

**Ecosystem Management: An Essential Approach  
When Establishing a Network of Marine Zones**

by  
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**Introduction**

This presentation focuses on some of the lessons learned during the development of an integrated, comprehensive management plan for the Florida Keys National Marine Sanctuary. The concept of ecosystem management has had various meanings over the decades. I lean toward the camp that defines the extent of an ecosystem on a broad spatial scale, recognizing the significance of watershed or catchment influences on their downstream natural communities. This approach conceptualizes ecosystems as a mosaic of landscapes and seascapes, instead of ecologically artificial jurisdictional boundaries. By sharing some of the lessons learned, I hope to be able to explain how an ecosystem approach to management was applied in the establishment of a network of marine zones in the Sanctuary, with particular emphasis on an integrated approach to ocean governance.

**Background**

The Florida Keys National Marine Sanctuary is administered by the National Ocean Service of the National Oceanic and Atmospheric Administration in the United States Department of Commerce and managed in a co-trustee partnership with the State of Florida. The Sanctuary is one of thirteen National Marine Sanctuaries that are managed as a system spread throughout the coastal U.S. and Great Lakes.

The Florida Keys extend approximately 404 km (220 miles) southwest from the southern tip of the Florida peninsula. Located adjacent to the Keys land mass are nationally significant marine environments, including seagrass meadows, mangrove islands, and extensive living coral reefs. These marine environments support rich biological communities possessing extensive conservation, recreational, commercial, ecological, historical, research, educational, and aesthetic values that give this area special national significance. The lure of the Florida Keys has attracted visitors for decades. The clear tropical waters, bountiful resources, and appealing natural environment were among the many fine qualities that attracted visitors to the Keys, in the past.

The National Marine Sanctuary Program has managed segments of the coral reef tract in the Florida Keys since 1975. The Key Largo National Marine Sanctuary was established in 1975 to protect 353 square kilometers (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 square kilometer (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 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 have been concentrated in these two marine protected areas. Even though these two Sanctuaries were located offshore, the health of their coral reef resources has been affected by land-based sources of pollution and nutrients. Managing these two sites was like trying to manage islands in the middle of the ecosystem. Obviously, the major threats come from outside the boundaries of the Sanctuaries. In order to be successful at management, an ecosystem approach had to be implemented. But the question remained, how large geographically should that ecosystem approach be?

Early on, from 1983 to 1988, I felt that I could protect Looe Key National Marine Sanctuary through good science, education, enforcement and other management programs. What I came to learn was that the science was telling us the problems affecting the coral reefs were not only complex in origin, but varied from local, to regional and global scales. By the late 1980's 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 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 sources. The more obvious causes of decline were from impacts due to non-point source discharges, habitat degradation due to development and over-use, and changes in reef fish populations due to over-fishing. The less obvious sources of decline to the health of the coral reefs were from those impacts that were originating at distant regional sources and those negatively impacting coral reefs on a global scale.

An example of this came from an expedition that I participated in to St Vincent and The Grenadines in October 1988. While assisting in the establishment of a marine protected area in the Tobago Cays, located near the southern end of the chain of islands that make up the Grenadines, many of the same problems that were affecting the coral reefs off the Florida Keys were observed. Here, I was in one of the most-eastern portions of the Caribbean, feeling geographically isolated from large population centers, yet the coral reefs were in serious trouble. I recorded coral bleaching, black-band disease, white-band disease, purple-band disease, and a variety of mystery diseases while diving the coral reefs around the Tobago Cays. Additionally, the water was very turbid and had a greenish tint as if there were high levels of chlorophyll. This turbidity persisted for our 3-week expedition. When I asked our charter Captain why the water was so green, he exclaimed, "It's the Orinoco Mon! Its plume reaches the Grenadines every October and November." Considering the mouth of the Orinoco River was over 200 miles away in Venezuela, this revelation about the potential geographical extent of non-point sources of pollution had an influence on my thinking about ecosystem management and had an immediate impact on the way I viewed the spatial extent of influences on coral reef resources.

We had already witnessed the Caribbean-wide die-off of the long spined sea urchin that began in January of 1983 in Panama and reached the Florida Keys in July 1983. The density of long spined sea urchins went from 100's of thousands in the Fore Reef at Looe Key reef in June of 1983 to where it was difficult to count a single urchin in a one-hour dive in August 1983. This regional event had and continues to have a major role in the ecological alteration of coral reefs in the Wider Caribbean.

In 1987, we witnessed the phenomenon known as coral bleaching progress from a local and regional event to a global event. This single coral bleaching event had an impact on coral reef scientists and managers alike, on a scale unlike anything ever discussed or observed. The only good that could be gleaned from such a world-wide stress on coral reefs was that it accelerated and elevated the scientific and legislative discussion and debate on the status and health of coral reefs to a global scale.

### **Sanctuary Designation**

In 1989, mounting threats to the health and ecological future of the coral reef ecosystem in the Florida Keys prompted Congress to take action to protect this fragile natural resource. The threat of oil drilling in the mid to late 1980's off the Florida Keys, combined with reports of deteriorating water quality throughout the region, occurred at the same time scientists were assessing the adverse affects of coral bleaching, the die-off of the long-spined urchin, loss of living coral cover on reefs, a major seagrass die-off, declines in reef fish populations, and the spread of coral diseases. These were topics of major scientific concern, and the focus of several scientific workshops. The “straw that broke the camel’s back” occurred when three large ships ran aground on the coral reef tract within a brief 18-day period in the fall of 1989. Coincidental as it may seem, it was this final physical insult to the reef that prompted Congress to take action to further protect the coral reef ecosystem of the Florida Keys. Although most remember the ship groundings as having triggered Congressional action, it was in fact the cumulative events of environmental degradation, in conjunction with the physical impacts that prompted Congress to take action. On November 16, 1990, President Bush signed into law the Florida Keys National Marine Sanctuary and Protection Act (FKNMS ACT).

The Act designated 9600 square kilometers (2,800 square nautical miles) of coastal waters off the Florida Keys as the Florida Keys National Marine Sanctuary. Although the shoreward boundary of the Sanctuary only goes to mean-high water, there are at least 22 local, state and federal jurisdictions who share authority in the Keys. A challenge was to integrate that management as comprehensively as possible while not usurping any the authority or jurisdiction of any of the agencies. The passage of the Sanctuary Act immediately addressed two major concerns of the residents of the Florida Keys. There was an instant prohibition on any oil drilling, including mineral and hydrocarbon leasing, exploration, development, or production within the Sanctuary. In addition, the legislation prohibited the operation of ships greater than 50 meters in length in an internationally recognized *Area to be Avoided* within the boundary of the Sanctuary.

One of the greatest threats to the environment, the natural resources of the Keys, and the Keys' economy has been the degradation of water quality over the past two decades. This has been a major concern for the residents of the Keys for years. Commercial and recreational users of the resources in the Keys, environmentalists, scientists, and resource managers are all in agreement that the water quality of the Keys is in sharp decline and the commercially and recreationally important resources are extremely threatened. Some of the reasons for the decline are believed to be: the lack of fresh water entering Florida Bay because of water-management practices on the south Florida mainland; nutrients from domestic wastewater such as shallow-well injection, cess pits and septic tanks; stormwater runoff containing heavy metals, fertilizers and

insecticides; marinas and live-aboards; poor flushing of canals and embayments; build-up of organic debris along the shoreline; sedimentation; lack of hurricanes; and environmental changes associated with global climate change and sea-level rise.

Congress recognized the critical role of water quality in maintaining Sanctuary resources when it authorized the Administrator of the Environmental Protection Agency, in conjunction with the Governor of the State of Florida and in consultation with the Secretary of Commerce, to develop a comprehensive Water Quality Protection Program for the Sanctuary.

The FKNMS ACT called for the Secretary of Commerce, in consultation with appropriate Federal, State, and local government authorities and with a Sanctuary Advisory Council, to develop a comprehensive management plan and implement regulations to achieve protection and preservation of living and other resources of the Florida Keys marine environment.

Since approximately 60% of the FKNMS encompasses State waters and the Sanctuary boundary overlaps or lies adjacent to numerous State and Federal areas of jurisdiction, it was imperative that the planning process for the Sanctuary be both an inter and intra-agency effort. An inter-agency Core Group was formed to assist in the development of an integrated comprehensive management plan. Also, due to the high level and diversity of public utilization of the resources in the Florida Keys and the importance of tourism to the economy of the Keys, it was equally important that the public have a strong role in the development of the comprehensive management plan.

The Sanctuary Act called for the public to be a part of the planning process, and that a Sanctuary Advisory Council (SAC) be established to aid in the development of the comprehensive management plan. A 23-member Advisory Council was selected by the Governor of Florida and the Secretary of Commerce. The council consisted of members of various commercial and recreational user groups; scientists; educators; environmental groups; businesses and private citizens. Over the course of the planning process, numerous public workshops were held to get input from knowledgeable individuals on a wide range of topics that could be implemented in the management of the Sanctuary. Development of the final management plan took six years of comprehensive planning and utilized an integrated approach with all the local, state, and federal agencies, as well as the public both directly and through the Sanctuary Advisory Council.

## **Perspective**

Since declining water quality and ocean pollution were identified as the greatest threats to the continued health of the coral reef in the Florida Keys, Congress directed the U.S. Environmental Protection Agency to work with the State of Florida and the National Oceanic and Atmospheric Administration to develop a Water Quality Protection Program (WQPP) for the Sanctuary. The EPA was authorized to form a high-level Water Quality Steering Committee to review and implement the Water Quality Protection Program. The WQ Steering Committee is composed of local, state, and federal agency heads and provides an integrated approach to assessing and resolving water quality issues within the Sanctuary. A Technical Advisory Committee, which is composed of a cross-section of agency, academic and private sector scientists and technicians, was authorized to provide input and recommendations to the Steering Committee. The WQPP

planning effort was initiated parallel to the development of the Sanctuary's management plan. Even though the geographic scope or spatial extent managers were considering as important to addressing water quality problems was enormous in both scope and extent area, it was soon learned not to be large enough.

At their first meeting in 1992, the Sanctuary Advisory Council pointed out that the problems affecting water quality in the Keys was not simply derived from the Keys themselves, but from upstream. Upstream was Florida Bay, South Florida, the west coast shelf of Florida and tributaries that drain a vast portion of South Florida. It became quite clear that we had to look well beyond the boundaries of the Sanctuary to address the source of water quality problems affecting the health of the coral reef. But how far should managers look for the source of impacts?

The answer to this question became clearer in June 1993, when a meeting was convened of the US Army Corps of Engineers and all of the federal resource managers in south Florida. This action initiated the formation of the South Florida Ecosystem Restoration Program that is currently underway. Today, local, state, federal, and tribal interests are all members of the South Florida Ecosystem Restoration Task Force whose primary objective is to "get the water right in South Florida."

Over the decades many mistakes have been made in the way we manage our fresh water and its' runoff into our estuaries. Today, we are attempting to get the quality, quantity, timing, and distribution of fresh water back into the system so as to resemble its' historic patterns of flow through the built environment and ultimately to the ocean.

### **The South Florida Ecosystem Restoration Story**

There are many lessons learned along the way in both the Sanctuary planning effort for the Florida Keys National Marine Sanctuary, as well as the South Florida Ecosystem Restoration project. A challenge in an ecosystem management approach is to get resource managers to create a vision that extends well beyond jurisdictional boundaries, both at national and international scales, and establish broader objectives in ecosystem management. Another challenge is to get scientists to re-think their classical definition of an "ecosystem" and apply the same broad vision of the ecosystem system as the managers. Important too, is that managers and scientists alike recognize that human activities are an integral part of ecosystem management and their activities have to be included in an ecosystem management program.

### **Process to Establish a Network of Marine Zones**

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 innovative tools that are available for protecting and sustaining coral reefs and their surrounding marine communities for the use and enjoyment of future generations. Sanctuary managers have attempted to protect Sanctuary resources 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 a primary mandate 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.

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 associated with each. 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. There are 27 Wildlife Management Areas that 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 fifth zone type is Existing Management Areas, which are the 21 areas under various local, state and federal jurisdictions that were included within the Sanctuary boundary. This type of zone is necessary to recognize the continued authority of the agencies overseeing these protected areas.

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. Marine zoning also promotes sustainable use of Sanctuary resources, protects diverse habitats, and preserves important natural resources and ecosystem functions.

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.

While there was large support for marine zoning 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, particularly in those areas under consideration for full protection, frequently called “reserves.”

In July 2001, the Tortugas Ecological Reserve (518 km<sup>2</sup>) was established to complete the Sanctuary’s network of marine zones outlined in the management plan. The Tortugas 2000 Process as it was dubbed concluded a 10 year management planning process during which many lessons were learned. This new 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. Today, approximately 6% of the Sanctuary, or 10% of the coral reef in the Keys, is set-aside as fully protected zones, or marine reserves.

The study area for the Tortugas Ecological Reserve was over 900 square nautical miles in size. Seven separate authorities have jurisdiction within the study area which includes a wide-range of marine habitats. At the core of the Tortugas 2000 Process was a 25-member working group comprised of diverse interests that were represented by Sanctuary Advisory Council members, stakeholders, and government agency representatives. Discussion of Working Group membership and composition was a priority at the first and subsequent meetings of the group; the goal of these discussions was to ensure that all constituents with an interest in or concern over activities in the Tortugas were at the table during the design phase.

In addition, all of the federal, state, and local agencies with resource management authority in the Tortugas study area were asked to commit a representative to participate in the Working Group process. A key agency partner was the National Park Service due to their trusteeship of the Dry Tortugas National Park (DRTO), a 104 square nautical mile park that is surrounded by, but jurisdictionally separate from, the Sanctuary. The Park Service's involvement in the design of the reserve was critical because of the important shallow water coral reef resources found within the DRTO and the connectivity of those resources with surrounding Sanctuary waters. Coordination with the National Park Service was further motivated by the fact that the DRTO was revising its general management plan concurrent with the design of the ecological reserve and was considering making part of the Park a no-take area.

The Tortugas 2000 Working Group was charged with reviewing available information to make an informed recommendation to NOAA on the placement of the Tortugas Ecological Reserve. The Working Group was directed by Sanctuary staff to ignore jurisdictional boundaries and to utilize an ecosystem management approach to determine the best location for the Tortugas Ecological Reserve.

## **Lessons Learned**

The following is a list of "lessons learned" as they relate to ecosystem management planning for the Florida Keys National Marine Sanctuary. Their inclusion does not mean to imply they were not considered from the outset, but only to emphasize their importance to managers. They are as follows:

### Ecosystem Approach

- Establish a comprehensive boundary for the ecosystem based on natural and physical processes and not political or jurisdictional boundaries (barriers). Strive to eliminate jurisdictional and administrative barriers to ecosystem management.
- Apply the principles of ecosystem-based management from the outset in the planning process. In other words, approach the planning process with an ecosystem perspective, focusing on watershed based management. Include the appropriate spatial extent within the boundary of the ecosystem.

- Use a public process to establish ecosystem management objectives and restoration goals based on our best understanding of the concepts of sustainability. Establish an Advisory Group made up of stakeholders and local elected officials, separate from an Interagency Core Group to assist in the planning process.
- Utilize an adaptive management process and in the absence of information, use the best science available upon which to base decisions.
- Planning process must be supported with analytical and technical expertise.

### Integrated Management

- Establish an integrated planning process but do not let the rigor of the process dominate the activities, but rather treat the process as another adaptive management tool. Utilize to the extent possible, existing integrated coastal management programs
- Bring all levels of government to the table for the planning process, from the local and regional level to the state, territorial, tribal and national. Consult international levels of government when feasible and necessary. Insure the integrated planning process moves vertically and horizontally through the structure of the agencies and all levels of government can participate in the planning process.
- Require that participating representatives have adequate authority to make decisions in the planning process.
- Focus on ways to implement effective ocean governance within the confines of existing authorities, but be open to new legislation when necessary.

### Socioeconomic Considerations

- Recognize from the outset that humans are a part of the ecosystem and that our activities, or the affects of our activities, cannot be separated from any holistic approach to management.
- Although we continue to struggle with a true definition of sustainability, continue to apply the spirit of what we collectively think as a sustainable approach on the most conservative side of management principles.
- Invest heavily in outreach efforts at all target audience levels with the recognition that the environment and economy are linked at the outset of the project. This is especially true of decision and policy-maker audiences.



- It is absolutely essential to bring socioeconomic information into the planning process as a foundation for informed participation at an early phase. Treat this discipline with the level of importance that you would give the natural or physical sciences.
- Utilize the concept of marine zoning in the management planning process. This management tool is useful to eliminate or lessen visitor-use conflicts. Establish marine reserves or “no take areas” where marine life is fully protected in critical marine environments.
- Listen to, and attempt to understand all points of view in an ecosystem management planning process.

## **Conclusion**

The success of an ecosystem management approach as described in this paper depends largely on how effective the managers are at defining the full extent of the ecosystem and the goals and objectives they want to achieve. Clearly, the old paradigm of managing just within the boundaries of one’s terrestrial or marine protected area does not and cannot succeed. It is critical that resource managers step back and take a broader perspective of the true spatial extent of the geographic and oceanographic boundaries that affect their areas. Next, a new approach to ocean governance is essential. This approach brings all of the authorities and jurisdictions within a specified area into the process and integrates their management into a comprehensive approach that focuses on common goals and objectives. This process also requires participation by the public through stakeholder involvement, including those stakeholders that represent the general public who do not have a vested economic interest in management decisions. Finally, the adaptable application of the best available natural and socio-economic sciences is a critical component of an ecosystem approach to management.