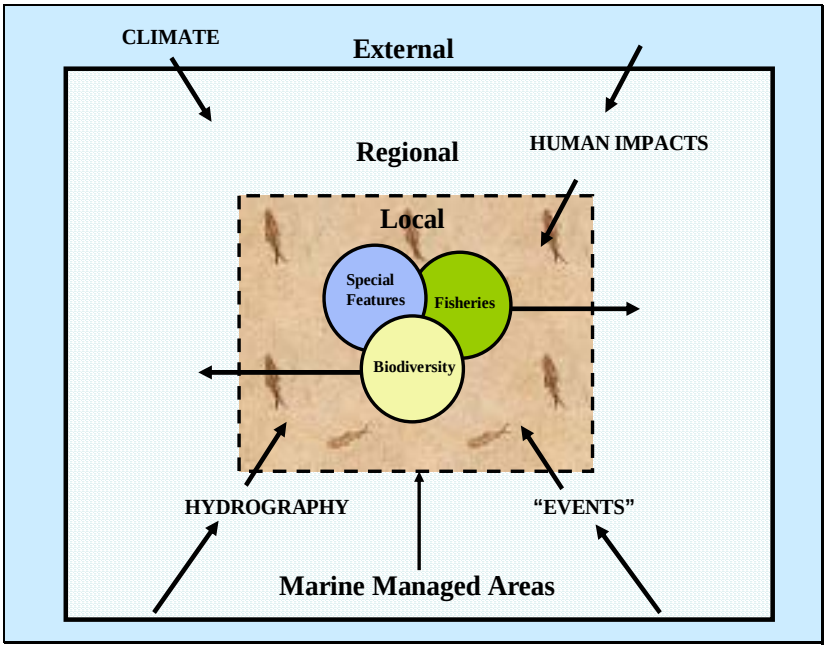
Spatial Management in the Chesapeake Bay: Applications, Issues, and Opportunities



Workshop Report

April 13 – 14, 2004
Fredericksburg, VA

Sponsored by the Chesapeake Bay Program's
Scientific and Technical Advisory Committee

August 2004
STAC Publication 04-004

About the Scientific and Technical Advisory Committee

The Scientific and Technical Advisory Committee (STAC) provides scientific and technical guidance to the Chesapeake Bay Program on measures to restore and protect the Chesapeake Bay. As an advisory committee, STAC reports quarterly to the Implementation Committee and annually to the Executive Council

STAC members come primarily from universities, research institutions, and federal agencies. Members are selected on the basis of their disciplines, perspectives, and information resources needed by the Chesapeake Bay Program.

STAC publications focus on issues of importance to the Chesapeake Bay Program.

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Preface and Summary

The Scientific and Technical Advisory Committee (STAC) of the Chesapeake Bay Program sponsored a workshop on Spatial Management, including protected areas, that was directed primarily at identifying and defining issues, concerns, and opportunities for increased implementation of spatial management. Stakeholders and resource managers are the primary audiences of the workshop report. The workshop was held on April 13 -14, 2004 and was the first of two workshops that STAC will sponsor on this topic. Results and recommendations of the present workshop will serve as a framework and foundation for the second workshop that will address technical issues related to design and implementation of spatial management plans.

Workshop participants represented a diverse group of stakeholders, management agencies, and academia. An opening plenary session featured a keynote address by Billy Causey, Superintendent of the Florida Keys National Marine Sanctuary (FKNMS), who spoke on the process that was followed for successful implementation of the FKNMS. Invited stakeholders, managers, and scientists with expertise and interest in the Chesapeake Bay made presentations to inform participants of the status of spatial management in the Bay or provided summaries of their concerns and examples of successful implementation of spatial management.

The plenary was followed by three working group breakout sessions- - Habitats, Biodiversity, and Fisheries Management. Reports and recommendations of each breakout group are included in the workshop report. The 'Summarized Recommendations' of the workshop were developed in a closing plenary session. These are presented as 'General and Cross-Cutting' recommendations, in addition to recommendations specific to Habitats, Biodiversity, and Fisheries Management.

A 'Concluding Statement' emphasizes that, while workshop participants were supportive of spatial management, many issues and concerns must be addressed. These include 1) stakeholder involvement at the outset and throughout development of spatial management planning; 2) the need for an inventory of present spatial management in the Bay ecosystem; 3) the need for science to define how spatial management could perform better than conventional management approaches; 4) the need for evaluation and monitoring of any spatially managed areas and benefits/costs of their implementation; and 5) the need to consider access privileges and the concern over 'permanency' of implementation in the absence of sufficient evaluation of performance. The 'Concluding Statement' also indicates broad opportunities for expansion of spatial management in support of Chesapeake Bay resource management and protection, especially for Habitats and Biodiversity Conservation, and potentially for Fisheries Management.

This report will be distributed by STAC to the Chesapeake Bay Program and its Subcommittees as they consider broader adoption of spatial management and protected areas in the overall management of the Bay ecosystem. The report identifies issues in spatial management and can serve as the background document for the planned technical workshop. Knowledge gained in the present workshop indicates that the proposed

technical workshop must include stakeholders, in addition to scientists and managers, to insure that balanced and representative plans, sensitive to stakeholder needs, are developed for spatial management in the Chesapeake Bay.

Introduction and Background

Application of spatially explicit management approaches, including Marine Protected Areas (MPAs) and other Marine Managed Areas (MMAs), potentially can be expanded to protect and conserve resources in the Chesapeake Bay. **Globally and nationally, persuasive arguments have been developed to promote increased implementation of spatial measures to conserve and protect marine ecosystems, to preserve or restore biodiversity, to protect habitats, and to be applied as tools that are alternatives or supplements to conventional fisheries management.** An extensive dialogue has evolved and a massive publication record now exists on spatial management issues, especially on areas commonly referred to as marine reserves or 'no-take areas,' which prohibit removal of resources and often any significant disturbance of the ecosystem.

Spatial management tools have been applied to resource management in terrestrial and aquatic ecosystems for centuries. In fact, much of the terrestrial resource management component in the Chesapeake Bay Program (CBP) consists of 'spatial,' approaches, but spatial management is less used in the estuary itself. **The CBP *Chesapeake 2000* agreement (CBP 2000) requires improved habitat protection and restoration, and new approaches to fisheries management that potentially can be partly addressed by spatial management approaches.** The newly-released report of the U.S. Commission on Ocean Policy (USCOP 2004) emphasizes ecosystem-based approaches, which include spatially explicit measures to improve management of marine ecosystems. The potential for expanded use of managed areas and spatially-explicit approaches in the Chesapeake Bay, and the effects of such expansion on stakeholders/users, raise many issues and concerns for consideration before additional spatial management approaches can be designated and implemented effectively in the Chesapeake Bay.

Much debate and stakeholder concern center on definitions and categorization of spatially explicit management and the numerous forms that it may take. Marine managed areas and marine protected areas afford protection or special recognition to living resources and habitats within boundaries of designated areas. The level of protection specified in spatial management can vary from relatively minor regulations to complete closure of areas to exploitation and removal or disturbance of living resources or habitat structure. The latter forms of spatial management, the so-called 'no-take' or 'fully protected' areas and marine reserves often cause most concern among stakeholders. It was not the objective of this workshop to define the range of spatial management options or to argue for particular types of spatial management in the Chesapeake Bay. Definitions and information on the various types of MPAs and managed areas have been

provided in numerous publications and are found on many websites (e.g., NRC 2001; National MPA Center, http://www.mpa.gov).

Problems in the Chesapeake Bay and the stresses that threaten it or compromise its productivity are not unlike problems in many of the world's heavily utilized coastal ecosystems. Degraded habitats, poor water quality, depleted fisheries, damaging fishing practices, and losses or threats to biodiversity lower not only the economic value of resources but also the value of ecosystem services and functions. More effective management measures are needed. Spatial management, while not new to the Chesapeake Bay or to other aquatic ecosystems, is an approach often underutilized (NRC 2001) and potentially can be expanded to benefit the Bay and stakeholders who rely on it. This workshop on 'Spatial Management in the Chesapeake Bay' addressed concerns and opportunities, from which recommendations were developed to guide consideration of expanded spatial management in the Bay ecosystem.

The Scientific and Technical Advisory Committee (STAC) of the Chesapeake Bay Program developed the workshop proposal. **STAC recognized that it was important to define what might be achieved through designation of MPAs and other spatial management tools in the Bay and its watershed that could not be achieved through conventional management, or could be achieved with greater probability of success and more economically through spatial management.** STAC proposed two complementary workshops: the first workshop, reported herein, was to broadly identify and address issues and opportunities for spatial management and MPAs from the perspectives of stakeholder representatives and management agencies. The workshop and this report will facilitate development of the agenda for the second workshop that will emphasize technical issues and science needs for planning and designing spatial management plans. Recommendations from the two workshops, after submittal to STAC, will be routed through the Chesapeake Bay Program and its Subcommittees to inform the CBP of potential benefits or drawbacks of expanded implementation of spatial approaches for management in the Bay ecosystem. It is anticipated that resource management agencies in the Bay region will utilize and benefit from this report as they develop long-range plans for protecting and restoring Chesapeake Bay resources.

The Workshop

The workshop had 24 participants, representing diverse stakeholders, management agencies, non-governmental organizations, and academic institutions (Appendix B). The number of participants was relatively small and, although representing diverse interests, may not have included the full-range of perspectives and expertise on some issues. Plenary presentations were followed by breakout group discussions that identified concerns and opportunities for application of spatial management approaches and developed recommendations in the broad areas of *Habitats*, *Biodiversity* and *Fisheries Management*. There were many common interests in spatial management shared by the diverse stakeholders represented in the three breakout groups.

Plenary Presentations

Eleven plenary presentations provided background, perspective, and an overview of issues that concern stakeholders. They also provided a view of opportunities for broader application of spatial management and marine protected areas in the Chesapeake Bay.

Ed Houde, University of Maryland Center for Environmental Science

Ed Houde gave the opening plenary talk, presenting a broad overview of spatial management and protected areas, and a summary of how these approaches have been applied globally and in the Chesapeake Bay. Dr. Houde reiterated the workshop goals, objectives, and work plan.

Doug Lipton, University of Maryland College Park and Maryland Sea Grant Extension

Doug Lipton summarized responses of workshop invitees to a web-based survey of stakeholder views on spatial management and protected areas (Appendix C) that had been made available to possible participants several weeks before the workshop. The survey was designed to seek opinions and assess degree of agreement with statements on spatial management and MPAs. Responses were diverse and often expressed specific interests of the various stakeholder groups represented at the workshop. **Despite the strongly divergent opinions, all respondents agreed that the goals and objectives of spatial management, or justification for adoption of protected areas, were not well documented for the Chesapeake Bay.**

Twenty-one individuals completed the survey. Number of responses by stakeholder category was: Natural resource managers (8); recreational fishermen (4); government researchers (3); academic researchers (3); environmental organizations (2); commercial fishermen (1). Respondents gave their level of agreement (from 1-10, with 1 being strong agreement) on a set of statements regarding spatial management and marine protected areas. As seen in the graphical summaries (Appendix C), researchers and managers tended to agree on issues more than user groups. Reponses by environmental organizations tended to fall between responses of users (commercial and recreational fishermen) and scientists/managers. Results for commercial watermen were submitted by a single individual, and the responses tended to be strategic, making it difficult to draw broad conclusions about commercial watermen attitudes with respect to spatial management.

Billy Causey, National Oceanic and Administrative Administration; Superintendent, Florida Keys National Marine Sanctuary

Billy Causey delivered a keynote presentation on the history, process, and lessons learned based on his experiences in leading the effort to develop and implement the FKNMS (Appendix D). In that decade-long effort, **stakeholder participation was key to the success in development of a consensus process for reaching agreements to insure progress. A mixture of 'top-down' leadership from collaborating federal and state agencies, and inclusive of 'bottom-up' participation by all stakeholder groups was critical for success**. In the FKNMS, sites and areas were categorized for prescribed

uses, with levels of protection keyed to the degree of protection required or to the nature of use. An Advisory Council was active and provided leadership throughout the process. Establishing the FKNMS was no easy task and successful implementation required more than a decade of planning. Lessons learned, however, can be invaluable to ease planning for spatial management in other regions.

Lauren Wenzel, National Oceanic and Atmospheric Administration, Marine Protected Areas Center

Lauren Wenzel summarized activities and programs of the NOAA MPA Center. NOAA is developing an inventory of Marine Managed Areas (MMAs) in the USA and information describing them. **The NOAA Office website (http://www.mpa.gov) is a recommended source of information on the diverse kinds of MMAs** and also the status of activities towards implementation of recommended actions called for in Executive Order 13158, which calls for the creation of a scientifically-based, national system of marine protected areas representing diverse U.S. marine ecosystems.

Mary Conley, Maryland Department of Natural Resources

Mary Conley described programs on spatial management sponsored by agencies of the state of Maryland. There is a broad range of managed areas, not only in the Chesapeake Bay and watershed, but also in the Maryland Coastal Bays. These areas serve a variety of purposes, including natural resource protection and restoration, public safety, public health, and national government activities. In addition, she reviewed the legislative authority within the state to establish marine protected areas.

Laura McKay, Virginia Department of Environmental Quality, Virginia Coastal Programs

Laura McKay described Virginia coastal programs that focus on spatial management. These **programs cover not only the Chesapeake Bay but also oceanside managed areas. There is a rich diversity of such areas in Virginia and activities leading to inventories, maps, and catalogs of information are already developed in many cases.** A notable objective of the program is its goal to categorize and specify types of activities in marine managed areas of Virginia with an eye to avoid and minimize conflicts among diverse stakeholders.

Larry Simns, Maryland Watermen Association

Larry Simns provided the perspective of a commercial fisher. He was skeptical with respect to potential of marine reserves and closed areas as management tools that could improve fisheries or benefit commercial fishers. **Commercial fishers are concerned when management planning is done in their absence; they must be at the table when spatial management planning takes place. With respect to MPAs, Mr. Simns argued that closed areas, like other management tools, should not be implemented permanently but should be evaluated regularly and modified or terminated if they fail to provide expected benefits. C**ommercial fishers believe that solving pollution problems associated with land runoff in the Chesapeake Bay's watershed should be a priority before additional spatial management regulations are imposed on fishers.

Michael Doebley, Recreational Fishing Alliance, and Maryland Saltwater Sportfishing Association

Michael Doebley presented views of recreational fishers who are concerned that marine reserves and protected areas often are recommended when conventional management could achieve management goals. **The privilege of maintaining access to fishery resources is a prime concern of recreational fishers.** Guarding the access privilege is critically important. He and **many recreational fishers believe that reserves and other closed areas should be a 'last resort' form of management, to be implemented only when valid and current science indicates that other management approaches are unlikely to succeed.** In this regard, organizations and constituents that Mr. Doebley represents were advocates for a 'Freedom to Fish' Act legislated by Maryland in 2004, which limits Maryland's authority to implement MPAs for recreational fishing, except when scientific study indicates that this approach will be effective and desirable.

Richard Welton, Coastal Conservation Association, Virginia Chapter

Richard Welton presented views and concerns of recreational fishers, with a Virginia perspective. He indicated that the organization he represents is opposed to marine protected areas as a general policy, except under specific circumstances where scientific justification can be provided. **Many recreational fishers are opposed to permanently closed areas. There is concern that, in spatial management and reserve designations, an inappropriate 'one size fits all' mentality may emerge.** Mr. Welton believes that those responsible for declining fisheries or ineffective management should be held accountable, generally by applying conventional regulations, rather than instituting marine reserves that impact the broader user community. He also believes that many recreational fishers would support spatial management that allowed catch and release fishing. If conventional management proves ineffective and scientific research justifies MPAs, many recreational fishers may support reserves, particularly if they eliminate those sources of fishing effort responsible for the problem.

Rob Brumbaugh, Chesapeake Bay Foundation

A NGO perspective on spatial management was provided by Rob Brumbaugh. Conservationists and much of the public believe that spatial management has a positive role in management of the Chesapeake Bay resources, especially with respect to protection and restoration of habitat and biodiversity. **Spatial approaches that specify acceptable uses or activities can be a proactive mechanism to avoid reactionary management of living resources. In this sense, spatial approaches can be a precautionary means to deal with uncertainties of both science and management.** Categorizing managed and closed areas as 'permanent' is of great concern to exploitative users (e.g., fishers) and might not be an advisable policy goal for spatial management aimed primarily at fisheries.

Rom Lipcius, Virginia Institute of Marine Science

Rom Lipcius informed workshop participants of a spatial management approach in the Chesapeake Bay designed to benefit the blue crab fishery. A 'corridor' in the Virginia mainstem of Chesapeake Bay is designated where crabbing is prohibited. The

corridor was implemented by the Virginia Marine Resources Commission after scientific study indicated it was a migration route for female crabs and that closing it to crabbing could significantly lower fishing mortality on females**. Involvement of crab fishers from the outset in developing the corridor plan was important in gaining their support.** The measure can be modified or rescinded by VMRC should it prove to be ineffective at some future time. Presently, there is evidence that the corridor approach, combined with protection of critical juvenile nursery habitats, is an effective tool for management of blue crab in the Bay.

Breakout Group Summaries

Three breakout groups (Habitat, Biodiversity, Fisheries) met to develop summaries and recommendations on spatial management potentials, issues, and concerns.

Habitat
Discussion Leader: Denise Breitburg
Breakout Group Participants: Mary Conley, Laura McKay, Richard Welton, Meredith Blaydes, Dan Murphy

There are key habitats in the Chesapeake Bay that require protection or restoration. Examples include submerged aquatic vegetation (SAV) beds, oyster beds and reefs, spawning areas of anadromous fishes in the tidal freshwater parts of the Bay and tributaries, wetlands, beaches, and terrestrial areas contiguous to the Bay which serve as links between the aquatic and terrestrial environments. Spatial management approaches already are applied to restore and protect such habitats and could be expanded to benefit living resources or to serve other human needs.

Most habitats are fixed in space and their protection and restoration require defining boundaries within which spatial-management rules are applied. Once the types of habitats for spatial management are identified, specific sites must be proposed. Habitat locations of especially high priority for protection include 1) those that provide multiple benefits, 2) those where land management is beneficial to in-water habitat quality, and 3) those whose spatial proximity to other key habitats increases their ecological or fishery values. Many habitats have multiple values and potentially contribute broadly to ecosystem health as well as fisheries sustainability.

The Habitats breakout group discussed how spatial management may be beneficial for habitat management in the Chesapeake Bay, as well as the concerns of stakeholders over prospects of new spatial management regulations. The breakout group included representatives of the research, management, sportfishing, and conservation communities. In general, there was strong consensus regarding the potential approaches and benefits of spatial management to protect or restore habitats. The group discussed the types of habitats that should be considered, the potential benefits to the Bay and its species, and particular concerns of stakeholders.

The workgroup identified five categories in which spatial management may be an appropriate tool for habitat protection and restoration:

1) Habitat that is physically damaged or highly susceptible to such damage;
2) Habitat that is critical to sustain populations of fish or shellfish, or the health of the Bay ecosystem;
3) Habitat whose function within the Chesapeake Bay itself is dependent on, or enhanced by, spatial linkages to other habitats;
4) Habitats that serve as critical links between terrestrial and aquatic ecosystems (e.g., wetlands, nesting beaches for birds, turtles or horseshoe crabs).
5) Habitat in which removals of untargeted living resources (i.e., bycatch) is especially problematic.

General Principles

Spatial management of habitats, or to meet other objectives, should include defined goals, regular monitoring, and appropriate evaluation. Effective implementation of spatial management that is minimally burdensome to stakeholders requires that **each designated habitat type or location have clearly defined goals, and that evaluation and monitoring be conducted to determine if goals are being met.** Habitats recommended for spatial management, but especially no-take areas or reserves, should be designed to facilitate collection of information required for effective, adaptive management.

If properly designed and implemented, spatial management directed at habitats can have multiple benefits. For example, habitat reserves may benefit fisheries by enhancing protection, leading to increased production and sustainability of targeted species. Spatial management potentially may reduce multiple use conflicts by clearly defining sites for designated activities that could have negative impacts on habitat, although providing economic value to some segment of the stakeholder community. In this sense, **spatial management akin to zoning may provide a framework for planning that reduces the negative impacts of emerging uses of the Chesapeake Bay's waters and shorelines.** For example, with respect to emerging interest in aquaculture, a structured process to decide how much area and which locations should be designated would be beneficial. Such 'zoning' designations should be planned carefully through processes that meaningfully include stakeholder groups. Furthermore, other emerging and non-traditional uses, such as ecotourism, should be considered in identifying habitats for spatial management.

In creating MPAs it is important to consider the duration and temporal boundaries of a closure. **Many protected areas should be long-term to insure desired benefits with respect to habitat protection or restoration. However, designating areas for permanent closure may be undesirable in some cases if it prevents the possibility of responsive, adaptive management.** Additionally, in some cases temporary closures or restrictions on access will be sufficient to allow protection of habitat or re-establishment of species targeted for restoration. In general**, the timeframe for spatial restrictions should be appropriate to the management goal**. Decisions to remove or relax closure

or other spatial regulations should be contingent on attainment of goals. Short-term closures may benefit submerged aquatic vegetation replanting efforts; medium-term closures may benefit migratory fish populations (e.g., American shad and river herrings) in areas newly opened to spawning by dam removal, and longer-term closures may be required for oyster restoration because of the massive loss this habitat has experienced.

Finally, **spatial management alone is insufficient to restore and protect habitats in the Chesapeake Bay.** All management measures, including permitting and activities that occur outside of spatially-designated management zones, should utilize methods and regulations that minimize habitat damage.

Specific Habitats

Specific habitats for which spatial management may be beneficial, or is currently employed, were identified. The list is not exhaustive, but includes:

- Submerged Aquatic Vegetation (SAV) beds (nursery value for fish and crabs, food for bird species, wave and turbidity control)
- Oyster reefs (both ecosystem and fishery value)
- Spawning, migration, and overwintering habitats (Virginia blue crab 'migration corridor' and overwinter areas; anadromous fish migration, spawning and nursery areas)
- Intertidal/extreme shallow areas (juvenile fish and crab refuges from predation, and shorebird foraging habitat)
- Saltmarshes (nursery and water quality value)
- Sandy beaches (e.g., reproduction by horseshoe crabs, terrapins; feeding habitat for migrating birds or nesting habitat for birds).
- Sea duck concentration areas (dredging and other activities may disrupt these concentrations
- Bird rookeries (shoreline and wetland areas of the Bay watershed)
- Bay Islands (protect mainland habitat from erosion; other services, e.g., bird habitats, terrapin nesting)
- Dredged areas and habitats singled out for construction activities (temporal closures to protect fishery habitat, spawning grounds and birds)

The breakout group discussed several Chesapeake Bay habitats in more detail. Recommendations and considerations for their spatial management are summarized below. These recommendations do not constitute a thorough consideration of issues, but summarize conclusions reached during brief breakout sessions.

Oyster Reefs

Spatial management is extensively used in replenishment activities to enhance commercial fisheries and for restoration. There is considerable disagreement over the value of long-term (e.g., one to several decade-long) closures in the presence of disease-related mortality of the native Eastern oyster *Crassostrea virginica*. Data are not currently available to determine whether long-term sanctuaries may provide greater long-

term ecological and/or fishery benefit than do harvest reserves, which in Maryland are opened to harvest after 2-3 years. More time, and restoration designed to facilitate comparisons of sanctuaries and harvest reserves, is required to evaluate potential benefits of long-term closures and the best methods to meet restoration goals.

Oyster reef closures generally prohibit removal of oysters, but do not prohibit taking of finfish, except where such closures are required to adequately enforce oyster regulations. The breakout group endorsed this policy, recommending that crabbing and fishing for finfish be allowed on oyster reefs protected to enhance oyster survival. The workgroup recognized, however, that the extent to which oyster reefs in the Chesapeake Bay enhance fish and crab production, versus simply increasing spatial aggregation of these animals, is not known. The potential for aggregation and high vulnerability to fishing should be considered for species in decline that are targeted in fishing on oyster reefs. In addition, activities that are destructive to oyster bottom habitat should be prohibited. These activities include anchoring within restoration areas and fishing methods that disrupt the bottom.

Submerged Aquatic Vegetation (SAV)

SAV would benefit from improved water quality and protection from physical destruction. Because nutrient over-enrichment and poor light penetration that are consequences of poor land-use practices limit SAV growth, protected areas for SAV should be located where land use is managed in ways that minimize harm to SAV. The breakout group also suggested consideration of SAV protection zones in which motorized boating activities are limited or prohibited. In general, more information is needed to determine how much restriction is important for effective spatial management of SAV.

Sea Duck Concentration Areas

These overwintering areas may need to be protected from dredging or other activities designed to facilitate shipping and navigation in the Bay's waterways.

Spawning Migration Corridors for Anadromous Fishes

Anadromous fishes spawn in the tidal freshwaters of the upper Bay and its tributaries, often just up-estuary of the salt-freshwater interface. The breakout group suggested that: 1) protection for striped bass and other anadromous fishes should be more spatially extensive and be applied earlier seasonally to protect spawners; 2) migration corridors leading to spawning sites should be protected against incidental (bycatch) mortality; and 3) applying uniform rules for commercial and recreational fishers is important to achieve consensus by both sectors. In addition, migration routes of shads and river herrings need restoration and maintenance, including resolution of issues related to dam removal.

Biodiversity

Discussion Leader: Rob Brumbaugh

Breakout Group Participants: Lauren Wenzel, Billy Causey, Kathy Brohawn, Doug Samson

'Biodiversity' is a broad term used to describe variation in biological organization or processes occurring at scales ranging from genes to landscapes. Conservation of biodiversity at the genetic level is important to ensure maximum health or "fitness" of a given population of organisms or to guide efforts to re-establish depleted populations. At the other end of the spectrum –the landscape scale – conservation of biological diversity may focus, for example, on the amount and taxonomic complexity of underwater grass beds throughout the Chesapeake Bay and watershed that are critical to protect ecological and structural integrity of the entire system. Most commonly, biodiversity is interpreted as describing the number of species (species-richness) within a given site or environment.

Operating Premises

The Biodiversity breakout group did not set specific goals for biodiversity conservation, nor did it attempt to define appropriate scales at which biodiversity was as risk in the Chesapeake Bay. Rather, the group worked to describe likely benefits and logistical considerations in employment of spatial management approaches to conservation of biodiversity.

To guide discussion, the breakout group outlined several operating premises or assumptions:

1) Conservation of biodiversity should focus on *native* species – recognizing that the introduction and proliferation of non-native species is a major threat to global biodiversity, second only to habitat loss and fragmentation.
2) Biodiversity conservation goals should focus not only on species of commercial or recreational value, but also on non-exploited (or unmanaged) species and habitats.
3) The Chesapeake Bay, now a focus of intensive restoration activities (water quality, habitat, depleted species), will require even greater levels of protection. The daunting task to restore the Bay should not pre-empt planning and implementation of biodiversity conservation.
4) Ocean-to-Bay linkages are important for conserving highly migratory species. Many fish and invertebrate species have life histories that extend beyond the geographic boundaries of the Chesapeake Bay and involve larval dispersal or migrations by other life stages within the coastal ocean (e.g., sturgeons, striped bass, American shad, blue crab). Understanding processes that affect survival of such species outside the Bay is critical for designing effective conservation inside the Bay.
5) Land-to-Sea linkages are important considerations for conserving species with strong connections across that interface. For example, conservation of migratory shore birds depends on ensuring an abundant supply of their primary foods during coastal migrations – e.g., protecting horseshoe crab eggs on spawning beaches. In

such circumstances management of aquatic and terrestrial resources should be integrated (i.e, spatial management for multiple species) rather than conducted in isolation.

What are the perceived benefits of spatial management approaches for conservation of biodiversity?

There are numerous approaches to promote conservation of biodiversity beyond spatial management or adoption of MPAs, for example protection of water quality or conventional fisheries management that regulates fishing effort to reduce bycatch and non-targeted fishing mortality. However, **the breakout group believed that MPAs represented a more comprehensive and effective tool for biodiversity conservation because MPAs could protect the majority of species that are otherwise "unmanaged". Beyond protecting individual species and biological communities, MPAs could be designed to protect specific ecosystem structure (habitat) and services (nursery functions, food-web dynamics, water filtration, nutrient cycling), and thus add resilience to an ecosystem.** This benefit is analogous to buying "insurance" against damage caused by natural events or management failures.

MPAs for biodiversity conservation could yield economic benefits such as providing refuge to species with pharmaceutical value (e.g., horseshoe crab) or fisheries production (e.g., nursery area protection of juveniles), as well as protect areas important to cultural and natural heritage. The breakout group also perceived MPAs as an effective 'ecological backstop' against shifting baselines when measuring the health of the Bay ecosystem as a whole. **Conserving a diversity of species and habitats within MPAs will allow reference levels to be defined for measuring health of the ecosystem beyond MPA boundaries,** provided that there is an effective monitoring program.

MPAs designed to conserve biodiversity in the Chesapeake Bay might also have 'value added' by eliminating or reducing physical disturbances to habitats from human activities. Examples of protective measures afforded by MPAs and managed areas elsewhere include use of mooring buoys to reduce anchor damage on reefs or in grass beds, and prohibition of habitat-altering activities such as channel dredging. The presence of a MPA to conserve biodiversity could serve as a focal point for enhanced resource management in surrounding areas, e.g., land conservation decisions, establishment of no-wake zones, and more protective discharge policies in nearby waterways.

Challenges and Opportunities for Implementation in the Chesapeake Bay

Implementation of any new public policy requires thorough consideration of potential impediments or conditions that may hinder effectiveness of the policy. Establishment of MPAs for conservation of biodiversity likely would face the same challenges as spatially explicit management measures implemented for other purposes. Questions of jurisdiction and stakeholder support for a MPA are obvious issues to be addressed early in the decision-making process. Other issues that are less obvious, but

ultimately important in the design and implementation of MPAs for conservation of biodiversity, such as potential effects of climate change or invasive species prevention and/or management, must be considered.

The question of "How much is enough?" is an important consideration in spatial management that, in part, is determined by goals and desired outcomes (e.g., preserving a single stand of eelgrass *Zostera marina* and its associated epifauna vs. preserving the nursery capacity for submerged aquatic vegetation in general). In other regions, the existence of "charismatic" fauna (e.g., manatees in Florida, sea otters in Monterey Bay) provides a strong public impetus to undertake conservation using spatial management approaches. **Developing public support for protected areas in the Chesapeake Bay in the absence of such obvious "poster species" may be a challenge.**

Despite challenges, lessons learned elsewhere, such as in the Florida Keys National Marine Sanctuary, could help to avoid obstacles or pitfalls in design and implementation of MPAs and other spatial management approaches. Ecosystem-based approaches to management with a biodiversity conservation goal, or other goals, can be a unifying theme for jurisdictions and stakeholders. The prospect of additional federal or shared funding (e.g., NOAA support for marine patrol officers in Florida Keys) is also an appealing benefit of shared management responsibilities in MPAs. **The public is increasingly aware of threats to biodiversity and the need to conserve it, which helps to secure political support to institute policy changes necessary for area-based management approaches across jurisdictions.**

<u>Starting the Process (Priming the Pump)</u>

Stakeholder buy-in is critically important for development of worthwhile designs as well as implementation of MPAs. Such support also reduces the challenge of enforcement if people understand and respect the purpose of MPAs. To that end, **there must be a clear vision statement – expressing not only why biodiversity is important but, additionally, outlining the expected "return" from spatial-management investments in biodiversity protection in the Chesapeake Bay.** The approach requires definition of biodiversity conservation goals (genetic diversity, species diversity, community diversity, ecosystem function, etc.) and identification of specific sites useful to attain these goals. In the Chesapeake Bay estuary, this might entail establishing managed areas that span the full range of salinities and habitat types.

In general, **areas designed for conservation of biodiversity should incorporate the following management objectives and principles:**

- AVOID destructive fishing and boating practices (e.g., dredging, anchoring, boat wakes).
- AVOID shoreline and shallow-water habitat alterations contiguous to the site.
- ALLOW active management designed to achieve goals (e.g., controlling invasive species, or perhaps altering abundance of predators).
- PROMOTE targeted watershed management in areas contiguous to the site.
- PROMOTE research to help refine approaches.

- PROMOTE awareness of biodiversity benefits.

From an adaptive management standpoint, it is necessary to develop effective metrics for monitoring the outcome of spatial management with respect to biodiversity conservation. While the Chesapeake Bay Program (CBP) has a well-established monitoring program throughout the Bay and some tributaries, it is probably insufficient for measuring progress within MPAs established for biodiversity conservation. It should be possible – and highly desirable – to integrate additional area-specific monitoring into the CBP monitoring program and database.

Fisheries Management

Discussion Leader: Doug Lipton

Breakout Group Participants: Chris Judy, Rom Lipcius, Michael Doebley, Margaret McBride, Bob Wood

Commercial and recreational fishers represent major sectors of the traditional stakeholder community who utilize the Chesapeake Bay and depend on its productivity and resources. Management of the Bay and its resources, including possible broadened use of spatial management approaches or MPAs, is of critical concern to fishers. The application of ecosystem-based management, as called for in the *Chesapeake 2000* agreement (*C2K*) and the NOAA Chesapeake Bay Office's newly developed Fisheries Ecosystem Plan (CBP 2000; NOAA 2004), increases the probability that spatial management of Bay fisheries will become more prominent. **Fishers are particularly concerned that spatial management based on insufficient science may limit access to fishing areas and that closed areas may be implemented as permanent measures, rather than subject to evaluation of effectiveness as a requirement for continued use.** Recently, legislation known popularly as the 'Freedom to Fish' Act was passed in Maryland that provides guidelines for designation of MPAs, and requires both public notice and strong scientific justification prior to closing areas to fishing.

A concise summary of key points and recommendations representing consensus views of the Fisheries breakout group follows.

<u>Key Points</u>

- Any discussion of spatial management must begin with a clear definition of spatial management, marine managed areas, marine protected areas, etc. Fishers must understand the implications of potential establishment of a managed area.
- Spatial management may consist of restrictions that not only involve regulations directly applied to fisheries, but also those applied to contiguous terrestrial systems, coastlines, etc. that affect fisheries production.
- **Spatial management is a tool that requires evaluation, as do more conventional fishery management tools (e.g., size limits, quotas, effort restrictions, gear restrictions, etc.), to determine its relative effectiveness in achieving fisheries management goals.**

- Spatial management in numerous forms is already widely used in fisheries management, including in the Chesapeake Bay, and often is a component of management plans that rely mostly on conventional management approaches. Examples of spatial components in fisheries management include:
    - area-specific quotas
    - temporal-spatial closures
    - area-specific size limits
    - area-specific gear restrictions.

Recommendations

1. **Develop a comprehensive inventory. Catalog and characterize existing spatial management practices in the Chesapeake Bay that affect fisheries**, including:

    - Spatio-temporal regulations (e.g., anadromous fish spawning and migration route closures or special management rules)
    - Oyster restoration sites and special regulations areas
    - Blue crab migration corridors and special regulations areas (e.g., areas closed to winter dredging; tributary regulations precluding crab pot use, etc.)
    - *De facto* spatial management
        - Military-base restrictions on access
        - Health-related (e.g., shellfish closures due to high coliform counts)
        - Safety and security areas (e.g., Liquid Natural Gas facility and surrounding area)
    - Reserves, parks, etc.

2. Improve the efficiency of existing management, including spatial approaches, for fisheries in the Chesapeake Bay
    - **Evaluate the extent to which existing management achieves stated goals**
    - **In the case of spatial management, recommend adjustments to fill gaps, make linkages, etc., to improve effectiveness of existing management.**

3. Conduct research on spatial management to address issues and needs, particularly with respect to emerging ecosystem-based fisheries management considerations:

    - Quantitative analyses and modeling research. Develop and apply statistical and numerical models to evaluate probable effects of spatial management relative to alternative management approaches.
        - Take advantage of natural experiments; analysis of areas now closed due to *de facto* closures

    - Evaluate existing spatial management in the Bay and its tributaries.
  - Include experimental approaches such as manipulation of populations to determine impacts of spatial processes (e.g., increase harvesting to reduce high fish densities; transfer or enhancement of populations to manipulate densities; mark-recapture experiments to determine migrations, movements, abundance, survival).

4. **Consider and address socio-economics. Evaluate efficiency and equity - - spatial management should be evaluated and compared with other approaches in terms of relative costs and benefits imposed on fishers.**

    - Consider the unique nature of spatial approaches in terms of impacts on fishers based on their geographic location. For example, some fishermen may be forced to travel long distances to avoid closed areas, while others will see little direct impact.
    - Consider unique safety and cost issues associated with implementing spatial approaches (e.g., illegal to traverse some areas with gear or fish on board).
    - **Consider and evaluate effects of displaced fishing effort on fished stocks, fishery landings and economics, and on habitats that remain open to fishing after closed-areas designations.**

Summarized Recommendations

The concise recommendations that follow are presented in four categories: General and Cross-cutting; Habitats, Biodiversity, and Fisheries Management. The recommendations, in conjunction with specific advice from each of the breakout groups, can contribute to development of a strategy for enhanced spatial management in Chesapeake Bay by the Chesapeake Bay Program and regional resource management agencies. The recommendations also provide a framework to support a future STAC-sponsored workshop on technical issues related to spatial management.

General and Cross-cutting

- Define the goals of proposed spatial approaches for management of Bay resources.
  Why is a spatial approach potentially advantageous?
- Distinguish and define terms that identify the diverse compendium of spatial management measures that range from areas having minor regulations on use to areas under complete closure.
- Develop a vision statement on spatial management and how it might contribute to a better Chesapeake Bay.

- Include stakeholders in all considerations of spatial management. Shared management is essential for spatial approaches to be supported broadly as a major element of resource management.
- Remember that 'permanency' in establishment of closed areas can be threatening to some users. Depending on goals, consider alternatives to permanent closures.
- Identify areas and resources in the Bay and tributaries that require protection and may benefit from spatial management approaches.
- Identify, consider, and address jurisdictional issues and institutional impediments that limit potential for spatial management approaches. Agency-specific and geographical/political jurisdictions (authority and responsibilities) are especially important to consider in spatial management.
- Recommend that the Chesapeake Bay Program jurisdictions develop a broad inventory of spatially-managed areas in the Bay and its contiguous areas.
- When appropriate, select potential MPA or MMA sites in areas where current use or lack of use are positive factors in promoting potential success.
- Evaluate research needs to determine potential benefits of spatial management approaches. High-quality science is required to support implementation of spatial management and MPAs as alternatives to conventional management. How much science is enough?
- Consider zoning and networking as spatial management concepts. At times these approaches can represent a 'middle ground' between reserves (no-take areas) and conventional management approaches.
- Remember that heritage, cultural appreciation, and existence values of some Bay sites are worthy justifications for designation of MMAs in the Bay.
- Evaluate and monitor performance of spatial management approaches, in a manner comparable to monitoring conventional resource management measures. Determine if goals are being met. Document costs and benefits.

Habitats

- Develop an inventory of representative sites in the Bay that represent the range of ecosystem types in need of management and restoration to meet goals of the Chesapeake Bay Program and its *C2K* mandates.
- Apply spatial management (e.g., protect or restore habitat) and other management measures (e.g., improve water quality) in an integrated approach to achieve habitat-related management goals.
- Restrict human impacts in areas that include critical habitats (e.g., SAV) or consider zoning to reduce conflicts among stakeholders in diverse Bay habitats (e.g., develop aquaculture zones).
- When compatible, areas designated for protection or restoration of a particular habitat type (e.g., oyster reefs) should allow human activities (e.g., finfish fishing over oyster reefs) that do not jeopardize or compromise the habitat protection goals.

- Coordinate spatial management in the aqueous environment of the Bay with management in contiguous terrestrial environments to insure that habitat-improvement goals are achieved.

Biodiversity

- Because biodiversity and habitat-related goals often are closely linked or complementary, spatial management should be undertaken with both in mind.
- Direct spatial management not only at biodiversity conservation of exploited species, endangered/threatened species, or charismatic species, but also at species with little economic or aesthetic value, but which may support important structure and function in ecosystems (e.g., so-called forage species).
- Emphasize spatial management directed primarily toward biodiversity conservation of native species.
- Develop representative MPAs as reference sites against which biodiversity in unprotected sites can be compared to judge effects of human activities (e.g., fishing) on biodiversity.

Fisheries

- Evaluate success of conventional management in meeting fisheries management goals before recommending potentially more burdensome spatial management measures.
- Preserve 'access' to fishing grounds to the extent possible and consider impacts of closed areas on users.
- Evaluate potential socio-economic benefits and costs of spatial management compared with conventional fisheries management.
- Consider spatial management as a potential tool to control bycatch and to protect juvenile fishes from fishing mortality on nursery grounds.
- Undertake experiments and conduct scientific research to determine when and how MPAs might be preferable to, or might complement, conventional fishery management in Chesapeake Bay.

Concluding Statement

Broader consideration and application of spatial management approaches have the potential to improve resource management in the Chesapeake Bay, but stakeholders have many concerns that must be addressed. Broadening the use of spatially explicit management tools, including MPAs and marine managed areas (MMAs), may change the emphasis in approaches to management and protection of many Bay resources. Such a shift would be responsive to recommendations by the U.S. Commission on Ocean Policy (USCOP 2004) in which ecosystem-based approaches are strongly emphasized. It also would promote achievement of many habitat-related and fisheries objectives of the Chesapeake Bay Program's *C2K* document (CBP 2000) and the recently developed Fisheries Ecosystem Planning document (NOAA 2004). In the case of fisheries

management, conventional approaches that depend primarily on regulating catches and fishing effort might be supplemented to a greater extent by designation of geographical areas in the Bay for particular fishing applications (i.e., zoning and networking). Zoning and networking may have even broader appeal as spatial management strategies to restore and protect habitats and to conserve biodiversity. Before spatial management in its more restrictive forms (e.g., no-take areas and marine reserves) is recommended, stakeholders must be fully informed and involved in any significant actions that are taken to restrict access or limit traditional uses of the estuary. Developing a process to achieve consensus is important.

A model for spatial management that provides valuable lessons is the establishment of the Florida Keys National Marine Sanctuary. The FKNMS model provided a multi-jurisdictional framework for development of a new "zoning" approach to management, and facilitated establishment of special management areas for numerous and diverse purposes throughout the Sanctuary. While the CBP provides a means to develop inter-jurisdictional goals for water quality protection and resource management, it lacks jurisdictional "co-management" authority for waters or sub-aqueous lands within states and localities. Mechanisms and processes that provide for active jurisdictional co-management, such as National Marine Sanctuary status, could complement the goal-setting and progress-tracking evaluations overseen by the CBP.

STAC recognizes that an early step in developing spatial management approaches is to clearly identify goals and objectives. Once the goals have been defined, a strategy to identify, plan, design, and implement appropriate spatial management measures is required. A strategic plan could include a spectrum of managed and protected areas. Spatial management measures must have clearly defined management goals for specific resources or for conservation of the structure and function of the Bay ecosystem. Developing an inventory of existing managed areas is essential at the outset. Development of the spatial management strategy can be an initial step in recognizing the heterogeneity of the Bay seascape and the need to manage it with that heterogeneity in mind. Stakeholders, technical experts from the natural and social sciences communities, resource managers, and concerned citizens should have opportunity to be involved in developing a spatial management strategy ('bottom-up' emphasis). If expansion of spatial management practices is recommended, a panel of stakeholders and experts should be charged to develop a strategy. While 'bottom-up' emphasis is critical, capable 'top-down,' leadership from appropriate management agencies also will be essential to assure success.

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CBP. 2000. Chesapeake 2000 Agreement. Chesapeake Bay Program, Annapolis, MD (*www.chesapeakebay.net/agreement.htm*).

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NRC. 2001. Marine protected areas. Tools for sustaining ocean ecosystems. National Research Council, National Academy Press, Washington, D.C.

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Appendix A

Spatial Management in the Chesapeake Bay:
Applications, Issues, and Opportunities

April 13-14, 2004
Holiday Inn Select, Fredericksburg, VA

April 13, 2004
Madison Room

8:30 a.m.	Registration and Refreshments
9:00 a.m.	Workshop Introduction *Ed Houde, UMD Center for Environmental Science*
9:20 a.m.	Spatial Management Survey Results *Doug Lipton, University of Maryland*
9:35 a.m.	Florida Keys National Marine Sanctuary: Issues and Concerns of Stakeholders and Managers *Billy Causey, NOAA Sanctuaries Program*
10:15 a.m.	Break
10:35 a.m.	NOAA Marine Protected Area Program *Lauren Wenzel, NOAA Sanctuaries Program*
10:55 a.m.	Perspectives on Spatial Management: MD and VA *Mary Conley, MD Department of Natural Resources* *Laura McKay, Virginia Coastal Programs*
11:25 a.m.	Crab Sanctuaries in the Chesapeake Bay *Rom Lipcius, Virginia Institute of Marine Science*
11:40 a.m.	Stakeholder Perspectives *Bill Goldsborough, Chesapeake Bay Foundation* *Larry Simns, MD Watermen's Association* *Michael Doebly, MD Saltwater Sportfishermen's Association* *Richard Welton, Coastal Conservation Association, VA Chapter*
12:35 p.m.	Lunch
1:45 p.m.	Plenary Discussion

3:15 p.m. Breakout Sessions
Fisheries Workgroup – *Patrick Henry Room*
Habitat Workgroup – *Room 360*
Biodiversity Workgroup – *Madison Room*

5:30 p.m. Adjourn

April 14, 2004
Madison Room

8:30 a.m. Refreshments

9:00 a.m. Workgroup Reports

10:00 a.m. Breakout Sessions
Fisheries Workgroup – *Patrick Henry Room*
Habitat Workgroup – *Room 360*
Biodiversity Workgroup – *Madison Room*

11:30 a.m. Plenary Discussion

12:30 p.m. Adjourn

Appendix B

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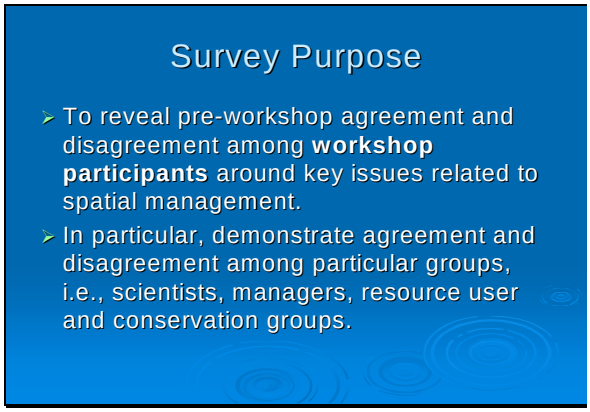
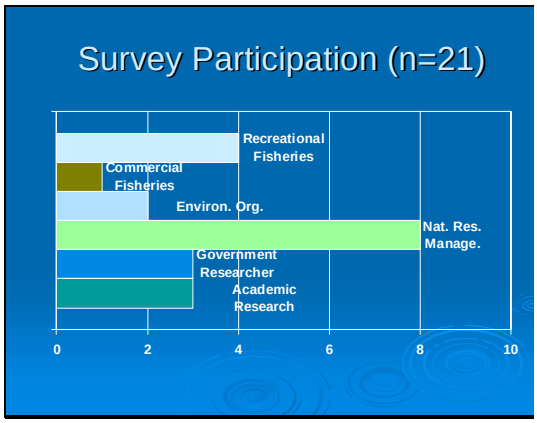
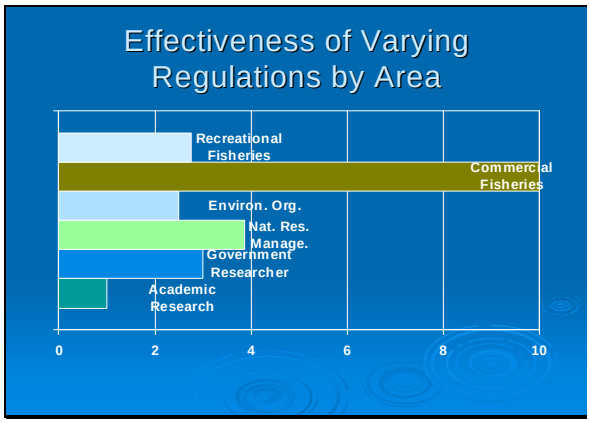
Appendix C

Workshop Survey on Spatial Management

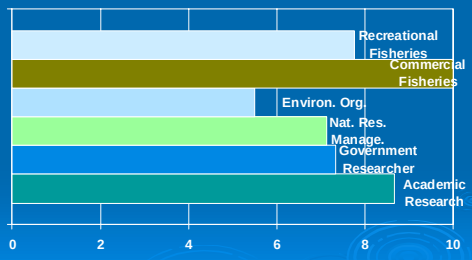
Responses are given on a scale of 1 to 10, with lower values indicating agreement and higher values disagreement with the survey statement.



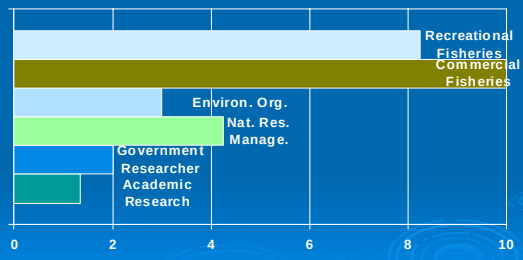




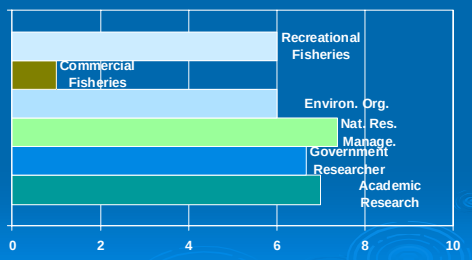
Goals, Benefit, Objective of Spatial Management Documented & Quantified



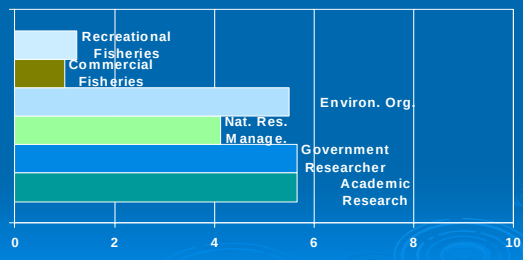
MPA's & Conventional Management Can Improve Fisheries Management



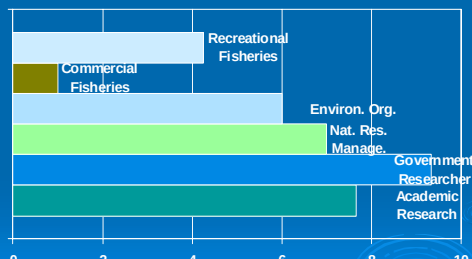
MPA's Effective for Non-Migratory, Not for Highly-Migratory



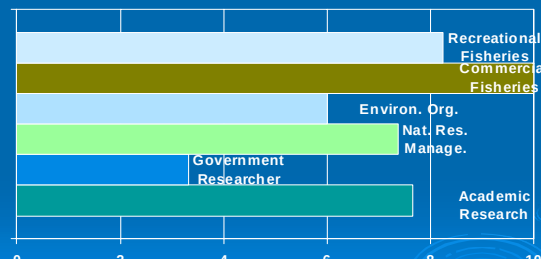
More knowledge about MPA's before expanding use in CB



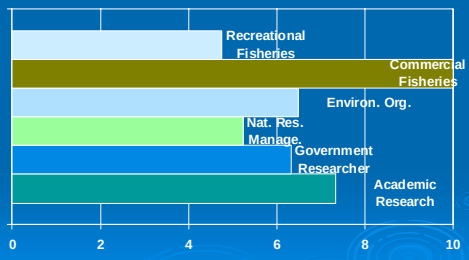
MPA's interfere with watermen earning a living in CB



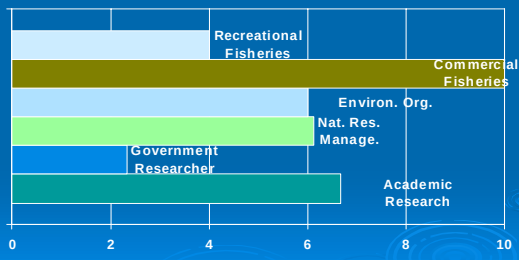
MPA's must cover large area to be effective



MPA's are more difficult to enforce than other management actions



Spatial management of fisheries linked to spatial management of nutrients and land use in CB



Appendix D

Florida Keys National Marine Sanctuary: Issues and Concerns of Stakeholders and Managers

Billy D. Causey, Superintendent
Florida Keys National Marine Sanctuary

The National Marine Sanctuary Program

The National Marine Sanctuary Program in the United States, managed by the National Oceanic and Atmospheric Administration (NOAA) in the United States Department of Commerce, comprises a network of 13 aquatic protected areas (Figure 1) that encompass marine and freshwater resources from Washington State to the Florida Keys, and from Lake Huron to the Gulf of Mexico. The tropical Pacific Ocean has two designated Sanctuaries, one in American Samoa and another in the Hawaiian Islands. A second Hawaiian Sanctuary, encompassing the Northwest Hawaiian Islands will be the fourteenth Sanctuary when it completes the designation process. NOAA's National Ocean Service has managed marine sanctuaries since passage of the Marine Protection, Research and Sanctuaries Act of 1972. Title III of that Act is now called the National Marine Sanctuaries Act. While some activities are managed to protect resources, certain uses, such as recreation, commercial fishing, and shipping are allowed to the extent that they are consistent with a sanctuary's resource protection mandates. Research, education, outreach, and enforcement activities are other major components in each sanctuary's program of resource protection.

Florida Keys

The National Marine Sanctuary Program has managed sanctuaries along the coral reef tract in the Florida Keys since 1975. The Key Largo National Marine Sanctuary was established in 1975 to protect 353 km^2 (103 square nautical miles) of coral reef habitat stretching along the reef tract from just north of Carysfort Lighthouse to south of Molasses Reef, offshore of the Upper Keys. In 1981, the 18 km^2 (5.32 square nautical mile) Looe Key National Marine Sanctuary was established to protect the very popular Looe Key Reef located off Big Pine Key in the Lower Keys. These two offshore National Marine Sanctuaries were, and continue to be, managed very intensively. The installation of mooring buoys to protect the reefs from anchor damage, educational programs, research and monitoring programs, and various resource protection programs, including interpretive law enforcement, were concentrated in these two marine protected areas. Both sites were located in federal waters. Since these two sanctuaries are located between 5-7 km offshore, the health of these coral reef resources has been affected by land-based sources of pollution and nutrients. Managing these two sites was like attempting to manage islands in the middle of the ecosystem. Obviously, the major threats came from outside the boundaries of the sanctuaries**.** In order to be successful at management, an ecosystem approach had to be implemented.

By the late 1980s**,** it became evident that a broader, more holistic approach to protecting and conserving the health of the coral reef resources had to be implemented. Regardless of the intensity used in managing small portions of the coral reef tract, sanctuary managers were witnessing declines in water quality and the health of corals from a wide range of causes. The more obvious causes of decline were point source discharges, habitat degradation due to development and over-use, and changes in reef fish populations due to over-fishing. Clearly, less obvious sources of decline were affecting the health of the coral reefs and these had to be identified. These impacts were occurring at the local, regional and global scales.

Social and Economic Significance

In 1995, the U.S. fishing industry added more than $20 billion to the economy**,** while coastal tourism generated more than $54 billion. For example, 3 million tourists visit the Florida Keys on an annual basis and stay an average of 13.3 million visitor days. While in the Keys, the tourists spend $1.2 billion each year. Their favorite activities are snorkeling and diving on the living coral reefs, fishing and simply enjoying the environment.

Sanctuary Designation

The United States Congress designated the Florida Keys National Marine Sanctuary (FKNMS), which is 9600 km^2 in size, in 1990 (Figure 1). The Sanctuary encompasses all of the waters surrounding the islands of the Florida Keys up to mean high tide. Some of the marine communities included in the Sanctuary are mangrove islands, lush seagrass beds, productive hard bottom, a variety of patch reef habitats, offshore spur and groove coral reef formations and deep coral reefs. The Sanctuary encompasses an estimated total 325 km^2 of coral reef, 143 km^2 in State of Florida territorial waters (< 3 nm from shore) and the remaining 182 km^2 federal-waters (>3 nm from shore).

With the designation of the Sanctuary, the entire coral reef tract of the Florida Keys was afforded certain levels of protection. Oil and hydrocarbon exploration, mining, and large shipping traffic are excluded from the Sanctuary. Anchoring on corals in shallow water is prohibited, as is touching coral, collecting living or dead coral, and harvesting “live rock”, a product of the aquarium trade. The Sanctuary has the authority to address discharges within its boundary, as well potential pollutants that originate from outside the Sanctuary, offering protection of water quality that is critical for coral reef health.

The purpose of the Sanctuary is to protect the unique marine resources found within the Florida Keys and to manage human use of these resources. The management plan for the Florida Keys National Marine Sanctuary contains a variety of management tools to protect and sustain the marine environment of the Florida Keys.

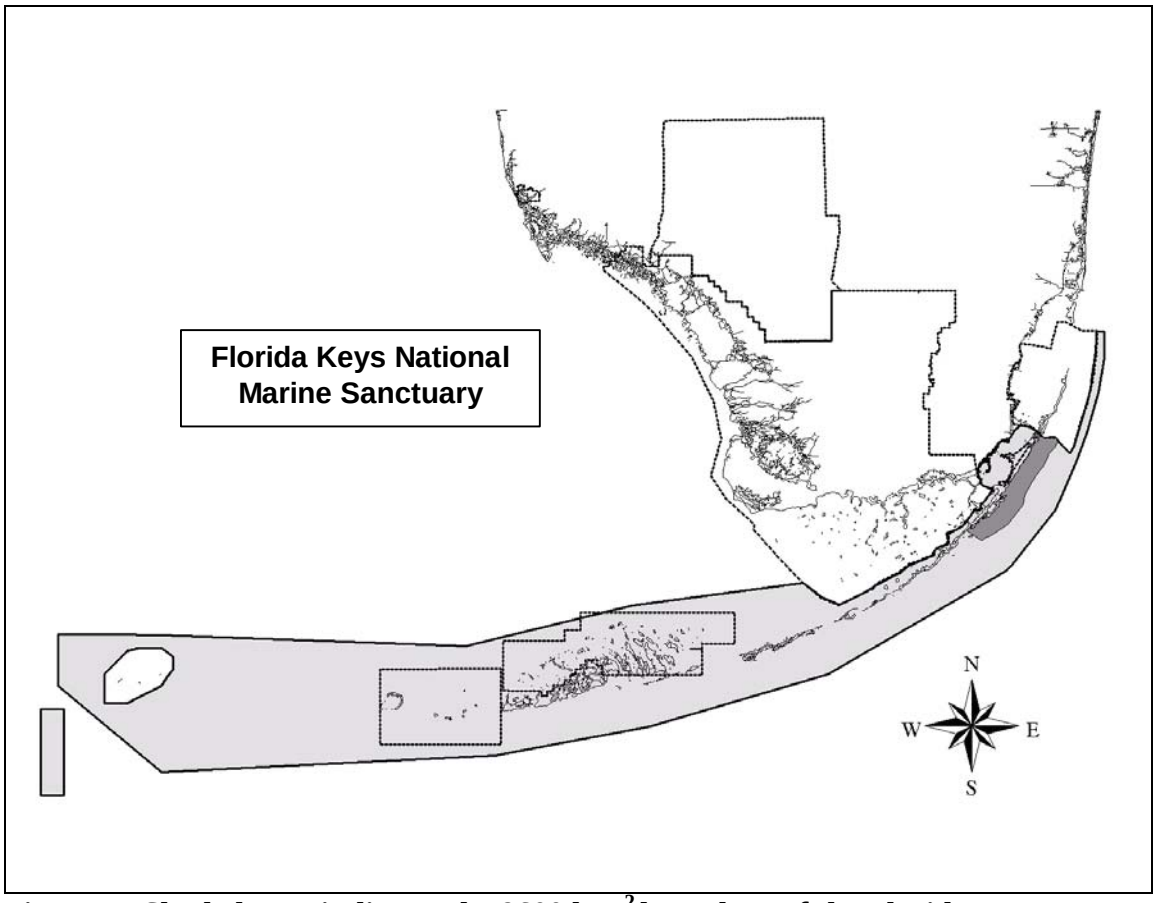


Figure 1. Shaded area indicates the 9600 km ^{2} boundary of the Florida Keys National Marine Sanctuary.

Sanctuary Management Tools

The Sanctuary's management plan was implemented in 1997. That plan was developed in an integrated process using various stakeholder groups, including a Sanctuary Advisory Council and all of the local, state, and federal agencies that have a management role in the Florida Keys. General categories for the management programs are:

- Research and Monitoring
- Education and Outreach
- Volunteerism
- Enforcement
- Threat Reduction Measures
- Marine Zoning

Research and Monitoring

To monitor changes occurring in the marine environment of the Florida Keys, the Sanctuary has implemented a comprehensive research and monitoring program. The goal of this program is to establish baseline information on the various components of the

ecosystem and ascertain cause and effect relationships. In this way, research and monitoring can ensure the effective implementation of management strategies using the best available scientific information.

Many groups, including local, state, and federal agencies, public and private universities, private research foundations, environmental organizations, and independent researchers, conduct research on the coral reef environment. The Sanctuary facilitates and coordinates research occurring within its boundaries by registering researchers through a regional permitting system, recruiting institutions to carry out priority research activities, overseeing data management, and disseminating relevant findings to the scientific community and to the public.

Monitoring within the Sanctuary occurs at a number of levels. The objectives of the monitoring program are to establish a reference condition for biological communities and water quality conditions within the Sanctuary so that the effectiveness of management actions, specifically the non-consumptive zones, can be evaluated over time.

The most comprehensive, long-term monitoring program underway in the Florida Keys is conducted through the Water Quality Protection Program (WQPP), funded by the U.S. EPA through the authority of the Sanctuary Act. The WQPP and its associated monitoring program began in 1994 and consist of three components: water quality, corals and hardbottom communities, and seagrasses. The status of reef fishes, spiny lobster, queen conch, benthic cover, and algal blooms are monitored Sanctuary-wide as well through NOAA funding.

In addition to fixed-station monitoring occurring under the WQPP, the effects of no-take management, which began in 1997 through the implementation of 23 discrete marine reserves, are specifically being monitored through a Zone Monitoring Program (ZMP). The goal of the ZMP is to determine whether the no-take zones are effective in protecting marine biodiversity and enhancing human values related to the Sanctuary. The ZMP is a three-level program that monitors changes in ecosystem structure (size and number of invertebrates, fish, corals, and other organisms) and function (such as coral recruitment, herbivory, predation). Measures of effectiveness will include the abundance and size of fish, invertebrates, and algae, as well as economic and aesthetic values of Sanctuary users and their compliance with regulations. Human uses of zoned areas are also being tracked.

Education and Outreach

The primary management tool used in the thirteen National Marine Sanctuaries is education and outreach. Increasing public awareness and understanding through education is critical to achieving resource protection and stemming many of the ocean problems described above. Aquatic protected areas such as National Marine Sanctuaries provide excellent settings in some of the most significant and fascinating marine and coastal environments in the U.S.

By reaching the recreational visitors to the coastal or marine environments with educational and outreach messages, we are able to spread our messages across the nation,

and indeed the world. However, it is also important that we reach our coastal residents with the same educational and outreach messages. For that purpose, the Florida Keys National marine Sanctuary has developed an informal education program that comprehensively targets both visitors and residents.

Our audience is the more than 80,000 year-round residents in the Keys, the 50,000 winter residents, and the 3 million visitors who spend 13.3 million visitor-days snorkeling, scuba diving, fishing, or relaxing in the tropical environment of the Florida Keys.

Impacts to the resources of the Florida Keys are numerous, including water quality degradation, habitat destruction, overfishing and increasing human pressures on a finite, fragile ecosystem whose balance began to topple in the 1950s. Each one of these threats to the marine ecosystem of the Florida Keys requires education and outreach programs that target specific audiences. For example, many of the impacts to the shallow water resources of the Keys come from boating activities. Whether it is prop-scarring in the seagrass beds or running aground on fragile coral reefs, much of the habitat destruction we are witnessing is the result of poor or inexperienced boat operation. In the last ten years alone, boater registration has increased 60% in the Florida Keys. There is one boat for every two households in the Keys. This does not include the tens of thousands of boats that are trailered into the Keys by visitors each year.

Some of the challenges we face in educating residents, visitors and the wider public are:

- There is no single point of entry to the Sanctuary,
- There are large numbers of users,
- There are diverse, multilingual residents and tourists, and
- Resource damage occurs from both direct and indirect impacts.

These challenges are not unlike many of those facing other aquatic protected areas around the nation or the world, for that matter. The goal of our education and outreach program is to meet and overcome these challenges with innovative and creative educational tools that increase the public's understanding of the marine environment. This will develop a more informed public who appreciate and use the marine environment for recreational, commercial or aesthetic purposes, recognizing their full impact on those resources.

The management plan for the Sanctuary contains an Education and Outreach Action Plan that uses a variety of tools to convey critical information to the various audiences. These tools are:

- Community-Based
- School-Based
- Partnership-Based
- Technology-Based
- Product-Based
- Media-Based

A description of these various programs can be found in the Sanctuary's final management plan.

Volunteers

The Sanctuary's volunteer program was established through a partnership with a non-governmental organization, The Nature Conservancy. Partnerships with the State of Florida, academic institutions and other non-governmental organizations have dramatically expanded the work begun by Sanctuary staff. With limited staffing and financial resources, the Sanctuary has been far more effective in carrying out some management programs because of the commitment of residents and visitors in seeing conservation work get done. For example, -more than 120,000 volunteer hours were donated to the Sanctuary between 1996 and 2000. This is equal to $1.8 million dollars in contributions, based on a national figure that calculates the value of volunteer hours.

Enforcement

While National Marine Sanctuaries rely largely on compliance with Sanctuary regulations, the history of the Sanctuary program in the Florida Keys has required a major commitment to enforcement activities by NOAA. When Congress expanded the Sanctuary boundary in 1990, it became abundantly clear to Sanctuary managers that a major enforcement presence would have to be maintained in order to protect and conserve Sanctuary resources. Sanctuary enforcement in the Florida Keys has traditionally been accomplished through a cooperative agreement between NOAA and the State of Florida. The state continues to be the primary enforcement arm for the Sanctuary. NOAA provides 100% of the funding for enforcement activities in the Sanctuary to the Florida Fish and Wildlife Conservation Commission. There are 17 state-certified law enforcement officers assigned to the Sanctuary enforcement team. In addition, NOAA's Office of Law Enforcement and the U.S.Coast Guard also provide enforcement support to the Sanctuary.

Threat Reduction Measures

The Florida Keys National Marine Sanctuary and Protection Act contains very specific prohibition of certain uses such as the operation of vessels greater than 50m (164') in length within an Area to be Avoided (ATBA) established around Sanctuary waters and a prohibition on oil and hydrocarbon exploration and mining within the Sanctuary. The Act also contains very precise directions from Congress on the development of a Water Quality Protection Program by EPA and a comprehensive management plan by NOAA.

There have been significantly positive results since Congress restricted vessel operation within ATBA surrounding Sanctuary waters. The ATBA has been very effective at decreasing the number of major ship groundings on the coral reefs of the Florida Keys. Prior to 1990, there was a major ship grounding (>50m in length) nearly every year. After the ATBA took effect in 1990, 6 years lapsed before there was amajor ship grounding and only 2 have occurred since 1990.

In addition, the Sanctuary and adjacent waters have been approved as a designated Particularly Sensitive Sea Area (PSSA). This designation has to be approved by the International Maritime Organization and only exists for 2 other areas around the world. PSSA designation, while not accompanied by any additional rules or regulations, serves to elevate international recognition of the sensitivity of the marine environment of the Florida Keys to any catastrophic events, such as oil spills or release of hazardous materials.

Congress recognized the decline in the nearshore water quality of the Florida Keys when it designated the Sanctuary. Legislators authorized the EPA to work with the State and NOAA to develop a Water Quality Protection Program (WQPP). Even before the implementation of the final plan in 1997, EPA and its partners had completed the WQPP. EPA incorporated the components of the WQPP into the Water Quality Action Plan contained in the Final Management Plan (1996). The EPA and its partners have continued to implement critical projects identified in the plan. The purpose and active role of the WQPP has been to recommend priority corrective actions and compliance schedules addressing point and non-point sources of pollution to restore and maintain the living coral reefs and other critical marine life in the Sanctuary. The WQPP consists of four interrelated components: 1) corrective actions that reduce water pollution directly by using engineering methods, prohibiting or restricting certain activities, tightening existing regulations, and increasing enforcement; 2) monitoring that includes a comprehensive, long-term water quality monitoring program designed to provide information about the status and trends of water quality and biological resources in the Sanctuary; 3) research/special studies that are designed to identify and understand cause and effect relationships involving pollutants, transport pathways, and biological communities of the Sanctuary; and 4) public education and outreach programs designed to increase public awareness of the Sanctuary, the WQPP, and pollution sources and impacts on Sanctuary resources.

Other threat reduction measures include the implementation of Sanctuary regulations under the authority of the National Marine Sanctuary Act to protect and conserve Sanctuary resources. The regulations are divided into Sanctuary-wide regulations and regulations that apply to specific marine zones in the Sanctuary. The Sanctuary-wide regulations are focused on decreasing the level of habitat destruction in the Keys and addressing water quality issues. Anchoring on corals in shallow water is prohibited, as is touching coral, collecting living or dead coral, and taking “live rock”, a product of the aquarium trade. Operating vessels in such a manner as to strike or otherwise injure coral, seagrass or other attached marine life is prohibited. The Sanctuary has the authority to address discharges within its boundary, as well as potential pollutants that originate from outside the Sanctuary, offering protection of water quality that is critical for coral reef health and vitality.

In addition to Sanctuary-wide regulations that address direct and indirect impacts to coral reef resources, regulations specific to 5 different types of marine zones were implemented in July 1997. At that time, the Florida Keys National Marine Sanctuary implemented the first network of marine zoning for a National Marine Sanctuary in the

United States. Five types of zones were implemented, each with different objectives and regulations. Three of the zone types, Ecological Reserves, Sanctuary Preservation Areas, and Special Use / Research-only Areas include a total of 24 individual "no-take" or "fully-protected" areas that have been established within the Sanctuary to protect critical habitat, preserve a diversity of species, and relieve pressure in heavily used coral reef areas. These areas comprise 6% of the total area of the Sanctuary, or 10% of the coral reef community. Stringent restrictions on taking, removing, etc. marine life and harming natural resources are in place in these zones to ensure their long-term health. Lobstering, fishing, spearfishing, shell collecting, and other consumptive activities are prohibited in these areas. A more detailed discussion of the marine zoning within the Sanctuary appears later.

Other threat reduction measures have included the implementation of a Sanctuary-wide mooring buoy program. Sanctuary Biologist John Halas first implemented the mooring buoy system now used in the Florida Keys National Marine Sanctuary in 1981 in the Key Largo National Marine Sanctuary. This simple, yet effective tool for reducing anchor damage to coral reefs and seagrass beds was later implemented in the Looe Key National Marine Sanctuary (1984) and eventually spread to other parts of the Keys. Sanctuary staff worked with Reef Relief, a grassroots conservation group in Key West, and 2 other grassroots groups in the Keys to install mooring buoys at many popular dive sites along the reef tract. While mooring buoys are excellent management tools, it is important to realize that other management programs must accompany a mooring buoy program, such as education, outreach, research and monitoring. When the Florida Keys National Marine Sanctuary was designated, the Sanctuary incorporated mooring buoys previously installed by other organizations in Key West, Marathon and Islamorada, expanding the number of buoys managed by the Sanctuary from 175 to more than 400. Besides mooring buoys, the Sanctuary staff have installed and maintain 109 yellow boundary buoys (30" diameter) and 120 Wildlife Management Area boundary buoys to mark the marine zones.

In addition to mooring buoys, the Sanctuary staff work closely with other agencies in implementing a Waterway Management Action Plan. Channel marking in the Sanctuary falls primarily under the jurisdiction of the United States Coast Guard (USCG) and the State of Florida. However, Monroe County, in which the Sanctuary is located, manages a large number of navigation aids that it has installed in Keys waters. The county uses boating improvement funds that come from the registration of vessels in Monroe County to install navigation aids in areas identified in their Channel Marking Master Plan. All channel markers and navigation aids have been inventoried; 600 (+/-) aids to navigation in the Florida Keys are maintained and referenced in a GIS database. A boat access survey of all Monroe County marinas, boat ramps and docking facilities has been completed and entered into a marine facilities GIS database.

The Sanctuary worked with the USCG, the owners of the *M/V Contship Houston*, and the Key West Propeller Club to place 8 Racon beacons on navigational aids along the reef tract from Loggerhead Key in Dry Tortugas National Park to Fowey Rocks in the northern end of Biscayne National Park. These beacons send a signal that is picked up on

the radar screens of passing ships, warning them of the coral reef tract. The Sanctuary used its authority to negotiate with the ship owners to have them purchase 10 of these highly effective beacons.

Marine Zoning

Australia has led the world in the application of marine zoning to protect and conserve marine resources, while those resources are being used by various groups. Following Australia's example, Sanctuary managers have attempted to balance protection of Sanctuary resources with their continued use through the implementation of a comprehensive network of marine zones. Marine zoning is the setting aside of areas for specific activities, which allows the balancing of commercial and recreational interests with agency mandates to protect marine resources. Comprehensive marine zoning is a fairly recent concept in the management of marine protected areas within the United States, but has been successfully implemented internationally for decades.

The coral reefs of the Florida Keys have been the focus of consumptive or extractive activities since before the invention of SCUBA in the 1940s. Naturally, these activities have increased in intensity over the past few decades and today many Keys residents simply talk about what it use to be like in the "old days." Stories of beds of Queen Conch, rafts of sea turtles, huge schools of tropical fish, grouper, snapper and so many lobster all you had to do was wade out from shore for them are common. The final plan for the Sanctuary includes a marine zoning plan that will make it possible for the coral reef to be like that again.

The marine zoning plan was one of the most controversial elements of the planning process, yet it provides the opportunity for the marine resources in some areas to be like they were when they were undisturbed, decades ago. Setting aside portions of the coral reef community as Ecological Reserves will allow these areas to return to what they were before man started disturbing them. Compared to the overall size of the Sanctuary, which is 2,900 square nautical miles (9600 km^2), the areas in the final plan are small, but they are necessary to accomplish the overall goals of the Sanctuary.

While there was large support for marine zoning from some groups during the development of the Sanctuary's management plan, it was the most controversial management tool considered. The topics of greatest concern in establishing the marine zoning plan were the proposed locations, sizes and allowable uses

In the early days of public consultation on the draft marine zoning plan, Sanctuary officials were hung in effigy by concerned commercial fishermen and other groups who opposed what NOAA was proposing. A large opposition movement was massed between 1992 and the implementation of the final management plan in 1997.

Between the release of the draft management plan in 1995 and the final plan, NOAA reduced the amount of area set aside as "no take" or "fully protected" in the marine zoning plan from less than 6% to less than 1%. However, Sanctuary managers did make

it clear in the final plan that a process would be developed to establish an ecological reserve in the western extent of the Sanctuary.

In July 1997, the Florida Keys National Marine Sanctuary implemented the first network of marine zoning for a National Marine Sanctuary in the United States. Five types of zones were implemented at that time, with different objectives and regulations. A brief description of the zones follows:

Sanctuary Preservation Areas (SPA). All activities that do not result in removal of marine life or damage to the resources are allowed in these areas. Activities that are prohibited in the Sanctuary Preservation Areas include spearfishing, shell collecting, tropical fish collecting, fishing and other activities that result in the taking of marine life by divers, snorkelers, and fishermen. In addition, direct physical impact to corals in these areas is prohibited. In an effort to reduce socioeconomic costs from the SPAs, regulations allow catch and release fishing by trolling in four of the Sanctuary Preservation Areas: Conch Reef, Alligator Reef, Sombrero Key, and Sand Key.

Special-Use Research Only Areas. There are only four special use areas in the Final Management Plan: Conch Reef, Tennessee Reef, Looe Key (patch reef), and Eastern Sambo Reef. These are all designated as research-only areas. No person may enter these areas except as specifically authorized by a valid permit.

Ecological Reserves (ER). All activities that do not result in removal of marine life or damage to the resources are allowed in these areas. Spearfishing, shell collecting, tropical fish collecting, and other activities that result in the harvest of marine life by divers and snorkelers, and fishing activities will be prohibited in this zone type. In addition, direct physical impact to corals and vessel discharges are restricted.

Wildlife Management Areas (WMA). There are 27 WMAs established in the Final Plan. The majority of these areas (20) fall under the jurisdiction of the U.S. Fish and Wildlife Service (USFWS), and Sanctuary regulations have been established to complement the USFWS criminal sanctions with Sanctuary civil penalties. Public access restrictions in these areas include idle speed only/no wake, no access buffer, no motor, and closed.

Existing Management Areas (EMA). Out of the total 19 existing management zones, 13 are administered by the State of Florida Department of Environmental Protection, 4 by the U.S. Fish and Wildlife Service, and 2 by NOAA. Managing these areas within the Sanctuary may require additional regulations or restrictions to provide complete resource protection. These additional management needs will be developed and implemented in cooperation with the relevant agency.

The marine zoning plan provides a very common sense approach to focusing protection in small critical portions of sensitive habitats, while not restricting activities any more than necessary. For example, the 18 Sanctuary Preservation Areas that are in the final plan protect over 65% of the shallow spur and groove reef habitat, while capturing approximately 80% of the year-round diving activity. These areas displace very few

commercial and recreational fishermen and their "no take or consumptive activity" status will lead to resource enhancement of the coral reefs. By making these areas "no take or consumptive activity" areas, the visiting divers are directed to reef habitat where their activity will have less impact. Approximately 6 percent of the Sanctuary is designated as "no take or extraction.

Three of the zone types, Ecological Reserves, Sanctuary Preservation Areas, and Special Use / Research-only Areas include a total of 24 individual "no-take" or "fully-protected" areas that have been established within the Sanctuary to protect critical habitat, preserve a diversity of species, and relieve pressure in heavily used coral reef areas. Stringent restrictions on harvesting marine life and harming natural resources are in place in these zones to ensure their long-term conservation. The 27 Wildlife Management Areas restrict vessel operation and provide resource protection to shallow-water habitats, including seagrass flats. These areas also serve to enhance the experience of catch and release fishermen. The Existing Management Areas are necessary to recognize the continued authority of the agencies overseeing these protected areas.

Most of the smaller zones (Sanctuary Preservation Areas) are located along the offshore reef tract and encompass the 65% of the most heavily used spur and groove coral formations.

Ecological Reserves are the most significant type of marine zone in the Sanctuary. They comprise the largest "fully protected" areas. These encompass large, contiguous diverse habitats and are designed to preserve biodiversity, provide spawning, nursery, and residence areas for marine life, protect habitats and species not covered by existing fishery management regulations, and allow areas to remain in or return to a natural state. The Sanctuary has two ecological reserves. The 30.8 km^2 Western Sambo Ecological Reserve protects offshore coral reefs, as well as all other habitats, including mangrove fringe, seagrasses, productive hardbottom reefs.

In July 2001, after a three-year collaborative design and planning process, the Tortugas Ecological Reserve (518 km^2) was established to increase the Sanctuary's network of marine zones outlined in the management plan. This concluded a 10 year management planning process during which many lessons were learned. This new reserve, located in the westernmost portion of the Florida Reef Tract, conserves important deepwater reef resources and fish communities unique to this region. The Tortugas Ecological Reserve preserves the richness of species and health of fish stocks in the Tortugas and throughout the Florida Keys, ensuring the stability of commercial and recreational fisheries. Restrictions on vessel discharge and anchoring were implemented in this zone to protect water quality and habitat complexity. It is expected that the reserve's geographical isolation will aid scientists in distinguishing between natural and human caused changes to the coral reef environment.

The Tortugas Ecological Reserve is also significant because it adjoins a proposed 157.8 km^2 Research Natural Area in the Dry Tortugas National Park, a zone where shallow seagrass, coral, sand, and mangrove communities will be conserved. Together, the

Sanctuary's Tortugas Ecological Reserve and the National Park's Research Natural Area fully protect nearshore to deep reef habitats of the Tortugas region and form the largest, permanent marine reserve in the United States.

Lessons Learned

There were many "Lessons Learned" during the process to develop and implement a marine zoning plan for the Sanctuary, including:

- Establish goals and objectives for the "reserve" at the beginning
- Agree on the ground rules
- Don't predetermine the location or size of a "no take" area
- Do not begin the process with a specific percent area to be set aside
- Include representatives of all stakeholder groups
- Don't assume one commercial fisher represents all aspects of commercial fishing
- Don't assume one conservation member speaks for all conservation interests
- Don't leave out representatives from the general public
- Include all affected fishery managers and agency representatives
- Involve scientists, but not just fisheries biologists. Ecologists and oceanographers must also be included
- Make sure the process is open and flexible
- Make sure the public has opportunities to engage in the process
- Strive for unanimous support or the highest level of consensus
- Allow the stakeholders to help guide the process

Planning a no-take reserve must be a bottoms-up procedure that includes a well-balanced group of stakeholders from the local community. Models or textbook approaches can use the most recent science or theory available but will not work if you exclude the local experts. The group must include those who make their living on the water, as well as those who have local conservation experience. For example, accord commercial fishers the same status as Ph.D. scientists; after all, commercial fishermen have "Ph.D.s in commercial fishing." Stacking a working group with outsiders raises suspicion and can lead to failure.

Furthermore, the procedure for selecting participants is important. The planning process must include those who will be respected by their peers as spokespersons for the stakeholder group. I cannot overemphasize the importance of this step. The selection process for the participants and the make-up of the working group must be viewed as balanced and representative if the process is to have any chance of gaining public confidence. The process is doomed to failure if individuals with extreme, uncompromising viewpoints are included.

Striving for balance does not mean achieving equal numbers of constituent groups, for example, one commercial fisher and one conservationist. However, make sure all aspects of the fishing and conservation community have representation in the group. Do not try to stack the membership of a working group in favor of a particular viewpoint. Both the

participants and general public will see through the façade and the process will lose credibility. Don't hesitate to include individuals with differing viewpoints. Let the science and the balanced, integrated approach to establishing a reserve stand on their own merit. Know that reasonable, knowledgeable, and experienced people will make good decisions when provided with good science.

Establish a high level of trust among the group as soon as possible. Participants must be willing to respect differing opinions. The idea is to empower those who know the resources best, and who have some vested interest in the reserve's success. However, you must be willing to seriously consider their advice and demonstrate how the experience and opinions of your local experts has influenced the reserve design.

Avoid allowing the group to begin discussions by proposing boundaries or arguing about the percentage of an area that should be designated no-take. Such discussions will polarize the group from the start. Instead, begin by providing the group with the best available scientific and socioeconomic data about the area.

Oceanographers can explain the current patterns so the participants can see for themselves the mechanisms for larval distribution. Geologists can explain the long-term perspective of natural forces affecting the area. Ecologists can discuss special natural features, and fisheries biologists can explain reproductive patterns in marine organisms. Try to establish long-term trends, which invariably show declines in many regions. Present all of this information as if you were building a geographical information system, layer by layer.

The most important layer is the various "uses" of the region. Find out from the experts where the fish spawning aggregations are. Learn about the seasonal and annual movement of fish and other marine life. Learn where the fishers work, and ask them what areas do they think are important and worthy of reserve protection.

Ask scientists, conservation groups, and non-extractive users of the area these same questions. The idea is to start developing a joint vision of the special areas that should be considered for protection.

It is important to conduct a thorough socioeconomic assessment. Fisheries economists must collect data at the most detailed scale possible. Incomplete or inaccurate information will fuel opposition from user groups. Thorough consideration of socioeconomic factors can build support for the reserve and boost the confidence of user groups in the process.

Success of Marine Zoning Implementation

The success of implementation of a marine zoning plan depends on the effectiveness of several other management programs. Those are:

- Marking boundaries on charts, with buoys and through inclusion in DGPS units
- Education and outreach

- Monitoring and research on zone effectiveness
- Enforcement

Marking Boundaries

Successful implementation will be best achieved if the public can voluntarily comply with regulations. This requires clearly marking the protected areas on navigation charts or marking the boundaries with buoys. Use of both of these tools leads to even higher compliance rates. Additionally, when possible, facilitate the inclusion of marine zoning boundaries in the Differential Geographical Positioning Systems (DGPS).

Education and Outreach

The majority of the general public will comply with marine zone regulations if they are aware of them. It is critical for a marine zoning implementation plan to include education and outreach programs designed to reach the general public before they have a chance to harm or damage the resources.

Marine Zone Monitoring and Research

Results from the Sanctuary's zone monitoring program indicate that three years after zone implementation, some heavily exploited species exhibit increases in abundance and size. Specifically, legal-sized spiny lobsters continue to be more abundant in Sanctuary Preservation Areas than in reference sites of comparable habitat. The average size of lobsters is larger and remains above the legal minimum size limit in the no-take areas, whereas lobsters found at reference sites have remained below legal size. The mean size of lobsters within the Western Sambo Ecological Reserve has been significantly larger than in reference areas in both the open and closed fishing seasons. Additionally, catch rates (number of lobsters per research trap) are higher within the Ecological Reserve than within two adjacent fished areas at all times of the year.

Overall, a high degree of variability has been documented with regard to reef fish abundance and size between no-take areas and reference sites. However, as would be expected with the added protection of no-take management, some species have shown increased abundance over time.

Enforcement

One of the major site selection criteria identified in the design of the Tortugas Ecological Reserve was "enforceability." All groups, ranging from commercial fishermen to conservation organizations ranked enforceability as a major criteria in selecting sites, as well as leading to their long-term success. This includes actions such as selecting boundary lines along latitude and longitude lines and committing to acquiring enforcement staff and resources necessary for them to do their job. While the majority of the public will comply with regulations, a small percentage of chronic violators will lead to lower levels of compliance and a loss of confidence by the general public, if enforcement is inadequate.

Conclusions

Marine zoning is critical to achieving the Sanctuary's primary goal of resource protection. Its purpose is to protect and preserve sensitive components of the ecosystem by regulating within the zoned areas, while facilitating activities compatible with resource protection. Marine zoning ensures that areas of high ecological importance evolve in a natural state, with minimal human influence, while allowing sustainable use of Sanctuary resources. Marine zoning can be effective at protecting diverse habitats, and preserves important natural resources and ecosystem functions.

Success in stemming the decline of our oceans depends on our collective understanding of the concept of sustainability. We must remind ourselves that our generation cannot use up the resources that are important to support the economy and environment that will be inherited by future generations. The use of marine zoning takes the guesswork out of managing and maintaining natural systems in the marine environment. We hardly understand the biology and ecology of many species of marine life that we allow to be taken; yet the quantity and quality of marine resources continue to plummet around the world.

"It is important to scientific study and to the health and sanity of man, that there be preserved some unique areas …… to observe nature's continuing evolution; …… the grandeur and peace of nature."

Samuel H. Ordway, Jr.

Appendix E

Documents Distributed to Participants Prior to the Workshop

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