White Paper on Marine Zoning:
An examination of some current marine zoning efforts and their potential applications in Long Island Sound

Contents

I. Overview

Marine zoning has become an important tool in the management of marine systems and in creating long-term marine policy initiatives worldwide. It not only focuses on ecological preservation and ecosystem-based management, but also creates a framework to help balance and mitigate different uses and interests within marine environments. Other countries, as well as some states within the United States, have implemented marine zoning initiatives as a new method to protect ecologically sensitive marine areas and balance commercial, social, and ecological interests.

In 2004, the Massachusetts Ocean Management Task Force released a report on recommendations for ocean governance, research and conservation through zoning all state waters. The Task Force was a collaborative effort made up of policy makers, private citizens, stakeholder groups, and research institutions. They recognized the need for comprehensive ocean conservation planning to help protect the ecological integrity of historic marine resources, manage ongoing and future marine needs and conflicts, and ensure societal health and welfare. The Ocean Management Task Force represents an important step in the creation of proactive, rather than reactive, ocean management decisions. In their 2004 report, the Task Force stated, "…The times are changing and the tools that the agencies have to do their jobs are not keeping pace with the increasing complexity and challenges of the management issues before them…the oceans are too valuable a resource to continue to manage in an ad hoc and reactive manner." (MA OMTF, 2004)

The purpose of this white paper is to examine current case studies of marine zoning initiatives, with regard to their relevance to Long Island Sound. In addition, this study will explore the concepts and research behind marine zoning itself, specifically focusing on the components that would be associated with implementing a marine zoning initiative in Long Island Sound. This study should serve as a guide for facilitating a discussion among local communities and governments, the Long Island Sound Study, and other agencies regarding marine zoning possibilities in Long Island Sound.

II. Introduction

Over the last century, increasing population density and development along our coasts have placed continued environmental stresses on our estuaries and marine ecosystems. Coastal communities in the United States comprise only 17% of the land area, but currently house 53% of the population and continue to increase in population density (Weinstein *et al.*, 2005; US EPA, 2005). Human activities, including over-fishing, commercial exploration and development, dredging, and underwater construction, negatively impact local marine resources. In fact, the overall condition of estuaries in the northeast United States is the poorest in the country with 27% and 31% impaired for aquatic life and human use, respectively (Figure 1; US EPA, 2005). Environmental stresses affect both species diversity and ecosystem health, and can also negatively impact local economies, fisheries, and human health. Increased occurrences of hypoxia, toxic algal blooms, invasive species, eutrophication, and decreased commercial fish stocks are being reported throughout many of the world's coastal waterways, including Long Island Sound. Future management strategies to address these issues must reflect the complexity of our coastal marine systems, addressing all of the factors negatively impacting their health and integrity.

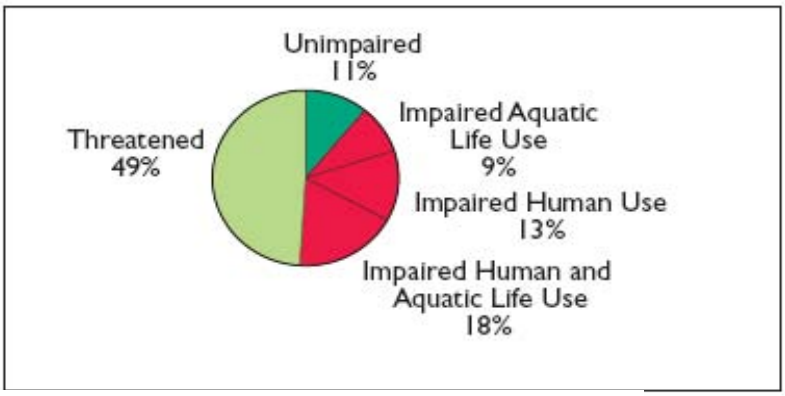

Figure 1. Northeast Coast estuarine condition (U.S. EPA, 2005).

Long Island Sound (LIS) is surrounded by one of the most populated metropolitan areas in the country and retains a high ecological, social and economic value (Figure 2; US EPA, 2005). Currently in the tristate region, nearly 20 million people live near the coasts (Swanson and Conover, 2006). According to current estimates, the coastline could be completely "built-out" within the next two decades (NYS DOS, 1999). Increased density of development along our coastlines, coastal runoff, anthropogenic nutrient inputs, damaging human activities (e.g. trawling, overfishing, and dredging), and pollution all negatively impact and stress important coastal and marine environments.

Many successful management efforts have helped better the ecological health and water quality in LIS, including lowering the occurrence of hypoxic events, restoring coastal wetlands, and reducing the levels of toxins entering the Sound (LISS, 2006). However, significant threats to LIS water quality, ecosystem structure and function, aquatic life, and human health and well being still exist and are continually discovered. New commercial ventures, continued coastal development, loss of shoreline buffering capacity and habitat, and rising water levels and temperatures from global climate change will further threaten the health and ecological integrity of Long Island Sound. Formulating sound marine environmental policy for our coastal waters represents an important opportunity to protect and restore these valuable natural resources. A holistic regional management approach, such as marine zoning, that addresses the cumulative impacts of current and future stressors is needed. With increasing coastal development pressure and new interest in commercial development of our local marine resources, marine zoning could be an important and timely management tool for Long Island Sound.

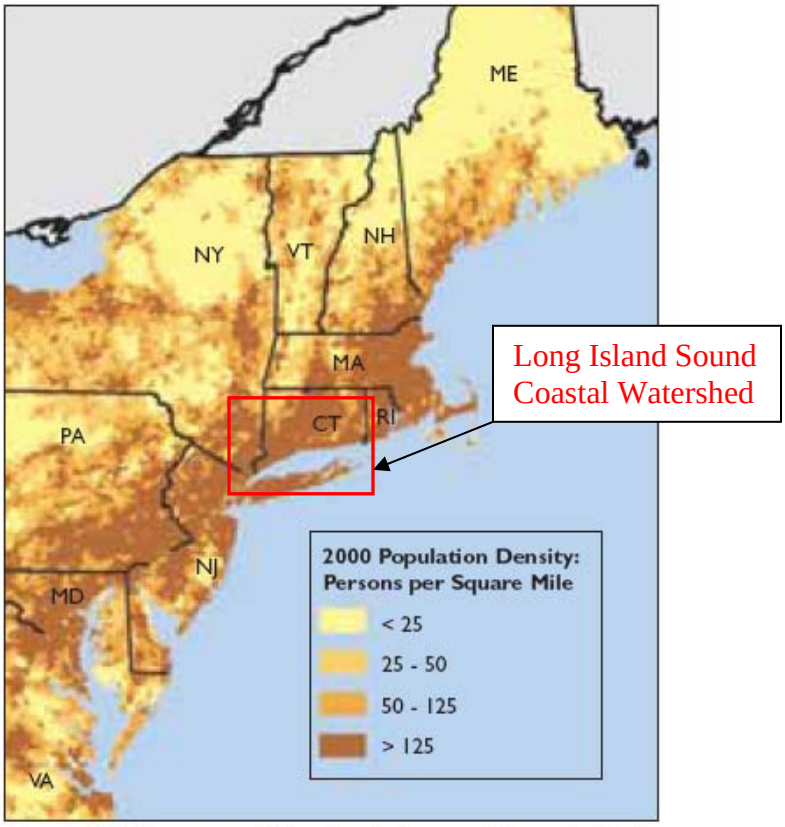

Figure 2. Human population density for the Northeast Coast (US EPA, 2005).

III. Marine Zoning: A Synopsis

> "A broad spectrum of land and ocean-based activities, coupled with continued growth of the human population and migration to coastal areas, is driving unanticipated, unprecedented, and complex changes in the chemistry, physical structure, biology and ecological functioning of oceans worldwide…as both the value and vulnerability of marine ecosystems become more broadly recognized, there is an urgent search for effective mechanisms to prevent or reverse widespread declines and to protect, maintain and restore ocean ecosystems."
>
> (Lubchenco *et al.*, 2003)

In the past emotion and economic interests have often trumped science in marine political debates (Swanson and Conover, 2006). However, with increasing use and exploitation of marine resources, basing policy on sound science is crucial in designing effective ecological management strategies for the future. Difficult environmental and marine policy decisions must incorporate the best science available. Marine zoning incorporates the concepts of ecosystem-based management, and, by definition, is the geographic regulation of marine access or use (Weinstein *et al.*, 2005). Marine zoning has recently been recognized as a key restoration tool that may conserve the biological and ecological integrity of marine ecosystems, contribute to economic and social welfare, and provide important research and educational opportunities (Villa *et al.*, 2002). There is emerging scientific consensus on the effectiveness of marine zoning and ecosystem-based management in the conservation of marine resources. A statement of scientific consensus was released by 219 scientists and policy experts on March 21, 2005 calling for ecosystem-based management of marine resources including specific provisions on zoning regions of the ocean, implementing networks of marine reserves, ecosystem level planning, cross-jurisdictional management goals, co-management strategies among all levels of government, adaptive management, and long-term observing, monitoring, and research programs (McLeod *et al.*, 2005).

Marine resources are finite. While humans depend on the oceans for many resources and services, our activities are threatening the continued health and productivity of the ocean (PEW, 2003). Not only do we depend on the ocean for recreational and commercial activities (e.g. fishing, transportation, energy, manufacturing, and waste disposal), but the coastline also provides important buffering benefits (Swanson and Conover, 2006). In addition, with the current rate of technological advances, coastal waters are being targeted for new, and historically unplanned for, uses every year (e.g. liquid natural gas facilities, aquaculture, and windfarms). If not managed effectively, conflicts arise between new and old uses, and ecology and biodiversity are further stressed. Freedom of the seas and laissez-faire can no longer effectively manage the breadth of activities being proposed in our oceans (Swanson and Conover, 2006). The scientific consensus statement warns "a delay in implementing management based on an ecosystem approach will result in continued conflict over resources, degradation of ocean ecosystem, disruption of fisheries, loss of recreation opportunities, health risks to humans and wildlife and loss of biodiversity" (McLeod *et*

al., 2005). The Pew Oceans Commission and the U.S. Commission on Ocean Policy recently released similar reports on the state of the oceans recognizing the serious negative effects humans are having on marine ecosystems and calling for ecosystem-based management techniques, such as marine zoning, to effectively manage marine systems long-term. Marine zoning helps plan for and manage human activities and needs as part of the ecosystem. Based on the principals of ecosystem-based management, marine zoning incorporates ecosystem structure and function, and accounts for interconnectedness within and among systems and the range of activities affecting them, including ecological, political, social, commercial, and economic factors (McLeod *et al.*, 2005). In order to sustainably manage and plan for the future health of marine systems, both state of the ocean reports concluded that the cumulative impacts of individual stressors must be considered and that coordinated management of marine systems is needed (McLeod *et al.*, 2005).

Many past marine conservation efforts focusing on conservation of a single species or protection of small areas have not been successful (Klaus *et al.*, 2003). Cloern (2001) suggests that these models of individual processes are gross oversimplifications, not taking into account the complex phenomena that exist within marine ecosystems. An ecosystem approach to marine conservation, however, accounts for biological and ecological complexities, including feedback loops, trophic interactions, complex life cycles, and chaotic variability (Cloern, 2001). Marine zoning is a holistic and integrated ecosystem approach to coastal management. It acts as a buffer to address management uncertainties and the dynamic, and sometimes unforeseen, nature of marine environments (Villa *et al.*, 2002; Babcock *et al.*, 2005).

Zoning of marine environments is based on spatial planning that separates and balances conflicting uses within an ecosystem. Multiple-use marine zoning plans incorporate a series of marine protected areas (MPAs) with buffer zones and areas zoned for a range of uses including recreation, commercial fishing, extractive activities, effluent discharges, development projects, and navigation (Day, 2002). Using this integrated approach, marine zoning is more effective than managing small or isolated MPAs independently (Day, 2002). MPAs are integral aspects of marine zoning and can vary in management objectives, size, and degree of activity allowed. "No-take" zones are MPAs where extractive activities are prohibited, and non-extractive activities such as SCUBA diving, recreational boating, and sightseeing may be limited. By spatially limiting or preventing harmful activities while allowing reasonable use, ecologically sensitive areas are protected and the sustainable use of marine resources is encouraged (Day, 2002; Villa *et al.*, 2002).

IV. Case Studies on Marine Zoning

Marine zoning has been implemented worldwide as a means of protecting and preserving important coastal ocean ecosystems and biodiversity while allowing managed human use of the ocean and the resources it provides us. Zoning has proven a successful tool in balancing ecological integrity with sustainable development in both developing

and developed countries. Separating conflicting uses through ocean zoning has been very successful in the Australia's Great Barrier Reef zoning plan, which takes an ecological, practical and social approach to managing the entire system as an integrated whole (Day, 2002). Marine zoning has been implemented in coastal zones of the Mediterranean Sea, Caribbean Sea, and the Atlantic, Indian and Pacific Oceans. In response to the success of marine zoning initiatives elsewhere, many municipalities within the United States have also embraced it as an integral tool for coastal management, undergoing ocean-planning processes of their own. Marine reserves, a subset of zoning, can already be found in the Florida Keys and California, and Massachusetts recently underwent a large-scale marine planning process to assess the potential of zoning state waters. These zoning success stories can serve as a model for how a similar approach could be realized in Long Island Sound. Evaluating zoning case studies provides us with valuable information for understanding the potential impacts on our local environment, society and economy and also offers us examples for crafting specific goals and objectives that could be the basis for marine zoning in Long Island Sound.

A. The Massachusetts Ocean Management Task Force

> "…Marine resources are not limitless, can take decades to restore, and require more vigilant protection in the future than in the past…Conflicts between different uses within our oceans have historically been few, but as more uses are permitted and proposed (in our oceans), greater conflict is inevitable."
>
> (MA OMTF, 2004)

In order to actively plan for future marine development, continue to provide for historic uses and protect coastal and marine ecosystems and biology, the Massachusetts Ocean Management Task Force underwent an important ocean planning process based on the concepts of integrated ecosystem management and ethics of ocean stewardship. Some of the notable recommendations of the Task Force included the creation of: a comprehensive Ocean Resource Management Act, regional/state cooperative ecosystem management and mitigation, working groups and a formal process to designate marine protected areas, advisory groups of scientists, a comprehensive management and research plan, research standards, standards for analysis of visual, cultural and aesthetic values and impacts, and a process to involve and educate the public. (MA OMTF, 2004)

The Task Force outlined six principles for regional ocean management:

1. Protect the public trust
2. Value biodiversity
3. Respect the interdependence of ecosystems
4. Foster sustainable uses
5. Make use of the best available information
6. Encourage public-participation in decision-making

(MA OMTF, 2004)

The Massachusetts state government recognized the need to develop a strategic plan for governance and allowable uses in the marine environment that fosters the ideals of ocean stewardship, and balances beneficial societal uses with conservation (MA OMTF, 2004). With the implementation of a comprehensive Ocean Resource Management Act, Massachusetts would set up a process to proactively manage and plan for current and emerging marine uses, including energy resources, while continuing to protect and restore important biological and ecological marine resources in waters up to three miles offshore. Specifically, the act sets out to streamline and strengthen current marine management statutes and environmental regulations currently managed and informed by different agencies, and establish a clear process for public participation and agency coordination in developing a management plan for each zoned area and standards for allowable use (MA OMTF, 2004).

In addition, one state agency would be assigned ultimate authority to develop, adopt, and enforce management plans and state agency guidelines including defining the geographic scope and goals of each individual ocean resource management plan. This legislation would strengthen the authority of state agencies to protect ocean resources, streamline types of permitted uses among different state agencies, and decrease user conflicts. By creating a zoning process that defines specific areas for fisheries, conservation and protection, energy development, shipping channels, and aesthetic and cultural significance, future user conflicts will be minimized and locations for proposed projects will be regulated in advance. To ensure accountability, a public appeal mechanism would also be included and the act would publicly be reviewed and renewed on a periodic basis.

As per the Task Force's recommendations, a formal legislative process for the creation of marine protected areas (MPAs) would be implemented by the state. They recognized importance of MPAs for the long-term sustainability of Massachusetts' marine resources. The model MPA suggested by the Task Force could be especially useful when considering a similar process in Long Island Sound. The Task Force's model includes coordination of and input from state and federal agencies as well as the public, and creation of a clear plan for implementation, monitoring and enforcement of MPAs. Suggested criteria for designation of MPAs include the protection and study of ecologically sensitive or unique marine habitats or organisms, biodiversity and ecosystem processes, and culturally important activities and resources (e.g., submerged shipwrecks or fishing activities) (MA OMTF, 2004).

In response to the Task Force's recommendations, a proactive and comprehensive ocean management bill was introduced in the Massachusetts State Senate on December 12, 2005, authorizing state agencies to develop an Ocean Management Plan and specify zoning restrictions in state waters. One of the first of its kind in the United States, the proposed marine zoning bill, An Act Relative to Oceans (S. 529), was favorably received and is currently pending in the state legislature.

Similar to proposed and ongoing activities in Long Island Sound, Massachusetts' coastal waters have provided an important resource for the state and must continue to

provide for emerging societal needs. As with Long Island Sound, there have been proposals for the ocean to serve the region's growing transportation, technological and energy needs including wave and wind energy, building natural gas terminals, underwater cables, increased marine shipping, and aquaculture. Coastal and marine development projects have historically been decided on an ad-hoc, first-come first-served basis. There will continue to be increased uses and activities proposed in marine environments, creating more conflicts between both different user groups and the already stressed coastal and marine ecosystems. Marine zoning in Long Island Sound would need to address complicated regional issues including limiting traditionally permissible activities, alleviating existing conflicts, and accounting for future development needs. The suggested model for ocean governance created by the Ocean Management Task Force in Massachusetts could prove useful for implementing a similar ocean zoning and planning process in Long Island Sound.

B. California: Marine Reserve Networks

In 1999, the state of California passed the Marine Life Protection Act (MLPA) establishing a network of marine reserves to protect the natural heritage, ecology and biodiversity of California coastal waters. The act is intended to improve and expand the existing MPAs in California. Basing reserve selection and design on sound science is central to the California plan. The plan incorporates multiple use zoning and no-take MPAs, which allows for sanctuary areas and provides for research and recreational opportunities. Each MPA proposal is assessed by the percentage of each habitat type represented in the proposed reserve and with regard to the entire network. Habitat types include sandy or gravel beaches, rocky intertidal and cliff, coastal marsh, tidal flats, surfgrass, eelgrass, estuary, and kelp forest. The planning process for the creation and implementation of the reserves includes scientists, managers, stakeholders and members of the public. (CA DFG, 2006)

The MLPA is prioritized into different objectives and stages including creating a draft master plan framework, completed in 2005, that outlines programmatic goals and strategies for planning, implementation, design, enforcement, monitoring and management. A strategy for long-term funding for each management component and formal agreements between various state agencies are other important objectives of the act. Although the time frame for implementation of the MLPA has been longer than expected, comprehensive marine reserve networks will be regionally implemented between 2006 and 2011(CA DFG, 2006). Also, full coordination with federal agencies has not yet been realized. For example, in the Channel Islands National Marine Sanctuary, proposed federal marine reserves have not yet been implemented because the roles of different federal agencies were unclear (Crowder *et al.*, 2006).

The California Department of Fish and Game and the Resources Agency serve as the lead agencies under the MLPA to present proposals and recommendations to the Fish and Game Commission, ultimately charged with reserve implementation. Policy and science advisors were very important in creating the draft master plan and in the planning process. Appointed political advisors were organized into the Blue Ribbon Task Force to

address scientific, economic and cultural issues. Scientists were appointed to a Master Plan Science Advisory Team, and tasked with providing the Blue Ribbon Task Force with research and scientific analysis. An external scientific peer review process was also created to ensure the legitimacy of the science behind the master plan and to evaluate alternative proposals for reserve networks. Public and stakeholder input was actively solicited during the planning process through regional meetings, workshops, hearings, and review and comment periods. Simplified zoning categories were created through a collaborative effort involving 11 state agencies and multiple stakeholder groups (see Appendix 1). (CA DFG, 2006)

Another important aspect of the California plan was the creation of public-private partnerships to provide alternative resources and funding, supplementing the state's limited resources and staff. Roles and responsibilities were clearly defined for each state agency and private partner in memorandums of understanding. The success of this act was incumbent on outside scientific planning and coordination provided by these partnerships (CA DFG, 2006).

C. New Zealand and Australia: World Leaders in Marine Zoning

New Zealand and Australia have been world leaders in the creation and implementation of marine zoning. New Zealand was the first country to create a plan zoning ocean waters up to the 200 nautical mile EEZ, with 30% of the seafloor protected in benthic protected areas (BPAs), limiting dredging and bottom trawling activities (Stokes, 2006). This controversial proposal was initiated by the fishing industry with the stated goal of protecting the integrity of New Zealand's deepwater fishery resources. Currently, only about 10% of New Zealand's ocean floor has been trawled, and this initiative would help protect the remaining pristine ocean floor from human disturbance while concentrating current trawling activities in existing locations (Stokes, 2006). Ultimately, it was economically beneficial for industries to plan in conservation measures as part of their development plans.

Australia's marine zoning initiatives offer some of the best examples for evaluating the long-term success of comprehensive marine zoning. Currently, Australia houses one third of the earth's marine reserves and was the first country to implement large-scale marine zoning with the creation of the Great Barrier Reef Marine Park in 1975 (See Figure 3; The Age, 2006; Hendrick, 2006). The Great Barrier Reef Marine Park is 345,000 km^2, zoned into MPAs of varying restrictions, including multiple use areas allowing commercial activities and fishing, and no-take preservation areas (Day, 2002; Crowder *et al.*, 2006). Zoning restrictions include the area above and below the ocean -- up to 915 m above the ocean surface and 1000 m below the seabed (Day, 2002). The park represents a wide variety of habitats, from near shore estuaries to deep ocean troughs 100-300 km offshore (Day, 2002). Although the GBR Marine Park Authority is the regulating agency, the marine park is managed and funded by various agencies and programs. The Park Authority also has jurisdiction over activities outside park

boundaries that could adversely affect the park's ecological integrity, including those on land (Day, 2002). The specific zoning objectives for the park include:

1. Conservation of the Great Barrier Reef (GBR)
2. Regulated use to protect the GBR while allowing for other reasonable uses
3. Regulation of exploitive activities to minimize effects on the GBR
4. Reservation of areas for public enjoyment and passive activities
5. Preservation of some natural areas in the GBR, protected from all human disturbances, except for scientific research. (Day, 2002)

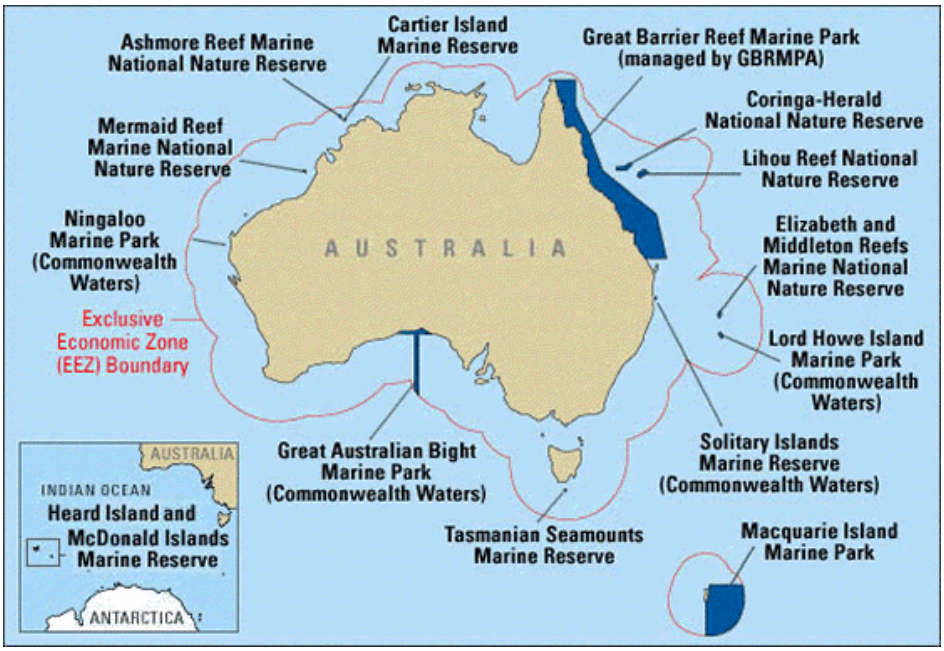

Figure 3. Australia's Marine Reserve System
(Australian Government, Department of Environment and Heritage, 2006).

Similar to Long Island Sound, much revenue is generated from recreation, tourism, fishing (both commercial and recreational) and boating in the Great Barrier Reef, supporting a large part of Australia's economy—1.2 billion annually (Day, 2002). Balancing human needs and conflicting uses with protecting and preserving the park's ecological and biological integrity has been an ongoing management challenge. Analogous to some of the challenges facing Long Island Sound, effective management of such a large system is complicated by multiple jurisdictions and its proximity to large urban and rural coastal populations (Day, 2002).

Figure 4.
Draft Activities Guide: Australia's Zones and Uses (Great Barrier Reef Marine Park Authority)

	General Use Zone	Habitat Protection Zone	Conservation Park Zone	Buffer Zone	Scientific Research Zone	Marine National Park Zone	Preservation Zone
Aquaculture	Permit	Permit [1]	No	No	No	No	No
Bait netting	Yes	Yes	Yes	No	No	No	No
Boating, diving, photography	Yes	Yes	Yes	Yes	Yes [2]	Yes	No
Collecting	Permit	Permit	No	No	No	No	No
Commercial netting	Yes	Yes	No	No	No	No	No
Crabbing	Yes	Yes	Limited [3]	No	No	No	No
Harvest fisheries (eg. bêche-de-mer, tropical rock lobster, aquarium fish)	Permit [4]	Permit [4]	No	No	No	No	No
Limited collecting (includes bait and oyster gathering)	Yes	Yes	Yes	No	No	No	No
Limited impact research	Yes	Yes	Yes	Yes [5]	Yes	Yes [5]	Permit
Limited spearfishing (snorkel only)	Yes	Yes	Yes	No	No	No	No
Line fishing [6]	Yes	Yes	Limited [7]	No	No	No	No
Research	Permit	Permit	Permit	Permit	Permit	Permit	Permit
Shipping (other than shipping area)	Yes	No	No	No	No	No	No
Tourism program	Permit	Permit	Permit	Permit	Permit	Permit	No
Traditional use of marine resources [8]							No
Trawling	Yes	No	No	No	No	No	No
Trolling (for pelagic species)	Yes	Yes	Yes [7]	Yes	No	No	No

Islands: All Commonwealth owned islands in the Great Barrier Reef Marine Park are zoned "Commonwealth Islands Zone". See the Draft Zoning Plan for details.

1. Aquaculture operations which do not include the addition of feed.
2. Scientific Research Zones at One Tree Island and the Australian Institute of Marine Science have public access restrictions. See the Draft Zoning Plan for details.
3. No more than 4 catch devices per person.
4. Accredited harvest fisheries may be conducted 'as of right' in the Zone.
5. Permit required if research is extractive.
6. Maximum of 3 lines/rods per person with a combined total of 6 hooks/lures.
7. Limited to 1 line/rod per person and 1 hook/lure per line.
8. Traditional use does not include activities that are otherwise as of right within each Zone (eg. limited collecting, line fishing, crabbing, etc.). A permit is required for traditional use if the activity is not as of right in the Zone, or involves hunting, unless it is conducted under a Traditional Use of Marine Resources Agreement accredited by the GBRMPA.

For clarification of any points or further information, contact the Great Barrier Reef Marine Park Authority.

Emergencies: Access to all zones is allowed in emergencies.

Many aspects of the marine zoning plan for the GBR have proven very effective and have provided important insights into successful marine zoning initiatives elsewhere. The distribution of marine resources, important habitat, and existing activities were taken into account in defining each zone (Crowder, 2006). For example, each zone is approved for various levels of reasonable activity that are clearly outlined (Figure 4). Zones are also each assigned a specific objective (along with conservation/protection), name, and color for ease of compliance and clarification of its purpose. Separating conflicting uses into different zones has also worked very well in the park (Day, 2002). In order to allow for emerging uses not originally included in a specific zone, an important clause allows for permits to be granted for unforeseen activities consistent with the zone's objectives (Day, 2002). Provisions have been included that allow for entry into preservation or scientific zones in emergencies. Furthermore, each MPA is managed as part of the larger park instead of individually; this method of integrated management has also proven very successful ecologically, practically and socially (Day, 2002). Federal and state agencies work together to coordinate and organize other zoning initiatives around the park in a similar manner to those in the GBR to reduce public confusion and allow for ease of enforcement across jurisdictional boundaries.

Public participation is encouraged and has been an integral part of the zoning and planning process in Australia. In fact, Australia's zoning initiative was driven by public participation and involved the input of over 30,000 citizens (Crowder, 2006). In addition, a public education program has become an important aspect for implementing new zoning provisions and promoting public acceptance and participation, including basic and sector-specific zoning information and workshops (Day, 2002). Zoning maps are provided to the public, clearly displaying federal and state zone boundaries (based on recognizable features or specific latitudes and longitudes) and allowable uses; these are now available in electronic format and can be used in conjunction with shipboard GPS and navigational equipment (See Appendix 2; Day, 2002).

The GBR zoning plan also provides a great deal of insight into what does not work well when implementing large scale zoning initiatives. Some lessons learned include the need to create simple zone boundary descriptions and markers, avoid multiple zones around geologically similar areas, manage high levels of tourism or recreation on a temporal scale, avoid sudden transitions between no-use zones and zones allowing for heavy use by incorporating buffer zones, and simplify zone types (Day, 2002). In addition, zoning plans and individual zones should be reviewed and updated periodically with respect to use patterns, emerging scientific research, or changing social, ecological and institutional needs (Day, 2002). Additional zoning provisions allow special management areas to be designated outside the zoning area, shipping areas and navigation, seasonal closure areas at breeding or spawning sites, fisheries research areas, and defense areas (Day, 2002).

The Australian government is currently protecting another 226,000 km^2 with the creation of 13 new marine protected areas along the southeastern coast (The Age, 2006). This area is important ecologically as well as economically, as it is a critical to Australia's oil and gas production. This reserve network is also being considered for

underwater carbon dioxide storage. Recognizing the importance of protecting this area from further ecological damage while still supporting the commercial businesses that operate there, changes were made in zoning boundaries to lessen the impact on industry. Similar to land-based transfer of development rights (TDR) programs encouraging the preservation of ecologically important open space, TDRs can be implemented in areas to be zoned in the ocean. For example, in Australia, as a tradeoff for designating these no-take reserve sites, fishermen were compensated $220 million dollars and 57% of the area was zoned multiple use to allow for some fishing and oil and gas drilling (The Age, 2006). TDR programs are designed to protect open space by allowing landowners, or fishermen in this case, in conservation zones to be compensated by selling their development/fishing rights for a particular area. TDRs have proven successful on land in the Pine Barrens on Long Island by limiting development of ecologically important areas while providing for growth in compatible areas, and might prove useful in managing the loss of fishing zones associated with marine zoning in Long Island Sound.

V. Long Island Sound: Making the Case for Marine Zoning

A. A Look at Long Island Sound

Long Island Sound is an urban watershed wedged between Long Island, New York City, and Connecticut, and is linked to the East River, the Hudson-Raritan Estuary and the Atlantic Ocean (Parker and O'Reilly, 1991). Surrounded by one of the most populated areas in the country, Long Island Sound already sustains a plethora of human stressors including chemical toxins, nutrient loading, and coastal ecosystem erosion. Fresh water enters the Sound from four major rivers and from coastal runoff and drainage (Wolfe *et al.,* 1991). Forty-four sewage treatment plants discharge directly into the Sound, most of which do not undergo tertiary treatment, which removes nitrogen. Wolfe *et al.* (1991) suggest that the disposal of the inadequately treated waste water, along with untreated urban storm water runoff, extensive coastal development, atmospheric contaminants, decreased stream flow, and groundwater seepage are all factors leading to the decline of water quality in Long Island Sound. Also, disturbances in local fish, shellfish, and crustacean populations due to human activities and environmental factors have had profound impacts on the local fisheries and economy.

The Sound supports lucrative fishing, commercial and recreational industries, providing an estimated $5.5 billion dollars per year to the local economy (US EPA, 2005). The area also provides critical habitat for marine fish, bird and plant species. Long Island Sound is designated as an estuary of national significance and was incorporated into the United States Environmental Protection Agency's National Estuary Program in 1988 (US EPA, 1994). The Comprehensive Conservation and Management Plan (CCMP) for Long Island Sound, developed by federal, state and municipal agencies and local citizens, was approved in 1994 (US EPA, 1994). The CCMP includes objectives and actions that relate to protecting water quality, shoreline habitats, and developing estuary-wide assessments and monitoring programs. However, although conditions have improved in some areas, the ecology and biology of the Sound still suffer from negative human impacts and other environmental stresses.

Long Island Sound represents a unique challenge in marine zoning because many conflicting uses already exist here, and many marine resources have already been damaged or exploited. Stakeholder demand will only continue to increase in Long Island Sound, leading to increased user conflicts and furthering stressing the system. Future development projects are being considered within the Sound, including wind farms and natural gas terminals to attend to the area's growing energy needs. Currently there is no clear comprehensive authority or policy regulating these activities in Long Island Sound, which has lead to emotion, rather than science, shaping debates on acceptable use (Swanson and Conover, 2006). Limiting traditionally permitted activities and providing for future development needs are management issues that need to be addressed. Marine zoning can promote the efficient utilization and sustainability of Long Island Sound's many different marine resources (Sanchirico, 2004). Marine zoning could be a timely solution for Long Island Sound, creating a process for managing existing and future environmental stresses, balancing complex ecological issues with continued commercial

and residential needs, and helping to preserve the area's cultural maritime heritage (MSRC, 2001).

B. Ecological Implications and Fisheries Management

Marine zoning could help restore populations of important economic fish species, and protect biodiversity and critical ecosystems in Long Island Sound. Fisheries management using an ecosystem-based approach is becoming more popular among scientists and environmental managers (Mangel and Levin, 2005; Frid *et al.*, 2005). Specifically, Frid *et al.* (2005) conclude that the current quota-based approach to fisheries management in the NE Atlantic region will eventually be replaced by an ecosystem-based approach (i.e. one considering all processes and uses within an ecosystem), requiring a new set of management tools and supporting science including marine zoning and MPAs. Marine reserves are networks of MPAs zoned for various uses and represent one component of a marine zoning initiative, focusing specifically on ecological and fishery goals. There is much scientific evidence to support the creation of reserves leading to the recovery of exploited species(Halpern 2003, Roberts *et al.*, 2003). However, if reserves are not coupled with a larger zoning initiative, incorporating the area beyond the boundaries of MPA's, then anticipated economic and biological gains may be compromised (Sanchirico 2004). For example, there is evidence that individual shellfish closures in Great South Bay may have led to overfishing in other areas (MSRC, 2001).

Successful marine reserve networks are designed to preserve biodiversity and ecosystem functioning (Roberts *et al*., 2003). In general, MPAs increase stock size and average individual size of exploited species within their boundaries (Ami *et al.*, 2005). Research has shown that MPAs are effective in increasing shellfish stock on a local scale. However, their effect on more motile species has been questionable (Verhulst *et al.*, 2004; Kaiser, 2005). The literature also states that small, fragmented MPAs are less effective in managing fishing impacts, and do not account for the dynamic nature of marine environments (Baskett *et al.*, 2005; Martell *et al.*, 2005). To increase their effectiveness, it is important that MPAs be managed as part of a larger marine zoning initiative, incorporating buffer zones and specifying alternative zones for conflicting uses. Also, a scientific understanding of necessary scales and spatial distributions of habitats, species migrations, and potential for species redistribution within the different zones is needed when designing MPAs (Frid *et al.*, 2005; Babcock et. al., 2005). No-take marine reserves have been successful in both habitat protection and fisheries management (Roberts *et al.*, 2003).

Roberts *et al.* (2003) found that reserve selection should be informed by biological value; however, socioeconomic valuation should guide final selection and stakeholders should be involved throughout the process. Reserve siting should also incorporate the needs of entire marine communities, rather than the needs of a single species (Roberts *et al.*, 2003). In order to support the conservation, fishery, and social objectives of the larger reserve network, individual reserves should: 1) incorporate key ecosystem processes supporting biodiversity, 2) be productive within reserve and 3) allow for movement of production outside reserve boundaries (Roberts *et al.*, 2003). The

criteria Roberts *et al.*, (2003) developed to assess the biological value of marine reserve sites include assessing biogeographic representation, habitat representation, human and natural threats, connectivity and ecosystem linkages, vulnerable habitats, vulnerable life stages, species of concern or exploitable species, and ecological services for humans.

There has been much debate regarding the necessary size and number of marine reserves needed to make a network successful. It has been suggested that many small reserve networks are best for managing fisheries, while fewer larger reserve networks protect biodiversity. The National Research Council (2000) suggests that 20% or more of each habitat type should be protected to ensure long-term biodiversity and fishery production (Roberts *et al.*, 2003). Halpern (2003) found that regardless of size, marine reserves lead to increases in biodiversity, biomass, and abundance of organisms, and that whether a reserve network represents a series of many small protected areas or a few large ones, the ecological benefits of reserve networks increase directly with the absolute area set aside for protection (Roberts *et al.*, 2003). However, there are important tradeoffs to consider when choosing between reserve size and reserve number. Ideal reserve size and number can be different for each species, taking into account their habitat needs, vulnerable life stages, dispersal distances, and recruitment requirements. Roberts *et al.* (2003) argues that small reserves will only be successful if they can support mobile populations and provide linkages to other habitats, and that larger reserves are needed when dealing with rare or fragmented habitats. Larger reserve networks also provide more protection from ecological disturbances, and may be logistically easier to enforce (Roberts *et al.*, 2003).

Understanding the local issues associated with the ecological and biological health of Long Island Sound would be an important aspect in the planning and design of marine reserves. For example, significant breeding or nursery sites and a fraction of each representative marine habitat should perhaps be grouped in no-take zoned MPAs with permanent or seasonal closure (Day, 2002). Furthermore, areas with large and diverse populations of bird, mammal and fish species might be considered for no-take MPAs, including Gardiners Island, the Gull Islands and Fishers Island (Swanson and Conover, 2006). Connectivity among habitats and zones must be considered as well. Fringe wetlands in Long Island Sound provide important nursery habitat for commercially important fish species such as flounder, butterfish, and scup (Stedman, 2006). Wetlands are also an important location of food for bluefish and striped bass, and provide habitat for the hard clam (Stedman, 2006). Factors that should be analyzed in a Long Island zoning plan include important commercial fisheries and current fishery management strategies, ecological issues associated with current fishing activities, important coastal and terrestrial habitats, critical nursery zones, distribution strategies of target species, and biodiversity in the Sound. For instance, eelgrass beds and other important habitat zones should be inventoried. MPAs should not be placed in areas with a high probability of disturbance. Therefore, a geographic review of water quality, environmentally degraded or sensitive areas, pollution patterns, and development pressures will also provide critical information when evaluating placement of MPAs in Long Island Sound. Properly managing the locations of storm water drains and waste effluent pipes is especially important.

C. Economics

All human uses and needs within an ecosystem are important factors to manage for in a zoning plan. Therefore, understanding the short- and long-term economic impacts and benefits to society is crucial, including calculating industrial and commercial needs, and intrinsic ecosystem, scientific research, and societal values.

Marine zoning and ecosystem-based management can be important tools in stabilizing and protecting the coastal economy. However, the true economic values of ecosystems are difficult to quantify and are often undervalued (McLeod *et al.*, 2005). For example, it is hard to quantify the cultural value associated with maintaining the area's historic maritime industry. The inherent existence value of a particular ecosystem is also difficult to quantify (MSRC, 2001). In addition, the aesthetic value associated with healthy coastal ecosystems is extremely important to property values, recreational interests, and tourism in the Long Island Sound watershed. Recreation and tourism alone represent multi-billion dollar industries in the Sound. However, recreational activities often clash with commercial development interests. Marine zoning may help spatially separate these conflicting uses, as well as protect and enhance aesthetically and recreationally important marine resources.

Coastal wetlands and estuaries can also help buffer the effects of storm events and sea level rise associated with global warming, protecting property values and expensive coastal real estate from erosion and destruction. In Long Island Sound's coastal communities, zoning could help create a framework to establish buffer zones or MPAs in areas prone to erosion, possibly limiting development, shoreline hardening, and other activities destructive to wetland habitats. Maintaining healthy functioning marine habitats also provides invaluable services such as "nutrient recycling, control of disease and pests, climate regulation, cultural heritage and spiritual benefits" (McLeod *et al.*, 2005). Swanson and Conover (2006) believe that zoning in Long Island Sound could especially be useful in determining buffer zones for mosquito spraying and other chemical applications to protect human and ecological health. In addition, zoning initiatives will likely reduce the duplication of conservation efforts, and prove more cost-effective in the long term (McLeod *et al.*, 2005).

As previously stated, all human impacts and needs, including those of commercial and industrial stakeholders, must be viewed as part of the ecosystem and subsequently considered in any management plan. Our region relies on revenue provided by industrial and commercial ventures in Long Island Sound. Marine ecosystems provide many goods and services to society including coastline protection, recreation, food, business, shipping, and energy. The delivery of these goods and services can be irreversibly disrupted if ecosystem functioning is not protected, causing crippling effects on the local economy (Roberts *et al.*, 2003). For example, the current loss of wetlands in Long Island Sound is thought to be contributing to the decline of commercially important fish species, especially bluefish (Stedman, 2006). Marine zoning can help restore populations of commercially important invertebrate and fish species and preserve the aesthetic and

recreational values of coastal marine systems. However, it is important to remember that marine zoning encompasses more than just fisheries management. For example, the Sound is a crucial commercial waterway in the region with a rich maritime history, including important working waterfronts and key industrial shipping routes for both passenger and cargo traffic. Each year 4,000-7,000 domestic commercial vessels travel through Long Island Sound alone (Boynton, 2006). LIS also accommodates many naval ships, hundreds of foreign vessels and fishing boats, and thousands of recreational boaters (Boynton, 2006). In addition, there are roughly 200 water-dependant businesses along the Sound's coasts, with the majority of those concentrated in only ten harbors (NYS DOS, 1999). Ensuring the long-term viability of the marine transportation industry in Long Island Sound is important to the economic health of the region. Managing an ecosystem with regard to the marine transportation industry and its needs can be as important as managing for the recovery of a specific species. Ecosystem-based management techniques, such as marine zoning, should account for all of the various and conflicting needs in a system. A comprehensive marine zoning plan can help provide for the continued services on which our region relies from the ocean by spatially mitigating extractive or damaging activities (e.g., mining, dredging, shipping, fishing, coastal development, underwater pipelines/cables, and emerging energy developments) with conservation goals.

Conducting a cost-benefit analysis for both extractive (e.g., fishermen and developers) and passive users, and economic analysis of management benefits and costs, and a social value assessment are important when considering a marine zoning plan (Ami et. al., 2005; Carter, 2003). For example, siting of restrictive use or conservation zones could interfere with extractive uses such as shipping routes and distribution centers, dredging or mining sites, and gas/energy lines (MSRC, 2001). Economic factors to be analyzed should include fisheries, tourism, recreational boating, commercial development, property values, and aesthetic value. The Long Island Sound Study (1994) calculated that boating, recreational and commercial fisheries, swimming, and beaches contribute over $5 billion to the regional economy annually. However, the Sound's ability to continue providing this revenue may be compromised as water quality, natural habitats, and fisheries are degraded by a growing number of anthropogenic stressors (US EPA, 1994).

Planning, management, enforcement, and monitoring/research needs, as well as implementation costs, should also be considered in any marine zoning plan. In addition, understanding and evaluating further scientific research needs must also be anticipated. For example, tools and resources that would be helpful in the creation and management of a marine zoning initiative in Long Island Sound include GIS and satellite maps of the seabed, coastal zone, and fishing intensity (Doherty and Butler, 2005). Specifically, mapping of benthic habitats using compact video, GIS, and visual assessments to create habitat maps have wide application in the planning and monitoring stage of marine zoning (Stevens and Connolly, 2005). Mapping circulation patterns within the Sound could also be important in managing the downstream effects of pollution from New York City.

D. Future Commercial Development Interests

Sea floor cables and pipelines, aquaculture projects, development or mining of underwater resources, and construction of windfarms or other energy facilities within the Sound are all possible future commercial and municipal development projects. Currently, the siting of these types of projects are considered in isolation; cumulative impacts and future needs are not accounted for. The Sound also serves as a sink for coastal runoff, many dredged materials, and over a billion gallons of waste effluent per day. Zoning could help provide a framework for managing the outfall locations and providing broad treatment specifications for sewage effluent entering Long Island Sound (Swanson and Conover, 2006). Marine zoning would not necessarily change existing environmental regulations, but would add a spatial component to management and separate incompatible activities (Crowder *et al*., 2006).

Marine zoning could be especially useful in balancing the region's increasing energy needs while limiting ecological, aesthetic, and recreational disturbances. Swanson and Conover (2006) argue that piecemeal decisions regarding the development of energy facilities in the Sound are detracting from developing a regional comprehensive energy policy. For example, with increasing fuel costs and a national focus on limiting carbon dioxide emissions, car and truck transportation becomes less desirable, leading to increased ferry traffic and marine shipping. Marine zoning in Long Island Sound would need to address issues and needs associated with the growth of the marine transportation industry, such as dredging and location of industrial transfer stations.

Furthermore, the recently proposed Broadwater project in Long Island Sound has extensive policy implications and represents complex social, economic, environmental, and political issues. Broadwater proposes to put a liquid natural gas terminal in Long Island Sound to attend to the area's increasing energy demands and the need for alternative fuel sources. There are many suggested benefits of this terminal, as well as possible negative environmental and social impacts. Comprehensive marine zoning would address the implementation and impacts of such projects and other commercial developments within Long Island Sound and aid in the policy making process for projects such as Broadwater. Zoning would provide a framework in which to assess the various trade-offs of projects such as Broadwater and other alternative uses (Swanson and Conover, 2006). More importantly, a Long Island Sound zoning plan could help address these developments issues (e.g., siting) before they ever surface.

F. Community and Stakeholder Involvement

In order to develop successful goals and objectives for a marine zoning initiative, it is essential to identify the needs of different user groups and stakeholders in Long Island Sound. Other marine zoning studies have concluded that stakeholder participation is crucial throughout the zoning process – from creation to implementation. Although the participatory process can be difficult to manage, it is the most effective strategy to ensure

the success of integrated management plans (Christie *et al.*, 2005). The viability of marine zoning initiatives relies on the ability to couple conservation policies with local community needs and regional economic development (Oracion *et al.*, 2005). The biological success of individual reserves bears a direct relationship to the degree of compliance (Roberts *et al.*, 2003). However, science must take an advocacy role in the establishment of marine zoning initiatives, mentoring stakeholders and monitoring management objectives, to ensure that achievable objectives are accepted over other alternatives (Frid *et al.*, 2005). Science should also lead in the design, location and implementation of MPAs (Ami *et al*., 2005).

Stakeholder involvement is especially important during the beginning stages of the project. If stakeholders feel alienated during the process, the success of the zoning initiative could be compromised. When creating marine zoning initiatives, understanding and addressing the different attitudes of each stakeholder group is essential early in the planning process and can help identify points of contention and management alternatives, as well as help justify chosen management strategies (Salz and Loomis, 2004). Research shows that when creating MPAs, anglers need to be convinced of the advantages of MPAs over traditional regulations on fisheries (Salz and Loomis, 2004). Salz and Loomis (2004) found that attitudes toward "no-take" zones and MPAs varied geographically; specifically New York and New Jersey fishermen had more positive views than did others in the Northeast.

Identifying and involving all of the different stakeholders in Long Island Sound, as well as use patterns, would be crucial throughout a marine zoning process. The community organizing structure currently in existence with the Long Island Sound Study's Stewardship Initiative and Citizen's Advisory Committee could be very useful in conducting outreach, encouraging participation, and surveying regional citizens and user groups. Specifically, a regional stakeholder survey should examine current and potential future needs, equity issues, attitudes toward current management strategies in the Sound, and ideas and attitudes regarding marine zoning in Long Island Sound.

G. Management and Political Implications

Historically, ocean policy and governance in the United States has separately dealt with individual marine sectors, such as shipping, oil and gas exploration, fisheries, cultural landmarks, recreation, and ecological preservation (Crowder *et al*., 2006). This approach may have resolved some conflicts within sectors. However, Crowder *et al.* (2006) argue that this kind of ocean policy ignores the cumulative effects of management decisions, and can potentially intensify cross-sectoral conflicts. Crowder *et al.* (2006) further suggest that the lack of cooperation and coherence in ocean and coastal management is responsible for many of our current marine environmental and resource issues.

Marine zoning can help limit the fragmentation in ocean policy. The case studies examined earlier demonstrate the success of streamlining management and conservation

efforts among different government agencies; across federal, state and municipal jurisdictions. Assigning one agency or advisory council ultimate authority, as was done in Massachusetts, California, Australia and New Zealand, and creating memorandums of agreement among all other agencies outlining roles and responsibilities as part of the larger conservation plan, have worked well. A Long Island Sound zoning initiative would require a bi-state agreement, between New York and Connecticut, and the cooperation of federal agencies and local municipalities. However, there currently are over 20 different federal agencies involved in managing the hundreds of federal ocean statutes alone (Crowder *et al*., 2006). On a more regional scale, New York and Connecticut also have multiple agencies dealing with marine and coastal decisions. Therefore, identifying local and regional management strategies and programs currently established for Long Island Sound and examining how a marine zoning initiative could complement or inhibit these existing conservation efforts would be important in the planning process.

In addition, it would also be necessary to look at the political impacts of a marine zoning initiative in the Sound because it would involve multiple jurisdictions including federal, state (New York and Connecticut) and local governments. For example, the location for the disposal of dredged materials within the Sound has previously been a point of contention between New York and Connecticut. States have jurisdiction over ocean resources up to 3 miles offshore, and must exercise their authority for the benefit of the public trust (US Commission on Ocean Policy, 2004). For instance, the Massachusetts zoning plan only includes those waters up to 3 miles. Long Island Sound, however, is a juridical bay and the waters west of Montauk Point on Long Island and Watch Hill Point on Rhode Island are considered internal state waters (Swanson, 1989). Therefore, the management of Long Island Sound and its resources is under the jurisdiction of both New York and Connecticut. However, issues associated with the pre-emptive rights of the federal government, especially homeland security and the military, need to be addressed regarding development and dredging projects within Long Island Sound. This may also apply to energy projects, such as Broadwater, where the Federal Energy Regulatory Commission (FERC) has final say over implementation, as per the current federal energy bill (HR-6) which was recently passed. In order for a marine zoning initiative to be successful, it would require the cooperation and participation among the different municipalities and all levels of government in designing management objectives, as well as agreements delegating responsibilities for management and enforcement.

Co-management of zoning initiatives between government agencies and stakeholder groups, combined with community-based participatory decision making, have also proven an effective management strategy, leading to a more supportive and educated public (Chase *et al.*, 2000; Carter, 2003). Co-management of parks, natural areas, and natural resources within the United States has become a widely accepted management strategy with the incorporation of “Friends of” groups into local marine and terrestrial conservation and restoration initiatives. Such public-private partnerships have been successful on a local level in both New York City and on Long Island. This may prove to be an effective option for the management of MPAs in Long Island Sound.

Following the Massachusetts model, in designing an appropriate marine zoning model for Long Island Sound, one would need to research and plan for design, implementation, monitoring, scientific research, enforcement and evaluation. A specific strategy to encourage political, scientific, commercial, environmental, and public awareness and involvement is needed. Any planning process should be designed to minimize conflicts and encourage stakeholder involvement and support in designing the specific goals and objectives, and identifying MPA siting and levels of protection. A comprehensive zoning plan would provide policy makers and resource managers with a detailed process outlining and encouraging stakeholder involvement in the decision making process, and could be used directly to evaluate and implement further conservation and restoration initiatives in the Sound. In addition, monitoring and evaluation plans should identify possible ecological and economic indicators that could be used to evaluate the success of specific objectives. Economic and biological indicators may include increased stock size of target species, and increased biodiversity. Measuring direct and indirect observed changes in conditions, along with changes in stakeholders' perceptions of environmental conditions will provide measures of success. The evaluation plan should also include a re-evaluation component that will allow for future changes in the zoning initiative.

H. Conclusion

As shown in Massachusetts, California, New Zealand, and Australia, marine zoning could be an important and timely environmental management tool for Long Island Sound. New York State has recently taken its first steps to incorporate ecosystem based management in coastal waters, including Long Island Sound. The New York Ocean and Great Lakes Ecosystem Conservation Act was signed into Law by Governor George E. Pataki in August, 2006. The Act created an Ecosystem Conservation council charged with developing a strategic plan to implement ecosystem-based management in New York's coastal waters, and to streamline the efforts of various government agencies (Conover, 2006). Workshops are currently being held throughout NYS to give people an opportunity to share their ideas and opinions on how to advance ecosystem-based management in New York State waters, and to gather public input to inform and advise the New York Ecosystem Conservation Council. New York State is starting to look at ocean conservation and management in a new holistic way. However, although this act could provide a mechanism for implementing marine zoning in Long Island Sound, a regional strategy and partnerships with other states, especially Connecticut, still must be established.

J.C. Day (2002) concluded that it is not necessary to know everything or resolve every uncertainty before implementing a marine zoning plan. For example, little was known scientifically or socially before the Great Barrier Reef zoning plan was implemented in 1975. Our current approach to ocean management in the United States is not sustainable, and a more holistic and zonal ecosystem approach is needed (Crowder *et al.*, 2006). Ocean policy and management should be defined by ecological boundaries, not political ones, and incorporate all elements and process in the system, including humans (US Commission on Ocean Policy, 2004). Piecemeal marine policy efforts are

not sustainable for Long Island Sound and a comprehensive marine policy, such as zoning, needs to be developed. Marine zoning can provide ecological, social, and economic benefits that would compliment existing management strategies to protect and restore the environmental health of the Sound. It is time to consider implementing marine zoning and reserve networks to ensure the long-term sustainability of our marine ecosystems and resources in Long Island Sound.

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VII. Appendices

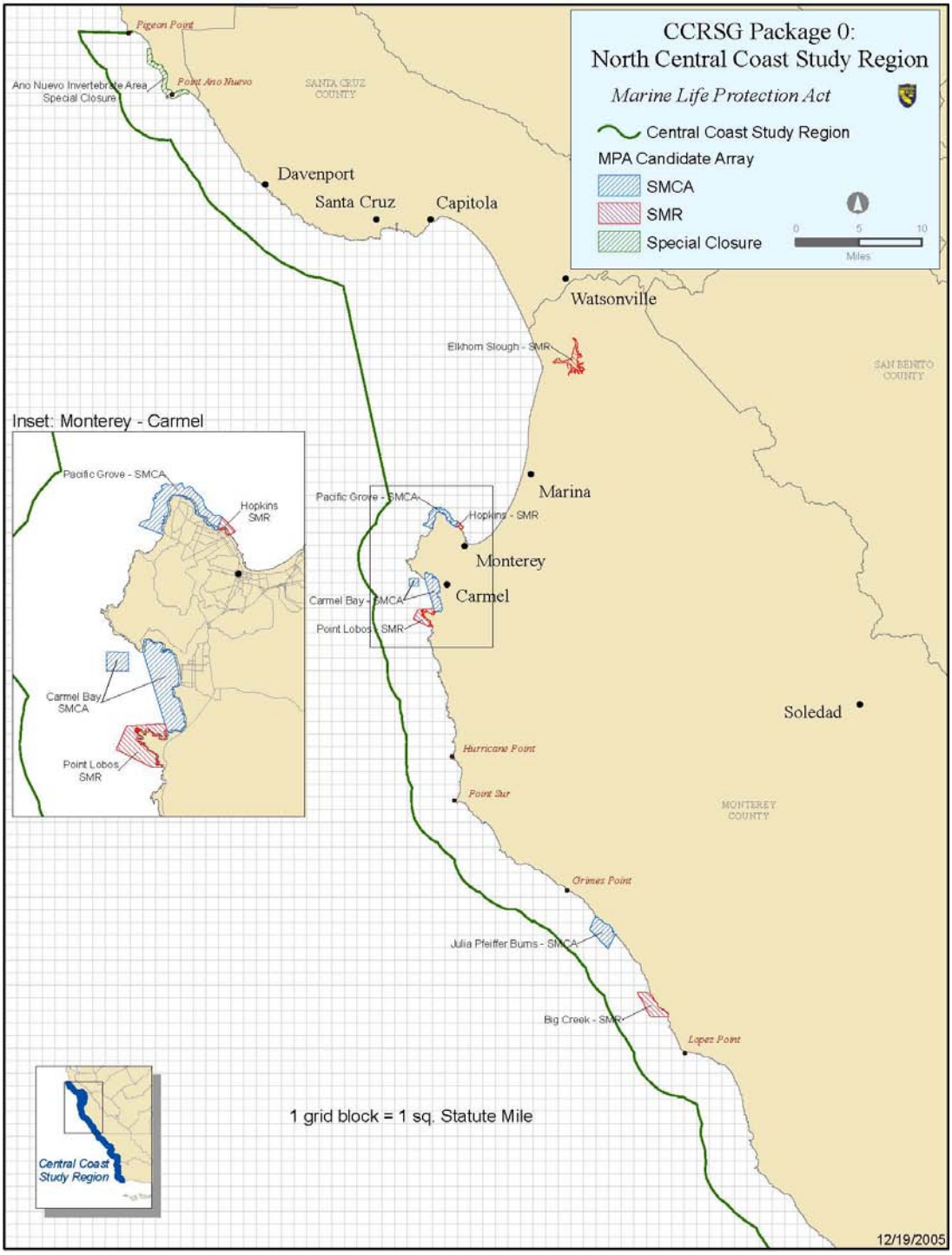
Appendix 1. California's Simplified Marine Zoning Classification System and maps

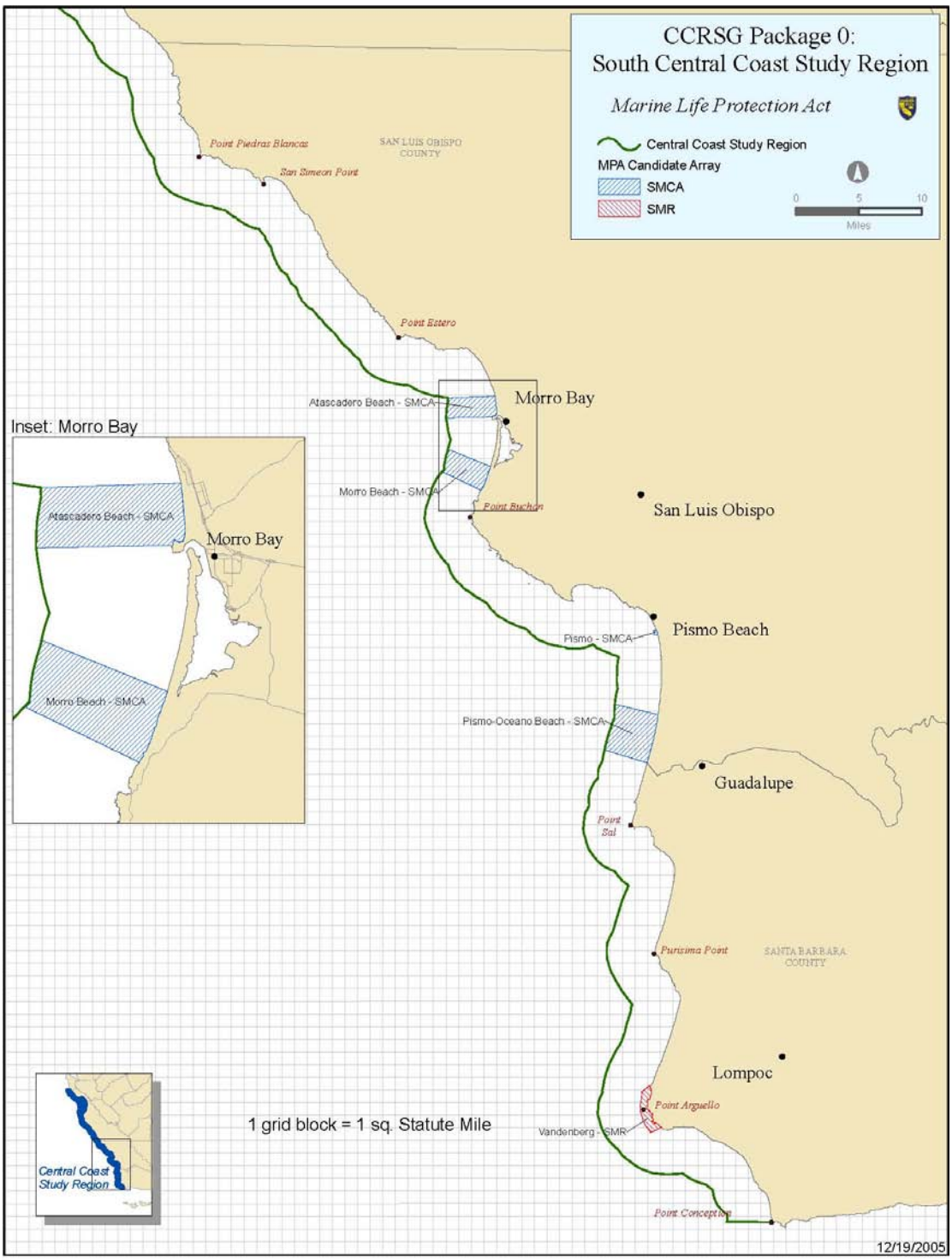
Source: California Department of Fish and Game; 2006
http://www.dfg.ca.gov/MRD/MLPA/defs.html#system

Description and Goal (non-terrestrial marine or estuarine area)	**Restrictions**	**Allowable Uses** (may require a permit from the managing agency)
State Marine Reserve Designated so the managing agency may achieve one or more of the following: • protect or restore rare, threatened or endangered native plants, animals or habitats in marine areas; • protect or restore outstanding, representative or imperiled marine species, communities, habitats and ecosystems; • protect or restore diverse marine gene pools; or • contribute to the understanding and management of marine resources and ecosystems by providing the opportunity for scientific research in outstanding, representative or imperiled marine habitats or ecosystems.	• Unlawful to injure, damage, take or possess any living, geological or cultural marine resource, except under a permit or specific authorization from the managing agency for research, restoration or monitoring purposes. • The area (to the extent feasible) shall be open to the public for managed enjoyment and study, the area shall be maintained to the extent practicable in an undisturbed and unpolluted state. • Access and use (such as walking, swimming, boating and diving) may be restricted to protect marine resources.	• Research, restoration and monitoring • Educational activities and other forms of non-consumptive human use
State Marine Park Designated so the managing agency may provide opportunities for spiritual, scientific, educational, and recreational opportunities, as well as one or more of the following: • protect or restore outstanding, representative or imperiled marine species, communities, habitats and ecosystems; • contribute to the understanding and management of marine resources and ecosystems by providing the opportunity for scientific research in outstanding, representative or imperiled marine habitats or ecosystems; • preserve cultural objects of historical, archaeological and scientific interest in marine areas; or • preserve outstanding or unique geological features.	• Unlawful to injure, damage, take or possess any living or nonliving marine resources for commercial exploitation purposes. • Any human use that would compromise protection of the species of interest, natural community or habitat, or geological, cultural or recreational features, may be restricted by the designating entity or managing agency.	• All other uses are allowed, including scientific collection with a permit, research, monitoring and public recreation (including recreational harvest, unless otherwise restricted) • Public use, enjoyment and education are encouraged, in a manner consistent with protecting resource values.
State Marine Conservation Area	• Unlawful to injure, damage,	• Research,

Designated so the managing agency may achieve one or more of the following: • protect or restore rare, threatened or endangered native plants, animals or habitats in marine areas; • protect or restore outstanding, representative or imperiled marine species, communities, habitats and ecosystems; • protect or restore diverse marine gene pools; • contribute to the understanding and management of marine resources and ecosystems by providing the opportunity for scientific research in outstanding, representative or imperiled marine habitats or ecosystems; • preserve outstanding or unique geological features; or • provide for sustainable living marine resource harvest.	take or posses any specified living, geological or cultural marine resources for certain commercial, recreational, or a combination of commercial and recreational purposes. • Commercial and/or recreational uses that would compromise protection of the species of interest, natural community, habitat or geological features may be restricted by the designating entity or managing agency.	education and recreational activities • Certain commercial and recreational harvest of marine resources
State Marine Cultural Preservation Area Designated so the managing agency may preserve cultural objects or sites of historical, archaeological or scientific interest in marine areas.	• Unlawful to damage, take or possess any cultural marine resource. • Complete integrity of the cultural resources shall be sought, and no structures or improvements which conflict with such integrity shall be permitted.	No other uses are restricted
State Marine Recreational Management Area Designated so the managing agency may provide, limit or restrict recreational opportunities to meet other than purely local needs while preserving basic resource values for present and future generations.	• Any activities that would compromise the recreational values for which the area may be designated are prohibited. • Specified recreational opportunities may be protected, enhanced or restricted, while preserving basic resource values of the area.	No other uses are restricted
State Water Quality Protection Area Designated so the managing agency may protect marine species, biological communities, or unique or significant resources from an undesirable alteration in natural water quality.	• Prohibits or limits by special conditions point source waste and thermal discharges. • Nonpoint source pollution is controlled to the extent practicable.	No other uses are restricted

California Marine Life Protection Act Initiative: Central Coast Study Region
Existing Marine Protected Areas MPA Package 0
North Central Coast Study Region Map: South Central Coast Study Region Staff
Summary of Area and Habitats
Source: California Department of Fish and Game; 2006
http://www.dfg.ca.gov/MRD/MLPA/defs.html#system





– *Package 0*

Source: California Department of Fish and Game; 2006
http://www.dfg.ca.gov/MRD/MLPA/defs.html#system

SUMMARY OF AREA AND HABITATS IN PACKAGE 0

Marine Life Protection Act Initiative, Central Coast Project

Source: California Department of Fish and Game; 2006
http://www.dfg.ca.gov/MRD/MLPA/defs.html#system

Type of MPA	# Proposed	Area (mi_2)	% of Study Region
Special Closure	1	2.20 mi2	0.19%
State Marine Reserve	5	7.45 mi2	0.65%
State Marine Park	0	0.00 mi2	0.00%
State Marine Conservation Area	7	33.50 mi2	2.91%
All MPAs combined	13	43.15 mi2	3.75%

PACKAGE 0 (Existing Central Coast MPAs, 2005)

MPA Name	Size (mi_2)	Along-shore span (mi)	Depth range (ft)
Ano Nuevo Special Closure (*)	2.20 mi2	5.52 mi	0-55 ft
Elkhorn Slough State Marine Reserve	1.36 mi2	3.16 mi	0-10 ft
Hopkins State Marine Reserve	0.15 mi2	0.52 mi	3-71 ft
Pacific Grove State Marine Conservation Area (*)	1.54 mi2	3.45 mi	0-65 ft
Carmel Bay State Marine Conservation Area (*)	2.80 mi2	3.11 mi	0-471 ft
Point Lobos State Marine Reserve	1.19 mi2	1.96 mi	0-203 ft
Julia Pfeiffer Burns State Marine Conservation Area (*)	2.65 mi2	2.07 mi	3-628 ft
Big Creek State Marine Reserve	2.27 mi2	2.19 mi	0-264 ft
Atascadero Beach State Marine Conservation Area (*)	6.33 mi2	1.61 mi	0-234 ft
Morro Beach State Maine Conservation Area (*)	6.82 mi2	1.96 mi	0-232 ft
Pismo State Marine Conservation Area (*)	0.08 mi2	0.38 mi	3-17 ft
Pismo-Oceano State Marine Conservation Area (*)	13.29 mi2	3.80 mi	0-133 ft
Vandenberg State Marine Reserve	2.48 mi2	3.68 mi	3-65 ft

Existing Central Coast MPAs:

Symbols following proposed MPA name indicate level of protection as determined by the Science Advisory Team. (***) indicates SMCA High, (**) indicates SMCA Moderate, (*) indicates SMCA Low, and (^) indicates SMP Low.

Habitat Representation in Package 0 (Existing Central Coast MPAs):
Source: California Department of Fish and Game; 2006
http://www.dfg.ca.gov/MRD/MLPA/defs.html#system

	Percentage of Habitat in Existing MPAs in the Study Region 1				
Habitat	**SMR**	**SMP**	**SMCA**	**SC**	**Total MPAs**
Intertidal					
Sandy or gravel beaches	2.36%	0.00%	6.45%	2.71%	11.51%
Rocky intertidal and cliff	7.99%	0.00%	6.07%	1.30%	15.36%
Coastal marsh	25.08%	0.00%	0.00%	0.00%	25.08%
Tidal flats	39.02%	0.00%	0.00%	0.00%	39.02%
Seagrass beds (0-30m): Surfgrass	6.05%	0.00%	7.34%	2.85%	16.23%
Seagrass beds (0-30m): Eelgrass	2.80%	0.00%	0.00%	0.00%	2.80%
Estuary	13.84%	0.00%	0.61%	0.00%	14.45%
Soft bottom					
0-30 meters	1.67%	0.00%	5.48%	0.70%	7.85%
30-100 meters	0.23%	0.00%	2.63%	0.00%	2.86%
100-200 meters	0.00%	0.00%	0.03%	0.00%	0.03%
>200 meters	0.00%	0.00%	0.00%	0.00%	0.00%
Hard bottom					
0-30 meters	1.41%	0.00%	2.88%	0.45%	4.74%
30-100 meters	0.69%	0.00%	1.79%	0.00%	2.48%
100-200m	0.00%	0.00%	0.00%	0.00%	0.00%
>200 meters	0.00%	0.00%	0.00%	0.00%	0.00%
Kelp forest					
Average Kelp ('89, '99, '02, '03)	3.35%	0.00%	6.23%	0.02%	9.61%
Persistent Kelp	6.29%	0.00%	6.61%	0.00%	12.90%
Submarine canyon					
0-30 meters	0.00%	0.00%	31.86%	0.00%	31.86%
30-100 meters	0.00%	0.00%	1.58%	0.00%	1.58%
100-200 meters	0.00%	0.00%	0.17%	0.00%	0.17%
>200 meters	0.00%	0.00%	0.00%	0.00%	0.00%

[1] *Note: These are MPA designations, NOT levels of protection assigned by the SAT*