TESTIMONY

on

Use of Marine Protected Areas (MPAs)

As a Fisheries Management Tool,

As a Means to Protect and Restore Marine Ecosystems,

and As a Research Tool

before the

Subcommittee on Fisheries Conservation, Wildlife and Oceans

23 May 2002

Edward D. Houde, Professor

University of Maryland Center for Environmental Science

Introductory Comments

I appreciate having the opportunity to address the Subcommittee and to present my views on the potential of Marine Protected Areas (MPAs) as an effective tool to manage marine fisheries and to conserve marine ecosystems. My comments represent personal views and do not necessarily represent views of the University of Maryland's Center for Environmental Science (UMCES).

Marine Protected Areas, if broadly adopted for marine fisheries and marine ecosystem management, will shift emphasis from controlling amounts of catches (removals) and amounts of fishing effort in marine ecosystems to an increased emphasis on spatially-explicit management. Adoption of MPAs as a significant component of a suite of ecosystem-based approaches for marine fisheries management will add emphasis to conserving the productive capacity of the ecosystem, in addition to its individual stocks.

Habitats and Spatial Management: a Role for Protected Areas

The NMFS Fisheries Ecosystem Principles Advisory Panel (NMFS, 1999) and the National Academy of Science's Committee on Marine Protected Areas (NRC, 2001) strongly recommended incorporation of protected areas and other spatially-explicit approaches for fisheries management into ecosystem approaches for fisheries management. These approaches can move management towards more ecosystem-sensitive approaches that can protect essential fish habitats, reduce bycatches, and protect threatened species. Closed areas, no-take zones, and other spatial restrictions on fishing or exploitative use are not new to fisheries management. Yet, they are seldom a major tool selected as a management option. Marine protected areas

(MPA) represent a hierarchy of spatial measures, ranging from wilderness areas, where no removals are allowed and no impact on habitat is tolerated, to areas where only a few restrictions on use may be designated. Three recent reviews and evaluations have concluded that MPAs, including marine reserves (no-take areas), have a role in management of U.S. coastal fisheries, especially if combined with conventional management approaches (NMFS, 1999; NAS, 1999, 2001). The consensus is that MPAs can be effectively included in broad coastal zone management plans to promote habitat protection/restoration and serve the goals of sustainable fisheries management.

The sea is a patchwork of habitats and water masses that support fishery stocks and biological communities at varying levels of productivity. This patchiness is appreciated by fishers who don't cast their nets randomly but focus effort in historically productive areas where fish aggregate around preferred habitat. As a consequence, stocks may be depleted and habitats impacted by fishing activities that are concentrated in productive parts of coastal zones. Broader implementation of MPAs in fisheries management would shift the emphasis of management policies from controlling catches and effort to recognizing the importance of spatial heterogeneity in marine habitats and the need to preserve the structure of marine ecosystems to ensure sustainable fisheries. Area closures to protect individual stocks have been a traditional management tool for centuries. Extending the concept to protect the ecosystem and its biological community for the benefits of multispecies management is an extension of the area closure concept, although more complex. Will all stocks benefit? Will benefits accrue to the aggregate fisheries? What are the costs of managing MPAs vs conventional management approaches? For many marine ecosystems, answers to these questions may not be immediately available.

Marine Protected Areas

The concept of marine reserves or other closed areas, with various restrictions on fishing and other human uses, was recognized in the 1996 reauthorization of the MSFCMA and has been on the planning tables of Regional Councils in recent years. Some marine areas have, in fact, been closed to certain kinds of fishing effort (e.g., parts of Georges Bank). The NAS Committee (NRC 2001) concluded that MPAs have a role in fisheries management as well as in conserving biodiversity and the integrity of marine ecosystems that are affected by human activities.

In a broad sense, setting aside areas as MPAs to protect spawning stock can serve as a buffer against the uncertainties and errors of stock assessments or effectiveness of regulations, i.e., a kind of insurance. More specifically, the NAS Committee recommended that MPAs for fisheries management should be designed as parts of broader networks of MPAs that are zoned for prescribed activities, and that these networks be embedded in an even broader plan of coastal ocean management that considers the full spectrum of human activities and need to protect ecosystem structure and function.

In the context of fisheries and fishing impacts, properly designed MPAs can:

- **•Protect nursery areas**
- **•Protect or restore critical habitats**
- **•Limit bycatch**
- **•Protect threatened or endangered species**
- **•Rebuild age and size structure of stocks (and increase fecundity)**
- **•Promote spillover and dispersal from protected to open fishing zones**
- **•Reduce fishing mortality rates**
- **•Reduce the need for stock assessment science**

- **•Recognize 'uncertainties' in science and management and adopt MPAs as insurance**
- **•Promote education and research on marine ecosystems.**

However, as with implementation of other kinds of fisheries regulations, **there may be economic costs to traditional users of fishery resources associated with initial designation of MPAs.** It is for this reason that fishers and other stakeholders must be included in all phases of MPA planning and implementation.

There is strong evidence that MPAs lead to increased abundance and sizes of protected species within the boundaries of reserves, but the benefits to surrounding areas are less certain in the absence of knowledge of dispersal or migration patterns of key organisms in a protected community. There is evidence that benefits may be exported to surrounding regions in some cases, including estuarine fisheries in Florida (Roberts et al., 2001).

MPAs will not solve all fishery management problems but their role and potential should be recognized. For example, language in the pending reauthorization of the Magnuson-Stevens Act could be added to: 1) address the issues and identify probable benefits of MPAs; 2) specify research needs; and 3) develop criteria for MPA implementation.

Planning and Design

Performance of MPAs is dependent on adequate planning and design, whether the overall goal is to promote biodiversity, manage fisheries, or some combination of goals. Design of effective MPAs should proceed through four sequential stages: 1) evaluate conservation needs at local and regional levels; 2) clearly define objectives and goals for establishing an MPA; 3) describe key biological and oceanographic features of the region; and 4) identify and choose site(s) that have highest potential for implementation.

To assure success in MPA implementation, **it is essential that all stakeholders, including those geographically distant from the site, participate in the planning and design phases.** Affected communities, especially fishing interests, cannot be isolated from a process that will impact their way of life and earning potential. In many cases, establishment of MPAs will have goals that go beyond improving fishery management (e.g., protection of biodiversity, rare species, habitats, cultural sites), and it is essential that the broad community of stakeholders be fully aware of, and involved in, the planning phase of MPA designation.

Selecting MPA sites is no simple task. There are few case studies on MPAs in U.S. waters and little knowledge of long-term performance of protected sites. Two major gaps in knowledge that are problematic are lack of information on movements of fish and a poor understanding of the responses of fishers to area closures. Dispersal of fish eggs and larvae, or migrations of older stages, are critical in MPA site selection. The nature and level of dispersal of early life stages and the so-called 'spillover' of young fish from an MPA to open areas depend upon a complex interaction of oceanographic factors and stage-specific behaviors of fish. Although little is known directly about these factors and interactions, modeling research clearly demonstrates that dispersal, combined with behavior of fishers outside the MPA, is a major determinant of whether an MPA will be a success (Lauck et al., 1998; Hastings and Botsford, 1999; Sladek-Nowlis and Roberts, 1999; Holland, 2000; Mangel, 2000). **Potential MPA sites that serve as 'sources' for dispersal, rather than 'sinks' that receive dispersed migrants have the highest potential to improve fisheries** that are under heavy exploitation (Crowder et al., 2000). Furthermore, it is very likely that protection of highly productive habitats and nurseries, rather than expanses of relatively unproductive areas, will provide greatest benefits to fisheries restoration and management.

Size and Number

There is no general rule, in my view, for allocating size, area, or numbers of MPAs to a marine ecosystem. Location, size and number of potential MPAs certainly must be considered in developing an MPA strategy. In some cases rather small MPAs, or networks of MPAs, in critical areas may play a significant role in protecting fish stocks, e.g., protecting vulnerable spawning aggregations of reef fishes. In other situations, e.g., for sedentary species of long-lived demersal stocks, percentages of an ecosystem much larger than 20%, a percentage often recommended, will be required to sustain or restore fisheries productivity (Lauck et al., 1998: Walters, 2000), especially if effective conventional management measures are not rigorously and synoptically applied. Modeling research indicates that, as a stand-alone management approach, MPAs occupying as much as 30-70% of a management region might be required.

Hundreds of MPAs are presently designated in the U.S. coastal zone, but a minuscule number have fisheries management as their primary goal and even fewer are true marine reserves where fishing is not permitted. The NOAA Marine Sanctuary Program is one prominent effort in which 13 sanctuaries have been established but, with only a few exceptions, the sanctuaries presently do not address fisheries management concerns in any major way. The Regional Fishery Management Councils presently are developing MPA plans within their respective jurisdictions. It seems clear to me that implementation of MPAs will increase in importance in the U.S. during the next decade as ecosystem approaches for fisheries management and the need to conserve biodiversity and habitats become prominent. In anticipation of this trend, careful site selection and consideration of the need to zone and network MPAs are recommended to assure that MPAs will meet performance goals.

Conventional Fisheries Management and MPAs

Conventional management that emphasizes controls over effort and catches will continue to be employed because fishing will continue and effort probably will increase outside the boundaries of MPAs after area closures.

The NAS Committee (NRC, 2001) considered weaknesses and drawbacks of conventional fisheries management in the context of alternative MPA-based management. Quota and effort controls have not always led to sustainability in U.S. fisheries and many analysts claim that conventional approaches have failed to achieve sustainability (Botsford et al., 1997). Quality of stock assessments is often uncertain; stock abundance or fishing mortality-rate reference points and targets are poorly known or imprecise for many fished stocks. Uncertainties in stock assessments, combined with overcapacity, the major problem in management of U.S. fisheries (NRC, 1999), lead to failed effort control, followed by declining stocks and poorly performing fisheries.

The NAS Committee concluded that MPAs can benefit habitats and fishery resources, but near-term benefits in yields or profits of MPAs to fishers are not certain or may be negative. **MPAs can protect vulnerable habitats from destructive fishing practices and other threats and they may be particularly effective in protecting nurseries that support young fish. MPAs properly located can reduce bycatch of pre-recruits of targeted species and reduce the unintentional catches of non-target species. They can be effective in protecting endangered or threatened species of mammals, turtles and birds. And, MPAs potentially can reduce excessive mortalities on species such as the tropical groupers that form highly vulnerable spawning aggregations. The argument that MPAs are insurance against the uncertainties of complex science and conventional management has merit and justifies consideration of MPAs as a management tool.**

Developing MPA Zones and Networks

Coastal regions are heavily utilized or appreciated by a multitude of industries and interests, which often are competing for resources or other benefits and services of marine ecosystems. In the U.S., the coastal ocean falls under jurisdictions of several federal, state, and local authorities. Effective management ultimately will require zoned use and cooperation, not only among users but also among management agencies. The possibilities for zoned use to alleviate conflicts and spatially partition acceptable uses of habitat should be considered; and, the potential to develop networks of complementary MPA sites to raise the probability for success should be evaluated. **The NAS study (NRC, 2001) recommends that MPAs, zoned for specific uses, ultimately must be developed within the broader context of coastal zone management.** Also, the report recognizes the broad spectrum of protected areas and reserves that could be designated. MPAs of various types, extending from terrestrial habitats to offshore, might be implemented within the jurisdictions of local, state and federal authorities. Such designs imply linkages and convey the obvious need for cooperation and coordination among agencies to insure effective MPAs that are protective of resources and habitats.

Designating protected areas and reserves of appropriate size in proper spatial context can enhance contributions of MPAs to habitat protection, biodiversity, and overall productivity. **Networks of MPAs have been proposed as an effective means to expand their utility. Networks imply that linked and complementary systems of MPAs (implying connectivity) can provide added value to protection and restoration of fishery resources.** Effective development of such networks requires broad knowledge of oceanographic characteristics, habitats, and community ecology, which is not consistently available for many marine ecosystems. A Presidential Executive Order (No. 13158) was issued by President Clinton in May 2000 that called for development and implementation of a coordinated network of MPAs in the U.S. coastal zone. This Order directs the National Oceanic and Atmospheric Administration (NOAA), in cooperation with the Department of the Interior, to establish a MPA Center and develop a framework for a national system of MPAs (See *http://www.mpa.gov/).*

Monitoring and Enforcement

Many of the thousands of protected areas in marine ecosystems throughout the world are little more than 'paper parks' because there is no enforcement of fishing and other regulations, or monitoring of ecosystem properties to determine if the MPA is performing up to expectations. Plans for routine monitoring and enforcement are essential and should be developed during the MPA design phase. Monitoring must include collection of socio-economic information on costs and benefits as well as information on fisheries catch and effort, habitats, and water quality.

Expectations for MPA performance may differ for single-species protection relative to MPAs for multispecies (or community) protection. Monitoring and regular evaluation of performance are required if MPAs are adopted as a major component of a marine-ecosystem or fisheries-management regime. It goes without saying that enforcement of boundaries and MPA regulations is essential for a spatial approach to be effective.

Performance Issues

The performance of MPAs depends on the particular migration and dispersal behaviors of organisms at each relevant life stage (Fogarty et al., 2000). In a fisheries context, MPAs usually are designated with the

expectation that benefits will be exported from the protected area to some wider surrounding area. That expectation should be evaluated through reviews of the state of knowledge, by experiments and by modeling during the MPA design phase. **To date, most evidence of MPA success in rebuilding fished stocks and restoration of ecosystem properties has been observed 'within' an MPA's boundaries. Export of benefits to surrounding regions (a usual goal) is less certain and dependent on dispersal patterns of fish and behavior of fishermen in areas that remain open to fishing.**

If MPAs are implemented, mechanisms should be in place to allow amendments to MPA policies and designations if performance does not meet expectations. For example, MPAs for fisheries management could be designated with fixed time limits during which evaluation of performance would determine if the MPA has met management goals. Non-performance should lead to revision of the MPA design or termination of an MPA in favor of alternative management approaches. Spatially-explicit management policies that include MPAs as a major tool should be instituted with the same adaptive flexibility as measures used in conventional management.

Research Needs

There is relatively little knowledge regarding performance of MPAs as a fisheries management tool. Research on fish dispersal and migration is critical to determine whether a designated MPA will be productive and serve as a source for spillover to areas that remain open to fishing. Evaluation of sizes and shapes of reserves with respect to reserve perimeter/area ratios and effects on dispersal for many species of fishes and fish assemblages are needed. Socioeconomic research on the impact of MPAs on fishermen and fishing communities, in both short and longer terms, is required.

Establishing MPAs will provide opportunities to not only monitor their performance but to conduct research on fish behavior, age-specific dispersal potentials, and productivity. In addition, fundamental information on life histories, stock structure, and population dynamics can be collected in MPAs. Manipulative experiments that involve mark-recapture approaches, or selective removals and additions of organisms, are possible in MPAs where potentially confounding effects of fishing are absent.

Costs and Benefits

There are costs and benefits associated with MPA-based management relative to more conventional fishery management approaches (Table 1, from NRC, 2001) and these must be considered when MPAs are planned. **Except in the case of collapsed stocks, there may not be economic incentive for MPAs or increases in profitability from MPA implementation and, in fact, profits may decline in the near term.**

Table 1. Some costs and benefits associated with MPAs in fisheries management (from NRC 2001).

ISSUE	COST	BENEFIT
Yield	Decrease catch. Negative impacts on yields of other fisheries	Higher stock fecundity and recruitments. Lower bycatch
Displacement	Increased fishing pressure in open areas	Reduced effort. Protect essential fish habitat
Management	New research and monitoring needs	Better estimates of population parameters
Economics	Disproportionate impact on local communities	Insurance against stock collapse.

Non-market values	Loss of customary fishing areas and rights to access	Restores ecosystem, habitats and species

Essential Fish Habitat, Fisheries Ecosystem Plans and Marine Protected Areas

The need to define essential fish habitat (EFH) and to manage fishing to insure its protection was highlighted in the amended MSFCMA (1996); additional required actions and recommended research have been proposed in the draft M-S reauthorization now before the 107th Congress. A report of the Congressionally-mandated Ecosystems Principles Advisory Panel (NMFS, 1999) included many specific recommendations on ecosystem approaches to improve fisheries management. That Panel also proposed a major conceptual recommendation--that each Council develop a Fishery Ecosystem Plan(s) (FEP) within its region. A FEP is envisioned to serve as an umbrella plan under which individual Fishery Management Plans (FMPs) would sit and to which they must adhere. An FEP essentially defines the important ecosystem considerations that must be addressed in a FMP. Language in the newly drafted M-S Act reauthorization Bill promotes development of criteria and research plans for FEPs in Council regions.

The EFH and FEP concepts are closely allied and are related to evolving thought on how MPAs will fit into ecosystem-sensitive approaches for fisheries management. **In my view, the pending M-S reauthorization does not need a National Standard that calls for MPA implementations by Regional Councils for fisheries management. However, the reauthorized Act would be well-served to explicitly recognize and encourage the designation of MPAs as a tool to protect critical habitats (EFH) and provide supportive management at the ecosystem level to insure conservation of the productive capacity of marine ecosystems (FEP) that can support sustainable fisheries.**

References

Botsford, L. W., J. C. Castilla and C. H. Peterson. 1997. The management of fisheries and marine ecosystems. Science 277:509-515.

Crowder, L. B., S. J. Lyman, W. F. Figueira and J. Priddy. 2000. Source-sink population dynamics and the problem of siting marine reserves. Bull. Mar. Sci. 66:799-820.

Fogarty, M. J., J. A. Bohnsack and P. K. Dayton. 2000. Marine reserves and resource management. In: Seas at the Millenium. Elsevier, Amsterdam.

Holland, D. S. 2000. A bioeconomic model of marine sanctuaries on Georges Bank. Can. J. Fish. Aquat. Sci. 57:1307-1319.

Lauck, T. C., C. W. Clark, M. Mangel and G. R. Munro. 1998. Implementing the precautionary principle in fisheries management through marine reserves. Ecol. Applic. 8(1):S72-S78.

Mangel, M. 2000. Trade-offs between fish habitat and fishing mortality and the role of reserves. Bull. Mar. Sci. 66:663-674.

NMFS. 1999. Ecosystem-based fishery management. Ecosystem Advisory Panel to NMFS. NOAA Tech. Memo NMFS-F/SPO-33. NOAA/National Marine Fisheries Service, Silver Spring, MD.

NRC. 1999. Sustaining marine fisheries. National Academy of Sciences, National Research Council. National Academy Press, Washington, D.C.

NRC. 2001. Marine protected areas: tools for sustaining ocean ecosystems. National Academy of Sciences, National Research Council. National Academy Press, Washington, D.C.

Roberts, C. M., J. A. Bohnsack, F. Gell, J. P. Hawkins and R. Goodridge. 2001. Effects of marine reserves on adjacent fisheries. Science 294:1920-1923.

Sladek-Nowlis, J. S. and C. M. Roberts. 1999. Fisheries benefits and optimal design of marine reserves. Fish. Bull., U. S. 97:604-616.

Walters, C. 2000. Impacts of dispersal, ecological interactions, and fishing effort dynamics on efficacy of marine protected areas: how large should protected areas be? Bull. Mar. Sci. 66:745-758.

####