in Puget Sound, portions of which included intertidal areas (Murray 1998).

The WDFW and FWC are the state agencies with responsibility and regulatory authority for non-tribal fishery management in state waters. Legal authority to create reserves to protect and enhance fisheries derives from general management authority specified in the WAC and RCW.

The Department's primary objective for considering MPAs in Puget Sound is to provide additional protection for depleted lingcod and rockfish populations. The use of marine reserves has been identified by WDFW in the Puget Sound Groundfish Management Plan as a viable fisheries management tool. The plan also states "The Department recognizes that substantial expanses of all habitats may need to be designated as no-take harvest refuges." The department has also called for inclusion of reserves to protect herring spawning habitat. In planning for MPAs, WDFW makes a distinction between needs of rocky habitat species such as rockfish and lingcod, and ecological reserves to protect biodiversity or unique habitats (Wayne Palsson, WDFW, pers. comm. 12/17/01).

Tribal governments are allocated 50% of the allowable resource and manage tribal use of fish and wildlife. Because tribal governments are not bound by state laws restricting non-tribal harvest or other fisheries in state-created MPAs, the cooperation and involvement of tribal authorities is essential to the process of creating MPAs in Washington. State and tribal governments are reviewing a draft Puget Sound Groundfish Conservation Plan that outlines conservation issues, prioritizes protection and rebuilding of stocks that depend on rocky habitats, and proposes a system of fisheries reserves in Puget Sound.

DNR has broad authority under RCW 79.70 to preserve natural areas of land or waters, and specific authority under WAC 332-30-151 to create scientific, environmental, and educational aquatic reserves. The aquatic reserve program seeks to maintain biodiversity, protect and restore ecosystem functions, and maintain appropriate public access to aquatic lands for scientific, educational, and recreational uses.

County-based implementation of MPAs derives from the Northwest Straits Marine Conservation Initiative. County-based, grass roots-level planning offers the opportunity to integrate land use planning with resource protection. A Resolution of the Northwest Straits Commission outlines the goal to restore and protect marine habitats of the Northwest Straits, primarily for protection of salmon listed under the Endangered Species Act. The Commission has also established performance benchmarks, including (1) establishing a science-based, regional system of MPAs, (2) demonstrating a net gain in ecologically productive nearshore, intertidal and estuarine habitats with no significant loss of existing high-value habitat, (3) exhibiting measurable increases in factors supporting the recovery of bottomfish, such as increased spawning biomass, increased size of fish, and increased abundance of prey species.

Process

A wide variety of processes have been used by various agencies and organizations to develop MPAs in Puget Sound. A diverse set of goals, levels of public participation, and steps involved in site selection and evaluation have been employed, and the patchwork of MPAs can be appropriately described as uncoordinated, with no clear policy or coordinated program to guide development.

Thus far the WDFW and FWC have implemented MPAs through their standard regulatory process. This process is analogous to the Alaska fisheries regulatory process, with cyclic consideration of proposals. Proposals are published and distributed to the public for review prior to FWC meetings. The public can comment in writing or provide testimony at the commission meetings. Public workshops are hosted by WDFW to gather additional public input on selected proposals. Unlike the Alaska BOF process, most proposals originate with the agency (WDFW). In the case of proposals that originate with the public, they are submitted by and with the support of WDFW.

The WDFW process for establishing MPAs is best described as a "work in progress." In the 2002–2003 Sportfishing Rule Proposal booklet, WDFW considers the use of MPAs as "still very much under development." The agency has made evaluation of new and existing MPAs a priority, and is approaching implementation of MPAs in "small, thoughtful steps." The agency has conducted a variety of studies using scuba divers and video cameras to assess the potential benefits of established no-take areas. WDFW has also divided Puget Sound into five distinct basins, with intentions of establishing a reserve network that includes closed areas in each basin. Four MPAs are proposed for the 2002–2003 WFC cycle, one of which is intended to alleviate conflicts between divers and shore-based fishers. The other three are proposed closures of non-tribal fishing to rebuild and protect rockfish and other bottomfish.

Coordination with other agencies and authorities is a necessary crucial step in the development of MPAs in Puget Sound. Perhaps most significantly, the state needs to coordinate planning and development with tribal authorities managing tribal fisheries. State and tribal co-managers are only beginning development of comprehensive, joint management goals, principles, and strategies to ensure conservation of groundfish in Puget Sound. Specific uses of MPAs and site selection criteria have not yet been jointly established.

Washington DNR has only recently developed the process for establishing aquatic reserves. The primary issues include (1) which activities would be allowed, (2) differences between environmental, educational, or scientific reserves, (3) difference between a reserve and an area withdrawn from leasing, and (4) how DNR would manage aquatic reserves. DNR has pledged to solicit and encourage the broadest possible public participation, using a process established in the State Environmental Policy Act (SEPA). The process will begin with a scoping period in which DNR will ask the public to help identify elements to be included in an aquatic reserve program, such as land management goals, selection criteria, priorities, and specific issues and interests. Most of those scoping meetings occurred in November

and December of 2001. Following the scoping phase, scientists, planners, and managers and policy staff will prepare alternatives for consideration to be included in a Draft Environmental Impact Statement (EIS) for public review. Comments will be considered and incorporated into a final EIS. After this, DNR would develop policies and procedures, review areas designated as reserves or withdrawn from leasing, and then establish site-specific management plans.

County-based implementation of MPAs under the Northwest Straits Commission is done through the MRCs described above. Although it may vary somewhat between committees, the process followed by the San Juan County MRC is one example. The County Board of Commissioners identified a list of marine resource related problems in response to public concern. The MRC was tasked with providing alternative solutions, and began by publishing a list of priority issues in a series of newsletters. Bottomfish recovery was the top priority. The MRC took testimony from scientists and resource managers, and then scheduled a series of public meetings at each major island to gauge support and identify areas perceived as overfished. Based on this input, the County Commissioners passed a resolution establishing eight Bottomfish Recovery Zones. These zones are intended as no-take areas in which fish can grow to maturity and reproduce without harvest. Because the counties do not have regulatory authority over fish and wildlife, the harvest prohibitions are voluntary. Signs and significant landmarks on the shore identify the Bottomfish Recovery Zones, and the zones extend ¼ mile out from shore.

As has been noted, establishment of MPAs in Puget Sound by a wide variety of agencies, through a variety of processes, and for a variety of goals, has been uncoordinated. State, tribal, and county agencies as well as conservation groups are calling for a cohesive process to set common goals, involve the public, and use the best available science in network design and site selection.

History

1923	Friday Harbor Laboratory established first subtidal preserve at Cypress Island.
1970	Edmonds Underwater Park was established as a no-take reserve in 1970 by the City of Edmonds
1972	Selected areas in San Juan Islands closed to sea urchin and sea cucumber harvest
1991	WDFW established San Juan Marine Preserves in Puget Sound.
1997	San Juan County establishes eight voluntary no-take reserves for bottomfish recovery.
1998	Northwest Straits Marine Conservation Initiative authorizes commission to coordinate marine conservation planning by counties

Inventory of Current MPAs

At least two thorough reviews and listings of MPAs in Washington have been completed. The first was prepared for the Puget Sound/Georgia Basin International Task Force Work

Group on Marine Protected Areas (Murray 1998). It was prepared by the Puget Sound Water Quality Action Team and includes background information on MPAs, methods used to identify and catalog MPAs, a review of institutions and agencies involved, as well as site profiles for 42 of 102 MPAs identified in the study.

The second document is an inventory of MPAs and sites of special designation off the coasts of Washington, Oregon, and California, prepared under contract for the Pacific Fishery Management Council (Didier 1998). It includes sites designated specifically for some level of protection by federal, state, or other local government agencies, as well as *de facto* protected areas. *De facto* areas includes areas where fishing access could be affected by regulations implemented for other purposes, such as undersea cables, drilling platforms, weather and scientific buoys, and hazards to navigation.

Resource Assessments in Washington MPAs

WDFW initiated research in Puget Sound in 1992 to examine the response of rockfish, lingcod, and other bottomfish to the creation of no-take reserves. They used scuba surveys to compare resources within MPAs and in adjacent fished areas. Results of these assessments were summarized in Palsson and Pacunski (1995) and Palsson (1998). Following this work WDFW initiated a new study to monitor fish recovery in a newly established no-take MPA, and to continue monitoring of the response of rocky reef fish in other established MPAs. Results of a recent habitat preferences study are presented in Pacunski and Palsson (2001).

The seven county MRCs established under the Northwest Straits Initiative are conducting a variety of habitat assessments either to assess benefits of established voluntary no-take areas or in preparation of site selection. For example, San Juan County has done some assessment work in their bottomfish recovery zones and is seeking funding for continued work. Skagit County recently received a grant to assess rocky reef habitat. Island County has launched a comprehensive eelgrass mapping project. Whatcom County is preparing a report and shoreline survey to help prioritize and make recommendations for future habitat inventories. These inventory efforts are funded in part by The Northwest Straits Commission and are dependent on substantial amounts of volunteer effort.

Case Study: Edmonds Underwater Park

Edmonds Underwater Park has the distinction of being the longest established no-take MPA in the Pacific Northwest. The park was established in 1970 when local divers approached the City of Edmonds to establish a no-take zone with the goal of providing a high-quality and safe recreational scuba diving site. The city enacted harvest restrictions as part of its coastal zone management planning process, and leased the lands within the underwater park from DNR for diving and conservation purposes. Harvest restrictions were adopted by WDFW years afterward.

The park is relatively small at 27 acres, with 16.8 subtidal acres. Harvest of foodfish and shellfish, and commercial harvest of sea cucumber are prohibited by state law. City of

Edmonds ordinances prohibit take of any marine life and use of any boat or watercraft of any kind within 200 feet of park boundaries (except by divers or instructors with prior approval). City ordinances also prohibit possession of devices for taking fish or any other marine life in or near the park. Supervision and maintenance is provided by a group of volunteers known informally as the Underwater Park Stewards. The support and presence of scuba divers and their influence on visitors and the public have provided effective supervision and peer-pressure enforcement. City police and Beach Rangers also provide enforcement.

Edmonds Underwater Park is also an example of a very successful MPA for temperate reef fishes. Though there is no historical data, anecdotal accounts are that fish abundance in the area of the park was low, and not substantially different from the surrounding areas within Puget Sound. Since 1992, WDFW has conducted scuba and video surveys at Edmonds Underwater Park, other Puget Sound MPAs, and at comparable fished areas with reef habitat. These studies showed that copper rockfish abundance was 15 times greater at Edmonds Underwater Park than in comparable fished areas in Puget Sound. Copper rockfish exceeding 16 inches in length were uncommon at fished sites but very common at Edmonds. Large quillback rockfish made up a greater proportion of fish at Edmonds than at fished sites, but quillback rockfish of all sizes were most abundant at a fished site. Lingcod were more than twice as abundant and considerably larger at Edmonds than at comparable fished sites (Palsson 2001).

Expectations for Future Status

WDFW has made a commitment to developing use of no-take areas to manage groundfish resources. The Puget Sound Draft Conservation Plan for groundfish calls for no-take areas or MPAs that would encompass 20% of the marine habitat in the sound. WDFW is also fully committed to developing a joint state-tribal approach to the planning and establishment of MPAs in Puget Sound.

The DNR public scoping process is complete, and DNR is expected to have a Final EIS to form the basis of DNR's aquatic reserve program by the summer of 2002.

The seven counties included in the Northwest Straits Initiative are expected to continue habitat and resource assessments and work together to continue establishment of no-take areas for bottomfish recovery.

Internet Sites

Washington Department of Fish and Wildlife: http://www.wa.gov/wdfw/

Washington Administrative Code (fishing regulations):
http://slc.leg.wa.gov/wacbytitle.htm

Revised Code of Washington (fishing regulations):
http://www.leg.wa.gov/wsladm/rcw.cfm

Puget Sound Groundfish Management Plan:
http://www.wa.gov/wdfw/fish/grndfish/grndfish.htm

Puget Sound Water Quality Action Team: www.wa.gov/puget_sound

People for Puget Sound www.pugetsound.org

Northwest Straits Marine Conservation Commission and links to county MRCs:
http://www.nwstraits.org/

BRITISH COLUMBIA MARINE PROTECTED AREAS

Current status, Definition and Legislation

There are 10 designation types for legislative marine protected areas at the provincial and federal level in British Columbia (BC) (Jamieson and Lessard 1998). In addition there are fishery closures and municipal marine parks (MMP) but these are not legislated and MMP only have fishery restrictions if Fisheries and Oceans (DFO) has implemented restrictions within the MMP. There are currently no no-take marine reserves in BC although it is anticipated that Race Rocks MPA will be no-take as will Endeavor Hotvent MPA and a portion of the Bowie Seamount MPA once these are officially designated as MPAs. As of 1998 the following marine protected areas were established in BC (Jamieson and Lessard 1998):

- Provincial (121)
  - Ministry of Environment, Lands and Parks (121)
    - Ecological Reserves (15)
    - Provincial Parks (85)
    - Wildlife Management Areas (4)
    - Designated Wildlife Reserves (16)
    - "Protected Areas" (1)
- Federal (9)
  - Parks Canada (2)
    - National Park (Reserves) (2)
  - National Marine Conservation Areas (NMCA) (0)
  - Environment Canada(7)
    - Migratory Bird Sanctuaries (5)
    - National Wildlife Areas (2)
  - Fisheries and Oceans Canada (DFO)
    - Marine Protected Areas (MPA) (0)
    - Fisheries Closures (579 in 1997)

DFO estimates that 1,955 square kilometers are currently protected under legislative marine protected areas (this area does not include the proposed MPAs or NMCAs). Table 6 in Jamieson and Lessard (1998) list the reasons for spatially persistent fishery closures and the species they affect.

In February 1997 Canada enacted the Oceans Act which provided the federal Minister of Fisheries and Oceans with the authority to co-ordinate federal involvement in all oceans-related issues. This included the establishment of Marine Protected Areas (MPAs); the establishment and enforcement by regulation of Marine Environmental Quality guidelines, criteria and standards designed to conserve and protect ecosystem health; and the development of Management Plans, including integrated coastal zone management plans. This is an extension of DFO's mandate to conserve and protect fishery resources. DFO is the lead agency and formed an Oceans Directorate within its structure to carry out the mandate of the Oceans Act.

In August of 1998 DFO released a discussion paper entitled "Marine Protected Areas, A Strategy for Canada's Pacific Coast". The MPA Strategy proposed three elements:

1. A joint federal-provincial approach: All relevant federal and provincial agencies will work collaboratively to exercise their authorities to protect marine areas.
2. Shared decision-making with the public: Commits government agencies to employ an inclusive, shared decision-making process with marine stakeholders, First Nations, coastal communities, and the public.
3. Building a comprehensive system: Seeks to build an extensive system of protected areas by the year 2010 through a series of coastal planning processes.

MPAs were defined as follows:

A marine protected area is an area of sea that forms part of the internal waters of Canada, the territorial sea of Canada or the exclusive economic zone of Canada; and has been designated under this section for special protection for one or more of the following purposes:

(a) conservation and protection of commercial and non-commercial fisheries resources, including marine mammals and their habitats;
(b) conservation and protection of endangered or threatened marine species, and their habitats;
(c) conservation and protection of unique habitats;
(d) conservation and protection of marine areas of high biodiversity or biological productivity;
(e) conservation and protection of any other marine resource or habitat as is necessary to fulfill the mandate of the Minister of Fisheries and Oceans.

All MPAs in British Columbia will share Minimum Protection Standards prohibiting ocean dumping, dredging and, the exploration for, or development of, non-renewable resources. Building on these minimum protection standards, the system of MPAs will accommodate multiple levels of protection. Levels of protection provided by an MPA will vary depending upon the objectives for each site. For example, MPAs may be highly protected areas that sustain species and habitats; areas that are established primarily for recreational use or cultural heritage protection; or multiple use areas that balance resource conservation with recreational and other activities such as commercial and sport fishing. Even within a particular MPA, levels of protection may vary through the use of zoning specifying permissible activities for sub-areas.

In 1998 four pilot MPAs were announced: Race Rocks (near Victoria), Gabriola Pass (near Nanaimo), Endeavour Hot-vents (offshore) and Bowie Seamount. Race Rocks and Endeavour have been designated as MPAs by the Regional Director but are still pending final approval in Ottawa, Gabriola Pass is tied up with consultations with First Nations, and it is expected that the Regional Director will designate Bowie soon. Industry consultations are underway for Bowie and the management plan is in its final stages. No additional areas

have been considered although there is integration with the National Parks initiatives for designation of National Marine Conservation Areas, Gwaii Haanas (Charlottes), Pacific Rim National Park (Westcoast Van. Is.) and the Strait of Georgia. More specifically under DFO's mandate (FISHERIES ACT) there has been focused attention on inshore rockfish and industry is being consulted about possible Marine Reserves for these species.

Legal basis

The legal authority to establish an MPA derives from one of several federal and provincial statutes including: Canada's Oceans Act, Fisheries Act, National Parks Act, Canada Wildlife Act, Migratory Birds Convention Act, or proposed Marine Conservation Areas Act; and British Columbia's Ecological Reserve Act, Park Act, Wildlife Act or Environment and Land Use Act.

DFO has published an **MPA Vision Statement** as follows:

> "Generations from now Canada will be one of the world's coastal nations that have turned the tide on the decline of its marine environments. Canada and British Columbia will have put in place a comprehensive strategy for managing the pacific coast to ensure a healthy marine environment and healthy economic future. A fundamental component of this strategy will be the creation of a system of marine protected areas on the pacific coast of Canada by 2010. This system will provide for a healthy and productive marine environment while embracing recreational values and areas of rich cultural heritage. Along the coast of British Columbia, comprehensive coastal planning processes will be undertaken, ensuring ecological, social and economic sustainability. These processes will provide the mechanism for establishing an MPA system and ensuring a holistic, inclusive and multi-use approach to resource use and marine management. This is the vision behind the MPA Strategy, a future that can be realized through a cooperative and integrated process, and by a step-by-step commitment to the key objectives outlined below."

According to DFO the following are the "Guiding Principles for MPA Development" (http://www.pac.dfo-mpo.gc.ca/oceans/mpa/dispap.htm):

1. *Working With People.* The federal and provincial governments will work in partnership with First Nations, coastal communities, marine stakeholders and the public on MPA identification, establishment and management.

2. *Respecting First Nations and the Treaty Process.* Canada and BC consider First Nations' support and participation in the MPA Strategy as important and necessary. Both governments will ensure and respect the continued use of MPAs by First Nations for food, social and ceremonial purposes and other traditional practices subject to conservation requirements. Therefore, MPAs will not automatically preclude access or activities critical to the livelihood or culture of First Nations. The establishment of any MPA will not preclude options for settlement of treaties, and will address opportunities for First Nations to benefit from MPAs.

3. *Fostering Ecosystem-Based Management.* An ecosystem-based approach to management requires that the integrity of the natural ecosystem and its key components, structure and functions are upheld. This means maintaining natural species diversity and protecting critical habitats for all stages in species life cycles.

4. *Learning-By-Doing.* A key aspect of Canada and BC's commitment to establishing MPAs is the concept of using a learn-by-doing approach. Both governments recognize that the process for MPA planning should evolve and improve over time given the variations between coastal regions, the dynamics of a marine environment, and the information constraints concerning marine species, processes and ecosystems. Flexibility and adaptability will be required to meet effectively and efficiently the needs of all marine resource users.

5. *Taking a Precautionary Approach*. Taking a precautionary approach means, "When in doubt, be cautious." This principle puts the burden of proof on any individual, organization or government agency conducting activities that may cause damage to the marine ecosystem.

6. *Managing for Sustainability*. The MPA Strategy is intended to contribute to sustainability in our marine environments. This means that resources in areas requiring protection must be cared for in the present so that they exist for future generations. In the marine environment, emphasis will be placed on maintaining viable populations of all species and on conserving ecosystem functions and processes.

Process

Step 1: Identification of Areas of Interest (AOIs)
Step 2: Initial Screening of AOIs
Step 3: AOI Evaluation and Recommendation
Step 4: Development of a Management Plan for Candidate MPA Site
Step 5: Designation of MPA
Step 6: Management of MPA

In some cases, steps may be taken concurrently or out of sequence.

The Minister of Fisheries and Oceans is responsible for recommending whether the Governor in Council should designate an MPA. To arrive at this recommendation, the Minister will make use of the framework, consulting as necessary with the public and other government agencies.

This National Framework allows for regional flexibility in establishing and managing MPAs. To reflect these differences, DFO Regions may develop specific guides to suit local marine conservation and protection needs. Regional guides must be consistent with the National Framework and may contain additional information on the steps and matters such as public input and consultations

Emergency MPAs
Under Section 36 of the Oceans Act, the Governor in Council, on the recommendation of the Minister may designate an MPA by order on an emergency basis, for short-term protection. This power may be used where the Minister is of the opinion that a marine resource or habitat is, or is likely to be, at risk.

This tool supplements others that could be used in emergency situations, such as fisheries closures and environmental orders. An interim MPA order will remain in effect for a maximum of 90 days. Interim MPA orders must be consistent with land claims agreements that have been ratified or approved by an Act of Parliament.

History

1994	Integrated Steering Committee appointed to look at issues surrounding MPAs
February 1997	Oceans Act passed
1998	MPA Strategy Document Released
1998	4 pilot MPA sites announced
2000	BC Fisheries Minister designates Race Rocks an Oceans Act MPA, submits paperwork to Ottawa (no final action has been taken)
2001	BC Fisheries Minister designates Endeavor Hot-vents as an Oceans Act MPA, submits paperwork to Ottawa (no final action has been taken)
2001	Pacific Biological Station (DFO) submits request to Ottawa to allow use of MPAs as management tool for inshore rockfishes
2002	estimated date of implementation of official MPA status for Bowie Seamount
2010	target date for creation of a system of MPAs in British Columbia

Inventory of Current MPAs

Jamieson and Lessard (1998) list all marine protected areas and spatially persistent fishery closures known in BC in 1997. The website publication has been updated since that time. They list site number, name, reasons for fishery closures, date, area in hectares, statistical area, and site maps. There is an individual description for each site.

There is also a DFO website specific to the 4 proposed pilot MPAs that has a background sheet regarding the area, press releases, and status of designation (http://www.pac.dfo-mpo.gc.ca/oceans/mpa/pilots.htm).

Case Study: Bowie Seamount

The Bowie Seamount is the southernmost seamount of the Kodiak-Bowie chain, which stretches from the Aleutian Trench off Kodiak Island to an area just west of the Queen

Charlotte Islands. Bowie Seamount is located in Canadian waters 180 km west of the Queen Charlotte Islands in the Northeast Pacific Ocean at 53° 18'N, 135°39'W. (Fisheries and Oceans Canada 1999, DFO in press)

Bowie is one of the shallowest seamounts in the Northeast Pacific. Although the base of the Seamount lies 3100m below the surface, its peak penetrates to within 25 m of the surface. The Seamount summit includes two distinct terraces at depths of 220–250m and 65–100m. In total, Bowie Seamount measures about 24 km wide and 55 km long. Bowie is relatively young in geological terms, and is believed to have formed less than one million years ago as an active volcanic island during the last ice age. Preliminary oceanographic studies indicate that Bowie Seamount is a biologically rich and productive marine area due to its summit rising steeply from deep oceanic water. This shallow-water area located far from the coast represents a unique habitat in BC waters and a rare habitat in the N.E. Pacific. (Fisheries and Oceans Canada 1999)

Bowie seamount was one of 4 areas designated as pilot MPAs by DFO in 1998 (It has not yet been officially designated). Following this announcement various projects were initiated to build awareness of the MPA program and to collect background information and provide recommendations with respect to the Bowie Seamount MPA including:

- An Ecosystem Overview contract carried out by AXYS Environmental Consultants Limited to collect and present all environmental, social, and economic information related to Bowie (Fisheries and Oceans Canada 1999).
- Establishment of an advisory team, consisting of representation from Fisheries and Oceans, other government agencies, First Nations, commercial fishing, commercial shipping, environmental non-government organisations, and academic science sectors. The membership of the team evolved throughout the process as stakeholder input was received, but their role was consistently to provide advice to Fisheries and Oceans regarding the development of the proposed MPA, and the consultation process.
- A workshop held in Vancouver, BC, for evaluation of the ecosystem overview, and for stakeholder consultation – the results of which were summarised in an Ecosystem Overview Workshop Summary document (Fisheries and Oceans Canada 2000).
- Creation of a Bowie Seamount Educational Media Kit – which includes a set of two CD's containing digitised underwater video footage, brochures on the Seamount and a video containing the uncut footage taken during the August 2000 CCGS John P. Tully Expedition combined with the footage from the National Geographic Expedition in 1995.
- Development of a management plan and proposed regulations based on stakeholder input, largely as a result of comments received during the stakeholder workshop.

The project management has been transferred from Vancouver to Prince Rupert and DFO is currently involved in more stakeholder meetings to resolve some outstanding issues. For example there is a sablefish resource on the seamounts that it not considered part of the IVQ program and provides income for some fishermen. DFO is also interested in trying to restrict marine transit over the "core" area of Bowie seamount and is involved in discussions with the shipping industry and Department of Defense regarding this issue.

Apparently the Department of Defense has some objections to designations of MPAs that restrict a variety of activities in an area.

It is expected that a request to have Bowie officially designated as an MPA will go to Ottawa in the winter of 2002 with approval sometime later that year.

Expectations for Future Status of MPAs

Both federal and provincial governments have committed to the completion of a system of marine protected areas on the Pacific coast by 2010. Some progress is being made, albeit slowly. In September 2000, federal Fisheries and Oceans Minister Herb Dhaliwal and BC Environment Minister Joan Sawicki announced that Race Rocks (XwaYeN) will become Canada's first Marine Protected Area under the Oceans Act. The recommendation from the Race Rocks advisory board was for a fully protected "no-take" MPA. This is a significant step forward, but as of yet the designation has not been legalized. The Endeavor Hotvents site was submitted for designation in early 2001 but final action has been held up on this as well. Gabriola is embroiled in controversy with First Nations and no-action is anticipated at that site anytime soon. A request to designate Bowie seamount is anticipated to be forwarded to Ottawa in the winter of 2002.

The Minister of Fisheries for British Columbia is expected to announce in the summer of 2002 a series of closed areas to protect rockfishes. After nearly a year of public meetings to reach consensus on areas of importance to rockfish, a list of approximately 160 areas have been identified. As many as 30 no-take closures will be implemented for yelloweye, quillback, and copper rockfishes (Sebastes ruberrimus, S. maliger, and S. caurinus). An estimated one-sixth of the rockfish habitat in the Strait of Georgia and 10% of the rockfish habitat between depths of 20 and 200 m on the outer coast will be closed to all forms of harvest.

Table C1. Federal and Provincial Marine Protection Designations in Canada.

MPA Protection Objectives Designation(s)	Potential Protective	Determining Criteria
To contribute to the protection of marine biodiversity, representative Ecosystems and special biological productivity and special natural features (e.g., upwelling environments, eelgrass beds and soft coral communities).	Oceans Act MPAs Marine Conservation Areas Marine Wildlife Areas Provincial Parks Ecological Reserves Wildlife Management Areas Migratory Bird Sanctuaries National Wildlife Areas	• representativeness • degree of naturalness • areas of high biodiversity • rare and endangered species • unique natural phenomena • ecological viability • vulnerability • unique habitat
To contribute to the protection and conservation of fishery resources and their habitats (e.g., spawning, rearing and nursery areas).	Oceans Act MPAs Ecological Reserves Marine Conservation Areas Provincial Parks	• areas of high biodiversity and/or biological productivity • vulnerability • rare and endangered species • areas supporting unique or rare marine habitats • areas supporting significant spawning concentrations or densities • areas important for the viability of populations and genetic stocks • areas supporting critical species, life stages and environmental support systems
To protect cultural resources of the Pacific coast of Canada and to provide opportunities for British Columbians and other to explore, understand and appreciate the marine and coastal cultural heritage of Canada's Pacific coast (e.g., shipwrecks and areas of cultural significance).	Marine Conservation Areas Provincial Parks	• presence of significant cultural heritage values, such as physical artifacts and structural features, places of traditional use or of spiritual importance
To provide a variety of marine and coastal outdoor outdoor recreation and tourism opportunities (e.g., scenic areas, boat havens, marine trails, and values dive sites).	Marine Conservation Areas Provincial Parks	• degree of naturalness • presence of significant recreation or tourism values • significance of cultural heritage values • ability to attract and sustain recreational use • facilitate close contact with the marine environment • aesthetics • rare, scarce, outstanding, or unique marine recreation features
To provide opportunities for increased scientific research on marine ecosystems, organisms and special features, and sharing of traditional knowledge (e.g., long term monitoring of undisturbed populations).	Oceans Act MPAs Ecological Reserves Marine Wildlife Areas Marine Conservation Areas Provincial Parks National Wildlife Areas	• value as a natural benchmark • value for developing a better understanding of the function and interaction of species, communities, and ecosystems • value for determining the impact and results of marine management activities
To provide opportunities for education and to increase awareness of marine and coastal environments and our relationship to them (e.g., interpretive signage, nature tours, and outdoor classrooms).	Oceans Act MPA Ecological Reserves Provincial Parks Marine Conservation Areas Wildlife Management Areas Marine Wildlife Areas Migratory Bird Sanctuaries	• ability to foster understanding and appreciation • area provides opportunities for use, enjoyment, and learning about the local natural environment • accessibility • suitability and carrying capacity

Lead agency(s), NGO(s) and Contact Information

In the Pacific Region, an Oceans Directorate has been established to co-ordinate and facilitate the Department's fulfilment of the provisions put forth in the *Oceans Act*.

Marine Ecosystems Conservation Branch
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British Columbia Chapter
502–475 Howe Street
Vancouver, BC
Canada V6C 2B3
Telephone: (604) 685-7445
Fax: (604) 685-6449
info@cpawsbc.org

Keith Symington
Marine Space coordinator
Marine@cpawsbc.org

Internet Sites

Pacific Region Oceans Programs
http://www.pac.dfo-mpo.gc.ca/oceans/

DFO website specific to the 4 proposed pilot MPAs
http://www.pac.dfo-mpo.gc.ca/oceans/mpa/pilots.htm

Pacific Region Fisheries Management Plans
http://www.pac.dfo-mpo.gc.ca/ops/fm/mplans/mplans.htm

Oceans Act
http://laws.justice.gc.ca/en/O-2.4/

Fisheries Act
http://laws.justice.gc.ca/en/F-14/index.html

Coasting Trade Act
http://laws.justice.gc.ca/en/C-33.3/

Jamieson and Lessard report on Marine Protected Areas and Fisheries Closures
http://www.pac.dfo-mpo.gc.ca/oceans/closure/contents.htm

APPENDIX D: LEGAL PROCESSES AND AUTHORITIES

PART I: REVIEW OF PROCESS FOR COUNCIL AND BOARD DESIGNATION OF MPAS

Currently, both the North Pacific Fishery Management Council (Council) and the Alaska Board of Fisheries (Board) are considering fishing related habitat protection measures. The Board has requested this review to develop policy guidelines to approach habitat protection through establishment of MPAs. The Council is now developing a major amendment to its BSAI and GOA groundfish fishery management plans to implement essential fish habitat (EFH) requirements of the 1998 reauthorization of the Magnuson-Stevens Fishery Conservation and Management Act. The Council's amendment is being developed through an analytic process that considers a series of alternative definitions for EFH and habitat areas of particular concern (HAPC). The next step for the Council will be the consideration of possible measures to mitigate undesirable impacts of fishing and fishing gear, depending on which EFH or HAPC definition it chooses. Mitigation measures could include gear modifications, gear preference, closures, or another type of MPAs.

Because the Council's process is under development, any process that the BOF develops to designate MPAs should include coordination with the Council. There are a number of reasons for this: (1) many of the resources managed by the Board in state waters are managed by the Council in adjacent federal waters; (2) some participants fishing in marine waters off the coast of Alaska may fish only in the EEZ under federal fishing permits and are thus regulated under federal law; (3) disparity of state and federal regulations makes enforcement difficult (most NMFS enforcement and state Fish & Wildlife Enforcement officers are cross deputized); (4) regulations developed jointly will have broader public and staff review and benefit from such input.

The Board and the Council have developed a number of institutional structures for coordination of management between state and federal.. First is the Joint Board/Council Protocol Committee. This committee is a sub-group of Council and Board members (three from each group) that meet from one to three or more times a year to discuss coordination issues. The group has been used successfully to work out differences and understand policy and regulatory approaches adopted by each body. The members of the committee seek resolution and/or return to their respective bodies and advise the full Council or Board of the issues at hand. The Committee may meet again to resolve specific conflicts.

The second coordinating step between the two bodies is the annual day-long Board/Council meeting that occurs on the first day of the February Council meeting. This annual meeting is usually an opportunity for each body to review the cross jurisdictional issues that the other body is considering in their current annual cycle. Staff presentations are made on the issues and Council or Board members seek clarification on conservation, management, regulatory or policy concerns.

The current sequence of events for the Board designating an MPA with fishing or fishing gear restrictions within state territorial waters would proceed as follows. The Board will either adopt a triennial cycle to consider MPAs or allow the submittal of public proposals during any statewide crab, scallop, groundfish or salmon cycle. It may also consider a Council generated proposal as provided under 5 AAC 39.999(b): "The board will, in its discretion, change its schedule for consideration of proposed regulatory changes as reasonably necessary for coordination of state regulatory actions with federal fishery agencies, programs or laws." Alternatively, the Board may consider staff or public testimony and generate a Board proposal on its own schedule.

Once the Board adopts a proposal, after the usual local fish and game advisory committee review, staff presentation and public testimony and Board deliberation at a scheduled Board meeting, the proposal is then forwarded to the legislature as a recommendation for creation of a marine reserve as provided in AS 16.05.251(a)(1).

If the proposed MPA requires coordinating federal regulation, then the Board can either send a letter to the Council requesting it consider adopting similar regulations, or go through the Joint Board/Council committee requesting the council consider complementary regulations. Either way, the Board's proposal would enter the Council amendment cycle. From start to finish the Council process normally takes at least 18 months. If the Council has major pressing issues on its agenda, such as responding to the Biological Opinion on Steller sea lions and fishery interactions and the resulting proposed reasonable and prudent alternatives, the process could take much longer.

Because the Council must consider adopting regulatory changes under the National Environmental Policy Act (NEPA) process, the Council must not only accept the Board's proposed action, but will need to analyze a reasonable suite of options, including the status quo. The NEPA process may include: a public scoping process; tasking and completion of a comprehensive analytical package that considers all of the alternatives against the biological, enforcement, social and regulatory impacts; adoption of a preferred alternative; sending out the analysis for public review; meetings and the taking of public testimony, input from the industry advisory panel and the scientific and statistical committee; Council selection of a final alternative; submittal to the Secretary of Commerce for review; drafting of proposed regulations; and taking final comment before the regulations becomes law.

If the resulting two laws were significantly different, the Joint Board/Council Protocol committee would need to find solutions for inconsistency.

PART II: NON-FISHING HABITAT PROTECTION TOOLS IN STATE WATERS

Alaska Coastal Management Program

The Alaska Coastal Management Program includes a state coastal plan, coastal district (local government) plans, standards for evaluating and managing uses and activities in the coastal zone, and a process to coordinate state resource agency permitting and approval of uses and activities in the coastal zone. The program was initially motivated by a desire to influence federal off-shore activities, but over time has become an important planning and coordination tool for coastal zone related topics and interests. The program requires management of habitats in the coastal area that are subject to the ACMP "so as to maintain or enhance the biological, physical, and chemical characteristics of the habitat which contribute to its capacity to support living resources." The ACMP is implemented through federal and state agencies, and through local governments.

Department of Environmental Conservation

The Department of Environmental Conservation implements statutes and regulations affecting air, land, and water quality. DEC is the lead state resource agency for implementing the federal Clean Water Act, including Section 401, the Certificate of Reasonable Assurance. DEC's regulatory and statutory authorities provide considerable opportunity to maintain high quality fish and wildlife habitats through pollution prevention.

Department of Fish and Game

The Department of Fish and Game protects estuarine and marine habitats primarily through cooperative efforts involving other state and federal agencies and local governments. The department has jurisdiction over the mouths of designated anadromous fish streams and legislatively designated state special areas (critical habitat areas, sanctuaries, and refuges). Some marine species receive special attention through the state's Endangered Species program.

Department of Natural Resources

The Department of Natural Resources manages all state-owned land, water and natural resources, except for fish and game, on behalf of the people of Alaska. This estate includes most of the state's tidelands out to the three-mile limit and some 34,000 miles of coastline.

DNR manages state lands and waters through a variety of statutory and regulatory authorities. Legislative action is required to close areas greater than 640 acres to multiple use. Legislative approval is need for establishment of State Parks, Alaska Marine Parks, State Recreation Areas, Special Management Areas, Bald Eagle Preserves, Roadside Rests and Beaches, and Trails, Footpaths, and Campsites.

DNR develops land use plans to guide the use, development, and disposal of state lands. Examples of marine and estuarine uses authorized by DNR include: log-transfer sites,

access, and support camps for timber development; set-net lease sites for commercial fishing and mariculture sites for the shellfish farming industry; lodge sites and access for the tourism industry; access for public and private entities across state lands and waters, including power and telephone lines; and water rights and water use authorizations. Through the Alaska Endangered Species Act, DNR implements measures to preserve the natural habitat of species or subspecies of fish and wildlife that are recognized as threatened with extinction.

Local Governments

Thirty-five coastal districts, including four Coastal Resource Service Areas, are established in Alaska. These range in size from Pelican, with 0.4 miles of shoreline, to Cenaliulriit, with 8,995 miles of shoreline. Of the 35 districts, 33 have coastal management plans that provide enforceable policies and guidelines concerning uses and activities in the district's coastal zone planning area. Special components of district coastal planning are "Areas Meriting Special Attention," discrete places that are specially managed for a particular resource value or use.

In addition to coastal plans, local governments with a coastal location have jurisdiction over estuarine and marine waters.

Alaska statutes and regulations define the powers and responsibilities of local governments; a range of land use planning and land management authorities exists among local governments located on the Alaska coast. All borough and larger municipality boundaries extend to the three-mile limit. Some small communities also have encompassing boundaries, for example, the boundaries of the city of St. George are "all the territory contained within the 3 mile perimeter surrounding St. George Island of the Pribilof group." Further, considerable amounts of tide and submerged lands have been conveyed to local governments since statehood.

Metlakatla Indian Community is a traditional Tsimshian community on the federal Annette Island Reserve (86,000 acres), the only Indian reservation in Alaska. Metlakatla was not part of the Alaska Native Claims Settlement Act (ANSCA).

APPENDIX E: INVENTORY OF MARINE PROTECTED AREAS IN ALASKA

This section presents a preliminary inventory of marine protected areas in Alaska, based on the following definition:

> "a marine protected area is a geographically defined area designated with special protections to enhance the management of marine resources."

Specifically, this inventory includes examples of waters closed to fishing at least seasonally, including single species closures, in contrast to the National Ocean Survey (NOS) definition used in the federal MPA inventory process, which includes only those areas with year-round protection. The purpose of including seasonal closures is to provide a comprehensive source of mapped regulatory restrictions to better inform the MPA decision-making process as new closures are proposed, and as existing closures are monitored and evaluated.[4]

To date, the inventory recognizes over 200 individual marine protected areas in 18 categories in Alaska state and federal waters (Tables E1 and E2, Figures E1–E13). Protected areas listed in the database include state critical habitat areas, state game refuges, state and federal fisheries management zones, wildlife sanctuaries and refuges, and the Alaska Coastal Zone Management Plan's areas meriting special attention. The size of the closures range from small marine parks to most of the eastern Bering Sea, and the purposes include bycatch reduction and protection of endangered populations, spawning populations, species' critical habitat ranges, and subsistence use. These closures were initiated as amendments to the North Pacific Fishery Management Council's (NPFMC) fishery management plans for groundfish in the Gulf of Alaska, and the Bering Sea and Aleutian Islands, Alaska Board of Fish regulatory actions, actions of the Alaska Coastal Management Districts, local government regulations, and others.

Protections for the listed areas vary. A small set of the closures in Alaska qualify as marine reserves (closed to all fishing year-round). These are the no-transit areas around numerous Steller sea lion rookeries (Figure 11) and the state waters closures of the Walrus Islands State Game Sanctuary (Figure 2). The closure at the Cape Edgecumbe Pinnacles near Sitka (Figure 1) prohibits groundfish fishing but not surface fishing (e.g., for salmon), and is best considered a groundfish fishery reserve. At the other extreme is the Kachemak Bay National Estuarine Research Reserve, which carries no restrictions. An important task ahead is to clearly describe the restrictions/protections in place for each area, and to fairly characterize the restrictions in regards to fisheries.

[4] NOS is proposing to inventory Marine Managed Areas under a definition similar to the more inclusive definition used here.

BUILDING A MARINE PROTECTED AREA INFORMATION SYSTEM FOR ALASKA WATERS

Staff in the Commercial Fisheries Division of the Alaska Department of Fish and Game, in conjunction with the department-wide task force, have begun cataloguing closed waters in a geospatial database, which will include descriptive attributes for each area as well as the spatial referencing and topological information necessary to perform spatial queries and display mapped information.

In an effort to increase the ADF&G marine protected area program's efficiency and efficacy, this information system will be used in development and coordination with the National Marine Fisheries Service's ongoing identification and mitigation efforts for essential fish habitat (EFH), habitat areas of particular concern (HAPC), and the federal marine protected areas inventory. The task force anticipates use of this database as a tool for mapping and spatial analysis of existing and proposed closures, and is proposing to develop products such as the following:

- a hard-copy atlas of closed waters in Alaska;
- a website with first static and then dynamically mapped closed areas allowing users to query the databases and display the mapped results of the query; and
- a CDROM application to display mapped data in an interactive format.

Table E1. Preliminary categories of Alaska MPA sites.

Category	Number of sites
Coastal Management Special Area (AMSA)	57
Federal Fisheries Management Zone	20
Federal Threatened/Endangered Species Critical Habitat	1
Federal Threatened/Endangered Species Protected Area	4
National Estuarine Research Reserve	1
National Historical Park	1
National Park	4
National Wildlife Refuge	10
Public Use Area	1
State Critical Habitat Area	12
State Fisheries Management Zone	30
State Game Refuge	10
State Game Sanctuary	2
State Marine Park	36
State Oil and Gas Closure	1
State Recreation Area	15
State Wildlife Sanctuary	1
State-Federal Refuge	12
Total	218