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Coastal and Marine Spatial Planning (CMSP):
An ecosystem based approach to conservation and management in Long Island Sound

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Abstract of the Dissertation

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Past approaches to ocean management in the United States are no longer sustainable because they were largely reactionary and applied in a piecemeal fashion. A more comprehensive ecosystem-based approach is needed. Ocean policy and management practices should be defined by ecological boundaries, not political ones, and should incorporate all elements and processes in the system, including human uses. Thus, a regional, multi-objective plan, such as coastal and marine spatial planning (CMSP), that addresses the cumulative impacts of current and future environmental stressors, is essential. Coastal and marine spatial plans separate conflicting uses in marine environments based upon an established community vision of how the ecosystem should be used, and prioritization of ecosystem services. In addition, best CMSP practices emphasize inclusion of stakeholders from the onset and documenting use conflicts and compatibilities. However, more effective research tools are needed for building comprehensive ecosystem visions and getting early stakeholder buy-in in the CMSP process. The objective of this dissertation was to advance the fields of EBM and CMSP research by developing and testing the effectiveness of such a tool using Long Island Sound (LIS) as a case study.

Long Island Sound is a highly urbanized estuary facing increased coastal development pressures. Many ecosystem services are important to the region and new uses are continually being proposed without an overall vision guiding them. Encouragingly, new federal and regional

initiatives have put LIS in a prime position to create and implement the process of CMSP. For this dissertation, I developed a targeted survey (n=394) as a new method to analyze stakeholder opinions and initiate early involvement. Opportunities for CMSP in LIS were evaluated with regard to relevant governmental, social, economic, and ecological factors. Theoretical and conceptual bases of CMSP were also explored.

The survey was administered to a diverse sampling of LIS stakeholder groups to gauge opinions on use, management approaches, and ecosystem health. The survey quantitatively discerned areas of disagreement and compromise, and measured relative values of ecosystem services in LIS – all of which are necessary components for building a comprehensive vision. Participants' perceived knowledge on LIS topics was analyzed, including on CMSP. Results showed that CMSP knowledge was lacking among most user groups except managers, scientists, and government officials, implying that CMSP information is not extending far beyond the policy community. Perceptions of LIS's ecological health varied regionally, with New York being slightly more negative than Connecticut.

Regional and stakeholder variations were observed on the valuation of ecosystem services including fisheries, infrastructure development, and historic significance. Principal component analysis on overall ecosystem service values suggested a 4-factor solution responsible for 57% of the variance: ecology, industry, community, and education. Overall survey results showed that although there are conflicts among stakeholders and regions, there are twice as many compatibilities, and further, that there is not only a need for CMSP in LIS, but a basis to begin organizing such a process. Results from this dissertation can help create a vision for LIS that will serve as a foundation for developing principles, goals, and objectives around a CMSP process.

Dedication Page

To all those who helped me on my journey.

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Chapter 1. *Introduction*

Past ocean management in the United States has often been based on fragmented ad hoc approaches, fostering divisions among different sectors (e.g., conservation, transportation, fisheries), agencies, and regions. As population increases, there is compounded pressure on our oceans, especially in coastal zones and estuaries. As these uses and stressors (e.g., climate change, development, etc.) multiply, the capacity of marine systems to provide the important resources and services (e.g., recreational opportunities, fisheries, nutrient recycling), on which both society and ecosystems rely, becomes compromised. Ocean management must adapt to our changing oceans and changing socio-ecological climate. Research and governance call for a more holistic ecosystem-based management (EBM) approach that recognizes that the sustainability of societies, economies and natural systems is inextricably linked (Pew Oceans Commission 2003, US Commission on Ocean Policy 2004, Ehler & Douvere 2007, Halpern et al. 2008, Douvere & Ehler 2009b, The White House Concil on Environmental Quality 2009). Ecosystem-based coastal and marine spatial planning (CMSP) is one such management tool that recognizes the complex connections between a healthy functioning environment and its ability to provide the services humans want and need (i.e., ecosystem services). By actively planning for how marine systems are used, based on a shared societal vision, CMSP spatially and/or temporally separates conflicting uses and streamlines management efforts. In addition, both early-on and active participation from different stakeholder groups are necessary for the success of CMSP initiatives (Ehler & Douvere 2009).

The main objective of this dissertation was to develop a replicable quantitative research tool that builds a framework for CMSP in Long Island Sound (LIS). Such a tool would also initiate stakeholder involvement and drive the development of a comprehensive vision based on ecosystem service values and the conflicts and compatibilities among different stakeholder groups. Long Island Sound provides a useful case study to test this new method because it is the archetypal urban estuary, with many valued ecosystem services and no overall vision guiding new proposals.

Long Island Sound is an environmentally, socially and economically important estuary on the east coast of the United States (US), located between New York's (NY) Long Island (LI), and Connecticut (CT) (Figure 1). It is jointly managed by CT and NY, with multiple federal, state, and local jurisdictions intertwined in the process. Because it adjoins one of the highest population densities in the United States, LIS is a complicated and unique place to study stakeholder involvement in the CMSP process and to examine how to implement a multi-objective CMSP.

Ehler and Douvere (2009) outlined best practices of CMSP that include ten steps needed to design and achieve successful initiatives (Table 1, Figure 2). The first two steps focus on who, why, where, and how of CMSP. First they suggest identifying the need for CMSP and establish if there is such a need, and who has the authority to implement it. The second step is obtaining financial support for the process as well as for implementation of the plan.

The third and fifth steps are outlined with a red rectangle in Figure 2, and are the ones this dissertation will address: *3. Organizing the process through pre-planning*, and *5. Defining and analyzing existing conditions*. The third step involves the creating a work plan, core team, and timeline. Defining goals and objectives of the CMSP plan is also a major part of this step. The fourth step is organizing stakeholder participation, which must be carried throughout the CMSP process. In step five, existing conditions are defined and analyzed, including identifying spatial conflicts and compatibilities among users and uses, as well as mapping human uses and ecologically important areas. Step six deals with forecasting and modeling future conditions, including mapping future uses and alternate spatial scenarios. In step seven, the CMSP is created and approved. After the plan is approved it must be implemented (step eight) and enforced. Steps nine and ten deal with monitoring and evaluation, and adaptive management (Ehler & Douvere 2009).

Although the literature emphasizes identifying CMSP objectives and goals, and conflicts and compatibilities, as well as encouraging early on stakeholder involvement, there is limited research on how to effectively do this (Maguire et al. 2012). Other than mapping, there is no agreed upon method to measure values and opinions of stakeholders to inform the CMSP process. Goals and objectives should be based on these data, not developed beforehand. In the pre-planning process there is no relied-upon method to significantly test where conflicts and

compatibilities exist; i.e., there is no quantitative methodology on how to measure stakeholder opinion and assess regional and stakeholder conflicts.

I have attended many meetings in the past few years in the Northeast and Mid-Atlantic dealing with the issues of ocean management, and in particular, EBM and CMSP. Time again I heard about the need to look at the social component of CMSP and understand how people value the different ecosystem services. In fact, it was the top research recommendation of a workgroup I mediated at the NY Marine Sciences Consortium Fifth Annual Research Symposium meeting in September 2012. After the meeting, all participants were able to vote on the recommendations coming out of each workgroup to develop a top-ten research priorities list for the NYS Department of Environmental Conservation's New York Ocean Action Plan (OAP). The top research priority was "Identify and define measurements and indicators of current and future ecosystem services." This is the pressing need identified by the scientific community. The Science Advisory Group of the NY Ocean and Great Lakes Ecosystem Conservation Council (NYOGLECC) also identified evaluating ecosystem services as a pressing research topic for NY (2008).

Long Island Sound represents a significant challenge in CMSP in that conflicting uses already exist, and many marine resources have been exploited or damaged. But, there are also many positive opportunities to further CMSP in LIS. For example, there is infrastructure in place guiding management decisions and research, with a group of engaged stakeholders. The Long Island Sound Study (LISS) represents the community, managers, government officials, and scientists. The LISS can provide a mechanism for negotiations and involvement in the CMSP process, as well as ensure that the process is informed by a shared vision. New federal and state EBM initiatives also provide a timely opportunity to begin gathering information to serve as the basis for CMSP in LIS.

This dissertation makes progress on defining a vision for LIS on which a multi-objective CMSP can be based, specifically by analyzing the relative value(s) of different ecosystem services and prioritization of management issues. A stakeholder survey was developed as a new EBM tool to rigorously measure ecosystem service valuations and management opinions in LIS. I used my survey to significantly test and compare data with regard to stakeholder groups and regions (i.e., NY vs. CT). This method allowed me to clearly and significantly illuminate conflicts and compatibilities in LIS. I was also able to document relative values of ecosystem

services along with the social, political, and ecological constraints and opportunities for CMSP in LIS. Current and potential future needs, equity issues, and attitudes toward current management strategies in LIS were considered, as well as ideas and attitudes regarding CMSP. Working closely with the LISS, the survey was electronically administered and involved businesses, NGOs, scientists, community members, recreational communities, managers, and policy makers. In the following chapters, using background research survey results, I make the case for a viable multi-objective ecosystem-based CMSP for LIS.

1.1 Hypotheses and Objectives

The main goals of this dissertation were to examine the feasibility of implementing an ecosystem-based comprehensive CMSP in LIS considering governmental, social, economic, and ecological factors, and to create a document that will build the initial framework for a multi-objective CMSP to be fully realized in LIS. A literature and background synthesis effort on CMSP and LIS is included in Chapter 3 of this dissertation. I proposed how existing and possible future conflicts and compatibilities may be affected by CMSP. In addition, I explored what constitutes necessary and sufficient information for responsible decision-making and management.

I developed a new method for working on some of the beginning steps in the CMSP process employing a survey-based approach. I created an EBM survey, which was used as a tool to quantitatively evaluate how ecosystem services are valued by various stakeholders in Chapter 4. In Chapters 5 and 6, conflicts and compatibilities among social, environmental, and regional constituencies in LIS are identified and discussed. The survey tool was also used in these chapters, but different analyses techniques and stakeholder groupings were applied. Chapter 5 focused on regional governance, while Chapter 6 explored the relationships among science, policy, and the public. Using survey results and multivariate analysis in Chapter 7, I looked at factors responsible for how individual ecosystem services are valued. Specific hypotheses and objectives are outlined below.

a. Main Hypotheses:

1. A survey can be used as a tool to develop a comprehensive vision for LIS on which a CMSP can be based.
    a. Compatibilities do exist among some stakeholder groups about their views on ecosystem services in LIS.
    b. There is general agreement on the use of CMSP as a tool to implement EBM between regions and stakeholder groups.
2. There are differences of opinion among various stakeholder groups regarding LIS (i.e., how it should be used) that generate apparent conflicts.
    a. Regional conflicts exist in management priorities.
    b. Regional conflicts exist in the valuation of ecosystem services.
    c. Ecosystem-based management knowledge gaps exist between scientists and non-scientists.
    d. Perceived issues and management priorities vary among stakeholder groups.
    e. Stakeholder groups value ecosystem uses and services differently.
3. All of the above issues are quantifiable and can be addressed in a quantitative way.
4. A survey is a good way to quantify conflicts and incorporate stakeholder opinion into CMSP process early on.

b. Objectives:

1. Define existing ecological, social, and political conditions.
2. Explore the theoretical and conceptual basis for CMSP.
3. Identify and synthesize relevant background literature.
4. Identify stakeholder groups.
5. Identify and assess ecosystem service values (by stakeholder groups and region).
6. Identify stakeholder groups' perceptions and knowledge of LIS.
7. Describe conflicts and compatibilities (by stakeholder groups and region).
8. Outline the need for CMSP.
9. Identify possible spatial use conflicts and compatibilities.
10. Analyze how CMSP could relieve user conflict.

11. Identify existing marine management measures relevant to LIS and examine how CMSP would interact with these.
12. Determine current governmental structure and function for marine management decisions for LIS with regard to CMSP.

Koppelman (2007) diagrammed a strategy for successful comprehensive terrestrial planning on Long Island. The first three steps include inventory, analysis, and projection (Figure 3). The 12 specific research objectives (see above) for this dissertation correlate well with Koppelman's three steps (Figure 3). In addition, Koppelman (2007) stated that these preliminary planning steps should be value-free and re-examined when goals are developed for the project. In moving forward on the fundamental steps in a planning process, the 12 research objectives (above) will lay the groundwork for goals to be created and decisions to be made surrounding a planning process in LIS.

Chapter 1 Figures:

Figure 1. A county map of New York and Connecticut. (ESRI 2013)

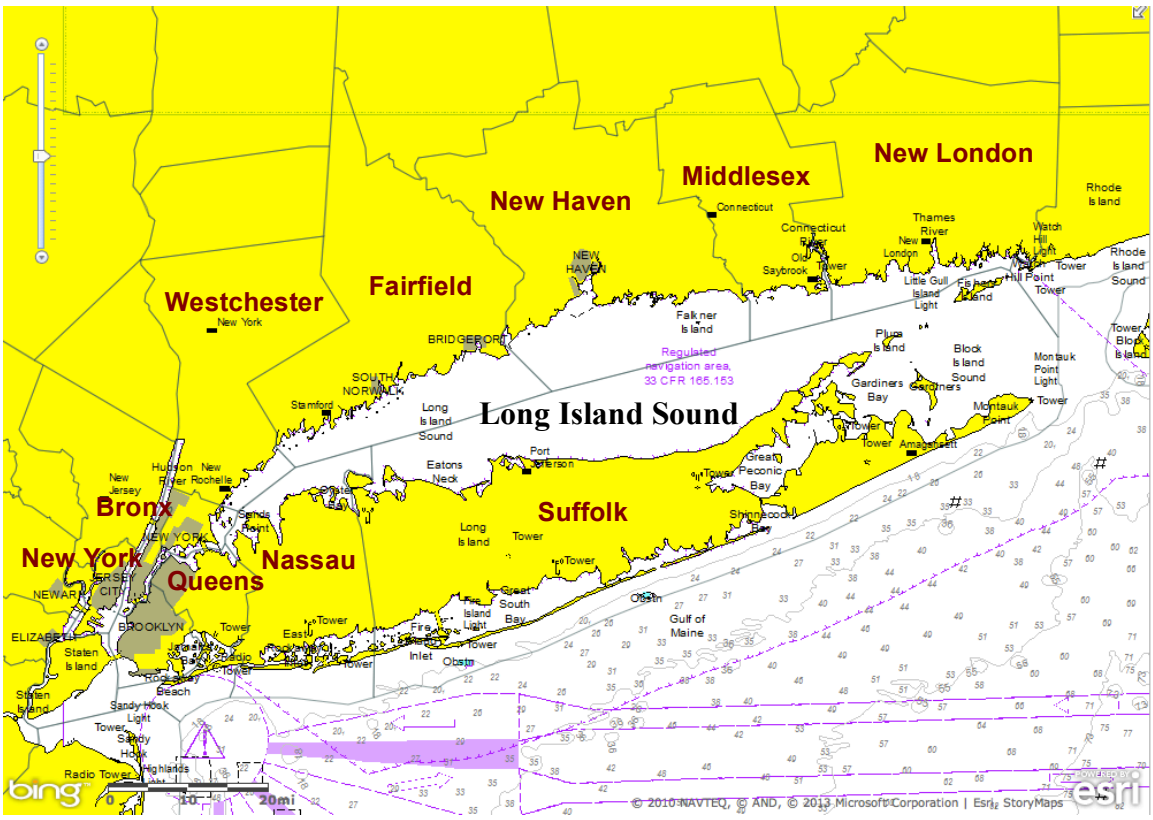


Figure 2. Ten step approach to CMSP. The red outline represents the steps this dissertation focuses on. Figure modified from (Ehler & Douvere 2009).

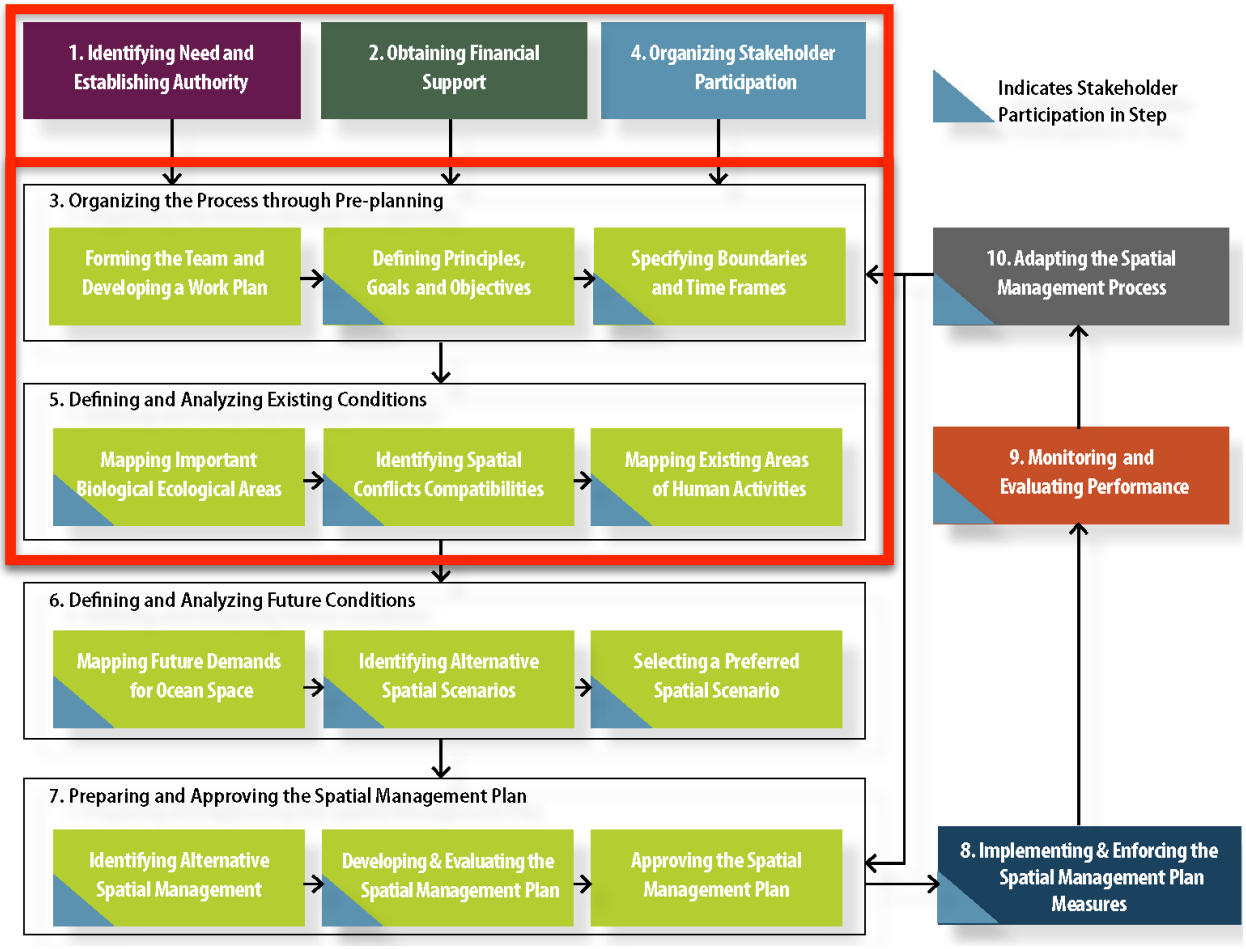
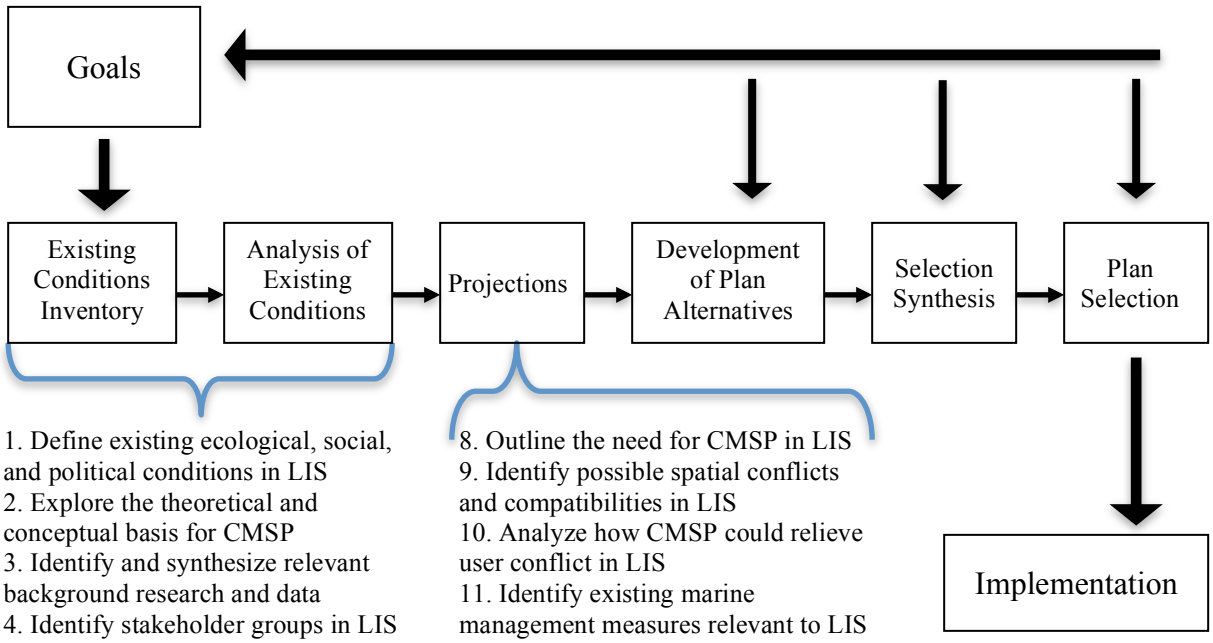


Figure 3. Comprehensive planning systems model for LI, with dissertation research objectives. Adapted from Koppelman (2007).



Chapter 1 Tables:

Table 1. Ten Steps for Successful CMSP (Ehler & Douvere 2009).

Nr.	Step
1.	Establish context/need and authority
2.	Obtain financial support
3.	Organize the process
4.	Organize stakeholder participation
5.	Define and analyze existing conditions
6.	Define and analyze future conditions
7.	Prepare and approve the spatial management plan
8.	Implement and enforce the plan
9.	Monitor and evaluate performance
10.	Adapt the process

Chapter 2. *Methodology*

2.1 Motivation and Approach

The overall goal of this dissertation was to examine how an ecosystem-based comprehensive coastal and marine spatial plan (CMSP) could be implemented in Long Island Sound (LIS) considering governmental, social, economic, and ecological factors. The conceptual basis for the design and implementation of a CMSP in LIS relied on established general approaches for land use planning and CMSP (Koppelman 2007, Ehler & Douvere 2009).

My initial findings, based on results from a pilot survey, literature searches, and unstructured interviews with various LIS stakeholders, suggest that there is a timely need to make advances in two out of the ten steps (Chapter 1, Figure 2) advocated by Ehler and Douvere (2009) in *Marine Spatial Planning, A Step-by-Step Approach toward Ecosystem-based Management.* The two particular steps are: "Identify need and establish authority," and "Set up planning for marine spatial management," (i.e., "Organize the process through pre-planning").

Briefly, the first step of the approach by Ehler and Douvere (2009) requires justification for implementing CMSP. Specific questions that need to be addressed include: is there actually a need for CMSP in LIS, and, are current management efforts sufficient? The first step also requires identifying an existing mechanism with "appropriate and sufficient authority" to create and implement CMSP (Ehler & Douvere 2009). For example, management authority over LIS is split between two states (i.e., NY and CT), which has created problems and mismatches in LIS governance in the past (O'Connell 2006, Melia 2011). Is there existing authority within a bi-state committee or organization to coordinate and implement CMSP in LIS? If not, how should we create such an authority and coordinate bi-state governance of CMSP in LIS?

The other step requires setting up the planning for CMSP and organizing the process through pre-planning. This involves creating a framework specifically designed to help guide important decisions during the planning stages of CMSP. Identifying stakeholders and ecosystem services in LIS is crucial here. It is also necessary to document relative importance of the individual ecosystem services. The planning process is organized by laying out different

management scenarios and anticipating possible conflicts from the start. Key players (agencies, NGOs, etc.) that should be involved in the initial planning effort are identified and discussed, including a plan to involve them (Ehler & Douvere 2009).

To investigate the complexity of issues surrounding the two above-mentioned steps, I have decided to rely on a survey and multi-disciplinary literature synthesis. While there are advantages and disadvantages to using a survey in research in this case, it was deemed appropriate as an efficient way to collect opinion data from a large group of people (Patten 2001, Altizer 2004). Using a representative subset of the population, such a survey would identify LIS knowledge gaps as well as perceptions of stakeholders that might be involved in a LIS CMSP. For example, a well-designed survey could help identify the current social and ecological conflicts as well as compatibilities. I argue that a survey is a powerful tool that explores the level of knowledge as well as perceived conflicts and compatibilities among various stakeholder groups and regions.

Therefore, a targeted stakeholder survey was developed in accordance with established guidelines for effective and ethical survey design and administration (Patten 2001, Altizer 2004). Using survey results, I was able to document conflicts and compatibilities for LIS, management priorities, perceived knowledge levels, and relative values of ecosystem services among user groups and regions, and identify and qualify use values and needs, management goals and perceptions, and visions for LIS. Specifically, current and future needs, equity issues, and attitudes toward existing management strategies in the Sound were examined, as well as ideas and attitudes regarding CMSP in LIS. By working closely with the Long Island Sound Study (LISS), the survey was electronically administered, and involved businesses, non-governmental organizations (NGOs), scientists, recreational groups, community members, naturalists, fishermen, managers, and policy makers.

Using this stakeholder survey and a synthesis effort of existing CMSP initiatives such as Australia's Great Barrier Reef Marine Park and the California Ocean Protection Act, I identified where potential conflicts or significant differences among user groups might exist. The literature synthesis also revealed current and past LIS conflicts using newspaper searches and unstructured interviews with LISS members. Case studies of other CMSP efforts provided important information on conflicts that may develop in the CMSP process and were used to identify at what

stage and level stakeholders should get involved in the CMSP process. In parallel, I compiled a list of the significant ecosystem services in LIS from management reports and literature reviews. The status of LIS's ecosystem services is described in the background section of this thesis. Using the survey, I sought to compare the relative values and importance of these ecosystem services by having participants score how they valued them.

2.2 Synthesis and Background

I conducted a review of CMSP and LIS management using multi-disciplinary literature searches and by informally interviewing members of the LISS. The interviews focused on historical conflicts in LIS, management problems, and political issues. The multi-disciplinary literature review included the fields of marine science, ecology, social science, economics, and history. The literature review informed development of the survey goals and questions, as well as overall assessments of CMSP in LIS and background research. Sources included journals, newspaper articles, management reports, research reports, and conference proceedings. I used the online database, Web of Science, to comb though journal articles on ecosystem-based management (EBM), CMSP, marine zoning, marine protected areas (MPAs), marine reserves/parks, integrated ecosystem assessments (IEAs), coastal management, survey design, ecosystem services, environmental economics, marine/ocean policy, and stakeholder involvement. I particularly emphasized research highlighting locations where some aspect of CMSP (e.g., MPAs) had been implemented, including Australia, California, and Massachusetts.

The databases Lexis-Nexis and ProQuest were used for newspaper searches to document management issues and conflicts in LIS. The newspapers I consulted included popular local sources such as *Newsday* and *The Connecticut Post*, as well as national publications such as *The New York Times*. Specific terms used in the search were "Long Island Sound," "conflict," and "management." In order to document various types of conflict in LIS, another specific search, going back to the year 2001, was done for the term "Long Island Sound" in the three area newspapers listed above. Duplicate articles were disregarded. Articles were recorded if they fit into one of the following five categories: dredging, funding/restoration, shipping, fishing/ lobsters, pollution, and conflicts (other) (Table 1). If an article fit into more than one of six

categories, the category that was more geared towards the main idea of the article was used. These results specifically helped in crafting possible responses for management priorities in the survey.

2.3 Survey Development

I researched best practices for survey methodology and reviewed the literature for effective design and analysis techniques. Using guidelines and principles published by the Ethics Resource Center (Altizer 2004), I designed both a pilot and final survey. In addition, I consulted with experts in survey design throughout development and administration of the pilot and final surveys. I worked with social scientists including Dr. Tara L'Heureux, Department of Psychology at the University of New Haven, Stephen McDonough, Department of Psychology at North Carolina State University, and Dr. Laura Kirsch, Department of Psychology at Curry College in Massachusetts. I also solicited comments and feedback from environmental professionals who had experience using surveys as research tools including Dr. Marci Bortman of The Nature Conservancy.

One of the first protocols in effective survey design is conducting background research and determining the purpose of the study (Altizer 2004). I conducted an extensive literature review using journals, regional and local newspapers, and management reports. As previously described, I used results from the literature search as background material needed to shape the survey. The literature search was specifically useful in the design of questions, as well as formulating an exhaustive list of response options. However, there are many other steps prior to designing the survey itself, including defining research goals, sample population, and sample size (Patten 2001, Altizer 2004). Research goals for my survey are defined in Table 2.

The target population was determined to be active stakeholders around LIS. For the purposes of this study, stakeholders are defined as persons that have an individual or group interest in the management of LIS or who are actively engaged in at least one ecosystem service in LIS. The survey was designed to target stakeholders who have some familiarity with LIS and its issues, and who might be involved early on in a CMSP process.

The next step of survey design is identifying mechanisms for distribution and collection. A pilot survey should then be developed and administered (Patten 2001, Altizer 2004). I developed

and tested a pilot survey based on my thesis research goals. Background research from the literature searches, informal interviews with LIS stakeholders, and discussions at LISS meetings helped shape survey design and administration. After my pilot survey was analyzed, I proceeded to final survey development. Paper questionnaires were used in the pilot survey and were distributed/collected in person. I chose an online platform for the final survey, as it had a greater reach to a broader audience.

In survey design, one of the most important points is minimizing bias. For my survey, I tried to reduce bias by having a large sample size (n>200), constructing questions per best design practices, incorporating feedback from participants in the pilot survey, and reviewing questions and analysis options with survey experts. I paid particular attention to the following best practices in survey design: specifying time periods (e.g., "10 years ago" versus "recent past"), having exhaustive response options, providing definitions for scientific jargon and poorly understood terminology (e.g., dredging), using "Don't know" or "N/A" sparingly, being very specific in each question, and repeating questions in different forms throughout the survey (Patten 2001). In addition, in order to maintain the privacy of survey respondents, all questions involving identification information and/or demographics were grouped together and not mandatory (i.e., could be skipped).

Likert scales were used in the design of many survey questions, because they are an effective question-type when measuring attitudes or opinions (Patten 2001). Likert scales often involve asking respondents how much they agree or disagree, support/don't support, value/don't value, are satisfied/not satisfied with a particular issue using a categorical scale. These scales can also be converted into numbers, which can be helpful in survey analysis. For example:

- Please give your opinion of this thesis so far using a 1-5 scale, with 1 being very good, 3 being neutral, and 5 being very bad.

Most Likert scales in my survey have an odd number of choices, with a neutral category in the middle and a balanced number of responses on either side. Although Likert scales can have up to seven categories, I used no more than five-point Likert scales, in order to reduce complexity for survey respondents and bias in survey analysis. In addition, "N/A," "Undecided," and "Don't know" categories were used sparingly. Research shows that having these options increases the chances of respondents checking off, "Don't know," instead of

actively thinking about the question (Patten 2001). Open-ended questions were also asked in both surveys to allow respondents to expand on their answers to previous questions.

a. Pilot Survey

A preliminary study, including a pilot survey, was utilized to better understand user group conflicts and perceived effectiveness of management strategies in LIS. The main goal was to inform the design of a larger-scale stakeholder survey to be used in this study. Background research was done to identify management concerns in LIS and the various stakeholder groups. Under the guidance of social scientists, a small-scale pilot survey was developed and administered in September and October 2010. The pilot survey targeted a representative sample of managers, scientists, and community leaders from both NY and CT directly involved in LIS (n=45, 64% response rate).

Participants were given a brief verbal description of the project and asked to fill out a survey at three different meetings I attended: the Long Island Sound Study's managers meeting and Science and Technical Advisory Committee meeting, both in Stony Brook, NY, and the LIS Biennial Research Conference in Stamford, CT. Paper copies were distributed and collected in a box at the end of the meeting day. Surveys were kept confidential and participants had the option of answering anonymously, and were also given the option to mail in their completed survey.

The pilot survey consisted of a mix of qualitative and quantitative questions. Five point Likert scales (e.g., a range of 1 to 5, 1 being least agree, 3 neutral, and 5 most agree) were used to gauge participants' opinions on statements and activities. In order to have an adequate scale for Likert-type questions in the final survey, a write-in "other" category was often given as a choice in the pilot survey's questions to see if any responses were missing. From this data, preliminary trends and patterns in perceptions of LIS were identified. A preference pattern emerged regarding certain uses and services over others by the NY (i.e., NY and NJ respondents) and CT (i.e., CT, MA, and RI respondents) regions. For example, in Figure 1, considering uses that fall above 0.3 or below -0.3 weighted mean (marked by the blue lines), the data show the NY respondents (on average) had a higher opinion of recreational fishing/boating, effluent disposal, party boats, ferries, waste-to-energy (WTE), liquid natural gas (LNG) facilities, and

motorized recreation than CT, while CT respondents had a higher view of commercial shell-fishing, aquaculture, dredge disposal, and wind/wave energy than NY. Both regions appear to agree on a negative view of runoff and coastal development, and a positive view of commercial fishing (no trawls), shipping/transportation, and commerce/ports.

The results of the pilot survey helped shape the types of questions, language, and overall development of the broader-based online stakeholder survey, on which much of this research project is based. After analyzing responses, questions were reassessed for their ease of understanding and effectiveness at contributing to my main research objective and survey goals.

Questions that were identified as problematic were either reformulated or excluded from the final version. The open-ended questions and "other" columns in the more quantitative ones were used to see if anything was missing in the pilot, such as uses/services or management priorities. Comments from participants were taken into account, including suggestions for additional questions they believed would provide essential data to initiate CMSP in LIS.

b. Final Survey Development

The final LIS Stakeholder Survey was conducted entirely electronically for ease of distribution and access to different stakeholder channels. Expedited review was received from the SBU Committee on Research Involving Human Subjects (CORIHS) in December 2010. The survey ran from March 13 to August 15, 2011, and took approximately 20-30 minutes to complete. Data collected for the survey were obtained in a coded manner using the first three letters of the mother's maiden name, and participants were given the choice to answer anonymously. Participants were given the opportunity to save their work and continue the survey at a later time.

The survey had five sections with 27 individual questions, however some questions had multiple components (Appendix 1). Some of the questions were made optional, and some mandatory. The first two questions involved contact information (optional) and asked if the respondent participated in the pilot survey (mandatory). The first section of the survey was *Background information*, questions 3-12, which identified respondents' relationship with the LIS ecosystem. Questions included their location, proximity to LIS, relationship with LIS, ecosystem knowledge, and opinions on the state of LIS. The second section (question 13), *How*

do you value LIS (uses and services), asked how the respondent personally valued 20 specific ecosystem services in five different ecosystem service categories using a five-point Likert scale, ranging from "do not value at all" to "strongly value."

In the third section, *Management challenges in LIS: current and potential*, questions 14-18, respondents were asked about management issues and satisfaction, as well as their perceptions of the ecological health and spatial conflicts in LIS. This section was a mix of quantitative and qualitative questions. Open-ended qualitative questions allowed for more in-depth answers from survey participants (Curtice et al. 2012).

The fourth section, *Your vision for LIS,* questions 19-22, dealt with evaluation of specific current and potential activities. Using the five-point Likert scale, responses ranged from "negative: reduce or eliminate/should not be in LIS," to "positive: would like to see more/ implement in LIS." The last section, *Management: looking ahead*, questions 23-27, evaluated opinions on and support for specific management and regulatory options, including CMSP, and thoughts on implementation. A mix of quantitative and open-ended qualitative questions was used in this section. I also inquired about respondents' perceptions of current spatial allocations in LIS for both commercial activity and habitat preservation/conservation. At the end of the survey, participants were asked if they were willing to be involved in any survey follow-up, and there was room for comments, along with my contact information.

c. Survey Distribution and Administration

Distribution of the survey was not conducted in a completely randomized fashion. Outreach efforts were specifically targeted to people who have been involved in LIS issues/ projects or are likely to be involved in/have opinions on future management efforts in LIS. This was to ensure that all participants were active stakeholders in LIS. Subjects were recruited in a variety of ways including working directly with the Long Island Sound Study's membership, Science and Technical Advisory Committee, Management Committee, Citizen's Advisory Committee, and Stewardship Initiative. I also reached out to organizations such as Save the Sound and The Nature Conservancy, and to state officials/agencies in NY and CT. Using my past experience as a professional community organizer, I employed established organizing and outreach techniques to distribute the survey. For example, a successful method was reaching out

to key players in existing groups/programs (e.g., sailing or fishing clubs, management agencies, or educational programs) and having them reach out directly to their networks, members, and affiliates with a personal note asking them to take my survey. I also solicited suggestions of other groups/individuals I should contact who could help the survey reach a broader audience. To attain a more representative sample of stakeholder groups, subjects were also identified through web-based research on businesses (e.g., marinas, fishermen, party boat companies), NGOs, local government officials, boating and fishing associations, and community groups/educational programs in and around LIS.

The online program and website Survey Gizmo (www.surveygizmo.com) was used to construct and administer the survey. Survey Gizmo allows for real-time monitoring and tracking of both invitations and responses. Initial outreach efforts involved sending an email (Table 3) explaining the project and asking subjects to click on a link that took them to the survey. The original email was sent to the Long Island Sound Study's (LISS) Management, Citizens Advisory, and Science and Technical Advisory Committees, the LISS Stewardship Initiative's network, Sound Vision's network, Connecticut Department of Environmental Protection's networks, and students and faculty at SBU's School of Marine and Atmospheric Sciences (Table 3). The number of subjects was carefully tracked on the forwarded invitations by always having groups include me in their distributions.

A second round of email invitations was sent to other groups and individuals involved in LIS. A total of 1,010 invitations were sent. Second and third requests to complete the survey were sent out in June and July, respectively. In addition, it is possible that participants who received the survey link forwarded it to others, whom I was unable to record in the overall invite list. In order to be conservative in calculating the survey's response rate, an additional 200 invitations were added to the recorded 1,010 (to account for this possible discrepancy) for a total of 1,210 invitations. The number 200 was chosen because it was assumed many of the people who may have received the link to participate from other sources would have already received an initial "accounted for" invitation since there was a very thorough distribution of the initial and second round of email invitations.

2.4 Survey Analysis

Most of the data analysis was done using the statistical software package SPSS, Version 18, and the rest with Microsoft Excel. For most questions, the tests of normality using Kolmogorov-Smirnov statistic is significant ($p<0.05$), suggesting a violation of normality. However, Tabachnick and Fidell (2007) discern that normality, including skewness (distribution) and kurtosis (sharpness of curvature), will not make a substantive difference in the statistical analysis if there is a sample size over 200, which is the case here (n=394). For these reasons, Likert scale data are treated as continuous versus interval, and ANOVAs are used to test for significance among user groups (Tabachnick 2007). Reliability of the survey itself was tested using Crobach's Alpha Coefficient, which looks at the quality of measurement procedure and internal consistency of the data (Pallant 2010). The survey had a reliability of >0.70, which is considered sufficient for most research situations.

a. Characterization of Sample Population

At the close of the survey, there were a total of 406 completed and mostly completed responses. After checking the integrity of the data and removing duplicate entries, a total of 394 surveys remained. Given the number of respondents, the survey had a 95% confidence level with a +/- 5% point margin of error. Only 11.2% of respondents reported having previously taken the paper pilot survey, confirming that the final on-line survey had a broader reach. The survey had a 33% response rate (a conservative estimate), where 52% (n=206) of completed surveys were from the Mid-Atlantic region (New York, New Jersey); 47% (n=185) from the New England region (Connecticut, Rhode Island, Massachusetts); and 1% (n=3) in neither region (Figure 2a). The specific breakdown by states is shown in Figure 2b.

The majority of respondents lived and worked within 10 miles of LIS, 58.9% and 64.6% respectively (Figures 3 and 4). Less than 13% of respondents lived or worked more than 50 miles away from LIS. In addition, the majority of respondents did not segregate themselves to just one of the six basins identified for LIS (Figure 5) – 56.8% identified visiting or working in the entire LIS (Figure 6). However the two basins that were reportedly used the most were the Western Basin South (Area 2A) and the Eastern Basin North (Area 4B) (Figure 6).

Participants were asked to identify and rank the top three user groups they most identified with. Although there were participants in each category, most identified themselves as Scientists, Recreationalists, or Community residents (Table 4).

Survey participants were able to designate a primary, secondary and tertiary user group for themselves in survey question 8, "What relationship do you most/best identify yourself as having with LIS," with primary being the group they best identified themselves with. Only the primary user group designation was used in much of the analysis unless otherwise noted. In addition, the survey's 16 user groups were condensed to eight for statistical analysis among stakeholder groups. The original 16 user groups represented much more specific interests than the broader eight (Table 5a). This was done to ensure robust results, putting a larger number ($n>20$) of respondents in each stakeholder category.

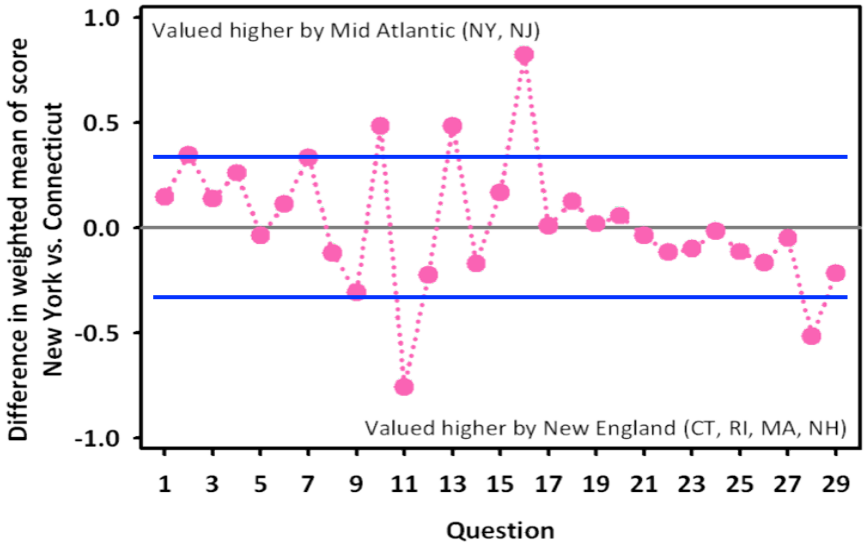
After reviewing the data, user groups were reassigned to the eight primary categories of: Managers (n=46), Scientists (n=84), Active Recreation (n=57), Passive Recreation (n=56), Businesses/Economic Interests (n=29), Community Members (n=38), Government (n=49), and NGOs (n=38) as per Table 5a and 5b. In order to account for discrepancies in the sample sizes of each group, means and ANOVAs were used in the statistical analysis. The original Education category (n=17) was entirely removed and participants were reassigned based on their secondary user group designation, as per Table 5b. This was done because the group "Educator" was deemed to be too broad and not necessarily representative of one particular user group's interests; that is, what you "educate" really depends on your motivations and what other user group you associate yourself with. For example, if participants identified themselves as primarily an Educator, but secondarily for Energy/Infrastructure, their priorities would be based on energy/infrastructure education, and if they secondarily identified themselves as a Scientist, it would be more science-oriented education.

I tried to determine economic bias by asking about respondent's business and economic involvement/relationship in LIS (Figure 7). Only 15.3% of survey respondents reported being involved in a water dependent business related to LIS. Of those, almost half, 43.3%, owned the business. When asked what they thought the economic prospect was for their business in the next five years, 23.4% thought business prospects were bad-very bad, 29.8% thought prospects were good-very good, while the largest percentage, 46.8%, was neutral. However out of the

23.4% that thought business would be worse, only 2.1% registered "Very Bad." These data, however, do not tell us what is actually influencing the prospects of the business over the next five years. For example, in a failing charter boat operation, is it lack of fish, bad business practices, or the economy hurting the business?

Chapter 2 Figures:

Figure 1. Value variations among Mid-Atlantic and New England users in pilot survey, displaying the differences in the weighted means between Mid-Atlantic (NY, NJ) and New England (CT, RI, MA, NH) respondents. When the difference was positive, it indicates that the use was valued higher in one region over the other; points that fall on the center line indicate agreement. The blue lines refer to 0.3 and -0.3 on the y axis. The questions that numbers on the x-axis are referring to are listed in the legend.



Legend: Question numbers (on x-axis) and ecosystem uses and services they refer to

Question #	Ecosystem Service	Question #	Ecosystem Service
1	Recreation/aesthetic services	16	Transportation (commuting, travel)
2	Scenic views/viewscape	17	Energy development (non-renewable)
3	Recreational fisheries	18	Energy development (renewable/green)
4	Active recreation (boating, jet skiing, etc.)	19	Ecosystem protective services
5	Non-consumptive recreation (bird watching, beach going, diving, swimming, kayaking, etc.)	20	Buffer wave energy, storm/flood protection
6	Public access	21	Biodiversity/trophic structure/food web
7	Tourism	22	Ecosystem Functional services
8	Aesthetic/existence value	23	Filter nutrients (i.e. from runoff, effluent)
9	Provisioning services	24	Wildlife habitat
10	Property values	25	Historic/Educational services
11	Aquaculture potential	26	Historic significance
12	Repository (i.e., dredge spoil, effluent disposal)	27	Stewardship/ educational value
13	Commercial fisheries	28	Working waterfronts
14	Leasing of shellfish beds	29	Research
15	Transportation (shipping)		

Figures 2a and 2b. Breakdown of survey respondents by New England and Mid-Atlantic regions (a), and by state (b).

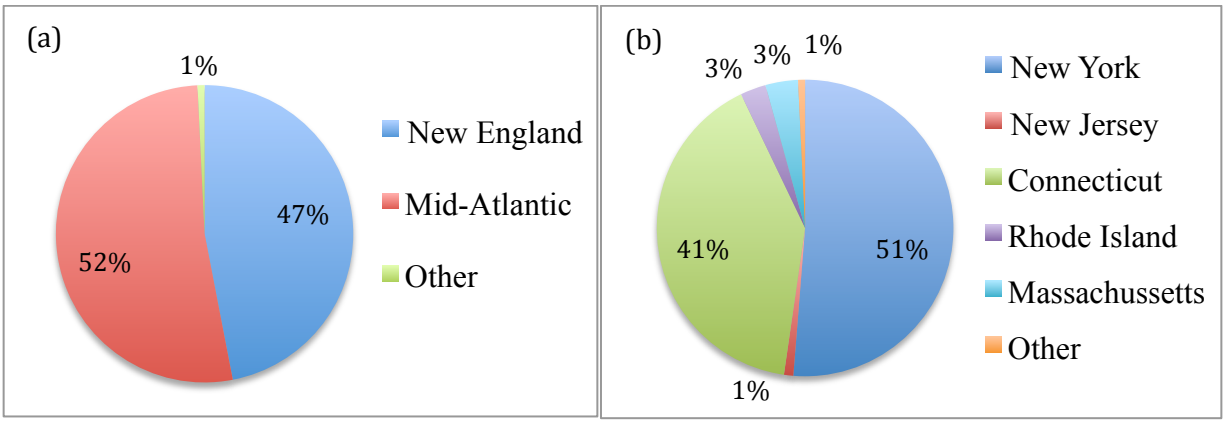


Figure 3. Distance of respondents' residences from LIS in approximate number of miles.

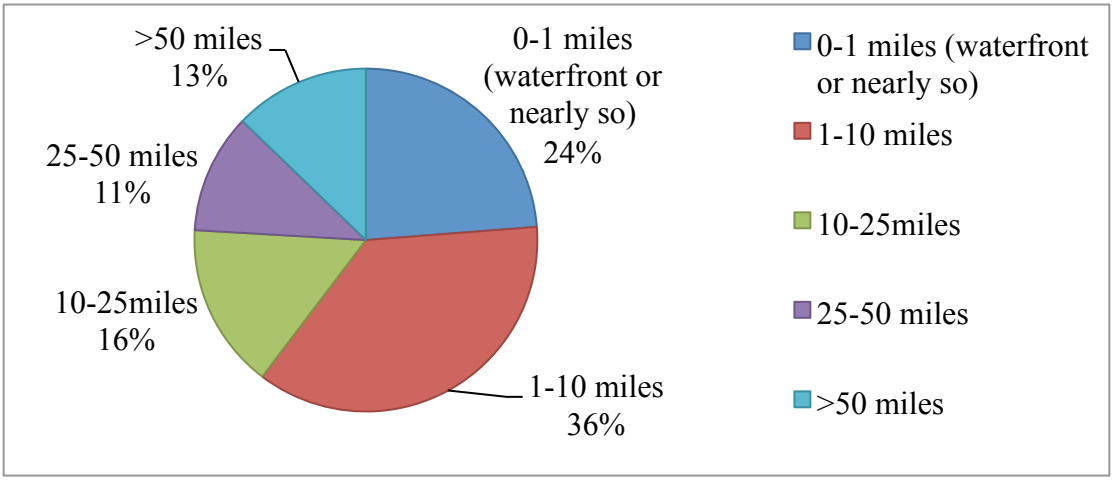


Figure 4. Distance of respondents' place of work from LIS, in approximate number of miles.

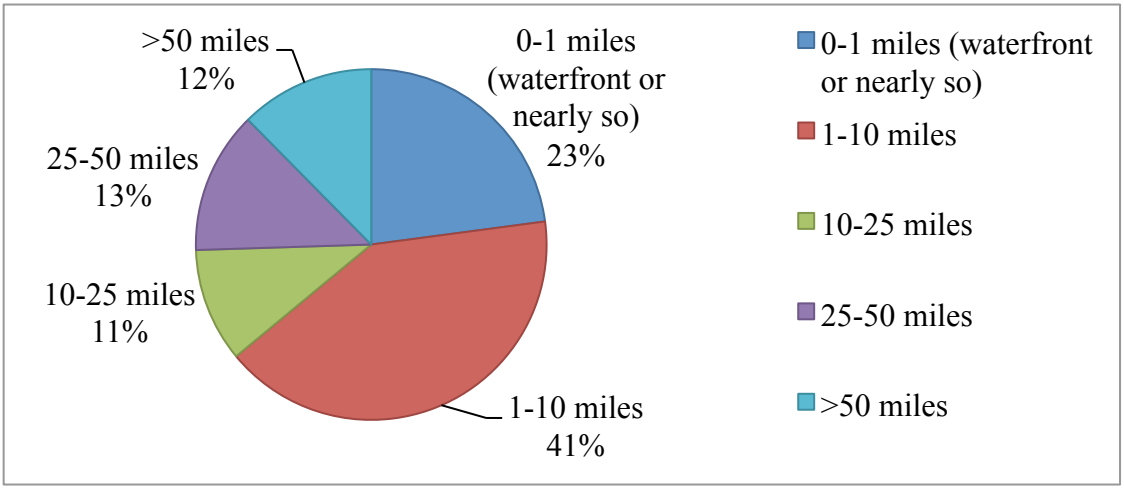


Figure 5. Map of different Long Island Sound basins (used in the survey).

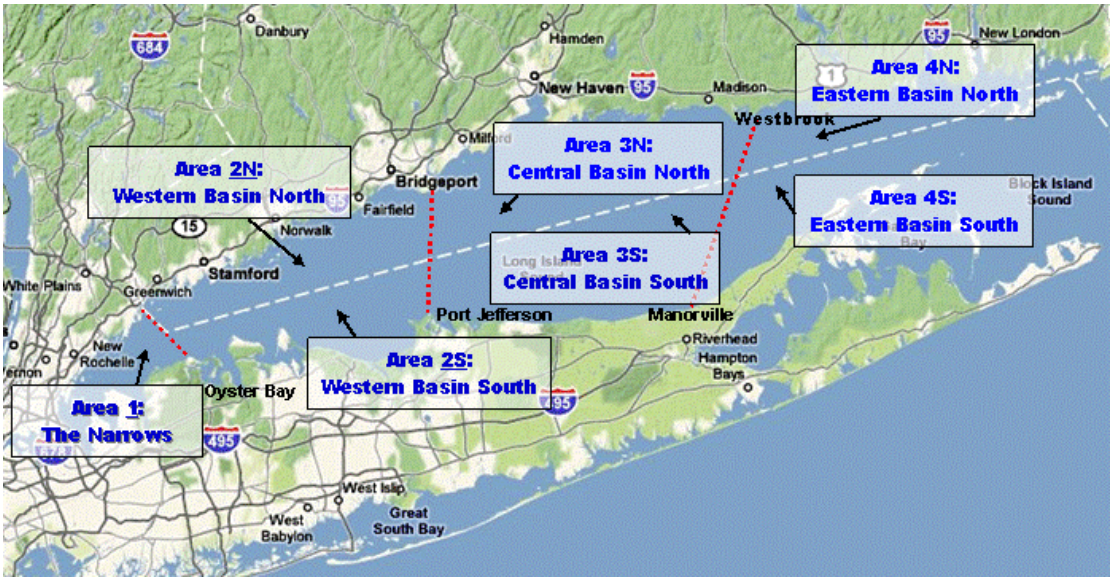


Figure 6. The areas of LIS (as per Figure 5) that respondents most often visited, worked (or their work impacted). Participants were instructed to check all that apply. Areas are listed from west to east across LIS.

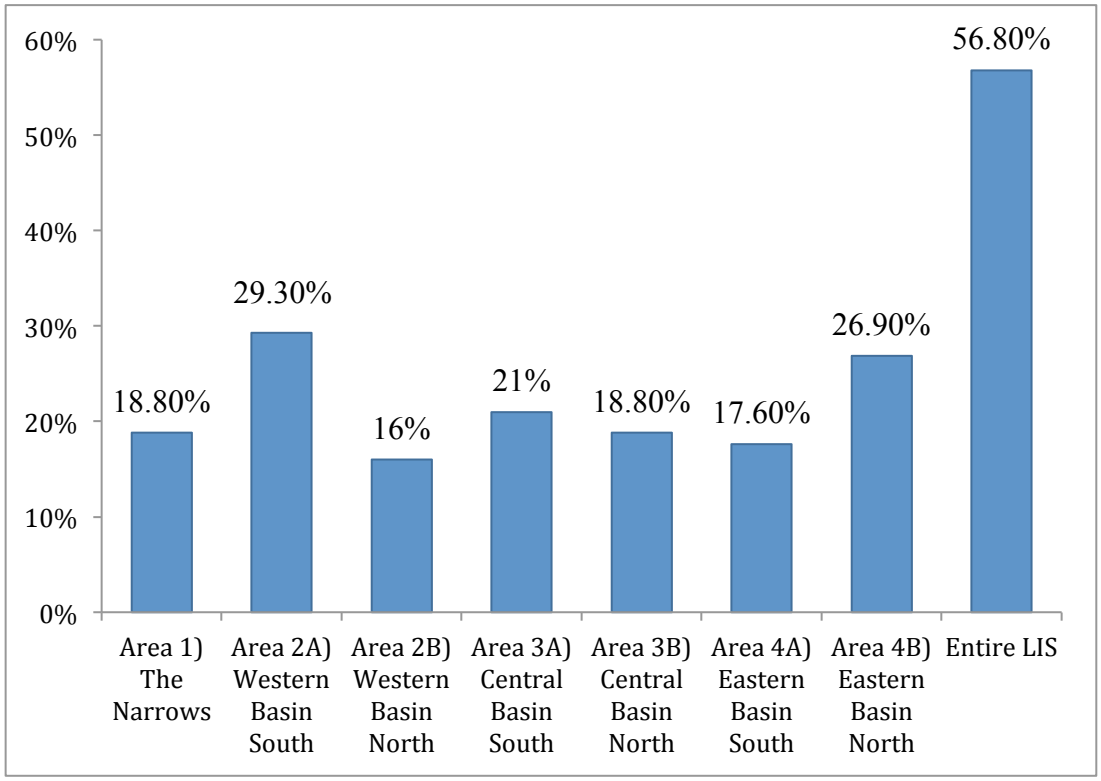
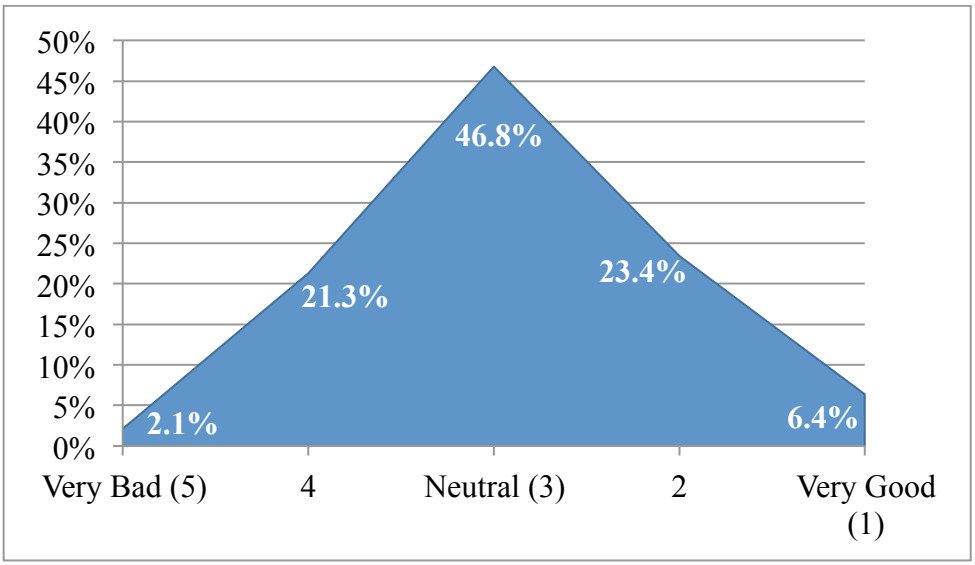


Figure 7. Five-year economic prospect for the businesses that respondents are involved in. The scale ranges from Very Bad to Very Good, from left to right on the x-axis.



Chapter 2 Tables:

Table 1. Search results of the term "Long Island Sound," from the newspapers *Newsday* (n=2,551 articles), *The New York Times* (including the Connecticut Weekly Desk, and Long Island Weekly Desk) (n=1200 articles), and the *Connecticut Post* (n>1986 articles) over the course of October-December 2012. The search included the term "Long Island Sound," and went back to the year 2001. Articles were counted if they fell into one of the categories listed below. Total (N) articles for each category are listed along the bottom row.

	Dredging	Funding/ Restoration	Shipping	Fishing/ Lobsters	Pollution	Conflict (other)
The New York Times	6	13	4	26	17	40
The Connecticut Post	14	10	3	15	9	6
Newsday	10	11	0	15	16	12
N	*30*	*34*	*7*	*56*	*42*	*58*

Table 2. LIS survey research goals.

LIS Survey Research Goals:

- Conduct a knowledge assessment of LIS issues and topics
    - Identify knowledge gaps

- Identify the perceived issues, ecological health, and management priorities
    - Identify the conflicts and compatibilities among user groups and regions

- Determine the relative values of LIS's ecosystem services
    - Identify where there is the most agreement
    - Identify where is the most disagreement
    - Determine relative importance of ecosystem services
    - Identify where there are conflicts and compatibilities

- Identify how current and proposed future uses in LIS are viewed
    - Identify where there is the most agreement
    - Identify where is the most disagreement
    - Identify the conflicts and compatibilities among user groups and regions

- Identify the amount of area that should be set aside in LIS for both commercial purposes and conservation
    - Identify the conflicts and compatibilities among user groups and regions

- Identify level of support for CMSP in LIS
    - Determine if and how opinions vary by user group and region

Table 3. Survey email invitation.

Colleagues,

You are being invited to take part in an online survey for Long Island Sound (LIS). If you don't mind, please click on the link below (or copy and paste in your browser) to begin: http://s-d50f90-i.edu.surveygizmo.com/s3/i-30466910-180869/

This survey will help us to better understand what kinds of activities people would like to see/not see in LIS, and public perceptions on LIS and its management. As a stakeholder in the region, your input is very valuable to this project.

We would like your completed responses by Monday, August 15th, which is when the on-line survey will close.

Your participation is very important to us and will help shape our work moving forward. We want to make sure the views of different user groups are well represented (including community residents, managers, policy makers, non-profits, scientists, fishermen, boaters, naturalists, industry, businesses, etc.).

Results will be used as part of an on-going thesis research project to better evaluate various management options and visions for LIS.

Survey analysis results will be made available to participants when complete.

I apologize for any cross postings, or if you have already taken the survey. Please feel free to contact me if you have any questions or comments.

Thank You!
Sincerely,
Christine O'Connell
School of Marine and Atmospheric Sciences
Stony Brook University
Stony Brook, NY 11794-5000
caoconne@ic.sunysb.edu
631-632-8641
http://s-d50f90-i.edu.surveygizmo.com/s3/i-30466910-180869/

Table 4. Weighted ranking of survey participants by their relationship to LIS.

Item	Total Score	Ranking
Scientist	297	1
Recreationalist (kayaking, etc.)	191	2
Community resident	183	3
Government official	167	4
Naturalist	161	5
Manager	141	6
Educator	132	7
Boater	129	8
NGO/Non-profit	122	9
Recreational fisherman or angler	113	10
Property owner	101	11
Business owner/operator	42	12
Commercial fisherman	19	13
Industry representative	13	14
Political representative	9	15
Energy/infrastructure developer	7	16

Table 5a. Revised stakeholder group scheme used in analyses, and broken down based on the original 16 user groups to eight.

Original User Groups	User Group Participants Most Identified With (n)			New User Groups	n	*Total N
	Primary	Secondary	Tertiary			
Manager	45	17	15	Manager	45	46
Scientist	79	48	19	Scientist	79	84
NGO/Non-profit	37	11	12	NGO	37	38
Educator	17	37	22	*Reassigned based on secondary associations (Figure 4b)		
Boater	29	25	35	Active Recreation	56	57
Recreational fisherman or angler	27	24	22			
Recreationalist	27	50	56	Passive Recreation	52	56
Naturalist	25	34	47			
Property owner	12	19	21	Business/ Economic	24	29
Business owner/ operator	7	9	8			
Commercial fisherman	4	4	2			
Industry representative	1	2	3			
Energy/infrastructure devpt.	0	3	2			
Community resident	35	36	52	Community	35	38
Political representative	0	2	6	Government	49	49
Government official	49	29	14			
n=	*394*	*350*	*336*		*377*	*394*

Table 5b: Identification scheme of the new group classifications for participants (n=17) who had marked off "Educator" as their original primary user group. New Groups for "Educator" were assigned based on participant's secondary group association.

Original Primary User Group	Secondary Association	n	New User Group Category
1. Educator	Manager	1	Manager (n=1)
2. Educator	Scientist	5	Scientist (n=5)
3. Educator	Scientist		
4. Educator	Scientist		
5. Educator	Scientist		
6. Educator	Scientist		
7. Educator	Recreational Fisherman	1	Passive
8. Educator	Passive Recreationalist	4	Recreationalist (n=5)
9. Educator	Passive Recreationalist		
10. Educator	Passive Recreationalist		
11. Educator	Passive Recreationalist		
12. Educator	Energy/infrastructure Representative	1	Business/Economic
13. Educator	Business Owner/Operator	4	(n=5)
14. Educator	Business Owner/Operator		
15. Educator	Business Owner/Operator		
16. Educator	Business Owner/Operator		
17. Educator	NGO	1	NGO (n=1)

Chapter 3. *Literature Synthesis and Background*

3.1 "Tragedy of the Commons"

Coastal zones are dynamic places, serving as centers of activity for both social and ecological systems. People have been drawn to coasts throughout history. Early American colonists clustered in the coastal zone, which then became hubs of development, culture, commerce, and transportation. Today, over half of the US population lives within coastal watershed counties, which occupy less than 20% of the nation's total area (Figure 1) (NOAA 2010). In addition, a myriad of marine and terrestrial organisms rely on coastal oceans at some point in their lifecycle.

Estuaries are the coastal interface between terrestrial and ocean environments. D.W. Pritchard (1967) defined an estuary as a, "semi-enclosed coastal body of water which has a free connection with the open sea and within which sea water is measurably diluted with fresh water derived from land drainage." Estuaries provide environmental, cultural, and economic benefits and services, from the basics of food, water, and shelter/habitat, to complicated energy, transportation, protection/security, commerce, and infrastructure systems. As complex environments, estuaries also facilitate important geological, chemical, biological, and climatic processes. However, of all ocean ecosystems, coastal marine ecosystems such as estuaries suffer from the greatest human impact (Halpern et al. 2008). Because ecologically sensitive coastal zones have significantly higher population densities than the rest of the country (Figure 1) and are projected to keep growing, there is correspondingly more demand on the surrounding air, land, and water resources (NOAA 2010).

In addition, as resources on land are depleted, the oceans are turned to more and more to fill this gap. These demands, along with new technologies that make it cheaper and easier to access marine resources and environments, compound the pressures on coastal environments. Over the next 25 years, the world's population will grow to nearly 9 billion, from currently over 7 billion, putting exponential stress on the earth's resources and coastal environments (United Nations 2012). The United Nations (2012) estimates that, "even by 2030, the world will need at least 50% more food, 45% more energy, and 30% more water…at a time when a changing

environment is creating new limits to supply." Therefore, managing the oceans as a public commons, with sector specific regulations is no longer sufficient to keep up with the growing needs of society and sustain healthy marine ecosystems. Instances of "The Tragedy of the Commons" can be seen throughout the world's oceans, with the large-scale collapse of fisheries as the prime example (Crowder et al. 2008). The capacity of coastal marine systems to provide the important resources and services on which both society and ecosystems rely, becomes compromised as uses and pressures (e.g., climate change, development, etc.) multiply.

Coastal zones and estuaries are relatively fixed spaces with limited resources. As the number of users increase, there will predictably be more conflicts among them. Inevitably, some uses and services of marine environments will interfere with others. For example, conservation areas may limit commercial fishing activities or industrial efforts. Construction of ports and infrastructure may disrupt benthic environments and wetland ecosystems that serve as pollution filters, storm protection, and nursery areas for marine organisms. The continued influx of residents and development in the coastal zone are challenges for both the planning and management of coastal marine environments (NOAA 2010).

3.2 Long Island Sound: An Urban Estuary

Long Island Sound is surrounded by the NY/CT metropolitan area, one of the most densely populated regions in the country. It is 3,419 km^2, with 966 km of coastline, and is nearly 34 km across at its widest point (LISS 2012a). It is bounded by CT to the north, LI to the south, with New York City (NYC) and Westchester County at its west end (Chapter 1, Figure 1). The Sound is an ideal example of an ecologically and socially important estuary facing many management challenges and conflicts (LISS 2012b).

In the tri-state region (New York, New Jersey, and Connecticut), over 23 million people live within 50 miles of LIS (Swanson & Conover 2006). It was estimated that the LIS coasts will be completely "built-out" within the next two decades (NYS DOS 1999). Increased population density, point source discharges from effluent pipes, coastal runoff, and other damaging human activities including trawling, overfishing, shoreline hardening, dredging, and spoiling all negatively impact and will continue to stress LIS.

In general, there is an east-west gradient across LIS of increasing population density and pollution/degraded water quality (Figure 2) (LISS 2012c). Current management efforts have helped improve the health and water quality of LIS to some extent, including restoring various coastal habitats and reducing the levels of nitrogen (Figure 3) and toxicants entering LIS (US EPA 2011). However, the ecology and biology of LIS still suffer from negative human impacts and other continued environmental stresses (LISS 2006). For example, dissolved oxygen concentrations in bottom water decline markedly in an east-west gradient, affecting species abundance and diversity (Parker & O'Reilly 1991, Howell & Simpson 1994). There is toxicity contamination of sediment in some LIS bays and harbors, and elevated levels in seafood; many shellfish beds continue to be closed due to pathogens (US EPA 2011).

Long Island Sound is located in a 43,564 km^2 urban watershed and is linked to the East River, the Hudson-Raritan Estuary and the Atlantic Ocean (Parker & O'Reilly 1991, LISS 2012a). Long Island Sound is a unique estuary in that it has connections to the ocean at both ends, its head at the East River (which connects to the Hudson River, and then the Atlantic) and its mouth at The Race (Tedesco et al. in press). In addition, the long-term net water and salt flux are upstream, toward its mouth (Tedesco et al. in press). Fresh water enters LIS from the Thames, Connecticut, Quinnipiac, and Housatonic Rivers in CT, the Hudson and East Rivers in NY, groundwater discharge, and from coastal runoff and drainage (Wolfe et al. 1991). In addition, LIS represents the southern range limit for many cold-water species (e.g., the American lobster, *Homarus americanus*) and the northern limit for many warmer water species and populations (Tedesco et al. in press).

Forty-four sewage treatment plants discharge directly into the Sound or its adjacent bays and harbors; most do not undergo tertiary treatment, a process that removes nitrogen (IEC, 2011). This adds up to over a billion gallons of effluent per day. In 1991, Wolfe *et al.* (1991) suggested that the disposal of the secondarily treated waste water and untreated storm water runoff, along with extensive coastal development, atmospheric contaminants, decreased stream flow, and groundwater seepage, were all factors leading to the decline of water quality in LIS. And yet, in 2013, human stressors, including chemical toxins, nutrient loadings, and coastal development, continue to negatively impact LIS. Also, disturbances in local fish, shellfish, and crustacean populations due to human activities and environmental factors have had profound

impacts on local fisheries and the economy. For example, a 1999 lobster mortality event in LIS caused the lobster industry to crash and it very likely will not recover. The annual lobster harvest went from 5.3 million kg/year in 1998 to .0.73 million kg/year in 2004, resulting in a $33 million average annual loss to the region (Balcom & Howell 2006).

Long Island Sound supports lucrative fishing, commercial, and recreational industries. Maritime and ocean sectors contribute a large percentage of the region's total GDP (Figure 4). It is estimated that boating, recreational, and commercial fishing, swimming, and beaches contribute nearly $9 billion to the regional economy annually (US EPA 2011). The area also provides critical habitats for marine fishes, bird and plant species, and is designated as an estuary of national significance. It was incorporated into the United States Environmental Protection Agency's (EPA) National Estuary Program in 1988 (US EPA 1994). The Comprehensive Conservation and Management Plan (CCMP) for LIS, developed by federal, state and municipal agencies, local citizens, and the scientific community, was approved in 1994 (US EPA 1994). It includes objectives and actions that relate to protecting water quality, shoreline habitats, building stakeholder involvement, and developing estuary-wide assessments and monitoring programs.

Eutrophication and hypoxic events have been identified as problems in many areas of LIS, especially in the western section, and were specifically targeted in the CCMP (Figure 5) (Parker & O'Reilly 1991). In 1994, a Total Maximum Daily Load (TMDL) for nitrogen was enacted in LIS by the EPA, with the goal of reducing nitrogen loads to LIS by 58.5% by 2014 (US EPA1994), but the deadline was recently moved to 2017. Through largely upgrades to sewage treatment plants, and implementing stormwater best management practices along the coastline, nearly a 43% reduction in nitrogen (from 1990's baseline levels) entering LIS has already been made (Figure 3).

However, despite these reductions in nitrogen (Figure 3), areas in Western LIS and Smithtown Bay continue to become hypoxic every summer for extended periods (Figure 5) (Wilson et al. 2008). In fact, the hypoxic event in the summer of 2012 was the fifth largest in area since 1987, and lasted roughly 40% longer than average (LISS 2012c). Therefore, addressing the nitrogen issue alone by establishing TMDL restrictions has not had its desired ecosystem effects (Wilson et al. 2008).

Furthermore, most fishery management decisions in LIS have been in reaction to the decline of a specific species. For example, management regulations may establish new catch

limits or quotas to help restore a targeted population. Strict management regulations were put in place when the striped bass, *Morone saxatilis,* population crashed in the 1980s. Although the population has recovered, there are still size and quota regulations - one fish per day per recreational fisherman during the 2012 season. In addition, there are often different catch limits, and dates of opening/closing of seasons between CT and NY recreational fishermen in LIS (Sattler 2009). New York is part of the Mid-Atlantic Fishery Management Council and CT is part of the New England Fishery Management Council. There are eight of these regional councils that design fishery management plans for their member states including setting catch limits, and delineating fishing seasons. Because of LIS's split jurisdiction, residents of NY may have one quota for a marine species, while residents of CT may have another quota or set of regulations for the same species, even though they are fishing in the same body of water.

Setting a catch limit for an exploited population does not address how the particular species (i.e., striped bass) affects and is affected by other complicated ecosystem relationships. Setting commercial catch regulations on one species often leads to overfishing of another species, and does nothing to account for bycatch, recreational fishers, or habitat disruptions (Crowder et al. 2008). Catch limits or quotas may also encourage markets for lower marine trophic levels, which can reduce populations of important bait fishes that higher trophic levels rely on for food and intensify conflicts among commercial and recreational fisheries (Crowder et al. 2008). In addition, they do not account for complex phenomena like climate change and its effects on marine populations, processes or habitats. For example, it is hypothesized that cold-water species are declining due to warmer temperatures in LIS, while warm water species are increasing in abundance (CT Department of Environmental Protection 2009). Thus, management strategies need to focus less on individual species and more on ecosystems processes and healthy habitats (Schubel 1998).

3.3. Ecosystem-Based Management (EBM) and Ecosystem Services

Ecosystem-based management (EBM) is the current paradigm for environmental management. Unlike many existing management efforts in LIS, such as catch limits for fisheries, EBM is a place-based, multi-sectored approach that focuses on sustainability (continued use and existence of marine resources), ecological health, and inclusion of humans in the ecosystem (Arkema et al. 2006). Ecosystem-based management is guided by science and emphasizes an ecosystem's structure, functioning, and key processes (Arkema et al. 2006). Most definitions of EBM include specific ecological, human dimensional, and management criteria (Table 1) (Arkema et al. 2006).

Many past marine management efforts focusing on conservation of a single species or protection of small areas have not been successful (NY Department of State 1999). Cloern (2001) suggests that these models of individual processes are gross oversimplifications, and do not account for the complexity of marine ecosystems. Ecosystem approaches to marine conservation, however, account for biological and ecological complexities, including feedback loops, trophic interactions, complex life cycles, and chaotic variability (Cloern 2001).

a. Ecosystem Services

What makes EBM unique from past management approaches is that it views humans as a key part of the ecosystem and manages the ecosystem based on the sustainable use of the services it provides to people (Foley et al. 2010a). The definition of "uses and services" is not just restricted to extractive activities such as mining, fishing, or dredging; we rely on ecosystems for so much more than these direct economic activities. Ecosystem services include all of the benefits gained from the marine environment (Millennium Ecosystem Assessment 2005). As a society, we expect coastal marine systems to sustainably provide services such as climate amelioration, nutrient recycling, and cultural, educational and aesthetic attributes. Understanding the greater role of the healthy marine ecosystems in societal functioning is key to the EBM approach. There is a direct correlation between the condition of an ecosystem and its ability to continue to provide the ecosystem services we value (Millennium Ecosystem Assessment 2005).

The concept of ecosystem services was championed by the United Nation's Millennium Ecosystem Assessment (MEA): Ecosystem and Human Well Being, A Framework for Assessment (MEA 2005). The framework outlines four ecosystem service categories that society values and relies on: provisioning, regulating, cultural, and supporting. However, for the purposes of this study, ecosystem services are divided into five different categories: provisioning, regulating, protective (supporting), aesthetic, and cultural (Table 2).

The MEA cultural services category was split into an aesthetics category and a cultural category to tease out their differences. The provisioning category encompasses the products and services that the ecosystem provides including fisheries, energy production, and waste disposal. Regulating services are the direct benefits we receive from the regulation of ecosystem processes including nutrient recycling, waste processing, and climatic regulation (MEA 2005). Protective services encompass the indirect defensive benefits a healthy functioning ecosystem provides us with, including flood control and storm surge protection. The last two categories, aesthetic and cultural services, are usually harder to quantify. Aesthetic services are the intrinsic values of the ecosystem based on pleasure, inspiration, or existence, such as scenic vistas, beautiful scenery, pleasing recreational experiences, and tourism. Cultural services are comprised of educational experience, cultural or historical significance, and traditional and environmental knowledge. Ecosystem services are often incorporated into EBM efforts to better assess the tradeoffs of various management decisions.

One of the problems managers face with EBM, however, is that logistically it can be challenging to implement. Policies have often preceded the development of tools that are needed to help managers effectively implement EBM into coastal management (Smith et al. 2007). For example, existing software tools designed to help managers implement EBM are frequently difficult to learn. In addition, these software programs require ongoing long-term support, training, maintenance, and funding, which is not always readily available (Curtice et al. 2012). Furthermore, many of these tools are developed by academia, where funding and expertise are often episodic (Curtice et al. 2012). To be useful in EBM, these software programs must regularly updated, freely available to managers, and have long-term consistent funding sources.

b. Coastal and Marine Spatial Planning: An Ecosystem Based Management Tool

There is no one agreed upon way to implement ecosystem-based management (EBM) in the marine environment. It is more of a management philosophy. Coastal and marine spatial planning (CMSP), however, is a specific EBM tool that also embraces the concept of ecosystem services and helps plan for and manage human activities and needs as part of the ecosystem. There is a suggested CMSP framework and various case studies around the world from which to draw examples. Foley et al. (2010) defines CMSP as:

> "…an integrated planning framework that informs the spatial distribution of activities in and on the ocean in order to support current and future uses of ocean ecosystems and maintain the delivery of valuable ecosystem services for future generations in a way that meets ecological, economic, and social objectives."

Coastal and marine spatial planning is a key management 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, Foley et al. 2010a). Rooted in the principles of EBM (Table 1), CMSP is a holistic approach management, considering the interconnectedness of marine systems and the range of activities affecting them (McLeod et al. 2005, Crowder et al. 2006a). The collective impacts of terrestrial and aerial activities are also accounted for. In this way, CMSP acts as a buffer to address uncertainties and the dynamic nature of estuarine environments (Villa et al. 2002, Babcock et al. 2005). CMSP would not necessarily change existing environmental regulations, it would separate incompatible activities and add a spatial and possible temporal component to management (Crowder et al. 2006a).

Coastal and marine spatial planning creates a framework to balance various uses of marine resources and other ecosystem services, and mitigate their consequences, based on economic, social, and environmental goals (Villa et al. 2002, McLeod et al. 2005, Arkema et al. 2006, Ehler & Douvere 2009, Foley et al. 2010b). With basic ecological principles at its core, ecosystem-based CMSP manages ecosystem services with regard to their value (not necessarily monetary) to society, spatially separating conflicting uses and ensuring sustainability (Foley et al. 2010a). For example, as a society we very much value the aesthetic and cultural services LIS

provides us. However, it is difficult to assign a monetary value to scenic views and education, or to regulating services, such as nutrient recycling or effluent processing. Yet, in order to continue to function as society, we strongly rely on these services. What would happen if New York City, for example, could no longer rely on the marine ecosystem to receive and process the 1.4 billion gallons of treated sewage effluent it creates daily? Ecosystem-based CMSP creates a more balanced system to compare and make use decisions regarding these harder to quantify services against more profit driven provisioning services, such as fishing and mining. Cumulative effects of these various uses on the ecosystem must be considered (Foley et al. 2010b).

c. Coastal and Marine Spatial Planning in Practice

Terrestrial planning and zoning have been used by municipal governments since the early 1900s to promote rational development by spatially regulating human use. The process divides communities into distinct districts or zones in terms of specific land uses based on a defined set of community or governmental values (Abeles 1989). Similar to terrestrial planning efforts, CMSP and marine zoning have become critical tools in sustainably managing marine systems and creating long-term policy initiatives worldwide (Villa et al. 2002, Weinstein & Reed 2005, Douvere & Ehler 2009b, Foley et al. 2010a, Maguire et al. 2012). The main concepts associated with terrestrial zoning and regional planning are at the core of CMSP. However, planning in marine environments is much more challenging due to additional spatial components, including the seabed, water-column, and surface waters, as well as the areas above the ocean surface and below the seabed. Further, planning and zoning for uses in the marine environment are more complex because it is not static (NY Department of State 1999), i.e., the water column, air-sea interface, seafloor, and living marine resources are all mobile, with each on different timescales. In addition, regional planning and zoning usually take place at the local level, each town able to design its own spatial plan. Coastal and marine spatial planning does not necessarily happen at the local level.

The complexity of zoning marine environments is demonstrated by the scope of damage caused by the recent Gulf of Mexico oil blowout. While the oil discharge was a point source and the blowout itself was quite localized, its effects were spatially and temporally expansive. Its consequences spanned many different marine sectors and habitats over a large area of ocean and several states. Coastal fisheries, human health, deep water and wildlife habitats, and tourism

were all affected by the spill. This spill demonstrates the limitations of fixed-gridded marine zoning in a dynamic ocean – water is not stationary. Marine organisms and processes can carry pollutants and their effects far away from a point source. A zoning plan without an integrated spatial planning process does not adequately address the complexity of marine systems, ignoring important interactions and feedback loops (Ehler & Douvere 2009, Cloern 2001).

Many marine conservation or zoning efforts focusing on a single species or sector (e.g., sewage treatment plant effluent, recreational boating discharges) have had limited success due to their piecemeal nature (Pritchard 1967, NY Department of State 1999, Kappel 2005, Crowder et al. 2006a, Halpern et al. 2008). CMSP should incorporate a multitude of different sectors including fisheries management, public health, commerce/trade, business, transportation, mining, recreation, and military (Figure 6). However, Foley et al. (2010a) argue that for ecosystem-based CMSP to be successful, it must, at its core, be based on the ecological principles that govern healthy ecosystems such as maintaining or restoring biodiversity, habitat connectivity, key species, and native species.

In addition to the spatial component, the temporal component of CMSP is also relevant. Marine environments, and organisms' interactions with them, can change on an hourly, daily, monthly, or seasonal basis. Temporal changes can involve physical processes such as tides and currents, seasonal heating and cooling, and winds, or biological processes such as phytoplankton blooms or spawning. For example, CMSP may include seasonal shellfish closures or use of dredging areas only in non-spawning periods (Arkema et al. 2006, Crowder et al. 2006a). Further, CMSP should be flexible, so that it can be adjusted as conditions and needs change (Arkema et al. 2006, Day 2008, Foley et al. 2010a).

Coastal and marine spatial plans should account for uncertainty: scientific, ecological, political, economic, and societal. Most marine spatial plans are adaptive, and require a re-assessment every few years to allow for the plan to evolve with changing conditions, data, or societal values. The Australian Great Barrier Reef marine zoning plan, the first large-scale marine zoning initiative worldwide, requires a periodic review and update (Day et al. 2008). In fact, the Great Barrier Reef zoning plan has changed considerably from the original 1981 version, adapting to changes in scientific understanding, use, technology, social values, and environmental conditions (Day et al. 2008). Specific changes include a stronger focus on protecting overall biodiversity rather than coral reef habitats exclusively.

d. Support for Coastal and Marine Spatial Planning

There is emerging scientific consensus on the overall effectiveness of CMSP 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. It called 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). The consensus statement warned that "a delay in implementing management based on an ecosystem approach will result in continued conflicts 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 US Commission on Ocean Policy released similar reports on the state of the oceans, recognizing the serious effects humans are having on marine ecosystems and calling for EBM tools such as CMSP to effectively manage marine systems long-term. In order to sustainably manage and plan for the future health of marine systems, both reports recommended more coordinated management and cumulative impact assessments (McLeod et al. 2005). Future management strategies must reflect the complexity of coupled human-natural coastal ecosystems. Specifically, management must address all of the factors impacting the health and integrity of marine environments, and evaluate tradeoffs between the various human needs and services from the system (O'Connell 2006).

Coastal and Marine Spatial Planning is being hailed internationally as the go-to method for implementing EBM in the marine environment (Foley et al. 2010a). The European Union has adopted the CMSP process for managing marine waters on both local and regional scales, including collaborative projects for the North Sea as well as for individual countries (Maguire et al. 2011). There has even been talk within the United Nations of CMSP in the high seas. Some areas in the US have experimented with aspects of CMSP over the past few decades, but it has only recently gained national recognition (Kappel 2005). However, existing CMSP efforts are frequently single-objective, limiting their ability to meet comprehensive system-wide goals (Ehler & Douvere 2009, 2010; Naidoo et al. 2008). In addition, many CMSP efforts are constructed around ocean development projects such as wind farms. To be most effective,

CMSP should have a substantial integrated approach to assessing tradeoffs between all human uses and ecosystem services in marine systems from the start, including commercial interests, environmental stewardship, and community values. Ecosystem-based CMSP grounded in core ecological principals and responsive to multiple objectives and all ecosystem services categories, is therefore an essential tool for managers to implement EBM.

There are many cases of marine planning efforts that are not truly ecosystem-based CMSP. For example, although the current Massachusetts (MA) Ocean Plan is multi-objective, it sat idle for years in the MA state legislature. In 2004, the Massachusetts Ocean Management Task Force underwent a through ocean planning process based on the concepts of ecosystem-based management. In response to the Task Force's recommendations, a proactive ocean management bill was introduced in the Massachusetts State Senate on December 12, 2005. One of the first of its kind in the United States, the proposed marine spatial planning bill, An Act Relative to Oceans (S. 529), authorized state agencies to develop an Ocean Management Plan and specify zoning restrictions in state waters.

However, it was not until 2008, after years of negotiation, when the MA Oceans Act was finally ratified. Coincidentally, the Act was only after oceanic wind farms began being proposed and gaining traction in the region. The final MA Ocean plan was largely constructed around the development of these marine wind farms. Jack Clarke, Mass Audubon Director of Public Policy and Government Relations said in a 2010 press release announcing the MA plan, "… The plan protects the environment while providing, for the first time, offshore renewable energy uses previously not allowed…the state developed a comprehensive and forward-thinking plan for marine wildlife conservation, habitat protection, and wind energy development" (Brooks 2010). However, for a truly ecosystem-based CMSP, having a shared vision that answers the questions, "How do we want to see our oceans and coastal areas being used?" is an essential first step that should be defined before such development projects are even considered.

In addition, other spatial planning efforts can focus too heavily on marine protected areas or reserve networks. For example, in 1999, the state of California passed the Marine Life Protection Act (MLPA) to safeguard the natural heritage, ecology and biodiversity of California coastal waters. A main feature of this Act was to establish a network of marine reserves along the California coast by 2011. The plan incorporated multiple use zoning and no-take MPAs, which allowed for sanctuary areas, and research and recreational opportunities. In the California

case, the original planning effort was very conservation based, with not enough input from different marine sectors such as shipping and fishing. Each MPA proposal was largely assessed by the percentage of habitat types represented with regard to the entire MPA network, not with regard to a multi-objective ecosystem-based CMSP (CA DFG, 2006). Also, lack of full coordination with federal agencies has been inhibitive in the California process (Crowder et al. 2006a). For example, there were issues with the implementation of the Channel Islands National Marine Sanctuary federal marine reserves because the roles of different federal agencies were unclear (Crowder et al. 2006a).

e. Components of Coastal and Marine Spatial Planning: Marine Protected Areas

Coastal and marine spatial plans usually incorporate a series of marine protected areas (MPAs), with buffer zones and areas zoned for a range of uses that may include recreation, commercial fishing, extractive activities, effluent discharges, development projects, ports, and ship navigation (Day et al. 2008). Marine protected areas are conservation areas that can vary in management objectives, size, and degree of activity allowed. They balance and isolate use of the marine environment and its resources, and can have both spatial and temporal components. By spatially limiting or preventing harmful activities while allowing reasonable use, ecologically sensitive areas and key species are protected and the sustainable use of marine resources is encouraged (O'Connell 2006, Day et al. 2008).

"No-take" zones are MPAs where extractive activities such as fishing, mining, or construction are prohibited, and non-extractive activities such as SCUBA diving, recreational boating, and sightseeing may be limited (Associated Press 2008). No-take marine reserves have been successful in both habitat protection and fisheries management (Agardy et al. 2011). While MPAs, by themselves, are useful for the ecological management of marine habitats, CMSP has broader goals, also targeting social and economic objectives (Arkema et al. 2006). For example, areas of commercial importance can be zoned for a wide range of uses, while other ecologically important habitats may be zoned as "no-take" MPAs (Arkema et al. 2006). 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 (Villa et al. 2002, Associate Press 2008).

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). CMSP should account for all of the various and conflicting needs in a system. A multi-objective CMSP can help provide for the continued marine services on which a region relies by spatially and/or temporally mitigating extractive or damaging activities.

Fisheries management using an ecosystem-based approach is becoming more popular among scientists and environmental managers (Frid et al. 2005, Mangel & Levin 2005). The current quota-based approach to fisheries management is being replaced by an ecosystem-based approach that accounts for the cumulative effects of the fishery, such as bycatch, habitat degradation, and trophic disturbances (Crowder et al. 2008).

The switch to EBM requires a new set of management tools, including CMSP, marine protected areas (MPAs), and supporting science (Frid et al. 2005). Successful marine reserve or MPA networks are designed to preserve biodiversity and ecosystem functioning (Agardy et al. 2011). There is much scientific evidence to support the creation of MPAs leading to the recovery of exploited species. In general, MPAs increase stock size and average individual size of exploited species within their boundaries (Halpern 2003, Ami et al. 2005, Crowder & Norse 2008, Agardy et al. 2011). However, if reserves are not coupled with a larger CMSP, incorporating the area beyond the boundaries of MPAs, then anticipated economic and biological gains might be compromised, including over-exploitation of resources outside of the MPA (Sanchirico 2004). For example, there is evidence that individual shellfish closures in NY's Great South Bay may have led to overfishing in other bays (MSRC 2001). A CMSP approach may help buffer the system, restore populations of economically important fish and invertebrate species, and also protect biodiversity and critical ecosystems in LIS.

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 (Day 2008). The National Research Council (2000) suggested that 20 percent or more of each habitat type should be protected to ensure long-term biodiversity and fishery production (Agardy et al. 2011). However, Halpern (2003) found that regardless of size, marine reserves led to increases

in biodiversity, biomass, and abundance of organisms, and that the ecological benefits of reserve networks increase directly with the absolute area set aside for protection (Agardy et al. 2011).

Although reserve selection should be informed by biological value, socio-economic factors play a large role in selection and enforcement (Browman & Stergiou 2004, Agardy et al. 2011). There are also important socio-economic and biological tradeoffs to consider when choosing between reserve size and reserve number. For example, ideal reserve size and number can be different for each species, as they have different habitat needs, vulnerable life stages, dispersal rates and processes, and recruitment requirements (Agardy et al. 2011). Larger reserve networks may also provide more protection from ecological disturbances and be logistically easier for monitoring and enforcement of use regulations (Agardy et al. 2011). Reserve siting should incorporate the needs of entire marine communities and the ecosystem services they provide. In order to support the conservation, economic, and social objectives of the larger reserve network, individual reserves should: 1) incorporate key ecosystem processes supporting biodiversity, 2) promote productivity, and 3) allow for emigration outside the reserve (Agardy et al. 2011).

f. Coastal and Marine Spatial Planning in Long Island Sound: Ecosystem Services

As mentioned previously, LIS is surrounded by one of the most populated metropolitan areas in the country and retains high ecological, social and economic values (US EPA 2009). Its marine ecosystems provide many goods and services to society including coastline protection, recreation, food, business, 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 (Agardy et al. 2011). The Sound is a crucial commercial waterway in a region with a rich maritime history, including important working waterfronts and key industrial shipping routes for both passenger and cargo traffic. The NY/CT region relies on revenue created by commercial ventures in LIS. In addition, LIS carries a high intrinsic aesthetic value for the millions of people living nearby, which is extremely important to property values, recreational interests, and tourism. However, new commercial ventures (i.e., wind farms, tidal power, LNG facilities), increased coastal development, overfishing, coastal runoff and pollution, loss of habitat, and climate change all stress our estuaries and coastal marine environments,

further threatening key species and ecological integrity. Below is a snapshot of some important ecosystem services that LIS provides.

Provisioning Services

There are many important fisheries in LIS, including striped bass, *Morone saxatilis*, hard clams, *Mercenaria mercenaria* (mostly aquaculture), scup, *Stenotomus chrysops,* tautog, *Tautoga onitis*, summer flounder/fluke, *Paralichthys dentatus*, and menhaden, *B. tyrannus*. The commercial fishing industry for NY State averaged about $270 million in 2012, and in CT it averaged around $59 million (Table 3).

In addition, each year 4,000-7,000 domestic commercial vessels travel through LIS (Boynton 2006). Long Island Sound also accommodates naval ships, hundreds of foreign vessels, and thousands of recreational boaters (Boynton 2006).

There are roughly 200 water-dependent businesses along the coasts of LIS, with the majority of those concentrated in just ten harbors (NYS DOS 1999). However from 2005-2010, only the Tourism and Recreation and Marine Construction sectors have had positive job growth in the counties surrounding LIS (Figure 7, 8).

The Bronx and Westchester are the only counties that have seen an increase in the number of jobs in the living resources sector (NOAA 2013). Even though ship and boat building jobs decreased in New York County (i.e., Manhattan), they have increased in New London. The largest percent increase in jobs by sector is the marine construction industry, with positive job growth in Suffolk, New York, Bronx, Westchester and New London Counties (Figure 7). Nassau, Queens, Fairfield, and New Haven Counties have seen a decrease in marine construction jobs in this same period (Figure 7). Although the maritime industry is important to the LIS region, there are notable regional disparities. For example, New London counts on a 12.3% share of ocean related jobs, while in Westchester, ocean jobs account for only 0.9% (Table 4). In general, CT counties seem to rely on ocean jobs more than NY counties, with the exception of Suffolk County.

The volume of overseas trade using US ports is projected to double in the next decade (US Commission on Ocean Policy 2004). LIS is often used as a transportation route by ships heading to NY, CT, or NJ ports. Ensuring the long-term viability of the marine transportation

industry in LIS is important to the economic health of the region. Ocean related goods and services are estimated at $18 billion in the counties boarding LIS alone (Table 4).

Sea floor cables and pipelines, aquaculture projects, offshore terminals, development or mining of underwater resources, disposal of dredge material, and construction of windfarms or other energy facilities within LIS are all possible future commercial and municipal development projects. The 40 km long Iroquois Pipeline already stretches along the seabed connecting Milford, CT to Northport, NY, with an extension from Northport to the Bronx, NY. However, the siting of these types of projects is typically considered in isolation with cumulative impacts and future needs not accounted for. For example, the current loss of wetlands in LIS is thought to be contributing to the decline of commercially important fish species, especially bluefish, *Pomatomus saltatrix* (Stedman 2006).

In addition, LIS serves as a sink or a conduit for coastal runoff, dredged materials, and over a billion gallons of sewage effluent per day. An EBM framework for LIS should include managing the outfall locations and providing broad treatment specifications for sewage effluent entering LIS (Swanson & Conover 2006).

Regulating Services

Maintaining healthy functioning of LIS marine habitats provides invaluable services such as nutrient recycling and regulation of the climate (McLeod et al. 2005). As land area is developed, the ecosystem's ability to function properly is lessened. Specifically increased impervious surfaces in the watershed and loss of forests and wetlands can lead to more runoff and a loss of natural filtration. In all of the counties surrounding LIS there has been a net increase in impervious surface cover and developed land from 1996-2006 (Table 5), with Suffolk County (NY), Middlesex County (CT), and New London (CT) having the largest net change. All NY counties lost wetlands or stayed the same (Bronx), whereas all CT counties gained wetlands over the same period (Table 5). All counties saw a net decrease in overall forest cover with Suffolk, Queens, and Bronx counties seeing the largest decline. Because nutrient regulation and cycling are important ecological and social services expected from LIS, the loss in pervious surfaces and forest cover in the watershed is troubling. Healthy buffer areas (e.g., wetlands, forests, pervious surfaces) along our coasts help filter pollutants as well as excess nutrients,

fostering other marine services such as improvements in water quality for swimming or marine life.

People want to live near the coasts for many reasons, including milder winters and cooler summers (than more inland), a consequence of water's high heat capacity. This is a service that we value as a society, evidenced in part by beachgoers and tourism in summer months. Swanson and Conover (2006) believe that CMSP in LIS could especially be useful in determining buffer zones for mosquito spraying and other chemical applications to protect human and ecological health. In addition, CMSP initiatives will likely reduce the duplication of conservation efforts and prove more cost-effective in the long term (McLeod et al. 2005).

Protective Services

Coastal wetlands and estuaries help buffer the effects of storm events associated with climate change, protecting property values, and expensive coastal real estate from erosion and destruction. Storm damage to coastal residential and commercial properties from Superstorm Sandy, the most recent intense storm to hit the NY area, is estimated to be in the billions of dollars for just Long Island's coastal communities. An EBM framework should be developed to establish buffer zones or protected areas in zones prone to erosion, possibly limiting development, shoreline hardening, and other activities destructive to coastal habitats.

Aesthetic Services

The aesthetic and recreational values associated with healthy coastal ecosystems are essential to LIS's economy. In addition, the real estate surrounding LIS holds enormous value, as waterfront properties are valued much higher than those inland (US Commission on Ocean Policy 2004). In a ruling of the US Commerce Department on whether to permit a liquefied natural gas facility in LIS, protecting the aesthetic ecosystem services of LIS ended up outweighing federal energy interests, a provisioning service (Rather 2009). This demonstrates the immense value of aesthetic services in LIS. According to a 2006 LISS survey, LIS is most used for passive and land based recreation, such as walking, beach going, picnicking, and scenic views (LISS 2006). In addition, the tourism and recreation industries have the highest percentage of jobs in ocean based industries in the counties surrounding LIS (Table 6, Figure 9). When compared to the rest of the US, both NY and CT have 15% greater percentage of their

ocean related economy coming from Tourism and Recreation, signaling that this is a very important industry for both states. In order for tourism and recreation to thrive, aesthetic services must retain a high economic and environmental value (NOAA 2013).

The Long Island Sound Study calculated that boating, recreational and commercial fisheries, swimming, and beaches contribute over $9 billion to the regional economy annually (LISS 2012a). However, LIS's ability to continue providing this revenue may be compromised as the viewshed, water quality, natural habitats, and fisheries are degraded by a growing number of anthropogenic stressors (US EPA 1994). Aesthetic values and recreational activities often clash with commercial development interests. Management efforts should spatially separate these conflicting uses, as well as protect and enhance aesthetically and recreationally important marine resources.

Cultural Services

Education, culture, and history are integral components of the character of communities in and around LIS. There are dozens of colleges and universities in the LIS watershed. Many of these institutions use LIS on a regular basis for research and education including Stony Brook University, University of Connecticut, City University of New York, Columbia University, and University of New Haven, to name a few. There are also federal, state, and private research institutions surrounding LIS, including the Coast Guard, Suffolk County Department of Health, Connecticut Department of Energy and Environmental Protection, etc. Long Island Sound also has an important historical and cultural context including working waterfronts, art and literature, fishing industry, and Native American populations. Historic shipwrecks in LIS serve as popular dive spots. Much of the coastline around LIS was colonized and built up around a once booming maritime industry. For example, the leader of the Connecticut Commercial Lobstermen's Association, referring to the collapse in the industry in LIS said, "We're losing a way of life. We're losing a heritage" (Melia 2011). Fisheries are a part of the cultural identity for many towns around LIS.

g. Challenges and Opportunities: Learning from the Past and Planning for the Future

Although some initiatives have helped improve the health of LIS, significant threats to water quality, ecosystem structure and function, aquatic life, and human health and well being

still exist (US EPA 2011). There have been mismatches as well as overlaps in management because of lack of communication and coordination between NY and CT, including disputes over dumping of dredge spoil and designations of no-discharge zones. The local newspaper article search that was conducted (methods discussed in Chapter 2), spanning the years 2001-2013, showed many conflicts exist in LIS. Articles mentioning LIS were sorted into the following six categories: Dredging, Funding/Restoration, Shipping, Fishing/Lobsters, Pollution, and Conflict (other) (Chapter 2, Table 1). Results showed that of the six categories, most articles fell under Conflict (other) (N=58). Out of the remaining categories, Fishing and Lobsters (N=56) had the most, then Pollution (N=42), Dredging (N=30), Funding or Restoration (N=34), and finally, Shipping (N=7) (Chapter 2, Table 1). The majority of articles in the Conflict category dealt with dredging, infrastructure, and a floating liquid gas natural facility (i.e., Broadwater). More specifically, conflict stemmed from a power cable on the bottom of LIS that would supply Long Islanders with electricity, and the dumping of dredge spoil. Other topics in the Conflict category included tapping aquifers, a cross-Sound tunnel, pipelines, nuclear power plants, and sewer planning.

Over 20 years ago, Wolfe et al. (1991) called for more integrated and multi-disciplinary management of LIS, stating, "Close interaction between environmental planners, managers, and scientists is required to identify effective control strategies for reducing existing pollutant stress to the Sound and for minimizing the effects of future development."

Management Challenges

In the past, LIS management efforts have largely been reactive and made on a piecemeal basis, not guided by an overall ecosystem plan or vision (Swanson & Conover 2006). The many disputes over the Broadwater Energy natural gas terminal in LIS a few years ago demonstrate this. In 2004, Royal Dutch Shell and TransCanada Corporation proposed putting a floating liquefied natural gas terminal in the middle of LIS, called Broadwater (Rather 2004). From the beginning, the project faced huge opposition from the community and local governments, and the debate only got more contentious as time went on. Many residents and community groups were concerned with the idea of industrializing LIS, especially by the oil industry (Rather 2004). Connecticut even threatened legal action against NY and the federal government if the project was approved.

Both federal and state agencies would have had to approve the project, including the Federal Energy Regulatory Commission (FERC), Coast Guard, Army Corps of Engineers, Department of Commerce, and NYS's Governor and Department of Environmental Conservation. After many public meetings, hearings and debates, NY eventually came out against the project. However, even though it was in NY State waters, FERC had final say over its implementation as per the federal energy bill H.R.-6, Public Law: 109-58 (2008), and approved the project in 2008 (Associated Press 2008; US House of Representatives 2005). By this time, there was staunch political opposition in both NY and CT against Broadwater including US senators, US Representatives, both governors, and many local elected officials (Rather 2009). The Department of Commerce also entered the debate, eventually ruling against the project. In the end, the $700 million dollar LNG facility was not built because of environmental and security reasons. Millions of dollars of public and private money was wasted in these debates, and the decision was not based on science, an overall energy plan for NY, or an overall vision for LIS.

The proposed LIS Broadwater project, with its extensive policy implications and complex social, economic, environmental, and political issues, exemplifies the need for CMSP. A Coastal and Marine Spatial Plan would have addressed the implementation and impacts of such projects within LIS. In addition, CMSP would aid in the policy making process by providing a framework to assess the various trade-offs of projects such as Broadwater over other alternative uses (Swanson & Conover 2006). More importantly, a LIS CMSP could help address these development issues (e.g., siting) before they ever surface.

Management Opportunities

On June 12, 2009, President Obama released a memorandum underscoring the importance of protection and restoration of oceans and coasts, creating an Interagency Ocean Policy Task Force (IOTF) charged with, among other things, developing recommendations for a nationwide framework to implement CMSP (IOTF 2009). The draft plan of the Interagency Ocean Policy Task Force called for creating several regional councils to develop a framework for CMSP in the nation's coastal and marine environments. According to the report, the work of these councils has to incorporate existing local and state initiatives; consequently, the process of creating a CMSP for LIS is extremely timely and relevant. Discussions around CMSP in LIS are

beginning to occur at various levels of government, and among a few environmental groups (e.g., The Nature Conservancy, The Sound Conservancy, Sound Vision, etc.) active in LIS. Documenting and integrating these efforts into a more comprehensive CMSP plan for LIS are imperative. In addition, background research is needed to support this process to highlight the important aspects of CMSP in LIS. This dissertation coalesces existing work and adds new perspective to conform to the national vision for marine management.

Future development projects for LIS may include wind farms, sea floor cables and pipelines, new commercial ship routes and ports, transport of municipal solid waste, and natural gas terminals. Coastal and marine spatial planning could be especially useful in balancing the region's increasing energy needs and decreasing our carbon footprint while limiting ecological, aesthetic, and recreational disturbances. Barges and other forms of marine transportation have significantly lower overall greenhouse gas emissions than their equivalents in truck and rail transportation (Texas Transportation Institute 2009) (Figure 10).

New York State is beginning to look at EBM and CMSP with the passage of the NY Ocean and Great Lakes Conservation (NYOGLEC) Act (2006). The NYOGLEC Council was created to look at ways to incorporate EBM into all state initiatives in the oceans and Great Lakes. It is currently focused on organizing CMSP around the NY Bight -- the continental shelf area between NY and NJ -- emphasizing siting for energy development. As such, it is attempting to be proactive, planning to minimize impacts to other sectors and important habitats/species when the federal government begins leasing underwater land and permitting energy development projects on the shelf. However, current efforts are not necessarily comprehensive or based on a multi-objective integrated CMSP approach; rather, they are largely based on siting for wind farms and planning for other uses and habitats around them, and thus are of limited use in LIS.

Because the majority of existing CMSP efforts are single-objective, focused around a single goal such as conservation or energy development (Ehler & Douvere 2010) they are not truly ecosystem based, nor adequate for LIS. A truly multi-objective, ecosystem-based plan includes designing CMSP around all of the different uses and services from the beginning. Long Island Sound represents an excellent opportunity for NY and CT to begin this process because it is entirely in states' waters, has distinct boundaries, established user groups, and mechanisms for public involvement. Ecosystem-based CMSP in LIS can go further than what is now being done on the continental shelf by incorporating the needs of all sectors and coastal zone services from

the start. It can also serve as a model for other states in that it represents a highly urbanized estuary, and already requires bi-state management.

As an alternative for current fragmented marine policy efforts in LIS, a multi-objective CMSP could provide an ecological, social, and economic vision that would complement existing management strategies to address the cumulative impacts of current and future stressors. Specifically, such a CMSP would need to deal with complicated regional issues including: limiting historically permissible activities, alleviating existing conflicts, and accounting for future development needs (O'Connell 2006). With increasing coastal development pressure and new interest in commercial development of local marine resources, CMSP in LIS could be a significant management tool. It is a timely undertaking for LIS, creating a comprehensive process for managing environmental stresses and balancing complex ecological issues with continuing commercial and social needs.

Chapter 3 Figures:

Figure 1. Population density in the US by county in 2010 in average number of people per square mile of land area (Ardron et al. 2008).

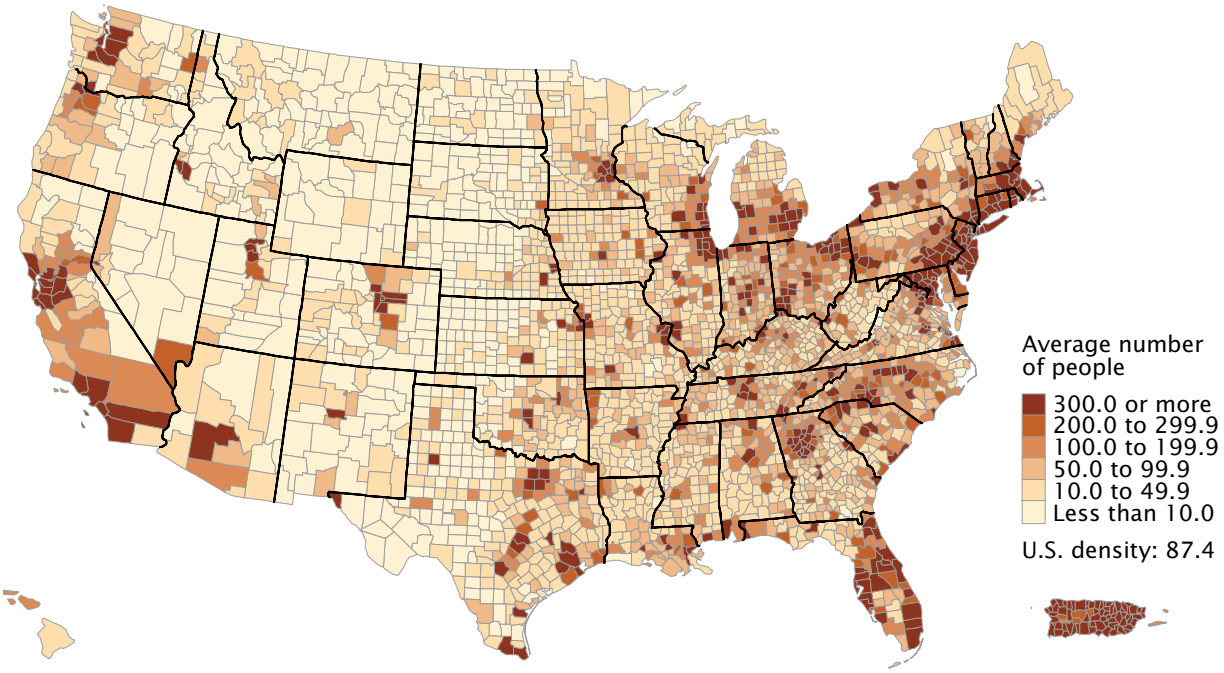


Figure 2. Long Island Sound population density (in thousands) (ESRI 2013).

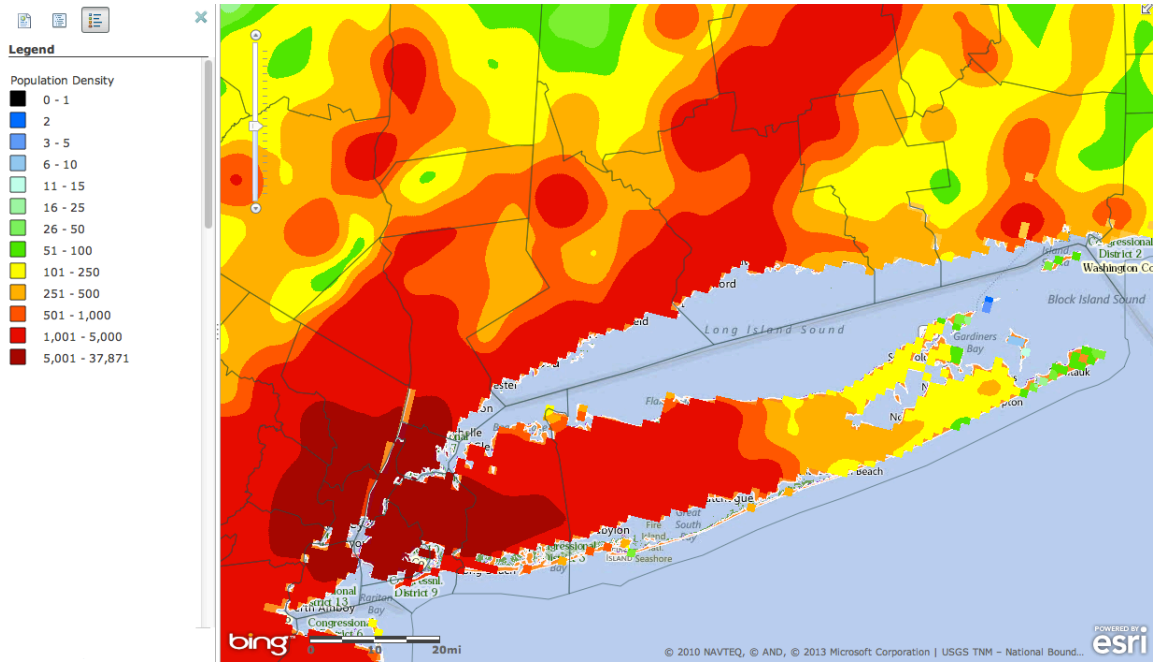


Figure 3. Long Island Sound point source nitrogen trade-equalized loads, 1995-2011, and 105 NY/CT sewage treatment plants in thousands of pounds per day (US EPA 2011).

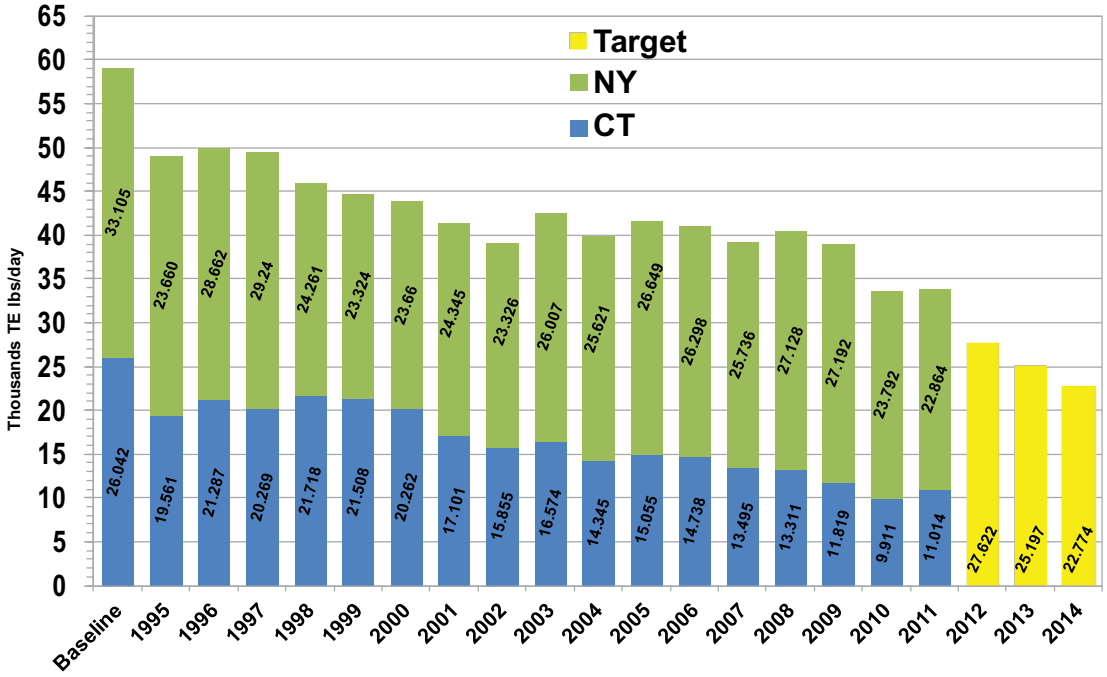


Figure 4. Percentage of ocean sector GDP by county (NOAA 2013).

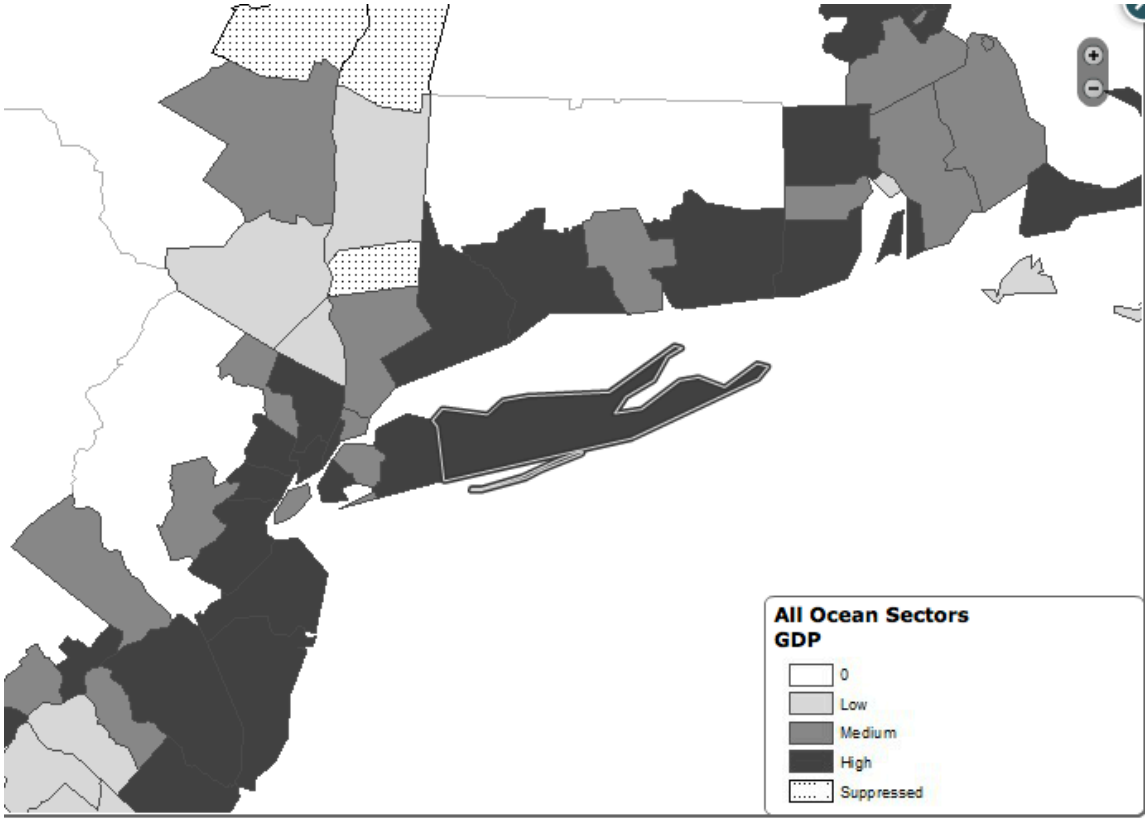


Figure 5. Extent and duration of Long Island Sound hypoxic zone trend from 2007-2011 (US EPA 2011).

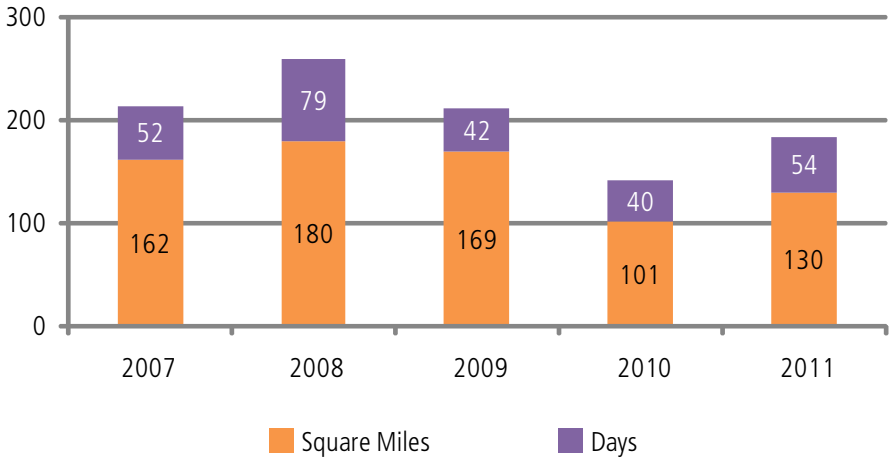


Figure 6. Marine spatial planning and single sector planning (Ehler & Douvere 2009).

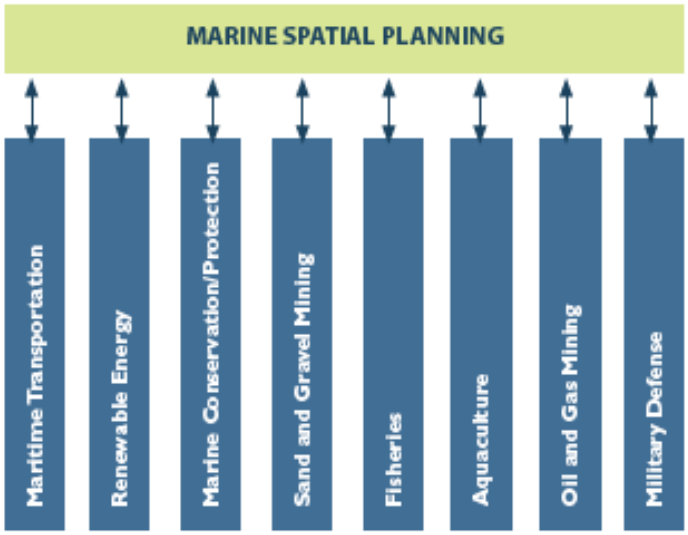


Figure 7. Percent changes in jobs by sector and by county from 2005-2010 (NOAA 2013).

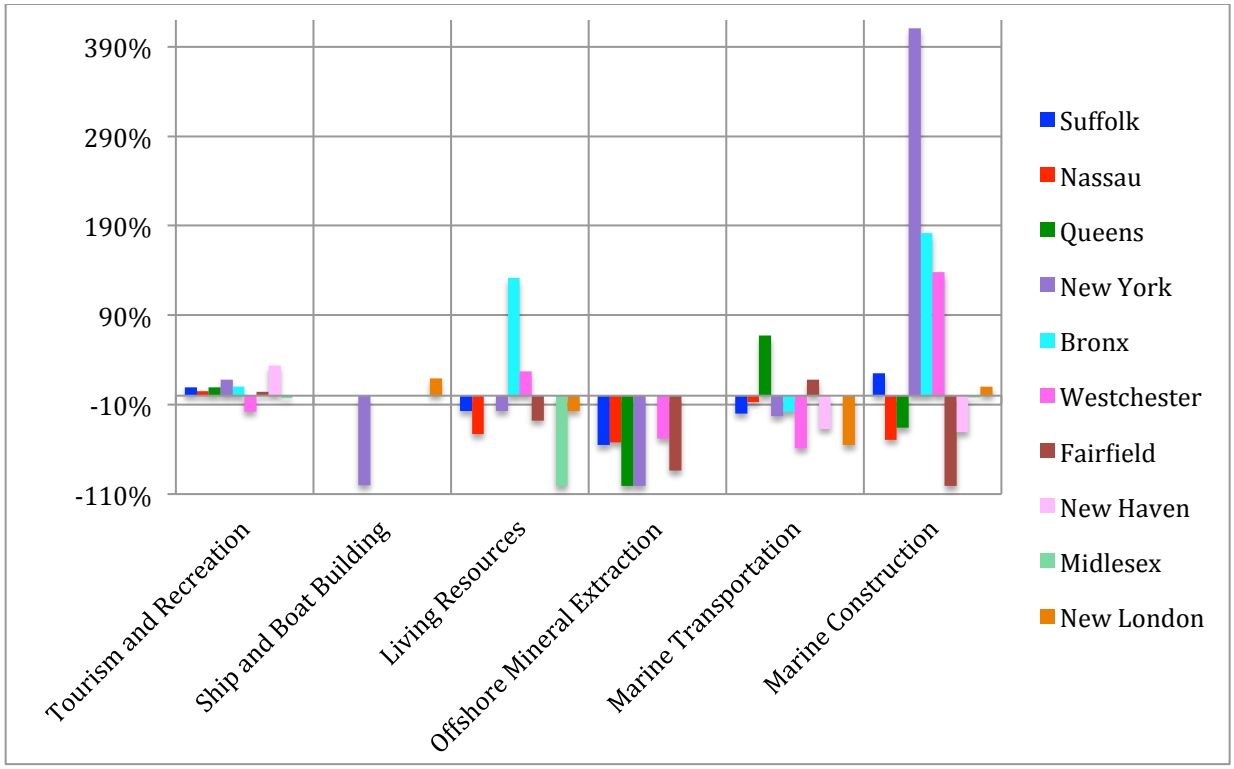


Figure 8. Relative regional contributions of specific ocean sectors to levels of employment by county. Darker colors represent higher numbers of jobs (NOAA 2013).

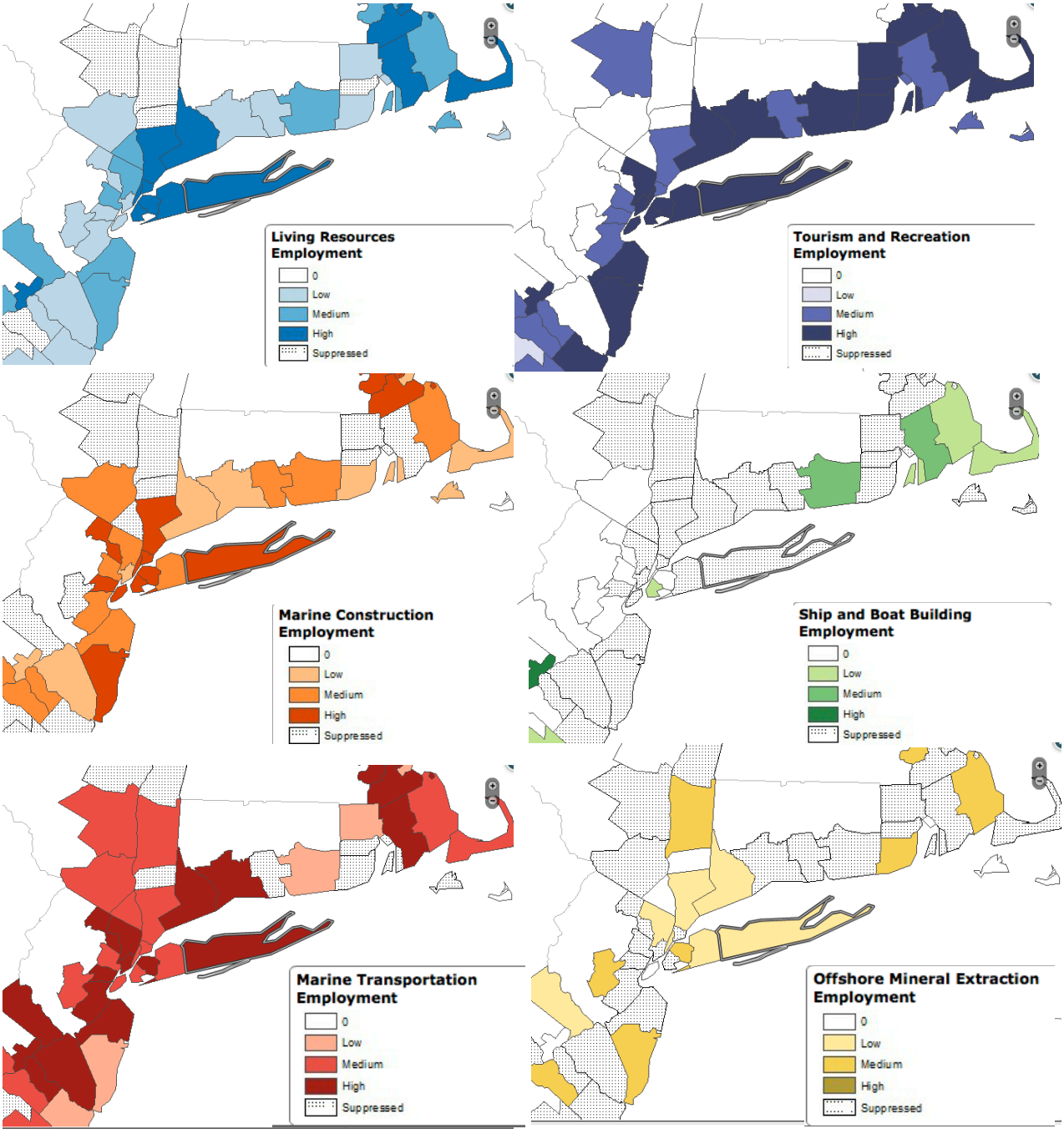


Figure 9. Percentage of ocean jobs in counties bordering LIS by sector, 2010 (NOAA 2013).

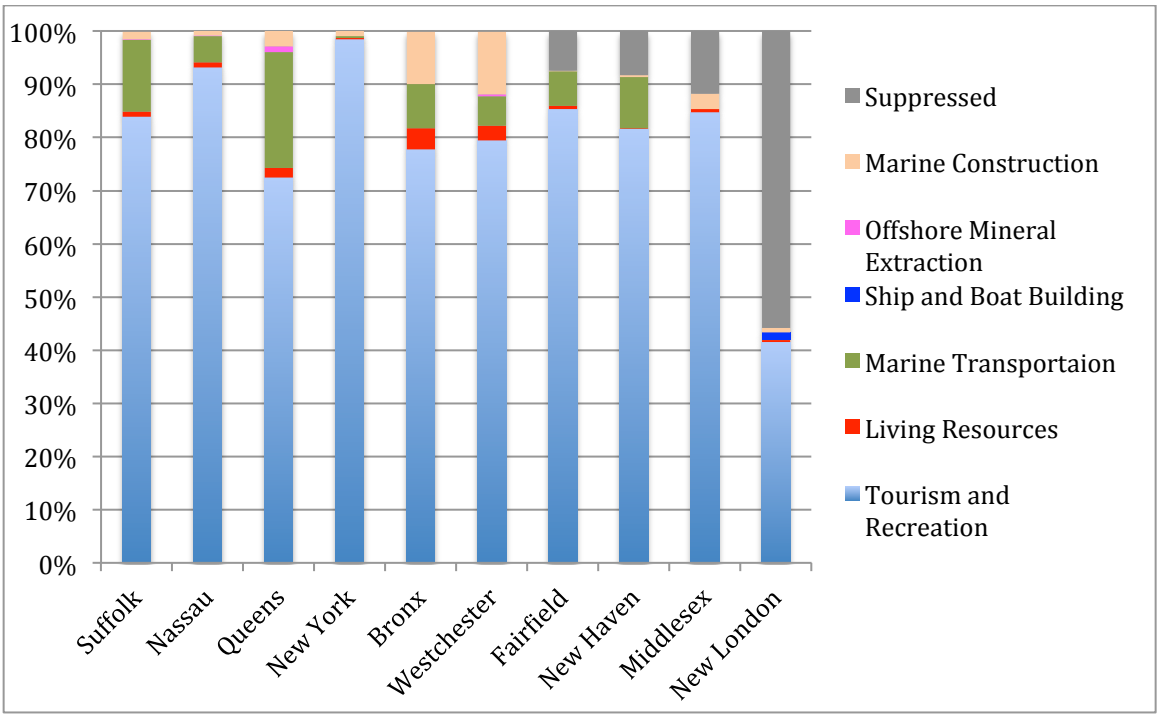
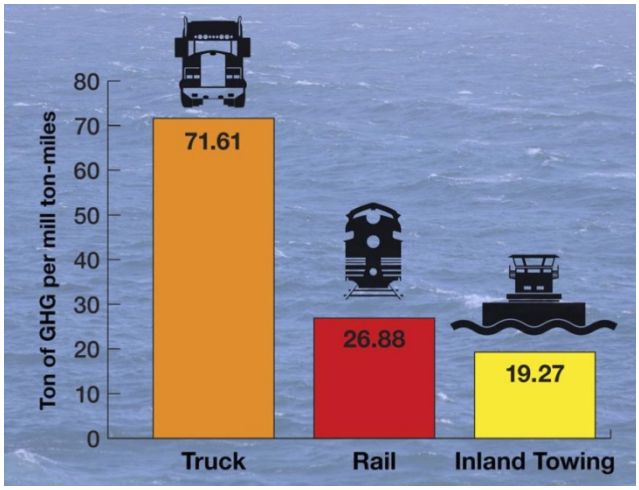


Figure 10. Tons of GHG per million ton miles (Texas Transportation Institute 2009).



Chapter 3 Tables:

Table 1. Principles of EBM. Adapted from Arkema et al. (2006).

Principles of EBM
• Ecosystems are dynamic and operate on spatial and temporal scales. • Ecosystems have complex trophic and habitat interactions, relationships and feedback loops. • Ecosystems provide many goods and services to humans and have aesthetic and economic values. • Management decisions are science based and interdisciplinary. • Management includes continuing research, monitoring and adaptive components. • Public participation is important throughout the planning process. • Collaboration between various levels of government, businesses, community members, and other stakeholders is encouraged to identify common goals and solutions, and promote co-management.

Table 2. Ecosystem service categories and examples. Adapted from the Millennium Ecosystem Assessment (2005).

Provisioning services
Transportation, waste disposal, fish and wildlife, drinking water, food production, energy supply, and mining
Regulating services
Nutrient recycling, water cleansing, advection & waste processing, providing habitat and climatic effects
Protective services
Storm protection, flood control, beach re-nourishment
Aesthetic services
Pleasure, scenic vistas, and tourism
Cultural services
Traditional and environmental knowledge, educational, cultural, and community identity

Table 3. Commercial fishing profits in the counties surrounding LIS, and totals for the NY State and CT. Source: NOAA (2013), Coastal County Snapshots Wetlands Benefits, www.csc.noaa.gov/snapshots/

2012	Jobs (Commercial Fishing)	Output from businesses (millions)	Revenue from self employed (millions)	Total (millions)
Suffolk	1011	$17.8	$36.7	$54.5
Nassau	268	$5.7	$7.8	$13.5
Queens	272	$6.7	$7.4	$14.1
New York (Manhattan)	385	$23.5	$1.3	$24.8
Bronx	213	$18.9	$2.3	$21.2
Westchester	127	$5.9	$2.7	$8.6
Fairfield	174	$8.5	$3.5	$12.0
New Haven	112	$1.3	$2.6	$3.9
Middlesex	63	$0.4	$2.2	$2.6
New London	193	$2.6	$7.7	$10.3
All of NY	*3961*	*$206.7*	*$72.3*	*$279.0*
All of CT	*800*	*$42.9*	*$16.1*	*$59.0*

Table 4. Number of coastal sector workers, jobs, wages, and goods and services in 2010 for the counties surrounding LIS. Source: NOAA (2013), Coastal County Snapshots: Ocean Jobs www.csc.noaa.gov/snapshots/

County	Number of workers	% of total jobs	% change in number of jobs since 2005	Wages ($ millions)	Goods and services ($ millions)
Suffolk	24,812	4.1	4.0	730	1,000
Nassau	12,961	2.2	3.0	284	572
Queens	8,843	1.8	17.0	206	391
New York	160,826	7.1	19.0	5,000	13,000
Bronx	4,102	1.8	21.0	121	239
Westchester	3,501	0.9	-15.0	114	224
Fairfield	14,666	3.7	9.0	493	1,000
New Haven	11,569	3.3	30.0	285	560
Middlesex	2,932	4.6	2.0	86	172
New London	15,303	12.3	2.0	866	1,000
Total	***259,515***			***8,185***	***18,158***

Table 5. Percent changes in land cover for the counties surrounding LIS. New York counties are italicized, and CT counties are not. Source: NOAA (2013), Coastal County Snapshots: Ocean Jobs, www.csc.noaa.gov/snapshots/

County	% Developed Land			% Impervious Surfaces			% Forests			% Wetlands		
	1996	2006	% Net increase	1996	2006	% Net increase	1996	2006	% Net change	1996	2006	% Net change
Suffolk	18.63	19.12	2.60	5.61	5.80	3.39	12.89	12.50	-3.05	3.36	3.35	-0.03
Nassau	48.20	48.57	0.78	20.85	21.01	0.76	9.78	9.62	-1.66	4.80	4.80	-0.03
Queens	56.07	56.22	0.26	36.51	36.61	0.28	1.79	1.72	-3.73	2.56	2.53	-1.06
New York	64.17	64.21	0.07	43.70	43.75	0.12	2.77	2.72	-1.64	3.31	3.30	-0.19
Bronx	63.29	63.71	0.65	39.39	39.71	0.80	7.06	6.53	-7.50	3.43	3.43	0.00
Westchester	31.58	32.07	1.57	9.62	9.79	1.79	48.49	48.15	-0.68	2.85	2.84	-0.42
Fairfield	24.46	24.83	1.51	7.61	7.75	1.88	44.31	43.99	-0.71	3.19	3.19	0.02
New Haven	23.56	24.11	2.30	7.89	8.10	2.66	38.95	38.41	-1.38	3.67	3.70	0.89
Middlesex	10.10	10.30	2.78	2.87	3.02	5.27	63.49	62.98	-0.81	6.15	6.17	0.23
New London	9.79	10.04	2.62	3.13	3.27	4.38	62.98	62.57	-0.66	10.53	10.53	0.00

Table 6. Percent of marine jobs by sector in 2012 for counties surrounding LIS, and in NY, CT and the nation as a whole. Source: NOAA (2013), Coastal County Snapshots: Ocean Jobs, www.csc.noaa.gov/snapshots/

County	Tourism and Recreation	Living Resources	Marine Transportation	Ship and Boat Building	Offshore Mineral Extraction	Marine Construction	Other
				%			
Suffolk	83.9	1	13.5		0.1	1.4	0.1
Nassau	93.3	0.9	5.0		0.1	0.8	
Queens	72.5	1.8	21.8	0	1.0	2.9	
New York	98.5	0.2	0.4	0	0.0	0.9	
Bronx	77.8	4.0	8.3			9.8	0.1
Westchester	79.5	2.0	5.6		0.3	11.8	0.1
Fairfield	85.3	0.7	6.4		0.0	0.2	7.4
New Haven	81.6	0.2	9.6			0.3	8.3
Middlesex	84.8	0.5				2.9	11.8
New London	41.5	0.4	0	1.4		0.9	55.8
CT	***85.3***	***0.7***	***6.4***	***N/A***	***0***	***0.2***	***7.4***
NY	***85.5***	***0.8***	***10.9***	***0.2***	***0.9***	***1.7***	
Nation	***69.8***	***2.1***	***16***	***5.2***	***5.2***	***2.1***	

Chapter 4. *Stakeholder Involvement: Conflicts and Compatibilities*

Identifying Social Perspectives, Ecosystem Service Values, and Use-conflicts among Long Island Sound Stakeholder Groups Regarding Coastal and Marine Spatial Planning (CMSP).

4.1 Abstract

Long Island Sound (LIS) is an urbanized estuary that faces continual development pressures. From the aquaculture near the coasts to pipelines on the seabed, the list of ecosystem uses and services is growing for LIS, along with the concern that new emerging services will not be spatially compatible with those that already exist. Currently, there is no overall strategic plan guiding new interests, thus instigating conflicts among stakeholder groups and decisions being made on an ad hoc basis. Coastal and marine spatial planning (CMSP) is a management tool that creates a framework to balance these various uses of marine resources and mitigate their consequences, based on economic, social, and environmental goals (Ehler & Douvere 2009). New federal and regional ocean initiatives, such as the Interagency Ocean Policy Task Force, put LIS in a prime position to begin a planning process. Best CMSP practices include stakeholders from the onset and document use conflicts and compatibilities.

To gauge opinions on current and future uses, ecosystem health, management satisfaction, and ecosystem service values, a survey was administered to a diverse sampling of eight stakeholder groups around LIS. Within this survey, participants' perceived knowledge on LIS issues as well as management strategies, such as CMSP, were assessed. Survey analysis showed that CMSP is not well understood by 62.5% of stakeholder groups, and those who were better informed were the managers, scientists, and government officials. This implies that CMSP information does not reach far beyond the policy community. Results support the notion that managers and scientists need to do a better job of reaching out to and communicating ecological concepts to the general public. Conflicts were identified regarding values of ecosystem uses and services, especially the provisioning services (e.g., fishing and dredging). However, the survey

also revealed a general consensus among stakeholder groups on issues dealing with the ecology and environmental health of LIS and the implementation of CMSP.

4.2 Introduction

a. Coastal Management

Over the last century, increasing population density and development along the coasts have placed continued environmental stresses on estuaries and other marine ecosystems. Coastal communities in the United States comprise only 17% of the land area, but currently house 53% of the population even as population density continues to increase (Weinstein & Reed 2005, EPA 2011). Human activities including commercial and recreational fishing, commercial development, navigation, and underwater construction, can all negatively impact local marine resources (Wolfe et al. 1991).

Historically, ocean policy and governance in the United States have dealt separately with individual marine sectors, such as shipping, oil and gas exploration, fisheries, cultural landmarks, recreation, and conservation/restoration (Crowder et al. 2006b). Although this approach may have resolved some conflicts within sectors, it can potentially intensify cross-sectorial conflicts (Crowder et al. 2006a, Ehler & Douvere 2009). Fragmented jurisdictional ocean policy ignores the cumulative effects of management decisions and the complexity of issues affecting the marine ecosystem (US Commission on Ocean Policy 2004, Crowder et al. 2006a). Crowder et al. (2006a) further suggest that the lack of cooperation and coherence in ocean and coastal governance is responsible for many of our current marine environmental conflicts and resource issues.

Ecosystem-based approaches to managing coastal oceans are becoming widely implemented as they take a more holistic approach, including multiple sectors and coordinating governance (Villa et al. 2002, Arkema et al. 2006, Ehler & Douvere 2009, Foley et al. 2010b). As part of a shared management jurisdiction between Connecticut (CT) and New York (NY), Long Island Sound offers significant ecological, aesthetic, social, and economic values to those living around it (EPA 2005). However, as discussed in Chapter 3, existing piecemeal marine policy efforts that are largely reactionary are not sustainable. Coastal and marine spatial planning is a tool of ecosystem-based management (EBM) that can help balance ecological

integrity with sustainable development. Coastal and marine spatial planning has been implemented worldwide as a means of protecting and preserving biodiversity and other ecosystem services, allowing for managed human use of the ocean and its resources (Arkema et al. 2006, Ehler & Douvere 2009, Foley et al. 2010b). Ecosystem services include all of the benefits gained from the marine environment including fisheries, climatic regulation, viewsheds, and recreational opportunities (MEA 2005).

Identifying and planning for areas of conflict and compatibility in ecosystem service values and management expectations are building blocks to initiate productive conversations and foster compromise. Once areas of agreement are identified, they can be starting points to build good will among stakeholder groups (Fisher & Ury 1985). This chapter deals primarily with differences and similarities among stakeholder groups, and specifically with their knowledge of LIS, management opinions, and ecosystem services values.

b. Stakeholder Involvement

A CMSP plan must capture the overall vision for the LIS, and stakeholders must be involved early on in the process (Fisher & Ury 1985, Salz 2004, Ami 2005, Christie 2005, Oracion 2005, Arkema et al. 2006, Douvere & Ehler 2009b). However, in general, there is limited literature focusing on the direct involvement of stakeholders in the CMSP process, including a lack of in-depth stakeholder analysis and methodology on how/when to best incorporate them (Maguire et al. 2012).

Furthermore, in order to have sustained and comprehensive stakeholder involvement, there must be intensive and targeted outreach to different sectors, specifically educating them on how implementation of a CMSP would translate to their use of LIS. Australia's Great Barrier Reef (GBR) Marine Park Authority conducted in-depth public outreach, garnering strong public support for the GBR Marine Park zoning plan. Australia was the first country to implement large-scale marine zoning (a component of CMSP) in 1975, revisiting their planning process every five years since (Day 2008). One of the reasons credited to the success of Australia's marine spatial plan was their strong focus on stakeholder participation. This included holding different workshops that were crafted and scheduled for individual sectors, such as fishing and tourism (Day 2008). However, more challenges exist in getting stakeholders involved and excited about conservation in LIS. Long Island Sound is not held in the same regard as the GBR,

which is considered a national (if not global) treasure. For the most part, people do not come from out of state or out of the county to visit LIS – they do for the GBR. Although LIS is part of the National Estuary Program, the general public does not necessarily see it as a great national resource. Although a 2006 LISS (LISS) poll showed that area residents had high levels of concern for the environment, this concern did not translate to changes in behavior regarding activities that would negatively affect LIS (Day 2008).

c. Spatial Conflicts and Compatibilities

Identifying existing and possible future conflicts among user groups is essential in CMSP (Carter 2003, Ami 2005). For example, LIS is a crucial commercial waterway in the Northeast with a rich maritime history, including important working waterfronts and key industrial shipping routes for both passenger and cargo traffic. Siting of restrictive use or conservation zones could interfere with shipping routes and distribution centers, dredging or mining sites, and gas/energy lines (MSRC 2001). Simply, some interests are spatially compatible, some are not.

Ehler and Douvere (2012) outline best practices for CMSP including multiple steps needed to design and achieve successful CMSP initiatives (Chapter 1, Figure 2). This chapter makes progress on a task in Step 3, *i.e.,* defining and analyzing existing conditions and identifying existing spatial conflicts and compatibilities. Specific outputs of this chapter include an inventory of current human activities and pressures in LIS as well as an assessment of possible conflicts and compatibilities, both among existing human uses and among existing human uses and the environment (Ehler & Douvere 2009). However, other than digitized spatial mapping (i.e., GIS), there is no agreed upon method to measure values and opinions of stakeholders to inform the process. Coastal and marine spatial planning goals and objectives should be informed by this data, not developed beforehand. In the pre-planning process (Chapter 1, Figure 2), there is no relied upon method to significantly test where conflicts and compatibilities lie. Specifically, there is no quantitative methodology on how to measure stakeholder opinion and assess conflicts.

A stakeholder survey was developed as a new method to rigorously measure opinions and values of stakeholder groups in LIS. It was designed to significantly test and compare data with regard to a diverse sampling of LIS stakeholder groups. The relative values and opinions of these stakeholder groups were quantitatively measured in terms of current uses, management

approaches, and possible future directions. The survey was tailored to look at how a CMSP framework could be established in LIS that has the potential to reduce stakeholder conflicts. Results identify not only perceived issues and conflicts, but compatibilities as well. Important ecosystem uses and services in LIS are discussed and survey data are used to help define ecosystem service values, making progress on this crucial step in the CMSP process. Creating an inventory of these values and priorities provides important background information that can be used and refined in the planning process.

d. Long Island Sound Stakeholder Groups

Eight main LIS stakeholder groups were identified based on goals, motivations, and interests: Managers, Scientists, Active Recreation, Passive Recreation, Business, Community, Government, and NGOs. Managers include those who are directly responsible for managing LIS resources. Scientists are those involved in gathering and synthesizing information about LIS and its resources/processes. Scientists include researchers at academic institutions (e.g., Stony Brook University, University of Connecticut, etc.), as well as those employed by government or not for profit organizations, such as The Nature Conservancy and Department of Environmental Conservation. There is an active Science and Technical Advisory Committee (STAC) representing over two-dozen organizations and institutions, conducting research and setting research priorities for LIS. The STAC is part of Long Island Sound Study, started by the EPA, CT, and NY as a partnership among stakeholders to restore and protect LIS.

For this study, Active and Passive Recreation were separated into different categories because they represent very different interests in and uses of LIS – one being more extractive (e.g., actively taking out/disturbing resources), and the other being largely non-extractive (e.g., passive enjoyment of resources). Recreation is integral to LIS's economy and quality of life, with direct and indirect economic contributions estimated at $5.23 billion (Blumberg 2012). Boating, sport-fishing, and swimming represent some of the highest grossing activities (Blumberg 2012). Active Recreation comprises the large community of boaters (i.e., boats that have motors), recreational fishers/anglers, and jet-skiers using LIS on a regular basis. Passive Recreation includes beach goers, swimmers, kayakers, naturalists, bird watchers, etc. Kayakers were separated from boaters, and put in the passive category because kayaks do not have a motor

and their environmental impact was considered minimal compared to docking and mooring of motor and sailboats.

I designated business stakeholders as those who have a direct economic stake in LIS, such as waterfront businesses and property owners, commercial fishers, and energy and infrastructure developers. Long Island Sound is an important shipping route to NY Harbor, and therefore has valued working waterfronts, businesses, ports and industries dotting its coasts. Economic interests such as restaurants, coastal real estate, commercial fisheries, party boats, energy facilities, marinas, and yacht clubs are all valuable commercial establishments dependent on a healthy and functioning LIS. In addition, there is a strong historical component to many of LIS's businesses, which increases their intrinsic value to many shorefront communities.

The Community category represents members of the public who may live around LIS and use, appreciate, or rely on its many ecosystem services. There are over 23 million people living within 50 miles of LIS (Figure 1) (LISS 2012b). There are also many political representatives, government officials, agency staff and policy makers involved in the management of LIS; these groups were put in the Government category. In addition, the Government category encompassed the active military installations in LIS, including a submarine base in Groton, CT, and Coast Guard installations in New Haven Harbor and Groton, CT, and Huntington Bay, NY.

The NGO category is comprised of the many non-profit and public interest groups advocating for LIS. The Nature Conservancy, Save the Sound, and the Audubon Society are a few examples. The Nature Conservancy (TNC) has a dedicated LIS program focused on preparing coastal communities for the effects of climate change, such as rising sea levels and stronger storms. They also work on restoring and protecting seagrass habitats, shellfish and migratory fish populations, and managing development pressure (TNC 2012).

4.3 Methods

I conducted multidisciplinary literature reviews, interviews with stakeholders, and newspaper searches to inventory current and possible future human activities (and pressures) in LIS. I then designed and administered a targeted stakeholder survey to look closely at perceived issues and management priorities in LIS, and to assess conflicts and compatibilities around human uses and the environment. The survey was also used to identify views regarding CMSP and document relative values of ecosystem uses and services among stakeholder groups.

The stakeholder survey was a compilation of both quantitative and qualitative questions, and was administered on-line for a five-month period, from March to August 2011. Distribution was targeted to active stakeholders in LIS and invitations to participate were sent out through various state agencies, community groups, management networks, recreational groups, NGOs, and business associations. I worked closely with the Long Island Sound Study (LISS) to administer the survey to targeted user groups including scientists, community groups, businesses, managers, and policy makers. The survey had a 33% response rate, which is considered good for on-line surveys. Detailed survey methodology is described in Chapter 2.

A total of 394 individual surveys were used in this analysis. Survey participants were able to designate a primary, secondary, and tertiary user group for themselves in survey question 8, "What relationship do you most/best identify yourself as having with LIS," with primary being the group they best identified themselves with. Only the primary user group designation was used in much of the analysis unless otherwise noted. User groups included the following eight primary categories: Managers (n=46), Scientists (n=84), Active Recreation (n=57), Passive Recreation (n=56), Businesses/Economic Interests (n=29), Community Members (n=38), Government (n=49), and NGOs (n=38) as per Chapter 2, Table 5a and 5b.

Levine's statistic, which looks at the equality of variances among samples (i.e., the stakeholder groups), was calculated to test the assumptions of homogeneity (Appendix 2), and if ANOVAs were appropriate, statistical tests. Where Levine's statistic was not significant, the assumptions of homogeneity have not been violated. Where Levine's statistic was significant, Welch and Brown-Forsythe statistical tests were run in addition to ANOVAs, as they are preferentially used to test significance in these cases (Palant 2010). Welch and Brown-Forsythe values are recorded in italics under the ANOVA significance value in relevant Figures. However, the results from these tests did not change whether or not the questions were significant at $p < 0.05$, when compared to the ANOVA results. This was true for most cases except for Question 12, "Use conflicts are currently a problem," where it became not significant at the $p<0.05$ level (Table 1).

ANOVAs were used to test for significant differences among stakeholder groups. ANOVAs account for disparities in sample sizes by using the mean score. Survey questions that were relevant to this chapter, and therefore included in these results are: 9 "Do you think you are well informed on the following," 12 "Please rate your opinion of the following statements," 17

"How do you personally value the following services/uses in LIS," 18 "How satisfied are you with the management of LIS," 19 "Rank the 5 most important management issues in LIS," 20 "Over the past 10 years, the ecological health of LIS has," 23 "What is your opinion of the following current uses of LIS," 25 "What is your opinion of the following possible future uses of LIS," 27 "For the following questions, please use your opinion, best guess or rough estimate for % of area used," 28 "Do you think a comprehensive CMSP should be implemented for LIS?," and 31 "How likely are you to support a…" (Table 2). Significance was measured at the 95.0%, 99.0%, and 99.9% confidence intervals. Where significant differences were found, a post hoc pairwise comparison test using Tukey HSD was employed to further diagnose the stakeholder group variations.

4.4 Results

a. Question 9: Perceived Knowledge on LIS Topics and Issues

Stakeholder groups were asked to rate their perceived knowledge on seven topics for LIS: management issues, economic issues, fishery issues, EBM, CMSP, regional infrastructure and energy needs, and community or stewardship efforts (Figure 2). Participants could choose among *well informed*, *fairly well informed*, *some knowledge*, and *not informed*. Perceived knowledge varied significantly among groups, specifically on the topics of management, fisheries, EBM, and CMSP (all at $p<0.001$), as well as community/stewardship ($p<0.01$) (Table 3). Compared to the other groups, Managers identified themselves as being most informed on the topic of management issues, falling somewhere between *fairly* and *very well informed* (Figure 2). Managers varied significantly ($p<0.05$) from Active Recreation, Passive Recreation, Community, and Business, which averaged toward just *some knowledge*. In addition, Scientist and NGOs appeared as significantly more knowledgeable ($p<0.001$) on management issues than Community (Table 3).

In terms of fishery issues, Community, Passive Recreation, Business, and NGOs recorded having the least knowledge (respectively), all leaning toward just *some knowledge*. However, Managers, Scientists, and Government averaged closer to *fairly well informed* on fishery knowledge in LIS, with Active Recreation claiming to know the most (Table 3). Specifically, Active Recreation considered themselves significantly more informed than Passive Recreation

($p<0.005$) and Community ($p<0.001$) on fishery issues, and Scientists varied significantly with Community ($p<0.05$) (Table 3).

Managers, Scientists, Government, and NGOs all rated themselves as having the most knowledge on EBM and CMSP, as *fairly well informed*. They also documented more overall knowledge of EBM than CMSP. All other groups leaned toward having at least *some knowledge* of EBM and CMSP. However, most groups reported they were least informed on CMSP compared to the other six topics, especially the groups of Community, Businesses, and Active and Passive Recreation. Specifically, Managers and Scientists varied significantly ($p<0.05$) with Community on perceived EBM knowledge; Managers also differed with Passive Recreation on this topic. Business significantly contrasted ($p<0.05$) with Government, Managers, and Scientists on EBM. Similarly, Managers, Scientists and Government all varied significantly ($p<0.05$) with Community and Business on how informed they are on CMSP. As for community issues and stewardship, Business ranked themselves as being the least informed, but only differing significantly ($p<0.05$) with managers (Table 3, Table 4).

b. Questions 12 and 20: LIS Ecology and Ecosystem Health

Using a five-point Likert scale, question 20 asked participants to rate how they felt about changes in the ecological health of LIS over the past 10 years: *much improved, somewhat improved, not changing, somewhat worse, or much worse*. Similarly, question 12 asked participants to rate their overall opinion on a five-point Likert scale regarding a series of statements dealing with the ecological health and conflicts in LIS. They could choose: s*trongly disagree, disagree, neutral, agree, and strongly agree*. Specific statements included:

- Water quality in LIS has improved over the past 25 years.
- The ecosystem structure and function of LIS's coastal areas are in good shape.
- LIS has a healthy diversity of plants and animals.
- LIS has a healthy food web/trophic structure.
- Reducing nutrient inputs into LIS has greatly improved its ecological health.
- Given current conditions, commercial fisheries will continue to be a viable industry in LIS over the next 10 years.

- Use conflicts (either spatial or temporal) among different stakeholder groups in LIS have been/are/will be a problem:
    - Over the past 25 years
    - Currently
    - Over the next 25 years

User group opinion varied significantly ($p<0.05$) for only one statement in question 12, "The ecosystem structure/function of LIS are in good shape" (Figure 3). Business had a significantly more positive view on this statement than both Scientists ($p<0.05$) and NGOs ($p<0.01$) (Table 1, Figure 3). There seems to be agreement among the different groups on the state of water quality, biodiversity, and trophic structure in LIS (Table 1). In addition, question 20 asked participants if the ecological health of LIS was worse or has improved over the past 10 years, and again there was no significant difference among user groups, with all groups citing at least some improvement (Table 5).

There was no significant difference among groups on the statement "Reducing nutrient inputs has greatly improved ecological health in LIS," with all hovering just below *agree* and above *neutral*. In addition, all user groups fell between *neutral* and *disagree* on commercial fisheries being viable in 10 years, and agreed on use conflicts being a problem in the past and even more so in the future (Table 1).

c. Question 15: Ecosystem Service Values

Question 17 asked participants how they personally, not professionally, valued 25 different ecosystem services in five categories based on a five-point Likert scale: *Do not value at all*; *Personally don't value, but see societal value*; *Neutral (don't feel strongly either way)*; *Somewhat value; Strongly value*. There were significant differences ($p<0.001$) regarding how groups valued many of the various ecosystem services including recreational fishing, fisheries potential, property values, repository for discards, infrastructure potential, energy development (non-renewable), and commerce or commercial development. The worth of Active Recreation also significantly differed ($p<0.01$) among groups (Table 6).

All groups agreed on Overall Provisioning Services having at least some value. However, there tended to be significant variance ($p<0.001$) on the assessment of individual

provisioning services, such as non-renewable energy or infrastructure. In fact, renewable energy development was the only provisioning service where there was no significant difference in groups' valuations (Table 6). Business was the only user group that registered strong positive values for non-renewable energy and infrastructure, while most other groups leaned toward, *personally don't value but see societal value.* In addition, commerce/commercial development was positively categorized by both Business and Government.

All groups agreed on and assigned some positive worth to recreation, aesthetics, non-consumptive recreation, public access, and tourism potential. All of the Overall Ecosystem Protective Services, Functional Services, and Historic/Educational Services, fell between *Somewhat value* and *Strongly value* (Table 6).

Active Recreation significantly valued recreational fishing/shellfishing more than Managers ($p<0.021$), Scientists ($p<0.018$), Passive Recreation ($p<0.022$), Community ($p<0.025$), and NGOs ($p<0.024$). Active Recreation also categorized active recreation higher than Managers ($p<0.001$), Scientists ($p<0.002$), and Government ($p<0.029$); as well as fisheries potential, more than Scientists ($p<0.011$), Passive Recreation ($p<0.001$) and Community ($p<0.015$). In addition they rated research and education much more negatively than Scientists ($p<0.045$) (Table 7).

Importance of property value was lower for Managers than for Active Recreation ($p<0.001$), Passive Recreation ($p<0.048$), and Business ($p<0.001$). In addition, although all on the negative side, Passive Recreation rated repository for discards (e.g., sewage effluent, runoff) significantly less than Active Recreation ($p<0.026$), Business ($p<0.001$), and Government ($p<0.049$). Business, however, was the only group on the positive side with regard to LIS being a repository for discards, and also significantly differed from NGOs ($p<0.020$) (Table 7).

Active Recreation and Business rated infrastructure significantly less negatively than Passive Recreation ($p<0.023$, $p<0.001$ respectively), and NGOs ($p<0.037$, $p<0.002$ respectively). Active Recreation took a more neutral stance, and Business was actually on the positive side. Business also had a significantly less negative view of infrastructure than Managers ($p<0.003$). Passive Recreation and NGOs valued infrastructure the least, significantly differing from Government ($p<0.036$) and Business ($p<0.003$). When evaluating non-renewable energy, Business leaned toward positively evaluating this service, which significantly differed from the negative view of Scientists ($p<0.001$), Managers ($p<0.003$), Passive Recreation ($p<0.003$), and

NGOs ($p<0.001$). In addition, Business significantly valued commercial development/commerce more than Managers ($p<0.019$), Scientist ($p<0.012$), Passive Recreation ($p<0.001$), NGOs ($p<0.001$), and Community ($p<0.012$). Passive Recreation assigned the most negative worth of all the groups to commercial development, significantly more so than Active Recreation ($p<0.020$) and Government ($p<0.014$), who were both around neutral (Table 7).

d. Question 18: Satisfied with the Management of LIS

Participants were asked to rate (on a five-point Likert scale) how satisfied they were with the management of LIS in question 18, choosing either *very satisfied*, *slightly satisfied, neutral*, *slightly dissatisfied*, or *very dissatisfied*. Although the ANOVA showed a significance of $p<0.041$, post hoc tests did not reveal significant differences ($p<0.05$) among the stakeholder groups for this question. The most notable result, although still not significant, was the difference in mean scores among Scientists and Managers at $p<0.065$, with scientists slightly more satisfied (Table 8). The fact that there were no significant values coming up on the post hoc tests shows that, for the most part, all user groups agreed on a neutral level of satisfaction for the management of LIS.

e. Question 23 and 25: Current and Future Uses of LIS

In questions 23 and 25, participants were asked to rate (using a five-point Likert scale) their opinions on a series of 35 current uses of LIS and 16 possible future uses. They were able to choose *Very Negative (reduce or eliminate/should not be in LIS), Negative, but (might be) willing to tolerate, Neutral, Positive (at current level/might be satisfied with)*, or *Very Positive (would like to see more/would definitely like to see in LIS)*. There was significant variance ($p<0.001$) among user groups on many current uses (Table 9, Table 10). There was also agreement on uses such as shellfish aquaculture and commercial fishing, with most groups around *neutral*. However, when asked specifically about fishing using trawls, opinions became strongly negative. There were no significant differences among groups on the disposal of runoff or sewage effluent in LIS, with all near *negative, but willing to tolerate*. In general, groups were more negative toward runoff versus effluent disposal. Most groups had a negative view of coastal development for housing, but had a more positive stance on working waterfronts.

Military use and passive recreation were the last two uses with no significant difference among groups (Table 10).

Active Recreation had a much more positive view of fishing than did Scientists ($p<0.012$), Passive Recreation ($p<0.003$), Community ($p<0.048$), and NGOs ($p<0.010$). Government had a significantly more positive view of commercial shellfishing than did Passive Recreation ($p<0.007$) and Community ($p<0.020$). Passive Recreation, however, was more negative toward recreational/public shellfish beds in comparison with Managers ($p<0.026$), Government ($p<0.001$), and NGOs ($p<0.028$). Government also had a significantly more positive view than Community ($p<0.048$) on public shellfish beds. On the topic of dredge material disposal, Scientists, Passive Recreation, Community and NGOs had a significantly more negative view than Business, who averaged *neutral*. Business also had stronger positive views of shipping lanes than did Passive Recreation ($p<0.038$). In addition, Businesses had a much more positive view of commerce and ports than did Scientists ($p<0.026$), Passive Recreation ($p<0.011$), and Community ($p<0.001$).

Community was also more negative toward commerce than Managers ($p<0.006$) and Government ($p<0.011$). Business had a more positive view of waterfront industries than did Scientists ($p<0.004$), Passive Recreation ($p<0.002$), and Community ($p<0.001$). Similarly, Active Recreation was more positive on waterfront industries, differing from Scientist ($p<0.049$), Community ($p<0.008$), and Passive Recreation ($p<0.026$). In addition, Business more strongly supported coastal development for business than Managers ($p<0.010$), Passive Recreation ($p<0.006$), and NGOs ($p<0.004$). Although all positive, Scientists, Government, and NGOs wanted to see more passive recreation beach access points around LIS than Business ($p<0.044$, $p<0.013$, $p<0.030$ respectively).

Community had a significantly more negative view of transfer stations than did Active Recreation ($p<0.049$), Business ($p<0.013$), and Government ($p<0.001$), who actually leaned on the positive side of the spectrum. Passive Recreation was also more negative than Government on this use ($p<0.014$).

Active Recreation significantly differed from Scientists ($p<0.024$), NGOs ($p<0.017$), and Passive Recreation ($p<0.004$), wanting more private marinas. However, they only differed with Scientists ($p<0.018$) and NGOs ($p<0.006$) when public marinas were suggested. Business also more strongly supported private marinas than did Scientists ($p<0.025$), Passive Recreation

($p<0.004$), and NGOs ($p<0.015$). In addition, Active Recreation and Business had a *slightly positive* or more *neutra*l view of bulkheads than the rest of the groups. They significantly differed from Managers ($p<0.001$, $p<0.001$), Scientists ($p<0.001$, $p<0.004$), and Governments ($p<0.001$, $p<0.034$) respectively, who all had a very negative view. However, only Active Recreation significantly differed from Passive Recreation ($p<0.013$) and NGOs ($p<0.004$) on the issue of bulkheads. Both Active Recreation and Business were less negative toward dredging bays and harbors compared to Scientists ($p<0.004$, $p<0.001$ respectively) and Passive Recreation ($p<0.043$, $p<0.009$ respectively). Boating only showed a significant difference among Scientists and Active Recreation ($p<0.040$), with Active Recreation viewing it much more positively. Groups in general were more positive about non-motorized sports than motorized sports, with Businesses ($p<0.044$) and Community ($p<0.031$) being significantly more in favor of motorized sports than NGOs. Again, Active Recreation agreed with Business on motorized sports, significantly differing with NGOs ($p<0.005$, $p<0.002$, respectively) and Government ($p<0.021$, $p<0.006$, respectively).

When asked about marine protected areas (MPAs), Business and Active Recreation had a less positive view compared with Passive Recreation ($p<0.012$, $p<0.009$, respectively) and NGOs ($p<0.043$, $p<0.049$, respectively). However, when it came to natural areas and coastal habitat restoration, Active Recreation ($p<0.002$, $p<0.039$), Managers ($p<0.014$, $p<0.039$), Scientists ($p<0.001$, $p<0.014$), Passive Recreation ($p<0.001$, $p<0.001$), Government ($p<0.001$, $p<0.003$), and NGOs ($p<0.001$, $p<0.001$) respectively, had a significantly more positive view than Business, with all supporting an increase in natural areas and restoration around LIS. Business was also the only group that averaged toward *slightly positive* on environmental education and stewardship. All of the other groups leaned toward *strongly positive, would like to see more* on environmental education and stewardship, but only significantly differed from Scientists ($p<0.001$), Passive Recreation ($p<0.001$) and NGOs($p<0.003$). Scientists wanted to see more scientific research in LIS, significantly more so than Businesses ($p<0.001$) and Government ($p<0.006$). Passive Recreation ($p<0.026$), and NGOs ($p<0.011$) were also more positive about scientific research than Business.

Business was the only user group that had even a slightly positive view of cables and pipelines in LIS and differed significantly from Passive Recreation ($p<0.017$), Community ($p<0.020$), and NGOs ($p<0.017$). Business and Active Recreation had a less negative attitude

toward power plants than did Passive Recreation ($p<0.006$, $p<0.048$, respectively), and NGOs ($p<0.002$, $p<0.015$, respectively). Active Recreation had a positive view of party boats, unlike Scientists ($p<0.006$), Passive Recreation ($p<0.001$), Community ($p<0.032$), Government ($p<0.030$), and NGOs ($p<0.001$). Business also had a positive view of party boats, but only significantly differed from Passive Recreation ($p<0.032$) and NGOs ($p<0.047$).

There was much more agreement among groups on future uses than on current uses. In general, groups leaned positively toward algal and fish aquaculture, wind and wave energy generation, and marine areas zoned for consumptive use. Negative leaning views were taken on energy generated from nuclear and natural gas, mining, and new energy pipelines or telecommunication cables (Table 11). Significant differences existed among groups on no-take and limited use MPAs ($p<0.001$), marine areas zoned for industrial use ($p<0.001$), and the filling of borrow pits ($p<0.01$). In addition, when asked about possible future energy uses, significant differences ($p<0.05$) were observed among groups regarding waste-to-energy facilities (WTE) and liquid natural gas facilities (LNG) (Table 11). Specifically, NGOs and Scientists ($p<0.017$) differed on their opinion of WTE facilities, with Scientists being less against them. Passive Recreation differed ($p<0.027$) with Business, having a much more negative view of LNG facilities.

Active Recreation and Business differed significantly on how they viewed possible no-take MPAs compared to Scientists ($p<0.001$, $p<0.001$), Passive Recreation ($p<0.001$, $p<0.011$), Government ($p<0.004$, $p<0.073$), and NGOs ($p<0.001$, $p<0.005$) respectively, taking a less positive, more neutral standpoint. A similar pattern existed for limited use MPAs with Active Recreation and Business being less positive than Scientists ($p<0.007$, $p<0.001$, respectively), and Passive Recreation ($p<0.034$, $p<0.002$ respectively). In addition, Business significantly differed with Government ($p<0.004$) and NGOs ($p<0.012$) on MPAs. All groups leaned negatively toward marine areas zoned for industrial use. However, Scientists views were significantly less negative compared to Active Recreation ($p<0.036$) and NGOs ($p<0.035$). NGOs were also more negative toward the filling of borrow pits in LIS, significantly more so than Managers ($p<0.007$) and Government ($p<0.006$).

f. Question 27: Spatial Allocations for Conservation or Development in LIS

Survey participants were asked to give their opinion/best guess or rough estimate for the percent of area in LIS that was either currently used for or should be used for habitat conservation or commercial/industrial activity. They could choose from 0-5%, 5-15%, 15-25%, 25-50%, or >50%. Coastal areas were considered separately from open water. There was agreement among groups on *current* open ocean allocations for habitat conservation, and commercial/industrial activity, as well as on *curren*t and *should be* coastal allocations for commercial activity (Table 12). On average, groups thought there should be less coastal allocation for commercial activity than there currently is, with a reduction from 15-25% to 5-15%. Regarding open water commercial activity, most groups reported wanting less allocated than at presently. Business, however, wanted to see a slight increase in commercial activity. For example, Business varied significantly with Passive Recreation ($p<0.005$) and Government ($p<0.023$) regarding views on the amount of open water in LIS that should be set aside for commercial/industrial activity, wanting slightly more at 15-20%, versus 5-15%.

All groups agreed that the amount of habitat conservation area set aside for protection in the open water part of LIS should increase from ~15% to 25-50% (on average). However, user groups did significantly vary on the specific percent of area that *should be* set aside in LIS open water for habitat conservation ($p<0.001$) and commercial/industrial activity ($p<0.05$). In addition, there were significant differences in the amount of coastline that *should be* set aside for habitat/conservation ($p<0.01$). For example, Passive Recreation thought that more open water should be allocated for conservation in LIS, significantly differing from Active Recreation ($p<0.005$), Business ($p<0.050$), and Government ($p<0.016$). Active Recreation wanted less area set aside for coastal habitat conservation (~15-20%) compared to Passive Recreation ($p<0.014$), and NGOs ($p<0.012$) who wanted more than 25%. Groups also agreed that there should be slightly less commercial/industrial activity on the LIS coastline than there currently is (Table 12).

All groups agreed that currently on average <5% of current open water in LIS was allocated for habitat conservation, 15% for commercial/industrial activity, and 12% for coastal industrial activity. Therefore, there were no significant differences among groups on what is currently allocated for any of these different uses.

g. Questions 28 and 31: Coastal and Marine Spatial Planning (CMSP) Support

Questions 28 and 31 dealt specifically with participants' support for CMSP and CMSP-like initiatives. Question 28 directly asked if a comprehensive CMSP should be implemented for LIS that was similar to land based zoning plans. The survey gave a definition of CMSP as a public planning process analyzing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic and social objectives that have been specified through a political process (Ehler & Douvere 2009). Land use zoning was described as a spatial planning process in cities or towns that designates how different areas can be used in accordance with a community vision. Survey participants could answer *Yes, No*, or *Not sure*. The majority of respondents (77%) voted *Yes* to CMSP for LIS (Table 13). However, although all user groups on average leaned slightly toward supporting CMSP being implemented in LIS, Business was significantly less supportive than Scientists ($p<0.009$), Passive Recreation ($p<0.007$), Community ($p<0.039$), Government ($p<0.040$), and NGOs ($p<0.036$) (Table 13).

Question 31 used a five-point Likert scale and posed the question of CMSP support in a variety of different ways including:

1) Support for a marine spatial planning initiative for LIS
2) Support for a NY and CT bi-state management effort (with implementation authority) for LIS
3) Support for a comprehensive planning process for LIS.

Participants were also asked how likely it was for them to be involved in a comprehensive planning process for LIS. Respondents could select *very likely, somewhat likely, neutral, somewhat unlikely*, or *very unlikely*. Again, all groups were *somewhat likely* to support a CMSP, NY and CT bi-state management effort, and comprehensive planning process for LIS. There were, however, significant differences in the level of support among Business and other groups (Table 14). Business was a bit less likely to support a CMSP for LIS than Scientists ($p<0.009$), Community ($p<0.008$), and NGOs ($p<0.014$). Business only differed significantly ($p<0.035$) from NGOs on their support for a bi-state management effort, being more *neutral*. Business also significantly differed from Community ($p<0.035$) and NGOs ($p<0.039$), being less supportive of a comprehensive planning process for LIS, but still being *somewhat likely* to support.

All groups identified themselves as at least *somewhat likely* to commit to being involved in a planning process for LIS; however overall answers were not as high for involvement versus CMSP support with an overall group average of 1.58 versus 2.26 (respectively), where 1=*very likely*, 2=*somewhat likely*, and 3=n*eutral* (Table 14).

4.5 Discussion

Effective CMSP can serve as a decision-making tool to evaluate tradeoffs among the competing human uses and services within an estuary or marine system (O'Connell 2006). Extensive case studies regarding the effectiveness of such planning processes emphasize three key factors: 1) involving all stakeholders from the outset; 2) compiling a comprehensive accounting of all current (and proposed) uses and services; and 3) discerning conflicts and compatibilities among stakeholders (Christie 2005, Arkema et al. 2006, Douvere & Ehler 2009a, Maguire et al. 2012). Using an extensive and targeted stakeholder survey, this dissertation defines a method to successfully initiate these three steps at the very early stages of CMSP. Specifically, this research advances the stakeholder involvement process by identifying perceived issues, knowledge gaps, conflicts, and priorities, as well as introducing the community to the idea of CMSP in LIS.

Even though all groups thought that the ecological health of LIS had slightly improved over the past 10 years, their satisfaction with the management of LIS was only neutral. This perhaps demonstrates the general lack of enthusiasm around current and past management activities in LIS. This attitude, combined with the strong consensus among all groups for CMSP in LIS, agrees with the general trend toward EBM. In addition, strong positive opinions on a bi-state planning process further builds a sound basis developing a CMSP for LIS.

There were some unexpected survey results including no significant differences in the relative level of satisfaction of management among user groups. There were less opinion differences than expected among groups on this matter, especially among Managers and Business, given that fishery quota meetings can get quite contentious at times. Results show that Managers are often feeling just as unsatisfied as Business regarding the management of LIS.

Interestingly, results from this survey showed that there were many unexpected compatibilities among groups. For example, all groups were positive regarding uses having to do with conservation in LIS. As conservation uses often clash with commercial uses and other

provisioning services, it was surprising to see such agreement. Conversely, other survey results seemed highly predictable. For example, it was not surprising that Active Recreation assigned a high value to fishing, as many of them are recreational fishermen. The agreement of highly intuitive responses with the results helps secure the validity of the survey as a robust tool for measuring user group opinion.

Some notable conflicts among groups included future LIS uses, such as commerce, ports, and transfer stations. Community and Passive Recreation, who strongly valued aesthetics, perhaps rated commerce and ports so low because these uses might interfere with viewscapes and accessibility, or cause a safety or pollution issue. Their conflict with Active Recreation, Business, and Government on the construction of transfer stations in LIS further supports this. As shipping might increase due to rising fuel costs and carbon dioxide concerns, there may be a need for increased transfer stations in the future around LIS. The Government may see this as a viable possibility to reduce truck traffic and greenhouse gas emissions, and Business as a positive economic venture. Community and Passive Recreation, however, probably have more of a not in my backyard (NIMBY) approach, as it would conflict with coastal aesthetics.

Business also predictably had a more positive view of cables and pipelines in LIS. Unlike Business who might profit from more infrastructure, Passive Recreation, Community and NGOs are most likely concerned about disruption of the ecosystem during the construction process, and long-term effects, therefore have a negative view.

Active Recreation and Business felt similarly on many issues, often standing apart from the other user groups. For example, Active Recreation and Business more strongly supported private marinas, as they would be an economic investment and are integral to motorized recreation, which they both also highly valued. On the other hand, Scientists and NGOs were very negative toward marinas, as they can disrupt natural coastal processes and habitats. However, a negotiating point may be around ownership. For example, Passive Recreation was more likely to side with Business and Active Recreation when marinas were public, not private.

Survey results will be useful in helping to construct a comprehensive vision for LIS. (Day 2008). One of the possible issues that surfaced for moving forward with CMSP in LIS were the knowledge gaps that existed between stakeholder groups. Perceived knowledge on CMSP seems to be the topic the majority of groups identified as being most lacking in knowledge of -- except

for Managers, Scientists, and Government. This discrepancy implies that information on CMSP/EBM is not reaching far outside the management/policy community.

Surprisingly, Community ranked themselves as only having some understanding of community issues or stewardship, and, with the exception of Business, had the least knowledge compared to all of the other groups. This may signify that community members are not as aware of community activities and stewardship opportunities as are managers and NGOs, who perceived themselves as being the most informed on this topic. Again, this is another example of the need for more effective public outreach and communication. In addition, issues regarding the economic and commercial sectors of LIS were, in general, poorly understood, even among managers. How can educated management decisions be made around commercial uses when they are not thoroughly characterized or understood for LIS, and their effects on other services unknown?

The survey results agree with findings from previous studies on stakeholder knowledge, especially a 2006 LISS general resident (i.e., LIS region) survey. In the 2006 survey, the general public in the LIS region had little knowledge of water pollution and runoff to LIS, and most did not think they had any impact on LIS's water quality (LISS 2006). As the stakeholder survey used in this dissertation targeted a more knowledgeable population on LIS issues, the findings still show general knowledge gaps among user groups, especially with the Community.

Managers and Scientists have not done a sufficient job of educating community members as to the various ecosystem services in LIS. Many survey results reinforce the obvious (i.e., business valuing powerboats, scientists thinking shoreline development for marinas is not a good idea). These intuitive opinions are the same ones that might have been predicted five years ago, indicating a failure in communication between managers, scientists, and the public. Future LIS management strategies must address crossing barriers between stakeholder groups. Specifically, LIS managers and scientists should explore how to best communicate issues in order to increase understanding of interconnections among ecosystem services, as well as result in opinion and behavior changes.

One of the main problems of EBM and CMSP initiatives in the Mid-Atlantic and Northeast regions are that meetings usually happen during the day. There are always agency representatives, academics, NGOs and industry representatives in attendance. Most of these participants will get paid for the day or afternoon they spend in that meeting. However, the

general public, recreational communities, and small maritime business communities (e.g., fisherpeople, ferry operators) are usually absent for one main reason – they are at work. Either they can't take off time from their jobs, or would lose an afternoon of fishing and profits. Also, many of them cannot travel long distances to attend meetings, or may not even know about them. Having attended many of these meetings myself over the past few years, the same key players are usually involved and the general community is generally absent.

The EBM and CMSP community should look at incorporating local community organizing models into their outreach. In environmental advocacy and community organizing, visioning meetings are usually held in the evening in local community centers or other centralized locations. In addition, many of these forums and outlets already exist through established local and regional groups that the CMSP community can tap into. A better effort needs to be made to involve all stakeholders in the process, specifically in understanding how they value ecosystem services and what the different services are. However, this is complicated by insufficient agency staffing and/or funding to work on local CMSP initiatives. Therefore, sustained funding and a strategic outreach component need to be part of any CMSP initiatives in LIS.

Too often in environmental management there is an "us versus them" attitude that permeates management initiatives. This destructive attitude often stems from managers, agency representatives, scientists, industry as well as the public. In debates on ecosystem service tradeoffs, people frequently presume they know what the other is thinking, assuming a defensive posture instead of listening. This survey can serve as a neutral tool in brokering the relationship among stakeholders involved in CMSP. Specifically, survey results can be helpful in shaping more productive and open discussions of management options and alternatives by addressing conflicts and motivations early on.

4.6 Conclusion

With the passage of the NYS Ocean and Great Lakes Ecosystem Conservation Act and final recommendations of the Federal Interagency Ocean Policy Task Force, CMSP is a practical option for the future management of LIS. Survey results will be useful in helping to construct a comprehensive vision for LIS, which should be at the basis of any CMSP initiative. The survey itself served as a catalyst to get stakeholders involved and give them an initial opportunity to

document their positions and values regarding LIS at an early stage of CMSP. Although there were many conflicts among the different user groups, there were more compatibilities on opinions of current and future uses, and ecosystem service values. These compatibilities are starting points for negotiation and evaluation of tradeoffs. In addition, the stakeholder survey can easily be standardized and replicated for other locations, serving as a model in other CMSP initiatives to help define motivations and values prior to initiation of the planning process.

Chapter 4 Figures:

Figure 1. Population increase by state for those living within a 50-mile radius of LIS. New York=NY, Connecticut=CT, New Jersey=NJ, and Rhode Island=RI (LISS 2012b).

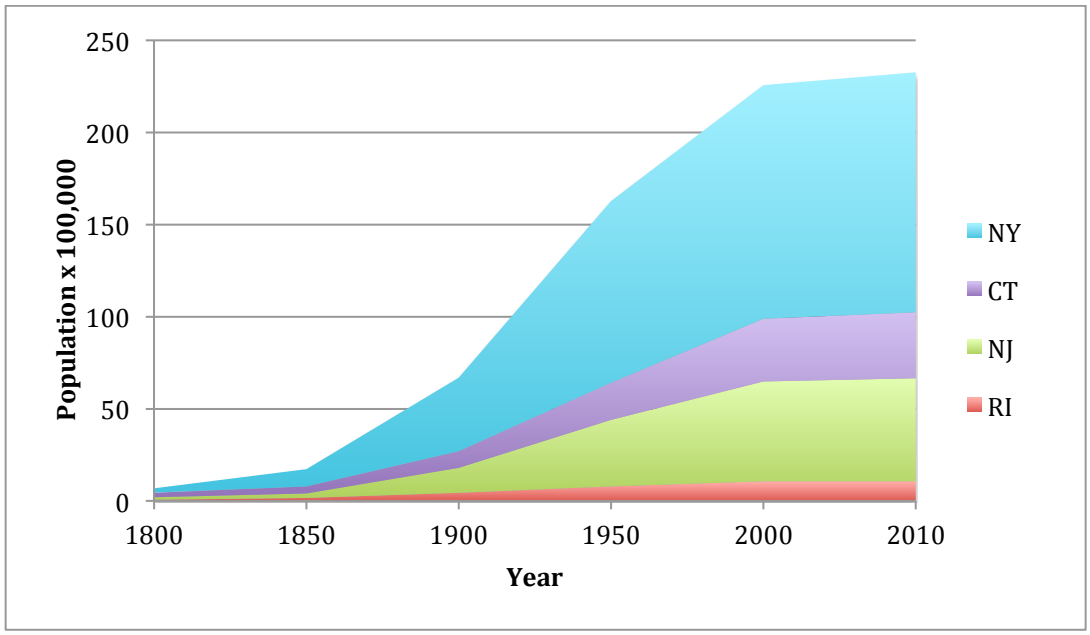


Figure 2. Stakeholder groups' perceived knowledge level on seven different LIS topics asked in question 12, management, economic, fishery, EBM, CMSP, infrastructure/energy, and stewardship.

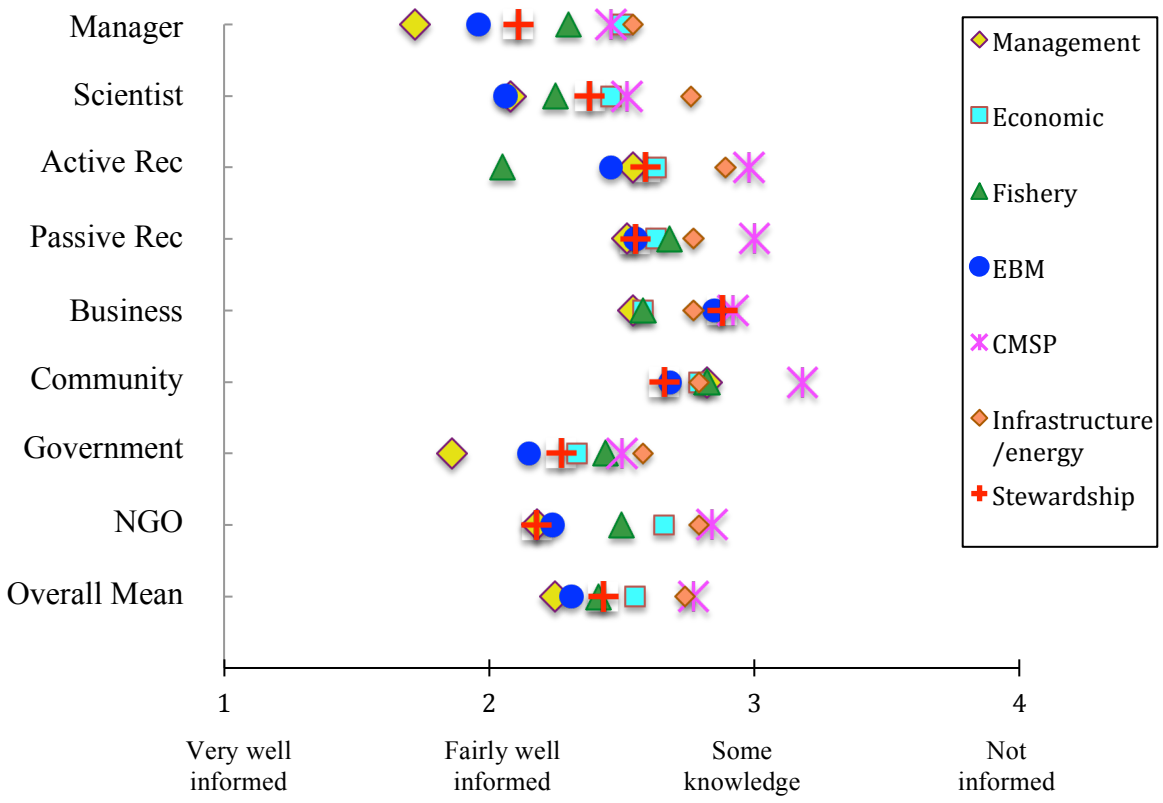
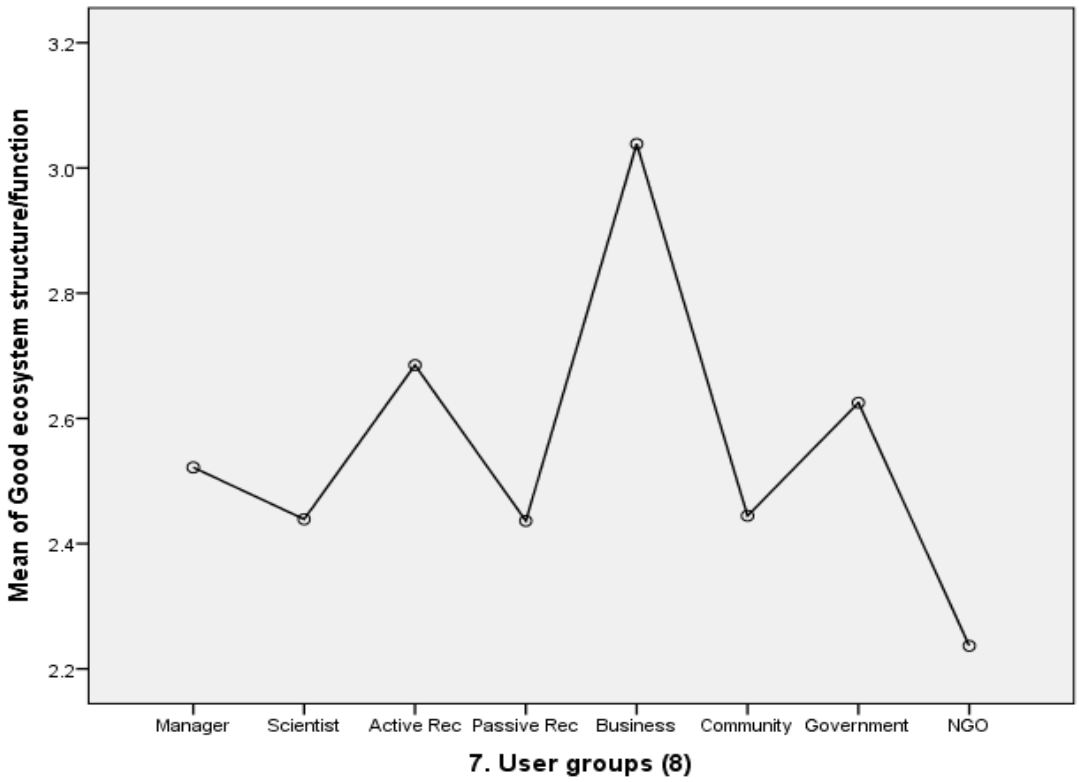


Figure 3. Comparison of stakeholder group opinion means on the statement, "The ecosystem structure and function of LIS is in good shape." On a 5-point scale with 5 being strongly agree, and 1 being strongly disagree.



Chapter 4 Tables:

Table 1. Stakeholder opinions on various statements on LIS's ecological health and status of conflicts where 1=strongly disagree; 5=strongly agree. ANOVA was used to test for significance. The Sig. column represents level of significance where *=p<0.05, **=p<0.01, and ***=p<0.001. Welch and Brown-Forsythe significance level are listed in italics under the ANOVA significance for questions that violated assumptions of homogeneity. Bolded numbers represent a negatively leaning opinion.

2) Question 12. Please rate your opinion (1=strongly disagree; 5=strongly agree)

Category	**User Group**								**ANOVA Significance**		
	Mgr	**Sci.**	**Act Rec**	**Pass Rec**	**Bus**	**Com**	**Gov**	**NGO**	**Mean**	**p value**	**Sig.**
Water quality has improved over past 25 years	3.96	3.70	3.80	3.55	3.85	3.60	4.08	3.74	3.78	0.11	
Ecosystem structure/ function of coastal areas are in good shape	**2.52**	**2.44**	**2.69**	**2.44**	3.04	**2.44**	**2.63**	**2.24**	**2.55**	0.01 *.023* *.012*	*
LIS has a healthy biodiversity	3.29	3.07	3.27	3.36	3.35	3.08	3.22	3.03	3.21	0.46	
LIS has a healthy food web or trophic structure	3.18	**2.87**	3.15	3.13	3.12	**2.92**	3.10	**2.86**	3.04	0.37 *.375* *.329*	
Reducing nutrient inputs has greatly improved ecological health in LIS	3.83	3.43	3.71	3.83	3.72	3.58	3.82	3.78	3.71	0.17	
Commercial fisheries will still be viable in 10 years	3.00	**2.68**	**2.63**	**2.58**	**2.88**	**2.56**	3.04	**2.76**	**2.77**	0.15	
Over the past 25 years, use conflicts have been a problem	3.98	4.01	4.06	4.06	3.68	3.86	3.90	3.89	3.93	0.54	
Currently, use conflicts are a problem	4.02	4.00	3.71	4.09	3.67	3.75	3.81	3.65	3.84	.05 *.055* *.059*	
Over the next 25 years, use conflicts will be a problem	4.27	4.19	4.00	4.31	3.88	3.86	4.00	4.00	4.07	0.06	

Table 2. Survey questions used in stakeholder group analyses to assess conflicts and compatibilities.

Question	Specific Survey Questions Used in Analyses
9	Do you think you are well informed on the following: a) Management issues in LIS; b) Economic issues around LIS; c) Fishery issues in LIS; d) EBM; e) CMSP; f) Regional infrastructure and energy needs; g) Community or stewardship efforts around LIS.
12	Please rate your opinion of the following statements: • Water quality in LIS has improved over the past 25 years. • The ecosystem structure and function of LIS's coastal areas are in good shape. • LIS has a healthy a) diversity of plants and animals, b) food web/trophic structure. • Reducing nutrient inputs into LIS has greatly improved its ecological health. • Given current conditions, commercial fisheries will continue to be a viable industry in LIS over the next 10 years. • Over the past 25 years, use conflicts (either spatial or temporal) among different stakeholder groups in LIS have been a problem. • Currently, use conflicts are a problem. • Over the next 25 years, use conflicts will be a problem.
17	How do you personally (i.e., not professionally) value the following services/uses (a-v) in the following categories (I-VI) in LIS?
18	In general, how satisfied are your with the management of LIS?
19	What, in your opinion, are the top 5 most important management issues in LIS. Please rank from 1-5 using the following list.
20	In general, over the past 10 years, the ecological health of LIS is:
23	What is your opinion of the following current/existing uses of LIS?
25	What is your opinion of the following possible future uses of LIS?
27	For the following questions, please use your opinion, best guess or rough estimate for % of area used. • How much of LIS: a) (water, not land area) is currently allocated for habitat/biodiversity conservation, b) should be allocated for habitat/biodiversity conservation/protection; • What % of coastline around LIS should be allocated for habitat/biodiversity conservation/protection; • How much of LIS (open water, not coastline) a) is currently used for commercial/industrial activity, b) should be used for commercial activity?; • How much of the LIS coastline a) is currently used for commercial/industrial activity?; b) should be used for commercial activity?
28	Similar to land based zoning plans (spatial planning processes in cities or towns that designates how different area can be used in accordance with a community vision), do you think CMSP should be implemented for LIS?
31	How likely are you to support a: a) MSP initiative, b) NY and CT bi-state management effort (with implementation authority), c) comprehensive planning process for LIS; or be involved in d) a comprehensive planning process?

Table 3. Comparison of stakeholder group means on perceived knowledge rating on different LIS topics, with 1=very well informed, 2=fairly well, 3=some knowledge, and 4=not informed. The Sig. column represents level of significance where *=p<0.05, **=p<0.01, and ***=p<0.001. Welch and Brown-Forsythe significance level are listed in italics under the ANOVA significance for questions that violated assumptions of homogeneity. Red numbers/cells represent a negatively leaning opinion.

1) Question 9. Do you think you are well informed on the following in LIS

(1=very well informed, 2=fairly well, 3=some knowledge, 4=not informed)

Category	User Group								ANOVA Significance		
	Mgr	Sci.	Act Rec	Pass Rec	Bus	Com	Gov	NGO	Mean	p value	Sig.
Management issues	1.72	2.08	2.54	2.52	2.54	2.82	1.86	2.18	2.28	0.00	***
Economic issues	2.50	2.46	2.63	2.63	2.58	2.79	2.33	2.66	2.57	0.25	
Fishery issues	2.30	2.25	2.05	2.68	2.58	2.82	2.44	2.50	2.45	0.00	***
EBM	1.96	2.06	2.46	2.55	2.85	2.68	2.15	2.24	2.37	0.00	***
CMSP	2.46	2.52	2.98	3.00	2.92	3.18	2.50	2.84	2.80	0.00	***
Infrastructure and energy needs	2.54	2.76	2.89	2.77	2.77	2.79	2.58	2.79	2.74	0.62	
Community or stewardship	2.11	2.38	2.59	2.55	2.88	2.66	2.27	2.18	2.45	0.01	**

Table 4. Multiple comparisons using Tukey HSD for Post-Hoc Tests on question 12, Table 3, $p<0.05$.

Dependent Variable			Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Informed on management issues	Manager	Active Rec	-.818*	.177	.000	-1.36	-.28
		Passive Rec	-.800*	.177	.000	-1.34	-.26
		Business	-.821*	.219	.005	-1.49	-.15
		Community	-1.098*	.195	.000	-1.69	-.50
	Scientist	Community	-.732*	.174	.001	-1.26	-.20
	Active Rec	Manager	.818*	.177	.000	.28	1.36
		Government	.679*	.174	.003	.15	1.21
	Passive Rec	Manager	.800*	.177	.000	.26	1.34
		Government	.661*	.174	.004	.13	1.19
	Business	Manager	.821*	.219	.005	.15	1.49
		Government	.681*	.216	.037	.02	1.34
	Community	Manager	1.098*	.195	.000	.50	1.69
		Scientist	.732*	.174	.001	.20	1.26
		Government	.959*	.193	.000	.37	1.55
		NGO	.632*	.204	.044	.01	1.25
	Government	Active Rec	-.679*	.174	.003	-1.21	-.15
		Passive Rec	-.661*	.174	.004	-1.19	-.13
		Business	-.681*	.216	.037	-1.34	-.02
		Community	-.959*	.193	.000	-1.55	-.37
	NGO	Community	-.632*	.204	.044	-1.25	-.01
Informed on fishery issues	Scientist	Community	-.566*	.173	.025	-1.09	-.04
	Active Rec	Passive Rec	-.626*	.166	.005	-1.13	-.12
		Community	-.763*	.185	.001	-1.33	-.20
	Passive Rec	Active Rec	.626*	.166	.005	.12	1.13
	Community	Scientist	.566*	.173	.025	.04	1.09
		Active Rec	.763*	.185	.001	.20	1.33
Informed on EBM	Manager	Passive Rec	-.589*	.185	.034	-1.15	-.02
		Business	-.890*	.228	.003	-1.58	-.20
		Community	-.719*	.205	.012	-1.34	-.09
	Scientist	Business	-.787*	.208	.004	-1.42	-.15
		Community	-.616*	.183	.019	-1.17	-.06
	Passive Rec	Manager	.589*	.185	.034	.02	1.15
	Business	Manager	.890*	.228	.003	.20	1.58
		Scientist	.787*	.208	.004	.15	1.42
		Government	.700*	.226	.043	.01	1.39
	Community	Manager	.719*	.205	.012	.09	1.34
		Scientist	.616*	.183	.019	.06	1.17
	Government	Business	-.700*	.226	.043	-1.39	-.01
Informed on CMSP	Manager	Community	-.728*	.210	.013	-1.37	-.09
	Scientist	Community	-.660*	.187	.011	-1.23	-.09
	Community	Manager	.728*	.210	.013	.09	1.37
		Scientist	.660*	.187	.011	.09	1.23
		Government	.684*	.208	.024	.05	1.32
	Government	Community	-.684*	.208	.024	-1.32	-.05
Informed on stewardship efforts	Manager	Business	-.776*	.230	.018	-1.48	-.08
	Business	Manager	.776*	.230	.018	.08	1.48

Table 5. Comparison of stakeholder group means on how the ecological health of LIS has changed over the past 10 years, where 1=much worse; 5=much improved. ANOVA was used to test for significance. The Sig. column represents level of significance where *=p<0.05, **=p<0.01, and ***=p<0.001. Welch and Brown-Forsythe significance level are listed in italics under the ANOVA significance for questions that violated assumptions of homogeneity.

Question 20.	User Group								ANOVA Significance		
	Mgr	Sci	Act Rec	Pass Rec	Buss	Com	Gov	NGO	Mean	p value	Sig.
Over the past 10 years, the ecological health of LIS is *(1=much worse, 5=much improved)*	3.65	3.27	3.46	3.21	3.48	3.42	3.67	3.58	3.47	0.170	

Table 6. Mean ecosystem service values by stakeholder group. Bolded numbers indicate a negative leaning value, where 1=strongly value, 5=do not value at all. ANOVA was used to test for significance. The Sig. column represents level of significance where *=p<0.05, **=p<0.01, and ***=p<0.001. Welch and Brown-Forsythe significance level are listed in italics under the ANOVA significance for questions that violated assumptions of homogeneity.

Questions15. How do you personally value the following ecosystem services in LIS?	User Group Mean (1=strongly value, 5=do not value at all)								ANOVA Significance		
	Mgr	**Sci.**	**Act Rec**	**Pass Rec**	**Bus**	**Com**	**Gov**	**NGO**	**Mean**	**P value**	**Sig.**
I. Overall Recreation/ Aesthetic Value	1.33	1.25	1.10	1.16	1.25	1.33	1.23	1.36	1.25	0.49 *.207* *.524*	
a) Aesthetics	1.41	1.41	1.16	1.22	1.25	1.42	1.27	1.19	1.29	0.23 *.170* *.226*	
b) Recreational fishing/ shellfishing	2.05	1.95	1.33	2.00	1.42	2.06	1.66	2.05	1.81	0.00 *.000* *.001*	***
c) Active recreation (rec)	2.32	2.14	1.37	2.02	1.67	1.92	2.09	2.05	1.95	0.00 *.000* *.001*	**
d) Non-consumptive rec	1.32	1.29	1.24	1.20	1.29	1.33	1.30	1.27	1.28	0.98	
e) Public resource/ access	1.41	1.32	1.27	1.31	1.46	1.47	1.36	1.30	1.36	0.834	
f) Tourism potential	2.33	2.19	1.76	2.04	1.92	2.11	2.02	2.14	2.06	0.263	
II. Overall Provisioning Services Value	1.95	2.15	1.71	1.92	1.88	2.03	2.00	1.89	1.94	0.381	
g) Property values	**3.25**	2.78	2.20	2.57	2.13	2.56	2.80	2.62	2.61	0.000	***
h) Fisheries potential	1.95	2.00	1.39	2.18	1.54	2.11	1.91	1.61	1.84	0.000	***
i) Repository for discards	**3.48**	**3.33**	**3.08**	**3.98**	2.55	**3.42**	**3.11**	**3.78**	**3.34**	0.001 *.002* *.001*	***
j) Infrastructure development potential	**3.53**	**3.41**	**3.10**	**3.86**	2.71	**3.51**	**3.12**	**3.89**	**3.39**	0.000 *.001* *.000*	***
l) Energy development (non-renewable)	**3.85**	**3.82**	**3.46**	**3.78**	2.58	**3.50**	**3.64**	**4.03**	**3.58**	0.001	***
m) Energy development (renewable/green)	2.53	2.29	2.40	2.10	1.88	2.06	2.14	2.54	2.24	0.142	
n) Commerce or development	**3.28**	**3.22**	**3.02**	**3.76**	2.30	**3.34**	2.98	**3.59**	**3.19**	0.000	***
III. Overall Ecosystem Protective Value	1.50	1.38	1.38	1.37	1.54	1.50	1.44	1.35	1.43	0.881	
o) Coastal protection potential	1.53	1.63	1.83	1.71	1.54	1.66	1.52	1.37	1.60	0.352	
p) Environmental significance	1.38	1.27	1.38	1.43	1.46	1.46	1.34	1.16	1.36	0.415 *.319* *.451*	

	Mgr	Sci.	Act Rec	Pass Rec	Bus	Com	Gov	NGO	Mean	P value	Sig.
IV. Overall Ecosystem Functional Value	1.40	1.30	1.42	1.55	1.39	1.51	1.33	1.14	1.38	0.114 *.047* *.127*	
q) Coastal stability	1.48	1.50	1.50	1.63	1.46	1.51	1.40	1.19	1.46	0.234 *.105* *.229*	
s) Spatial ecology	1.30	1.32	1.45	1.33	1.54	1.46	1.35	1.08	1.35	0.106 *.008* *.122*	
V. Overall Historic/ Educational Value	1.74	1.81	1.73	1.61	1.71	1.71	1.72	1.56	1.70	0.891	
t) Historic significance	1.78	2.08	1.71	1.82	1.67	1.86	1.98	1.76	1.83	0.307	
u) Stewardship	1.78	1.85	1.82	1.61	1.71	1.83	1.65	1.46	1.71	0.359	
v) Research/education	1.68	1.29	1.69	1.41	1.58	1.57	1.51	1.50	1.53	0.053	

Table 7. Significant differences among user groups in valuation of ecosystem services in post-Hoc multiple comparison test using Turkey HSD, $p< 0.05$. (Question 15, Table 6)

Dependent Variable			Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Recreational fishing and shellfishing	Manager	Active Rec	.725*	.217	.021	.06	1.39
	Scientist	Active Rec	.623*	.184	.018	.06	1.18
	Active rec	Manager	-.725*	.217	.021	-1.39	-.06
		Scientist	-.623*	.184	.018	-1.18	-.06
		Passive Rec	-.673*	.203	.022	-1.29	-.06
		Community	-.729*	.222	.025	-1.41	-.05
		NGO	-.728*	.221	.024	-1.40	-.05
	Passive rec	Active Rec	.673*	.203	.022	.06	1.29
	Community	Active Rec	.729*	.222	.025	.05	1.41
	NGO	Active Rec	.728*	.221	.024	.05	1.40
Active Recreation	Manager	Active Rec	.948*	.233	.001	.24	1.66
	Scientist	Active Rec	.772*	.196	.002	.17	1.37
	Active Rec	Manager	-.948*	.233	.001	-1.66	-.24
		Scientist	-.772*	.196	.002	-1.37	-.17
		Government	-.724*	.224	.029	-1.41	-.04
	Government	Active Rec	.724*	.224	.029	.04	1.41
Property value	Manager	Active Rec	1.046*	.224	.000	.36	1.73
		Passive Rec	.681*	.223	.048	.00	1.36
		Business	1.125*	.272	.001	.30	1.95
	Active Rec	Manager	-1.046*	.224	.000	-1.73	-.36
	Passive Rec	Manager	-.681*	.223	.048	-1.36	.00
	Business	Manager	-1.125*	.272	.001	-1.95	-.30
Fisheries Potential	Scientist	Active Rec	.612*	.174	.011	.08	1.14
	Active rec	Scientist	-.612*	.174	.011	-1.14	-.08
		Passive Rec	-.789*	.191	.001	-1.37	-.20
		Community	-.723*	.210	.015	-1.36	-.08
	Passive rec	Active Rec	.789*	.191	.001	.20	1.37
	Community	Active Rec	.723*	.210	.015	.08	1.36
Repository for Discards	Active rec	Passive Rec	-.898*	.275	.026	-1.74	-.06
	Passive rec	Active Rec	.898*	.275	.026	.06	1.74
		Business	1.435*	.350	.001	.37	2.50
		Government	.866*	.283	.049	.00	1.73
	Business	Passive Rec	-1.435*	.350	.001	-2.50	-.37
		NGO	-1.238*	.369	.020	-2.36	-.11
	Government	Passive Rec	-.866*	.283	.049	-1.73	.00
	NGO	Business	1.238*	.369	.020	.11	2.36

Dependent Variable			Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Infrastructure	Active rec	Passive Rec	-.759*	.230	.023	-1.46	-.06
		NGO	-.788*	.250	.037	-1.55	-.03
	Passive rec	Active Rec	.759*	.230	.023	.06	1.46
		Business	1.154*	.283	.001	.29	2.02
		Government	.746*	.236	.036	.03	1.47
	Business	Passive Rec	-1.154*	.283	.001	-2.02	-.29
		NGO	-1.184*	.299	.002	-2.10	-.27
	Government	Passive Rec	-.746*	.236	.036	-1.47	-.03
	NGO	Active Rec	.788*	.250	.037	.03	1.55
		Business	1.184*	.299	.002	.27	2.10
Energy: Non-Renewable	Manager	Business	1.263*	.325	.003	.27	2.25
	Scientist	Business	1.237*	.292	.001	.35	2.13
	Passive rec	Business	1.201*	.310	.003	.26	2.15
	Business	Manager	-1.263*	.325	.003	-2.25	-.27
		Scientist	-1.237*	.292	.001	-2.13	-.35
		Passive Rec	-1.201*	.310	.003	-2.15	-.26
		Government	-1.053*	.318	.022	-2.02	-.08
		NGO	-1.444*	.328	.000	-2.44	-.44
	Government	Business	1.053*	.318	.022	.08	2.02
	NGO	Business	1.444*	.328	.000	.44	2.44
Commercial Development and Commerce	Manager	Business	.971*	.288	.019	.09	1.85
	Scientist	Business	.916*	.262	.012	.12	1.71
	Active rec	Passive Rec	-.744*	.222	.020	-1.42	-.07
	Passive rec	Active Rec	.744*	.222	.020	.07	1.42
		Business	1.460*	.277	.000	.62	2.30
	Business	Government	.788*	.228	.014	.09	1.48
		Manager	-.971*	.288	.019	-1.85	-.09
		Scientist	-.916*	.262	.012	-1.71	-.12
		Passive Rec	-1.460*	.277	.000	-2.30	-.62
		Community	-1.039*	.296	.012	-1.94	-.14
		NGO	-1.290*	.293	.000	-2.18	-.40
	Community	Business	1.039*	.296	.012	.14	1.94
	Government	Passive Rec	-.788*	.228	.014	-1.48	-.09
	NGO	Business	1.290*	.293	.000	.40	2.18
Research and Education	Scientist	Active Rec	-.408*	.132	.045	-.81	-.01
	Active Rec	Scientist	.408*	.132	.045	.01	.81

Table 8. Management satisfaction and opinion on ecological health of LIS by stakeholder group, where 1=very satisfied, 5=very dissatisfied. Bolded numbers indicate a negative valuation. ANOVA was used to test for significance. The Sig. column represents level of significance where *=p<0.05, **=p<0.01, and ***=p<0.001.

Question 18.	User Group								ANOVA Significance		
	Mgr	**Sci**	**Act Rec**	**Pass Rec**	**Buss**	**Com**	**Gov**	**NGO**	**Mean**	**p value**	**Sig.**
In general, how satisfied are you with the management of LIS *(1=very satisfied, 5=very dissatisfied)*	**3.43**	2.82	2.93	2.92	**3.13**	**3.03**	**3.33**	2.83	**3.02**	0.041	*

Table 9. Specific LIS uses showing a significant difference among stakeholder groups' opinions.

Significance Level		
<0.001	**<0.01**	**<0.05**
Commerce/ports	Recreational fishing	Recreational boating
Waterfront industries	Shipping lanes	Non-motorized sports
Transfer stations	Cables/pipelines	Passive rec and beach access points
Power plants	Coastline development for business	
Party boast	Town marinas	
Private marinas		
Motorized sports		
MPAs		
Natural areas		
Coastal habitat restoration		
Bulkheads/hardened shorelines		
Dredging bays/harbors		
Scientific research		
Environmental education/ stewardship		

Table 10. Opinion on current LIS uses by stakeholder group, where 5=negative, reduce or remove, 4=negative, but willing to tolerate, 3=neutral, 2=positive, but at current level, and 1=positive, would like to see more. Bolded numbers indicate a negatively valued use. ANOVA was used to test for significance. The Sig. column represents level of significance where *=p<0.05, **=p<0.01, and ***=p<0.001. Welch and Brown-Forsythe significance level are listed in italics under the ANOVA significance for questions that violated assumptions of homogeneity.

Question 23. What is your opinion of the following current/existing uses of LIS?	**User Group** (1=positive, would like to see more; 5= negative, reduce or remove)								**ANOVA Significance**	
	Mgr	**Sci**	**Act Rec**	**Pass Rec**	**Bus**	**Com**	**Gov**	**NGO**	**Mean**	**p value**	**Sig.**
Recreational fishing	2.11	2.23	1.63	2.36	1.83	2.29	2.21	2.35	2.12	0.002	**
Commercial fishing (no trawls)	2.63	2.83	2.93	**3.02**	2.96	**3.07**	2.69	2.79	2.86	0.590	
Commercial fishing using trawls	**4.00**	**4.19**	**4.19**	**4.33**	**3.91**	**4.36**	**3.83**	**4.41**	**4.15**	0.208	
Commercial shellfishing	2.37	2.66	2.70	2.96	2.39	3.00	2.03	2.58	2.58	0.008	**
Shellfish aquaculture/ leased beds	2.06	2.36	2.21	2.71	2.04	2.64	1.95	2.24	2.28	0.058	
Shellfishing areas (recreational/public)	1.85	2.01	2.02	2.58	1.96	2.36	1.62	1.84	2.03	0.001 *.002* *.000*	**
Dredge material disposal	**3.63**	**3.96**	**3.71**	**4.27**	3.00	**4.14**	**3.51**	**4.00**	**3.78**	0.001 *.009* *.002*	**
Sewage effluent disposal (secondary/ tertiary treatment)	**3.57**	**3.72**	**3.84**	**4.20**	**3.52**	**4.14**	**3.68**	**3.79**	**3.81**	0.101 *.027* *.113*	
Runoff disposal	**4.31**	**4.20**	**4.26**	**4.34**	**4.00**	**4.21**	**4.28**	**3.97**	**4.20**	0.745	
Ferries/ water taxis	2.20	2.24	2.33	2.41	1.96	2.48	2.33	2.32	2.28	0.670 *.565* *.669*	
Shipping lane	2.49	2.85	2.74	2.98	2.30	3.00	2.54	2.82	2.71	0.008 *.003* *.008*	**
Commerce/port	2.34	2.83	2.53	2.93	2.13	**3.18**	2.39	2.67	2.63	0.000	***
Waterfront industries	2.37	2.67	2.07	2.78	1.74	2.96	2.13	2.58	2.41	0.000	***
Transfer stations	**3.17**	**3.26**	2.93	**3.41**	2.70	**3.67**	2.66	**3.27**	**3.13**	0.000 *.003* *.001*	***
Cables, pipelines	**3.60**	**3.54**	**3.30**	**3.73**	2.83	**3.81**	**3.39**	**3.79**	**3.50**	0.009 *.049* *.013*	**
Power plants	**3.74**	**3.74**	**3.58**	**4.20**	**3.30**	**4.07**	**3.65**	**4.34**	**3.83**	0.000 *0.000* *0.000*	***

	Mgr	Sci	Act Rec	Pass Rec	Bus	Com	Gov	NGO	Mean	p value	Sig.
Coastline development for business	**4.11**	**3.74**	**3.88**	**4.11**	**3.04**	**3.96**	**3.74**	**4.21**	**3.85**	0.005	**
Coastline development for housing	**4.31**	**3.93**	**4.14**	**4.11**	**3.61**	**4.07**	**4.26**	**4.24**	**4.08**	0.210	
Working waterfront	2.49	2.62	2.43	2.91	2.23	2.79	2.47	2.72	2.58	0.260	
Party boats (fishing)	2.60	2.66	1.98	2.87	2.09	2.71	2.66	2.88	2.55	0.000 *0.000* *0.000*	***
Marinas (town)	2.17	2.57	1.95	2.49	2.22	2.41	2.28	2.76	2.36	0.006	**
Marinas (private)	2.66	2.97	2.33	**3.16**	2.17	**3.04**	2.87	**3.12**	2.79	0.000	***
Recreational boating	2.29	2.38	1.84	2.20	1.86	2.43	2.26	2.36	2.20	0.024	*
Military use	**3.29**	**3.29**	**3.07**	**3.31**	2.87	**3.50**	**3.31**	**3.33**	**3.25**	0.512	
Passive recreation	1.51	1.32	1.38	1.27	1.52	1.57	1.29	1.13	1.37	0.077	
Non-motorized sports	1.46	1.35	1.32	1.22	1.65	1.64	1.36	1.12	1.39	0.012 *.007* *.021*	*
Motorized sports/rec	**3.24**	**3.09**	2.62	**3.09**	2.32	**3.21**	**3.51**	**3.67**	**3.09**	0.000 *0.000* *0.000*	***
Passive recreation or beach access points	1.46	1.33	1.38	1.42	1.86	1.61	1.21	1.24	1.44	0.016 *.064* *.030*	*
Marine parks/ protected areas	1.63	1.30	1.76	1.13	1.87	1.54	1.24	1.18	1.46	0.000 *0.000* *0.001*	***
Natural areas	1.26	1.20	1.19	1.16	1.78	1.39	1.13	1.03	1.27	0.000 *0.002* *0.001*	***
Coastal habitat restoration	1.31	1.32	1.33	1.16	1.87	1.36	1.18	1.00	1.32	0.000	***
Bulkheads/hardened shorelines	**4.43**	**4.20**	2.93	**3.80**	**3.13**	**3.74**	**4.10**	**3.97**	**3.79**	0.000 *0.000* *0.000*	***
Dredging bays/ harbors	**3.26**	**3.75**	2.90	**3.67**	2.61	**3.52**	**3.13**	**3.36**	**3.28**	0.000 *0.000* *0.000*	***
Scientific research	1.46	1.10	1.36	1.29	1.83	1.50	1.58	1.21	1.42	0.000 *0.000* *0.000*	***
Environmental education/stewardship	1.34	1.13	1.33	1.13	1.78	1.46	1.39	1.13	1.34	0.000 *0.007* *0.003*	***

Table 11. Opinion on future LIS uses by stakeholder group, where 5=negative, should not be in LIS, 4=negative, but might be willing to tolerate if put in LIS, 3=neutral , 2=positive, might be ok with it in LIS, and 1=positive, would definitely like to have/implement in LIS. Bolded numbers indicate a negatively valued use. ANOVA was used to test for significance. The Sig. column represents level of significance where *=p<0.05, **=p<0.01, and ***=p<0.001. Welch and Brown-Forsythe significance levels are listed in italics under the ANOVA significance for questions that violated assumptions of homogeneity.

Question 25. What is your opinion of the following possible future uses of LIS?	**User Group** (1=positive, would like to see in LIS, 5=negative, do not want in LIS)								**ANOVA Significance**		
	Mgr	**Sci**	**Act Rec**	**Pass Rec**	**Bus**	**Com**	**Gov**	**NGO**	**Mean**	**p value**	**Sig.**
Algal aquaculture/seaweed cultivation	2.21	2.04	2.33	2.42	2.32	2.41	2.31	2.35	2.30	0.728	
Fish aquaculture	3.00	2.57	2.67	2.75	2.22	2.61	2.41	2.85	2.63	0.334	
Wind energy generation	2.67	2.30	2.70	2.31	2.35	2.46	2.18	3.00	2.50	0.116	
Wave/tidal energy generation	2.66	2.20	2.37	2.22	2.52	2.23	1.89	2.50	2.33	0.258 *.126* *.297*	
Energy - nuclear	**4.18**	**4.09**	**3.91**	**4.40**	**3.57**	**4.11**	**3.92**	**4.52**	**4.09**	0.065 *.051* *.081*	
Energy - natural gas	**3.91**	**3.85**	**3.60**	**4.22**	**3.35**	**3.89**	**3.61**	**4.15**	**3.82**	0.052	
Energy - waste-to-energy	**3.48**	**3.01**	**3.14**	**3.47**	2.96	3.00	**3.39**	**3.94**	**3.30**	0.019	*
Mining (sand, minerals, etc.)	**4.21**	**4.33**	**4.29**	**4.49**	**3.83**	**4.39**	**4.03**	**4.58**	**4.27**	0.051 *.099* *.056*	
Liquid natural gas facilities	**4.33**	**4.14**	**4.27**	**4.60**	**3.74**	**4.25**	**4.08**	**4.58**	**4.25**	0.028 *.023* *.045*	*
Marine areas zoned for no-take	1.97	1.46	2.71	1.58	2.61	2.00	1.73	1.45	1.94	0.000 *0.000* *0.000*	***
Marine areas zoned for limited use	1.88	1.54	2.28	1.58	2.65	1.89	1.62	1.67	1.89	0.000 *0.002* *0.000*	***
Marine areas zoned for consumptive use	2.66	2.33	3.00	2.64	**3.09**	2.64	2.38	2.76	2.69	0.078	
Marine areas zoned for industrial use	**3.16**	**3.06**	**3.84**	**3.59**	**3.17**	**3.71**	**3.08**	**3.91**	**3.44**	0.003	**
Filling of borrow pits	2.81	**3.29**	**3.31**	**3.47**	2.96	**3.48**	2.85	**3.82**	**3.25**	0.002 *.001* *.002*	**
New energy pipelines/cables	**3.63**	**3.59**	**3.50**	**3.80**	**3.29**	**3.73**	**3.60**	**4.09**	**3.65**	0.472	
New telecommunication cables	**3.47**	**3.49**	**3.46**	**3.56**	**3.65**	**3.60**	**3.44**	**3.96**	**3.58**	0.809	

Table 12. Stakeholder group opinion on what percentage of LIS is currently or should be allocated toward either habitat/conservation or commercial/industrial activity, looking at both the coastline and open water using the scale: 0-5%=1; 5-15%=2; 15-20%=3; 25-50%=4;>50%=5. The Sig. column represents level of significance where *=p<0.05, **=p<0.01, and ***=p<0.001.

Question 27. How much of LIS should be or is currently allocated for the following:	**User Group** (0-5%=1; 5-15%=2; 15-20%=3; 25-50%=4;>50%=5)								**ANOVA Significance**		
	Mgr	**Sci**	**Act Rec**	**Pass Rec**	**Bus**	**Com**	**Gov**	**NGO**	**Mean**	**p value**	**Sig.**
Current ocean: Habitat/conservation	1.50	1.49	1.75	1.85	1.65	1.93	1.53	1.75	1.68	0.14	
Should be ocean: Habitat/conservation	3.13	3.31	2.97	3.86	2.94	3.56	3.05	3.69	3.31	0.00	***
Should be coasts: Habitat/conservation	3.45	3.29	2.94	3.78	3.06	3.56	3.41	3.84	3.42	0.01	**
Current ocean: Commercial/industrial activity	3.00	3.00	2.69	3.27	3.00	3.22	2.65	3.07	2.99	0.28	
Should be ocean: Commercial/industrial activity	2.60	2.56	2.57	2.27	3.35	2.70	2.38	2.53	2.62	0.03	*
Current coasts: Commercial/industrial activity	2.65	2.72	2.67	3.05	2.56	2.92	2.51	3.16	2.78	0.14	
Should be coasts: Commercial/industrial activity	2.32	2.26	2.40	2.26	3.00	2.23	2.19	2.50	2.40	0.07	

Table 13. Support for CMSP by stakeholder groups' mean score (1=yes;1.5=not sure; 2=no), and significance among groups using ANOVA, $p<0.01$. Welch and Brown-Forsythe significance levels are listed in italics under the ANOVA significance for questions that violated assumptions of homogeneity. The Sig. column represents level of significance where *=$p<0.05$, **=$p<0.01$, and ***=$p<0.001$.

Question 28.	User Group								ANOVA Significance	
	Mgr	Sci	Act Rec	Pass Rec	Buss	Com	Gov	NGO	Mean	p value	Sig.
Should CMSP be implemented for LIS? *(1=yes;1.5=not sure; 2=no)*	1.21	1.12	1.27	1.09	1.42	1.12	1.14	1.13	1.19	0.003 *.052* *.008*	**

Table 14. CMSP support and involvement by stakeholder group, using mean scores within each groups and ANOVAs to test the significance among groups. The Sig. column represents level of significance where *=p<0.05, **=p<0.01, and ***=p<0.001. Welch and Brown-Forsythe significance levels are listed in italics under the ANOVA significance for questions that violated assumptions of homogeneity.

Question 31. CMSP Support	**User Group** (1=very likely; 5=very unlikely)								**ANOVA Significance**		
	Mgr	**Sci**	**Act Rec**	**Pass Rec**	**Bus**	**Com**	**Gov**	**NGO**	**Mean**	**p value**	**Sig.**
How likely are you to Support CMSP for LIS	1.88	1.56	2.13	1.65	2.52	1.38	1.95	1.48	1.82	0.00	***
Support a NY and CT bi-state management effort (with implementation authority) for LIS?	1.70	1.68	1.92	1.74	2.38	1.52	2.06	1.45	1.81	0.03 *.052* *.008*	*
Support a comprehensive planning process for LIS?	1.67	1.49	1.74	1.60	2.10	1.22	1.59	1.26	1.58	0.03 *.036* *.030*	*
Be involved in a comprehensive planning process for LIS?	1.78	2.44	2.56	2.44	2.25	2.23	2.00	2.38	2.26	0.09	

Chapter 5. *Regional Governance*

Identifying Conflicts and Compatibilities Between the New York and Connecticut Regions to Establish Ecological and Social Baselines for Coastal and Marine Spatial Planning (CMSP) in Long Island Sound.

5.1 Abstract

With increasing coastal pressures and new interest in commercial development of local marine resources, coastal and marine spatial planning (CMSP) could be an important and timely management tool for Long Island Sound (LIS), especially with regard to a shifting national ocean policy focus. Because LIS is entirely in state waters, it is jointly governed by both New York (NY) and Connecticut (CT). Having a united vision for LIS is essential for the two states given that management of ecosystem services and reducing conflict are at the core of CMSP. Understanding where the conflicts and compatibilities exist between various stakeholders from the NY (NY/NJ) and CT (CT/MA/RI) regions is a crucial starting point for CMSP discussions. Results from a stakeholder survey were used to examine the differences and similarities between the NY and CT regions regarding the status of LIS. Possible jurisdictional and management issues are also discussed. Differences in regional views on the ecological health, management, and knowledge base were compared and analyzed for significance using ANOVAs. New York had a slightly more negative perception of LIS's environmental status than did CT. Regional variations were also observed on the valuation of ecosystem services including fisheries, infrastructure development, coastal protection and stability, stewardship, and historic significance.

5.2 Introduction

Environmental stressors affect biological diversity and overall ecological health, thus impacting local economies, fisheries, and human health. Increased occurrences of eutrophication, harmful algal blooms, invasive species, and decreased commercial fish stocks are being reported throughout many of the world's coastal waterways, including Long Island Sound

(LIS). In fact, according to the overall condition of estuaries in the United States, the northeast ranked the poorest in 2005 with 27% and 31% impaired for aquatic life and human use, respectively (EPA 2005). According to the U.S. Environmental Protection Agency (EPA 2011) estuaries in the northeast, such as LIS, have the worst national scores on overall benthic health. There are also generally more contaminants in fish tissue than elsewhere. However, despite these challenges, estuaries such as LIS also offer significant ecological, aesthetic, social, and economic values to those around it (EPA 2005).

Long Island Sound is part of a shared management jurisdiction between Connecticut (CT) and New York (NY). As discussed in Chapter 3, existing piecemeal marine policy efforts that are largely reactionary are not sustainable for LIS. Rather, a regional ecosystem-based management (EBM) approach such as coastal and marine spatial planning (CMSP) that addresses the cumulative impacts of current and future stressors is essential. A CMSP plan for LIS would need to consider and balance current uses such as recreation, habitat restoration, conservation, fisheries, and tourism, with possible future large-scale energy, aquaculture and transportation projects. Boating, recreational and commercial fisheries, swimming, and beaches contribute nearly $9 billion to the LIS regional economy annually (EPA 2011). However, the continued reliance on this revenue may be compromised as water quality, natural habitats, and fisheries are degraded by a growing number of anthropogenic stressors (EPA 2005). Future development projects may include windfarms, liquid natural gas terminals, bridges, pipelines, and even tunnels. Sustaining and fostering a productive working waterfront and sound economy have to be integrated with the strong conservation and environmental ethic.

Coastal and marine spatial planning has been very successful along Australia's Great Barrier Reef, where conflicting uses are spatially separated and ecosystem services are managed with regard to ecological, economic, and social objectives (Day et al. 2008). It has also been implemented in parts of the Mediterranean Sea, North Sea, and Caribbean Sea, as well as the Atlantic, Indian and Pacific Oceans (Ehler 2008, Douvere & Ehler 2009b). In response to the success of CMSP initiatives elsewhere, many states within the United States undergoing ocean-planning processes have embraced it as an integral tool for coastal management as well. Marine protected areas (MPAs), a component of CMSP, exist in the Florida Keys and California. Beginning in 2008, Massachusetts underwent a large-scale marine planning process in which CMSP played a large part.

Although CMSP can help limit historic fragmentation that existed in ocean policy, it requires the cooperation and participation among different municipalities and all levels of government to be successful (Crowder et al. 2006a). Therefore, one of the first steps in embarking on CMSP involves identifying if there is a need, and establishing who has the authority to not only create the plan, but to implement it (Ehler & Douvere 2009).

Long Island Sound is an example of a complex urban estuary, where ecological and political boundaries are not the same, as both CT and NY have jurisdiction. According to Swanson and Bowman (in press), jurisdiction gives the states authority to "proscribe, prescribe, adjudicate, regulate, and enforce laws." However, many federal agencies, city and town departments, and local villages also have a hand in managing and delegating policy in LIS. Therefore, in LIS, coordination between the states is extremely important when designing management objectives, and agreements delegating responsibilities for both management and enforcement (Crowder et al. 2006a, Ehler & Douvere 2009). Political boundaries and jurisdictional turf wars do not align well with ecosystem priorities or promote efficient or effective management. However, while there have been conflicts between the two states in the past over issues such as the dumping of dredge spoil and construction of pipelines, the states have come together collaboratively in initiatives such as the Long Island Sound Study (LISS). Identifying and addressing these points of contention and agreement is a crucial first step for CMSP in LIS.

The objective of this chapter is to use results from an online stakeholder survey to establish an ecological and social baseline on which to better understand the differences between the NY and CT regions regarding issues, improvements, ecosystem services, and priorities for LIS.

5.3 Methods

An extensive literature review was conducted to define the theoretical and conceptual basis for CMSP, and to analyze recent ecological, social, and political situations in LIS. A synthesis review of governing mechanisms used in existing CMSP initiatives was used to assess their appropriateness relative to LIS. Groups and agencies working in LIS were contacted to explore different pathways to establish a CMSP authority.

Informal phone interviews and in person meetings were conducted with agency staff from the New York State (NYS) Department of Environmental Conservation (DEC) (n=3), NYS Department of State (DOS) (n=3), Connecticut Department of Energy and Environmental Protection (CT DEEP)(n=2), the Long Island Sound Study (LISS) (n=12), US Environmental Protection Agency (EPA) (n=2), New York and Connecticut Sea Grant (n=4), The Nature Conservancy (n=2), and other relevant state and local agencies, policy makers, and stakeholders. Current opinions on CMSP and LIS were documented.

Existing management efforts in NY and CT waters, jurisdictional issues, current management concerns, and social constraints were considered in the analysis. Finally, existing relevant federal, state, and local initiatives and authorities, laws and legislation were reviewed in following with Ehler and Douvere's (2009) 10 step approach to CMSP (Chapter 1, Figure 2). Specifically, this chapter addresses steps *3. Organizing the process through pre-planning*, and *5. Defining and analyzing existing conditions*.

A list of LIS management priorities was generated from discussions at LISS meetings, a review of current literature, and from meetings with groups such as the Citizens Advisory Committee (CAC) of the LISS, and The Nature Conservancy. Discussions with these groups, comprised of 2 to 40 persons, were also used to identify and describe the status of some of the important ecosystem services and specific current and future uses included in the online survey. Detailed survey methodology is described in Chapter 2, and the survey itself is provided in Appendix 1. Working closely with the LISS, the online survey was designed and administered specifically with the help of the LISS outreach coordinator for New York Sea Grant, Larissa Graham, the co-chairs of the CAC, Curt Johnson and Nancy Seligson, Mark Tedesco and Joe Salata of the EPA, and Leah Schmaltz of the LIS Visioning Project and CT Fund for the Environment. Scientists, managers, policy makers, and other LIS stakeholder groups (e.g., fishing associations, recreationalists, and non-governmental organizations (NGOs) were included in the survey.

Using the statistical software package IBM SPSS, Version 18, analyses of variance (ANOVAs) were used to detect significant differences in responses between survey participants from the New England states of Connecticut, Massachusetts, Rhode Island, New Hampshire, and Vermont; and the Mid-Atlantic states of New York, New Jersey, and Pennsylvania. As the

majority of survey participants from New England and the Mid-Atlantic were from either CT or NY, the regions are henceforth referred to as NY and CT regions in this chapter.

5.4 Governance Results

a. Regional Conflicts and Considerations

While a LIS CMSP initiative would require an agreement between NY and CT, there would need to be cooperation of federal agencies and local municipalities as well. There are currently over 50 different federal agencies and departments involved in managing the hundreds of federal ocean statutes alone (Crowder et al. 2006a, O'Connell 2006) (Figure 1). On a state scale, NY and CT have additional departments and agencies dealing with marine and coastal decisions. For example, NY alone has over 40 different departments or agencies at the State, county, city, town, or village levels that are responsible for at least a piece of LIS management.

In addition, many of the local municipalities bordering LIS claim coastal management jurisdiction. For example, on Long Island, the Town of Smithtown has governance rights in Smithtown Bay and along LIS, but only between mean high water (MHW) and mean low water (MLW), however, the state owns underwater lands that are under tidal influence (although Smithtown has some shellfishing rights) (Swanson & Bowman in press). There are even private ownership rights for underwater lands in Stony Brook Harbor, off of Smithtown Bay. Therefore, authorities in this one LIS bay include NYS Department of State (DOS), NYS Department of Environmental (DEC) Conservation, and the Office of General Services (OGS), the Towns of Smithtown and Brookhaven, Villages of Head-of-the-Harbor and Nissequogue, and private land owners (Swanson & Bowman in press). In addition, there is necessary compliance with federal laws and regulations such as the Clean Water Act and National Environmental Protection Act.

To further complicate matters, the Town of Smithtown has its own coastal zone management (CZM) program. The Village of Head of the Harbor and Village of Nissequogue, located within Smithtown and along the coast of LIS have a joint CZM program. This has caused conflicts between municipalities in the past (Swanson & Bowman in press). For example, Head of the Harbor's vision for the coast, large residential homes and small beaches, is very different from that of a neighboring village, Port Jefferson, which is largely commercialized.

In NY, the issue of home rule has always been important when dealing with local municipalities, especially around land use or coastal management (Swanson & Bowman in press). Some local coastal laws even date back to pre-colonial times (Swanson & Bowman in press). The Town of Smithtown had a dispute with NY State over who owned the bottom waters of Stony Brook Harbor. Smithtown claimed they had 100 years of shellfishing rights, while the State claimed it had jurisdiction. However, towns and villages do have to get approval from NYS DOS and the federal government (National Oceanic and Atmospheric Administration) for local CZM and waterfront revitalization programs, making sure it is consistent with the State's CZM program.

There have also been some rudimentary efforts to zone NY waters, including Suffolk County's aquaculture program in the Peconics, and the local zoning of Huntington Harbor. Land use planning and zoning, at their core, are the regulation of public and private property rights for a specific societal purpose. Zoning is a restriction of use with the management of ecological, social, or economic resources as its goal (Schubel 1975). For example, planning and zoning have been used to regulate use in national forests and parks, and separate residential and commercial developments in cities. Marine zoning, by definition, is the geographic (and sometimes temporal) regulation of marine access or use (Weinstein & Reed 2005). It is an important aspect of a CMSP, and may limit local authority (i.e., home rule) in the management of coastal waterways.

Unlike land use zoning, spatial planning in the marine environment deals mostly with restrictions on public property instead of private property rights (O'Connell 2006). Land use plans often have a legally recognized appeals process. States have jurisdiction over ocean resources up to three nautical miles offshore, and must exercise their authority for the benefit of the public trust (US Commission on Ocean Policy 2004). Long Island Sound, however, is a juridical bay and the waters west of Montauk Point on Long Island (LI) and Watch Hill Point on Rhode Island are considered internal state waters (Swanson 1989). Therefore, LIS is under the jurisdiction of both NY and CT. There is a boundary down the center of LIS (represented by the dotted red line in Figure 2), with CT managing LIS and its resources to the north of the line, and NY to the south.

Both NY and CT regulate LIS under the Public Trust Doctrine, and must hold it in trust for the public to use. However, the states do have the right to regulate certain uses if deemed

necessary for the public good (e.g., continued viability of a resource) (Bray 2007). A CMSP initiative in LIS would restrict public use of and rights to this common resource under the Public Trust Doctrine.

Both NY and CT have established coastal zone management programs (CZM) and both states participate in the LISS, which developed a Comprehensive Conservation and Management Plan for LIS in 1994. Some current management activities in LIS include fishery regulations, nitrogen reduction, wetland protection and restoration, and regulation of structures, dredging, fill, construction, and submerged lands leasing (i.e., for shellfish aquaculture). There have been historical conflicts between the two states on use of various ecosystem services in LIS, especially around the dumping of dredged spoil. There have also been mismatches in the governance and management of LIS. For example, CT received a no discharge zone (NDZ) status (i.e. waters where the discharge of treated or untreated waste material from vessels is prohibited) for its side of LIS in 2007. States must submit an application to and get approval from the U.S. Environmental Protection Agency (US EPA) in order to be designated as a NDZ.

On a more local scale, some bays and harbors in NY, including Huntington, Northport, Port Jefferson, Hempstead and Oyster Bay, had already taken action on their own, applying for and receiving no discharge status. However, with only the CT side of LIS designated as a NDZ and some NY bays and harbors, boaters could simply cross the boundary line into the NY side to discharge their waste. Was CT really achieving its goals if boaters were discharging waste in LIS anyway? New York applied for and received NDZ status for its section of LIS in 2011.

New York State took its first steps to incorporate EBM in coastal waters in 2006. Then NYS Governor George E. Pataki signed the New York Ocean and Great Lakes Ecosystem Conservation (NYOGLEC) Act into law in August 2006 (NYS 2006). The act created the NYOGLEC Council, charged with developing a strategic plan to implement EBM in NY's coastal waters and to streamline the efforts of various government agencies (Conover 2006). Workshops were held throughout NYS giving people an opportunity to share their ideas and opinions on how to advance EBM in state waters, and gathering public input to inform and advise the NYOGLEC Council. Although this act could provide a mechanism for implementing CMSP in LIS, a regional strategy and partnerships with other states, especially CT, still must be established. Currently, NY is in the process of creating an Ocean Action Plan, incorporating work from the initial NYOGLEC Council workshops and final recommendations from the

Council's Scientific Advisory Group. This plan will mostly cover the ocean waters of the Atlantic, but could still be relevant for LIS.

b. Federal Conflicts and Considerations

Although LIS is under state jurisdiction, conflicts associated with the pre-emptive rights of the Federal government, especially Homeland Security and the military, also need to be addressed regarding development and navigation projects within LIS. In addition to defense, the Federal government can intervene in state waters regarding commerce and navigation, power generation and energy, and international issues (US Commission on Ocean Policy 2004).

An example of a recent conflict between the states and the Federal government was the Broadwater energy project. In 2004, energy companies proposed putting a floating liquefied natural gas (LNG) terminal at the east end of LIS; the project was called Broadwater. Under this plan, the terminal would receive, store, and distribute liquefied natural gas. Tankers would dock there and unload, and then the gas would be warmed and dispersed to the land using the existing Iroquois pipeline, and an additional 35.4 km of new pipelines constructed on the seabed (Rather 2004, 2009). The terminal location was to have been in NY waters, nine miles from LI, and ten miles from CT (Associated Press 2008). From the beginning, there was staunch opposition to this project from the community and local governments because it involved, in their view, the industrialization of LIS. Connecticut even threatened legal action if the project was approved. After years of hearings and debates, NY finally came out against the project. However, even though it was in NY state waters, the Federal Energy Regulatory Commission (FERC) asserted sole authority on implementation of LNG facilities as per federal energy bill H.R.-6 (U.S. House of Representatives 2005). The Federal Energy Regulatory Commission approved the project in 2008, despite strong political opposition and conflicts with the states. In the end, the $700 million dollar project did not happen because of environmental and security concerns, and a Commerce Department ruling that put LIS's aesthetic ecosystem service values over those of energy (Associated Press 2008). The time, money, and energy invested in this five-year conflict between the NY state and Federal governments might have been lessened if there was an existing marine spatial plan, where CT and NY agreed on a vision for LIS.

The Federal Interagency Ocean Policy Task Force established a National Policy for the Stewardship of the Ocean, Coasts, and Great Lakes on July 19, 2010, creating the National

Ocean Council (NOC) to coordinate ocean governance, and directing the creation of regional ocean councils to create and implement flexible CMSP frameworks. Within these regional ocean councils, existing state statutes and plans must be taken into account in any new CMSP initiatives, which is why it is even more important for CT and NY to begin a CMSP process in LIS. Unfortunately, LIS falls in between two of these regional ocean councils, the Northeast Regional Ocean Council (NROC) and the Mid-Atlantic Regional Council on the Ocean (MARCO), with CT in NROC and NY in MARCO. The Federal plan does include provisions for this type of situation and directs the two councils to work together on plans for marine ecosystems that fall in both jurisdictions. However, without one overall governing body directing CMSP efforts, LIS might not be as much of a priority for the individual councils.

5.5 Regional Differences in Survey Results

a. Knowledge Assessment

Because CMSP would be a bi-state initiative, it is important to understand the needs of the two regions as well as where knowledge gaps exist, especially in understanding the CMSP process and related issues in LIS. Survey analysis showed significant regional variations on knowledge of management issues ($p<0.001$), economic issues ($p<0.01$), fishery issues ($p<0.05$), EBM ($p<0.05$) and community/stewardship ($p<0.001$), with the CT region being more informed (Table 1). Only on knowledge of infrastructure and energy needs, and CMSP were there no significant differences, with both regions, on average, falling between fairly well informed and some knowledge. However, for these two specific topics, the NY and CT regions reported being the least informed compared to all of the other topics.

b. LIS Opinion

The only significant differences between the NY and CT regions on their views of LIS were in statements on water quality improvement, ecosystem structure, and function of coastal areas, and whether reducing nutrient inputs improved LIS health ($p<0.001$, $p<0.05$, and $p<0.01$ respectively) (Table 2). While both regions leaned toward disagreeing with the statement, "ecosystem structure and function of coastal areas are in good shape," NY had a significantly ($p<0.05$) more negative opinion. Connecticut more strongly agreed that there has been water-

quality improvement in LIS over the past 25 years ($p<0.001$), and that reducing nutrient inputs into LIS has greatly improved its ecological health ($p<0.01$).

As summarized in Table 2, representatives of both regions took a similarly negative view on the viability of commercial fisheries industry in the coming 10 years. In addition, they agreed that in the past, present and future, use conflicts have been and will continue to be a problem in LIS. Conflicts over the next 25 years will be even greater. More and more uses are being proposed for LIS, so this assessment makes sense. Both regions shared a neutral stance on whether or not LIS has a healthy food web or trophic structure. However, they were both slightly more positive when asked about biodiversity in LIS.

c. Ecosystem Service Value

Overall, both the CT and NY regions positively valued most ecosystem services; only in the Provisioning Services category did values lean toward the negative end of the spectrum (Table 3). For example, slightly negative views were recorded for using LIS as a repository for discards, infrastructure development potential, non-renewable energy development, and on commerce or commercial development. Significant regional differences ($p<0.001$) were noted in views on infrastructure development potential, with NY being more neutral, and CT leaning more negatively toward, "do not personally value, but see societal value." The two regions also had significantly ($p<0.001$) different values on the fisheries potential of LIS with CT taking a slightly more positive stance; however, both regions registered at least "somewhat value" for this ecosystem service.

Although both regions positively valued coastal protection and coastal stability, CT rated these two services significantly higher ($p<0.001$) than NY (Table 3, Figure 3). Another ecosystem service category of regional dispute was "Overall historic/education value" ($p<0.01$), with each service in this category valued slightly more by CT including historic significance, stewardship and research/education (Figure 3).

d. Management and Ecological Health

There was no significant difference in management satisfaction between the two regions, with both nearly neutral (Table 4). However, both regions in general thought the ecological health of LIS had slightly improved over the past 10 years, but CT rated it as having improved

slightly more ($p<0.05$). This is consistent with questions discussed earlier, where CT registered more of an improvement in LIS water quality and nutrient reduction impacts than NY.

There was general regional agreement regarding the top five management priorities for LIS, specifically water quality, non-point source pollution, habitat loss/coastal development, and point source pollution (Table 5). However, CT included loss of biological communities in their top five, while NY highlighted privatization of waterfront/public access instead. The NY region also ranked overfishing and climate change higher than CT – ranked 6 and 7 versus 10 and 9. Both regions ranked economic development as a low priority, but CT ranked transportation the lowest. The CT region ranked alternative energy low, while it was a bit higher on NY's priority list.

e. Current and Possible Future Uses

Regarding specific uses in LIS, the CT and NY regions varied significantly on, but still both have a positive opinion of commercial shellfishing ($p<0.001$), shellfish aquaculture ($p<0.01$), public shellfishing areas ($p<0.001$), shipping lanes ($p<0.01$), commerce/ports (.01), recreational boating ($p<0.05$), commercial fishing-no trawls ($p<0.01$), waterfront industry ($p<0.01$), and ferries/water taxis ($p<0.05$). The CT region had a higher opinion on all of these uses, especially those involving shellfishing and fishing. In fact, most of the significant differences between NY and CT regions had to do with issues involving fishing or waterfront industry, where CT had more positive opinions of these (Table 6).

New York often took a significantly stronger, more negative stance than CT on uses it (i.e., New York) felt negatively toward. For example, both regions held negative leaning views toward dredge material disposal ($p<0.001$), transfer stations ($p<0.001$), runoff disposal ($p<0.01$), dredging bays/harbors ($p<0.01$), and military use ($p<0.05$), but NY's opinion was significantly more negative.

All of the following were viewed at least somewhat positively by both regions with no significant difference between them: natural areas, environmental education and stewardship, coastal habitat restoration, scientific research, passive recreation, marine protected areas (MPAs), non-motorized sports, passive recreation (e.g., walking, bird watching,) and public access, recreational fishing, town marinas, party boats, working waterfront, and private marinas (Table 7). Conversely, the regions were overall more negative (at various levels) toward motorized

sports and recreation (e.g., boating or jet skis), cables, pipelines (gas, etc.), power plants, hardened shorelines, sewage effluent disposal, coastal development business, coastal development housing, and commercial fishing using trawls (Table 7, Figure 4).

Only dredge material disposal (just the NY region), coastal development for housing, commercial fishing using trawls, and runoff disposal (just NY) were looked at very negatively, (i.e., reduced or eliminated in LIS). In addition, both regions had very negative views on LNG facilities and felt more negative toward LNG facilities than any other proposed energy sources.

In terms of possible future or proposed uses, the NY and CT regions only varied significantly on waste-to-energy facilities, with NY having a less negative view, falling at neutral, while CT fell closer toward the "Negative, but willing to tolerate" category. Both regions rated all new energy uses negatively, with the exception of wave/tidal and wind energy. Liquid natural gas facilities were rated most negatively, with nuclear and natural gas trailing close behind. Both regions were strongly negative toward mining in LIS, and somewhat negative toward marine areas zoned for industrial use, such as filling of borrow pits, new energy cables/pipelines, and adding new telecommunication cables.

Both the NY and CT regions at least somewhat valued possible future uses of LIS including algal aquaculture/seaweed cultivation, fish aquaculture, and marine areas zoned for consumptive use. Marine areas zoned for limited use and no take MPAs were the most positively supported future uses by both regions (Figure 4). In addition, for the most positively rated future uses, there was no significant difference between the regions. However, this pattern did not hold true for the future uses with the highest negative scores (Figure 4). For the most part, significant disparities in regional opinions were not visible until the ratings fell around or below "Positive, but at current level." These strong agreements of high positive scores that leaned toward "Positive, would like to see more," may signify that, on the uses they would most like to see in LIS, more compatibilities than conflicts exist. Those uses include natural areas, environmental education-stewardship, coastal habitat restoration, scientific research, passive recreation, marine parks or protected areas, non-motorized sports, and passive recreation and public access (Table 7). Not surprisingly, all of these uses fall into either the recreation-aesthetic value or historic-education value ecosystem service categories.

f. Spatial Extent of Habitat Conservation or Industry

Connecticut and NY differed significantly ($p<0.05$) on their opinions of the amount of coastline that should be designated for commercial/industrial activity, with CT wanting a larger allocation (Table 8). However, both states registered that less coastline and open water should be set aside for commercial activity than currently exist. Further, they both thought the amount of space currently allocated for habitat conservation in the open waters in LIS should be considerably increased. The perceived current level of open water set aside for conservation was less than 5-15%. Both states wanted the spatial extent of the area set aside for habitat protection in both the open waters of LIS and the coastline areas increased to 25-50%.

g. Coastal and Marine Spatial Planning

Both NY and CT showed support for CMSP implementation in LIS. They were both "somewhat likely" to "very likely" to support CMSP, a bi-state management effort, or a comprehensive planning process for LIS (Tables 9a, 9b). Although supportive, both NY and CT survey participants were somewhat less likely to "be involved in" a comprehensive planning process for LIS than they were to support it.

5.6 Discussion

Acknowledging the regional differences in opinions on the management of LIS and ecosystem service values is an important first step in defining a common ground between NY and CT on which to base CMSP. As shown in Table 4, neither NY nor CT residents are particularly happy with past or current management of LIS and its resources, especially with regard to the structure and functioning of LIS's ecosystems. The current focus of TMDL management in LIS is not working (as discussed in Chapter 3). This type of management is no longer relevant given the realities of ecosystem level disturbances from overdevelopment, over-use, and climate-change.

In addition, the states must plan for the increased conflicts they foresee in LIS over the next 25 years in order to anticipate what possible conflicts and sticking points there might be before entering into CMSP negotiations, especially around ecosystem services and a changing climate. As future storm intensity is predicted to increase, CT and NY must plan for how that

will affect ecosystem services in LIS. Oyster and clam beds in CT were severely damaged by Superstorm Sandy in Fall 2012, and many homes suffered from flooding. Interestingly, CT valued coastal protection and stability significantly higher than NY did in the survey.

In the past, some larger regional conflicts between the two states have included a power cable being placed on the bottom of the LIS to supply Long Island with electricity, the construction of the Indian Point pipeline, CT's dumping dredged materials, and miss-matches in fishing regulations. Many of these historical conflicts surfaced in the analysis of survey results, including dumping of dredge spoil, construction of LNG facilities, and laying of new cables and pipelines. The stakeholder survey was able to capture the major conflicts between the two states, which more so validates the results. In addition, this survey can be more confidently replicated for other marine ecosystems.

Interestingly, some of the main regional conflicts that arose in this survey involved commercial development, specifically of LIS's embayments. New York had a much more negative view of commercially related activities along the coasts than did CT. These uses included construction of transfer stations, runoff disposal, dredging of bays and harbors, and military installations. Connecticut's coastal zone is more developed than NY's (i.e., mostly the north shore of Long Island), and has more working waterfronts and connections between towns and waterfront businesses. In comparison, the north shore of LI, where there are some working ports and industry, is mostly wealthy residential properties and exclusive communities. It seems there might be more interactions between CT residents and LIS's working waterfront than for NY residents. Commercial fishing boats are regularly seen unloading in CT harbors, something not often seen on Long Island's north shore. In addition, CT has a large naval base in New London, where submarines can often be seen coming into the harbor. Connecticut also has some established aquaculture programs, and leased shellfish beds in LIS, which is why they may have rated these specific uses higher than NY.

Because it has a more industrialized coastline, perhaps residents of CT are more used to seeing these types of uses and therefore have less negative opinions of them. This may explain why the CT region had more positive views toward ecosystem services and specific uses involving commerce and business. Further supporting this idea is that CT rated higher the amount of coastline that should be dedicated to commercial/industrial activity in LIS than did NY.

However, when it came to commercial type activities outside of the coastal areas and in the open waters of LIS, NY often took a more negative view than CT. For example, NY had a more negative view on dredge material disposal in LIS, which has always been a point of contention between the states. In addition, although not significant, the CT region on average rated cables/pipeline more negatively than NY. This is another issue of contention between the two states, with NY, specifically LI, not having many cost-effective options other than running lines through LIS to connect to northern resources.

Interestingly, for both the NY and CT regions, there were not many current uses that fell past the "Negative, but willing to tolerate," level. Where differences existed, most were not that extreme and fell between "Negative, but willing to tolerate" and "Positive, but at current level." These are the uses that will most easily be negotiated because most stakeholders don't hold extreme views on them.

The survey also shows much agreement between the two regions on how they value different ecosystem services. In addition, where disagreements existed, they were not extreme, and there were always points of agreement, which is good news for CMSP. For example, results showed that even though CT and NY significantly differed in their opinions of the exact amount of coastline that should be designated for commercial/industrial activity in LIS, both regions agreed that it should be less than it currently is. In addition, as previously stated, many of the conflicts that did surface between the regions have been on-going historical conflicts over issues such as dredge material disposal and construction of cables and pipelines.

Table 6 showed regional conflicts and compatibilities of current and possible future uses of LIS. There are some significant conflicts between the two states as discussed earlier, however, there are more than double the amount of compatibilities. Especially notable is that for most potential future uses, both regions agree, with the exception of WTE. However, even with WTE, both NY and CT rated it negatively, CT much more so.

The general agreement between both states on LIS's energy future is a great starting point for building a vision around energy use in LIS. However, more education and research on this topic is needed since both regions reported being least informed on energy and infrastructure needs in LIS. Basically, other than "green" sources of energy, neither state wanted it in or on the shores of LIS. The strongest negative opinions surfaced around LNG facilities. As discussed

earlier, there was a contentious debate with community opposition to the proposed Broadwater LNG facility in LIS a few years ago. Both NY and CT fought this proposal all the way to the federal level. It is likely LNG had the worst score because of the Broadwater proposal, which is still somewhat fresh in people's minds.

In a presentation on CMSP at the CT Sea Grant Conference at the University of Connecticut Avery Point Campus, in 2010 Bud Ehler explained that, based on examples in Europe, successful CMSP programs need to have not just the authority to create the plan, but also the authority to implement it. It would need to be integrated with current and future resource protection and use management efforts in LIS including states' CZM programs, local waterfront revitalization plans, submerged lands leasing programs, and the public trust doctrine (Bray 2007; Slade et al. 1997).

Because the entirety of LIS is state waters legally held in trust by NY and CT, those states could exercise their authority under the Public Trust Doctrine to pursue comprehensive, area-based management in LIS (Bray 2007). Unlike state regulatory programs, an exercise of state public trust authority would be less subject to being overruled or pre-empted by federal regulatory agencies (Carlson 1990). In addition, with the creation of the Federal Interagency Ocean Policy Task Force in 2009, regional councils are being created that will develop frameworks to implement CMSP. The work of these councils has to incorporate existing local and state initiatives; consequently, the process of creating a CMSP for LIS is extremely timely and relevant. In order for CMSP to be successful in LIS, there must be a clearly defined government framework with sanctioned authority (Ehler & Douvere 2009).

A collaborative management body already exists in the LIS, including stakeholders, scientists, and managers from both NY and CT – the LISS. The LISS could serve as a starting point for a CMSP initiative in LIS with planning authority, and possibly implementation authority. There was even language inserted in the LISS reauthorization bill (S.2018) giving the office and staff, who are federal employees, the responsibility of: ''planning initiatives for Long Island Sound that identify the areas that are most suitable for various types or classes of activities in order to reduce conflicts among uses, reduce environmental impacts, facilitate compatible uses, or preserve critical ecosystem services to meet economic, environmental, security, or social objectives.'' This sounds extremely similar to the definition of ecosystem-based CMSP.

However, giving the LISS authority to manage spatial planning in LIS might cause some problems with the states, as it is ultimately seen as an offshoot of a Federal agency. I imagine that NY and CT would want to retain ultimate management jurisdiction in LIS. In addition, the issue of home rule in the CZM process would need to be addressed.

5.7 Conclusion

Ultimately, there needs to be cooperation and agreement between the two states co-managing LIS, CT and NY, for CMSP to work there. The states must jointly develop a leadership and guidance role in this process. They must broker the process of creating a LIS vision, and negotiate agreements and concessions among stakeholder groups. Therefore, they should have their own visions for LIS worked out in advance. In building consensus, identifying where conflicts have traditionally existed, and what issues might surface in the future is crucial. Specifically, building off of agreements on how they would like to see LIS used, and how they do not want to see LIS used, is an important starting point when devising a shared vision for a LIS CMSP. The survey in this dissertation is a novel, quantitative method to begin measuring and recording conflicts, compatibilities and values, to develop a shared regional vision for LIS. This chapter showed that there was much more in common between the two regions than there were differences. Building off regional compatibilities on how LIS should be used, now and in the future, could help shape a vision and give the states a leading role to begin a CMSP process (Table 7). However, before a CMSP process could begin in LIS, both regions require more information and training on ecosystem-based CMSP since they reported not being very well informed on the topic.

Chapter 5 Figures:

Figure 1. Various federal agencies and departments involved with ocean policy and coastal management.

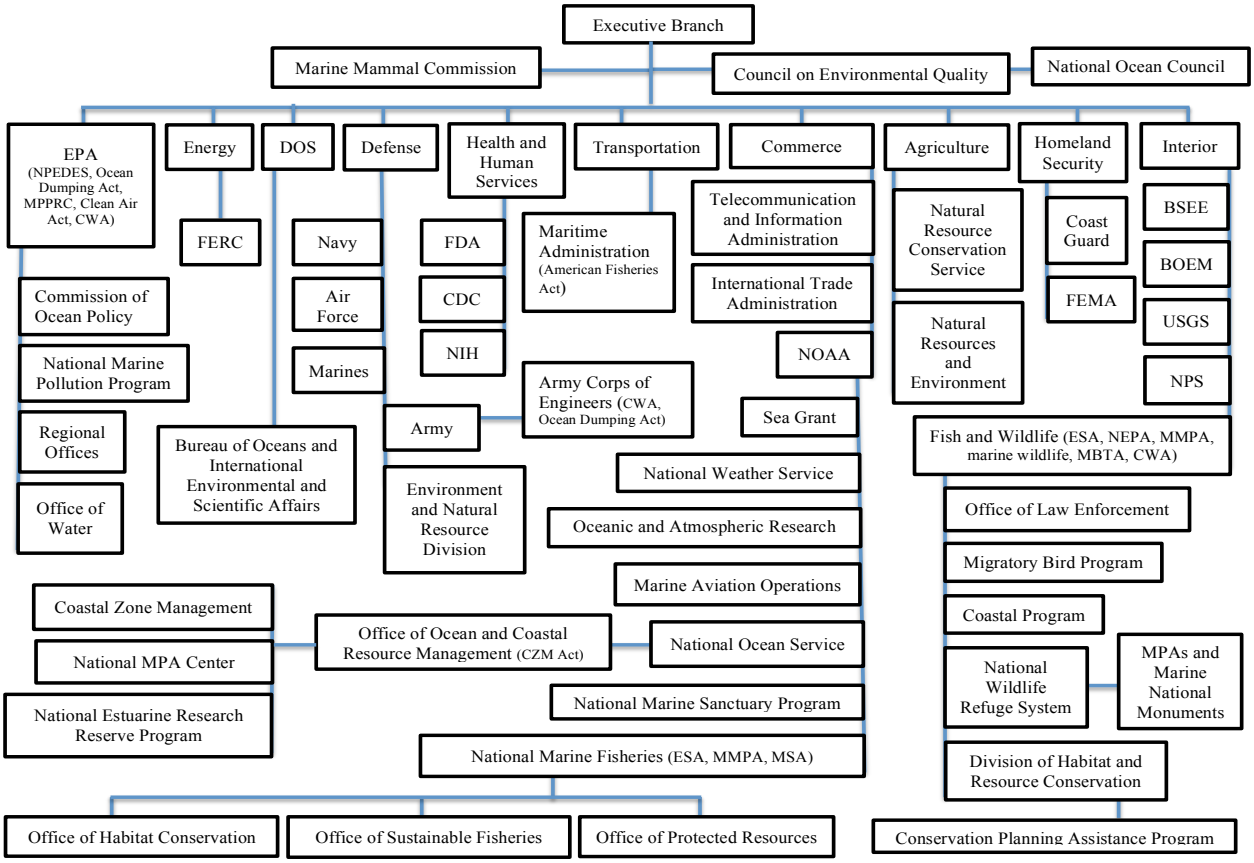
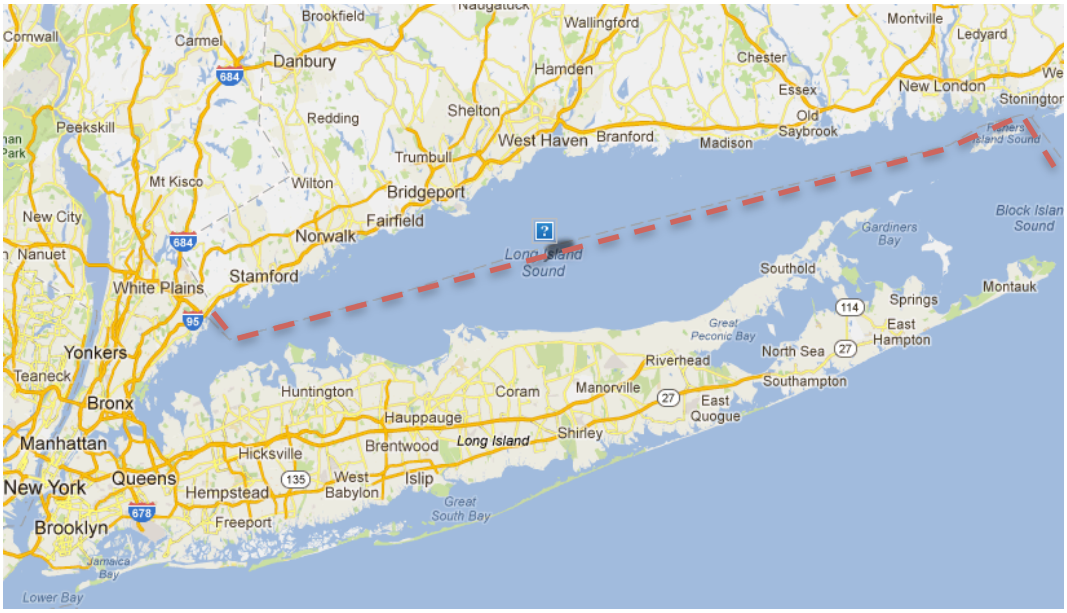


Figure 2. State boundaries in Long Island Sound. Source: Google Maps (2013)



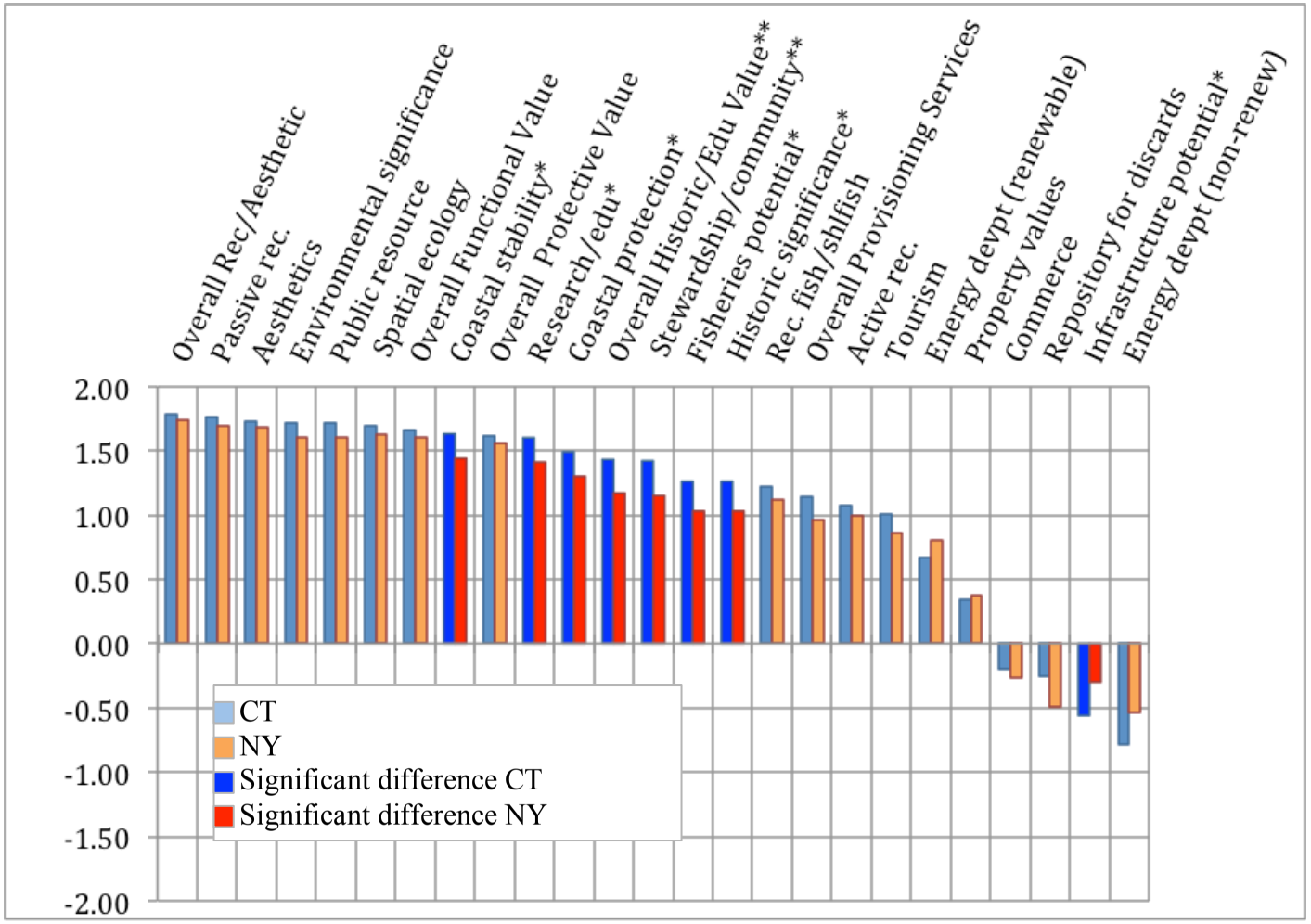


Figure 3. Relative mean values of different LIS ecosystem services for both the CT and NY regions. Ecosystem services are displayed from left to right, most highly valued to least valued. The scale for the y-axis was calculated by subtracting 3 (as it represented neutral) from all ecosystem service averages, and then multiplied by -1. This resulted in relative negative and positive values for individual services. A positive value signifies a positive view; while a negative value signifies a negative view. The larger the positive value, the more positive the view. Where the bars are brighter colors, there were significant differences between CT and NY. Level of significance are indicated next to the ecosystem service values on the x-axis, where *=$p<0.05$, **=$p<0.01$, and ***=$p<0.001$.

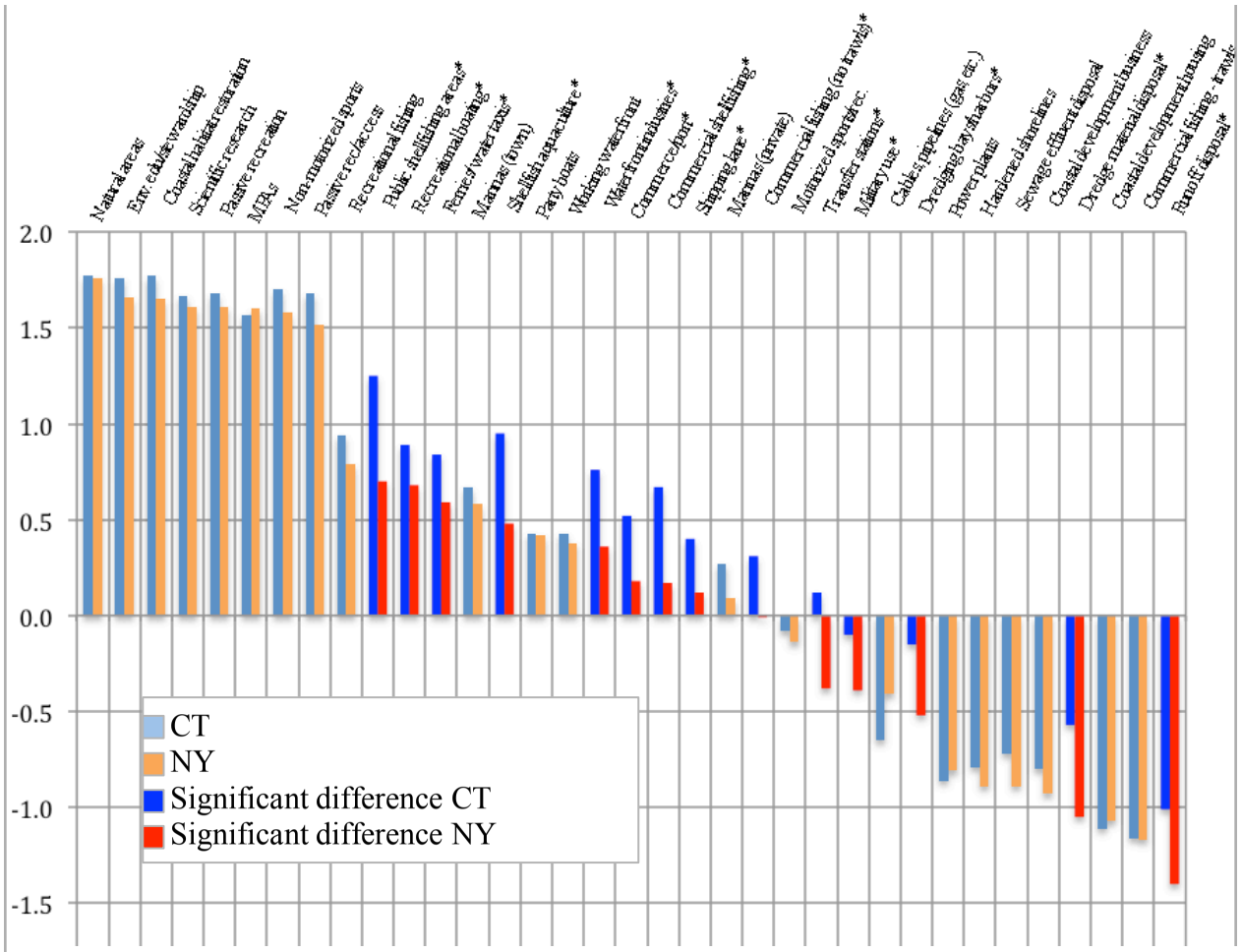


Figure 4. Relative opinions on uses in LIS for the CT and NY regions. Uses are displayed from left to right, most positively viewed to most negatively viewed. The scale for the y-axis was calculated by subtracting 3 (as it represented neutral) from all use averages, and then multiplied by -1. This resulted in relative negative and positive values for individual uses. A positive value signifies a positive view; while a negative value signifies a negative view. The larger the positive value, the more positive the view. Where the bars are brighter colors, there were significant differences between CT and NY. Level of significance is indicated next to the ecosystem service values on the x-axis, where *=$p<0.05$, **=$p<0.01$, and ***=$p<0.001$.

Chapter 5 Tables:

Table 1. Mean levels of perceived knowledge on LIS issues and needs by region. Likert scale key: 1=very well informed, 2=fairly well, 3=some knowledge, 4=not informed. The Sig. column represents level of significance where *=p<0.05, **=p<0.01, and ***=p<0.001.

Do you think you are well informed on the following in LIS? (1=very well informed; 4=not informed)	**CT n=184**	**NY n=209**	**ANOVA p value**	**Sig.**
Management issues	2.06	2.42	0.000	***
Economic issues	2.42	2.67	0.004	**
Fishery issues	2.31	2.50	0.041	*
EBM	2.19	2.42	0.020	*
CMSP	2.69	2.84	0.131	
Infrastructure and energy needs	2.69	2.78	0.293	
Community or stewardship	2.22	2.62	0.000	***

Table 2. Opinions on LIS by regional mean scores. Likert scale key: 1=strongly disagree; 3=neutral, 5=strongly agree. The Sig. column represents level of significance where one star (*)=p<0.05, two stars (**)=p<0.01, and three stars (***)=p<0.001.

Please rate your opinion (1=strongly disagree; 5=strongly agree)	**CT n=182**	**NY n=204**	**ANOVA p value**	**Sig.**
Water quality has improved over past 25 years	3.98	3.59	0.000	***
Ecosystem structure/function of coastal areas are in good shape	2.62	2.44	0.044	*
LIS has a healthy biodiversity	3.25	3.16	0.362	
LIS has a healthy food web or trophic structure	3.00	3.06	0.530	
Reducing nutrient inputs has greatly improved ecological health in LIS	3.84	3.55	0.003	**
Commercial fisheries will still be viable in 10 years	2.74	2.76	0.853	
Over the past 25 years, use conflicts have been a problem	3.99	3.93	0.472	
Currently, use conflicts are a problem	3.90	3.85	0.604	
Over the next 25 years, use conflicts will be a problem	4.14	4.06	0.377	

Table 3. Mean values of LIS ecosystem services by region. Likert scale key: 1=strongly value; 3=neutral, 5=do not value at all. The Sig. column represents level of significance where *=p<0.05, **=p<0.01, and ***=p<0.001.

How do you personally (i.e., not professionally) value the following ecosystem services/categories in LIS? (1=strongly value, 5=do not value at all)	**CT n=165**	**NY n=194**	**ANOVA p value.**	**Sig.**
Overall Recreation/Aesthetic Value	1.22	1.260	0.616	
Aesthetics	1.27	1.32	0.383	
Recreational fishing/shellfishing	1.78	1.88	0.337	
Active Recreation (boating, jet skiing, etc.)	1.93	2.00	0.532	
Non-consumptive recreation	1.24	1.31	0.319	
Public resource/accessibility	1.29	1.40	0.125	
Tourism potential	1.99	2.14	0.154	
Overall Provisioning Services Value	1.86	2.04	0.077	
Property values	2.66	2.63	0.769	
Fisheries potential	1.74	1.97	0.031	*
Repository for discards	3.26	3.49	0.114	
Infrastructure development potential	3.56	3.30	0.037	*
Energy development (non-renewable)	3.79	3.54	0.069	
Energy development (renewable/green)	2.33	2.20	0.252	
Commerce or commercial development	3.20	3.27	0.554	
Overall Ecosystem Protective Value	1.39	1.44	0.437	
Coastal protection potential	1.51	1.70	0.039	*
Environmental significance (i.e., biodiversity, trophic structure)	1.28	1.40	0.096	
Overall Ecosystem Functional Value	1.34	1.40	0.397	
Coastal stability (e.g., climate control, nutrient buffer, etc.)	1.37	1.56	0.011	*
Spatial ecology (e.g., wildlife habitat, restoration/ natural areas)	1.31	1.38	0.336	
Overall Historic/Educational Value	1.57	1.83	0.005	**
Historic significance	1.74	1.97	0.016	*
Stewardship/community	1.58	1.85	0.003	**
Research/education	1.40	1.59	0.012	*

Table 4. Management satisfaction and opinion on ecological health of LIS by regional means. Likert scale management satisfaction key: 1=very satisfied; 3=neutral, 5=very dissatisfied. Likert scale ecological health key: 1=much worse; 3=neutral, 5=much improved. The Sig. column represents level of significance where *=p<0.05, **=p<0.01, and ***=p<0.001

	CT n=156	**NY n=182**	**ANOVA p value**	**Sig.**
In general, how satisfied are you with the management of LIS (1=very satisfied, 5=very dissatisfied)	3.12	2.94	0.107	
Over the past 10 years, the ecological health of LIS is (1=much worse, 5=much improved)	3.58	3.33	0.016	*

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Table 5. Rankings of management issues by region (by %). Management priorities are listed on the left and rankings (as a % of total score for each state individually) in the right two columns. Each of these columns add up to 100%. The values for the top five management priorities are bolded; the lowest are italicized and bolded.

Management Issues	CT	NY
Non-point source pollution	**17.5**	**17.3**
Water quality	**17.4**	**17.8**
Habitat loss/coastal development	**11.8**	**10.8**
Point source pollution	**8.7**	**7.8**
Loss of biological communities	**6.1**	4.9
Privatization of waterfront/public access	5.9	**6.9**
Invasive species	5.4	4.0
Cohesive management	4.6	3.9
Climate change	4.3	5.7
Overfishing	3.9	6.5
Lack of science	3.2	2.4
Public involvement/perceptions	3.0	2.2
Dredging	2.8	2.1
Leasing of bottom lands	1.9	1.4
Loss of working waterfront	1.5	1.7
Alternative energy	0.9	2.5
Economic development	0.9	***0.8***
Transportation	***0.4***	1.3

Highest Ranked — Lowest Ranked

Scale

Table 6. Mean regional opinions on specific current and future uses of LIS. Likert scale key: 1=positive, would like to see (more); 2=positive, but at current level; 3=neutral; 4=negative, but willing to tolerate; 5= negative, reduce or remove/do not want in LIS. The Sig. column represents level of significance where *=p<0.05, **=p<0.01, and ***=p<0.001.

What is your opinion of the following current/future uses of LIS? (1=positive, would like to see (more); 5= negative, reduce or remove/do not want in LIS)	**CT n=148**	**NY n=169**	**ANOVA p value**	**Sig.**
Recreational fishing	2.06	2.21	0.152	
Commercial fishing (no trawls)	2.69	3.01	0.006	**
Commercial fishing using trawls	4.16	4.17	0.893	
Commercial shellfishing	2.33	2.83	0.000	***
Shellfish aquaculture/leased beds	2.05	2.52	0.001	**
Shellfishing areas (recreational/public)	1.75	2.30	0.000	***
Dredge material disposal	3.57	4.05	0.000	***
Sewage effluent disposal after secondary or tertiary	3.72	3.89	0.179	
Runoff disposal	4.01	4.40	0.001	**
Ferries/ water taxis (transportation)	2.16	2.41	0.022	*
Shipping lane	2.60	2.88	0.003	**
Commerce/port	2.48	2.82	0.001	**
Waterfront industries (e.g. boat building, repair)	2.24	2.64	0.001	**
Transfer stations (i.e. for barge transportation)	2.88	3.38	0.000	***
Cables, pipelines (gas, etc.)	3.65	3.41	0.051	
Power plants	3.86	3.81	0.631	
Coastline development for business	3.80	3.93	0.306	
Coastline development for housing	4.11	4.07	0.749	
Working waterfront (shops, restaurants, etc.)	2.57	2.62	0.694	
Party boats (fishing)	2.57	2.58	0.919	
Marinas (town)	2.33	2.42	0.407	
Marinas (private)	2.73	2.91	0.123	
Recreational boating	2.11	2.32	0.042	*
Military use	3.10	3.39	0.017	*
Passive recreation (beach going, birding)	1.32	1.39	0.335	
Non-motorized sports (kayaking, windsurfing, etc.)	1.30	1.42	0.089	
Motorized sports/recreation (jet skis, power boats)	3.08	3.14	0.706	
Passive recreation or beach access points	1.32	1.48	0.052	
Marine parks/protected areas	1.43	1.40	0.757	
Natural areas (wetlands, etc.)	1.23	1.24	0.891	
Coastal habitat restoration	1.23	1.35	0.127	
Bulkheads/hardened shorelines	3.79	3.89	0.516	
Dredging bays/harbors	3.15	3.52	0.006	**
Scientific research	1.33	1.39	0.460	

	CT	NY	ANOVA	Sig.
Environmental education/stewardship	1.24	1.34	0.155	
Algal aquaculture/seaweed cultivation	2.18	2.35	0.198	
Fish aquaculture	2.54	2.74	0.175	
Wind energy generation	2.52	2.43	0.559	
Wave/tidal energy generation	2.23	2.36	0.384	
Energy - nuclear	3.99	4.21	0.100	
Energy - natural gas	3.86	3.84	0.885	
Energy - waste-to-energy	3.52	3.08	0.003	**
Mining (sand, minerals, etc.)	4.22	4.36	0.211	
Liquid natural gas facilities	4.38	4.17	0.085	
Marine areas zoned for no-take	1.90	1.84	0.619	
Marine areas zoned for limited use	1.86	1.78	0.551	
Marine areas zoned for consumptive use	2.57	2.69	0.394	
Marine areas zoned for industrial use	3.55	3.29	0.075	
Filling of borrow pits	3.27	3.25	0.873	
New energy pipelines/cables	3.76	3.49	0.092	
New telecommunication cables	3.67	3.41	0.116	

Table 7. Significant conflicts and compatibilities between NY and CT regarding current and future uses in LIS. * signifies the use was significantly valued more positively, ** use was valued more negatively. Italicized text indicates possible future uses.

Conflicts	**Compatibilities**	
Connecticut	**Positive***	**Negative****
Commercial fishing*	Natural areas/MPA	Motorized rec.
Shellfish/aquaculture*	Passive rec/access	Cables/pipelines
Shipping/commerce*	Stewardship/education	Power plants
Recreational boating*	Research	Bulkheads
Ferries/taxis*	Rec. fishing	Effluent disposal
Waterfront industry*	Party boats	Development
Waste-to-energy (WTE)**	Marinas	Trawl fishing
	Working waterfront	*Liquid natural gas*
New York	*Wave/tidal energy*	*Nuclear*
Dredging/disposal**	*Aquaculture*	*Natural gas*
Transfer stations**	*MPA's: limited, no-take,*	*Mining*
Runoff disposal**	*consumptive*	*Industrial zones*
Military use**		

Table 8. Percentage of LIS coastline or open water that respondent thought is currently set aside for either habitat conservation (habitat) or commercial/industrial activity (commercial), and the percentage that respondent felt should be set aside. Likert scale key: 1=0-5%; 2= 5-15%; 3=15-20%; 4=25-50%; 5 >50%. The Sig. column represents level of significance where *=p<0.05, **=p<0.01, and ***=p<0.001.

How much of LIS is currently or should be allocated for the following: (0-5%=1; 5-15%=2; 15-20%=3; 25-50%=4;>50%=5)	**CT n=131**	**NY n=159**	**ANOVA p value**	**Sig.**
Conservation - current open water	1.64	1.67	0.779	
Conservation - should be open water	3.27	3.39	0.366	
Conservation - should be coastline	3.43	3.42	0.918	
Commercial - current open water	2.88	3.07	0.169	
Commercial - should be open water	2.57	2.55	0.893	
Commercial - current coastline	2.87	2.71	0.225	
Commercial - should be coastline	2.47	2.24	0.024	*

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Table 9a and 9b. Support for CMSP in LIS by region. Likert scale key for 8a: 1=yes, 1.5=not sure, 2=no. Likert scale key for 8b: 1=very likely, 3=neutral, 5=very unlikely. The Sig. column represents level of significance where *=p<0.05, **=p<0.01, and ***=p<0.001.

CMSP Support	**CT n=142**	**NY n=161**	**ANOVA p value**	**Sig.**
9a. Should CMSP be implemented for LIS? (1=yes;1.5=not sure; 2=no)	1.16	1.17	0.646	
9b. For the next set of statements (1=very likely; 5=very unlikely)				
How likely are you to Support CMSP for LIS?	1.86	1.70	0.200	
Support a NY and CT bi-state management effort (with implementation authority) for LIS?	1.89	1.67	0.071	
Support a comprehensive planning process for LIS?	1.61	1.52	0.419	
Be involved in a comprehensive planning process for LIS?	2.21	2.37	0.253	

Chapter 6. *Science and Policy*

Scientific and Political Challenges for Implementing Coastal and Marine Spatial Planning (CMSP) in LIS: Knowledge Gaps, Use Opinions, and Conflicts in Management Priorities Among Scientists, Policy Makers and the Public.

6.1 Abstract

New federal and regional initiatives have put Long Island Sound (LIS) in a prime position to begin documenting a coastal and marine spatial planning (CMSP) process. In this chapter, scientific and political challenges to moving forward with CMSP in LIS are highlighted, specifically with regard to identifying gaps with the general public in knowledge, use values, and priorities. A targeted survey (n=394) was administered to a diverse sampling of stakeholder groups in LIS, gauging opinions on ecosystem services, health, and management. Participants' perceived knowledge on LIS concepts/issues was analyzed, including CMSP. Conflicts and compatibilities in management priorities among different user groups for LIS were also examined. Ranking of LIS management issues could help create a framework for the prioritization of these in any future planning efforts. The top two management priorities for LIS were water quality and non-point source pollution; however, agreements among user groups began to splinter shortly thereafter. Some other notable findings included a discrepancy among scientists and all other groups on climate change being a top priority. Knowledge gaps existed between users and those involved in science and policy, especially around ecosystem-based management (EBM) and CMSP, signifying that the ecological, economic, and social issues are not being effectively translated to the public.

6.2 Introduction

As space and resources on land are used up, marine environments are looked to more and more as viable options for provisioning services, such as energy and mining. The continued rising population density of coastal areas in the United States adds further stress. As complex ecosystem level changes occur around the oceans globally, stronger, more effective management

techniques are needed for conservation and restoration (Lubenchenco et al. 2003). The expanding scope of uses and problems in the marine environments makes it even more important to start creating a vision of how we want to see our oceans, estuaries, and bays managed.

Stakeholder demand will only continue to increase in LIS, leading to increased user conflicts and further stresses to the system. As discussed in the previous chapter, survey respondents from both the NY and CT regions expect use conflicts to increase in LIS over the next 10 years. Future development projects are being considered to attend to the area's growing energy needs. Currently there is no clear comprehensive authority or policy regulating these activities in LIS, which has led to emotion, rather than science and reason, that shape debates on acceptable use (Swanson and Conover 2006). In general, management efforts in LIS have been reactive, not proactive. Limiting traditionally permitted activities, such as fishing and recreational boating, and providing for future development needs are management issues that must be addressed. Coastal and Marine Spatial Planning can promote the efficient use and sustainability of LIS's many different marine resources (Sanchirico 2004).

Having a set of agreed upon principles and goals to guide any spatial planning process is a crucial first step, especially before moving ahead with design and implementation (Koppelman 2007; Ehler and Douvere 2009). In fact, one of the specific outputs Ehler and Douvere (2009) listed in their CMSP best practices guide includes setting up planning for marine spatial management (Chapter 1, Figure 2). They suggested developing a set of principles to guide CMSP, specifying management goals and objectives, and creating a plan to involve stakeholders from the beginning (Ehler and Douvere 2009).

The local issues and science associated with the ecological health of LIS are integral aspects in the planning and design of a CMSP initiative. For instance, marine protected areas (MPAs) should not be placed in areas with a high probability of disturbance. Properly managing the locations of stormwater drains and waste effluent pipes are especially important, and are good examples of current mismanagement in LIS. In addition, 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). 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 the

Sound provide critical nursery habitat for commercial fish species such as summer flounder (*Paralichthys dentatus*), butterfish (*Poronotus triacanthus*), and scup (*Stenotomus chrysops*) (Stedman 2006). Wetlands are also a vital location of food for bluefish (*Pomatomus saltatrix*), and striped bass (*Morone saxatilis*), and provide habitat for the hard clam (*Mercenaria mercenaria*) (Stedman 2006). Siting of restrictive use or conservation zones could interfere with shipping routes and distribution centers, dredging or mining sites, and gas/energy lines (MSRC 2001).

Successful CMSP is based strongly on science (Douvere & Ehler 2001, Crowder et al. 2006a, Douvere 2008, Force 2009, Foley et al. 2010a, Douvere & Ehler 2011, Halpern et al. 2012). Therefore, it is important to explore some of the key factors responsible for disconnects between the general public and scientists, as well as policy makers. Do scientists, policy makers, and the public identify the same problems in LIS? Do they have the same vision? It is crucial for scientists to be able to elucidate and communicate the current ecological status of LIS, especially the importance of harder to quantify ecosystem attributes, such as biodiversity.

Using analyses from the stakeholder survey, this chapter explores some of the linkages between science and policy, and how these might affect future management of LIS. Specifically, I will distinguish various differences in ecological and social priorities among scientists, policy makers, and the general public. I will also assess the top management priorities for LIS, and discern where conflicts might exist among user groups.

6.3 Methods

A targeted stakeholder survey (n=394) was administered to various user groups in LIS, as per methods described in Chapter 2. Survey participants were asked to rank, in order, the top three user groups that they most identified themselves with. Primary user group categories were broken up into Managers, Scientists, Non-Governmental Organizations (NGOs), Active Recreationalists, Passive Recreationalists, Business, Community and Government as described in Chapter 2. To develop a comprehensive list of management priorities for LIS, existing management efforts were inventoried and catalogued using multidisciplinary literature searches, and research from a preliminary pilot study. Informal interviews with managers and officials were also conducted.

Survey respondents were allowed to rank their top five management priorities. Weighted averages were then calculated in each management category by user group. These averages were then converted to percentages, where each individual user group column in Table 1 totals 100%. Management issues ranked first by participants were considered most important, and given a score of 5.0, those ranked second a 4.0, third a 3.0, fourth a 2.0, and fifth were given a 1.0. Issues that were not ranked in an individual's top five were given a score of 0.0. To get a weighted sum, total scores were summed for each management issue by user group. The weighted average was then calculated by dividing the weighted sum for each issue, by the total sum for all the management issues in that particular user group. This was multiplied by 100 to get the percent importance. The overall management issues ranking from 1-18 was calculated using the weighted averages of all of the survey respondents by management issue (i.e., not broken down by user group).

To further explore the relationship between science and policy, survey participants were broken down into Scientists (n=146) versus Non-Scientists (n=248). As stated in Chapter 2 (Methods), each survey participant could designate and rank three stakeholder categories they most identified with. If anywhere in their top three a participant chose "scientist," they were put into the Scientist category; all others went into Non-Scientist. Management categories were ranked using the methods discussed above with regard to these two new categories. Using ANOVAs to test for significance, other survey questions were also analyzed using this new group designation including Question 10 on perceived knowledge; Questions 13, 19, and 21 on ecosystem health and management satisfaction; and Questions 18, 24, and 26 on ecosystem service and specific uses.

To try to capture the differences between those who are involved in policy making for LIS and those who use its resources/services, respondents were also broken up by these two categories, which will henceforth be referred to from now on as Policy, or User. Using the original primary designation user group categories (Chapter 2, Figure 5a), managers, scientists, NGOs, government officials and political representatives were put in the Policy category (n=210). Educators, boaters, recreational and commercial fishermen, recreationalists, naturalists, industry representatives, energy infrastructure representatives, community residents, and property and business owners all were categorized as Users (n=184).

6.4 Results

a. Management Priorities

Stakeholders

There was general agreement on the top two management priorities among the eight user groups: water quality and non-point source pollution (Table 1, Figure 1). However, government, NGOs, and active recreationalists viewed non-point source pollution as more of a priority than water quality. Most groups agreed on habitat loss/coastal development as either third or fourth in importance, except active recreationalists and business, as it did not even register in their top five. Point source pollution made it into the top five management priorities for most groups except scientists and government. Privatization of waterfront/public access was only in the top five for managers, active recreation, community and government. Overfishing was ranked among the top five for active recreation and business, but was rated considerably lower by managers, government, and NGOs. Government was the only group that had loss of biological communities in its top five management priorities; conversely, business rated it very low. More notably, scientists were the only group who registered invasive species or climate change among their top priorities. Scientists also ranked lack of science comparatively higher than most other groups. Cohesive management (i.e., all agencies and different levels of government working well together) was only in the top five for NGOs. Similarly, dredging was only a priority for business, and rated extremely low by scientists. In addition, business registered alternative energy and economic development as much higher than the other groups. Working waterfront was a higher priority for active recreation than for any of the other groups.

Much discrepancy existed in the lowest scored management issues. There was agreement among managers, scientists, active recreationalists, and NGOs that transportation was the lowest priority, although active recreationalists ranked public involvement/perceptions just as low, and NGOs and managers ranked economic development with the same low score. Passive recreationalists registered loss of working waterfront as the lowest priority, business – lack of science, and community and government – economic development.

Groupings of the overall top ten management issues are shown in Figure 1 by user group. The higher the issue scores on the y-axis, the more prioritized it was. As can be seen, the top two management priorities (water quality and non-point source pollution) clustered together

higher than the others. This further suggests a strong agreement between all user groups on these. However, the remaining eight management priorities were lower on the scale, and much more intertwined. There were slight clusters around habitat loss and point source pollution as the third and fourth highest priorities, except for managers, who put privatization of waterfront or lack of public access before point source pollution, and government who prioritized loss of biological communities over point source pollution.

Scientists vs. Non-Scientists

When survey participants were broken down specifically as scientists and non-scientists based on their top three relationships to LIS instead of just their primary, there were differences between the top five priorities of scientists (Table 2). When compared to the smaller group of scientists in the eight-user group analysis, point source pollution took the place of invasive species in their top five. Otherwise, there was general agreement regarding the top five research priorities for LIS: water quality, non-point source pollution, habitat loss/coastal development, and point source pollution. Scientists and non-scientists differed on one of the top five priorities, climate change. As in the previous eight-stakeholder group analysis, scientists registered climate change in their top five, while non-scientists chose privatization of waterfront/public access as more of a priority.

Policy Makers vs. Users

The same management priority analysis was then repeated for policy makers versus users. There was general agreement between policy makers and users regarding their top five research priorities for LIS, specifically water quality, non-point source pollution, habitat loss/coastal development, and point source pollution (Table 3). However policy makers identified climate change in their top five, while users thought overfishing and privatization of waterfront/public access were higher priorities.

b. Science and Policy

Knowledge Assessment

Participants were asked to assess their personal knowledge of various LIS issues, needs and efforts in question eight using a four point Likert scale with options of: "not informed," "some knowledge," "fairly well informed," and "very well informed" (Table 4). Topics included

management, economic, and fisheries issues, EBM and CMSP, infrastructure and energy needs, and community stewardship efforts. Consistently, scientists significantly rated themselves as more informed on management issues ($p<0.001$), fishery issues ($p<0.01$), EBM ($p<0.001$), and CMSP ($p<0.001$) than non-scientists. For all other categories, both groups rated themselves between some knowledge and fairly well informed. Infrastructure and energy needs was the topic scientists felt the least well informed on, while CMSP was the topic of which non-scientists had the least knowledge.

There were also significant differences ($p<0.001$) in perceived knowledge between policy makers and users, specifically on management issues, EBM, and CMSP. Unlike scientists and non-scientists, they did not significantly vary on knowledge of fishery issues, but did on community/stewardship. In general, users felt less informed than those directly involved with management or shaping policy. This pattern even held true for how users perceived their knowledge of community or stewardship efforts (i.e., at a level less than policy). However, all users leaned toward at least some knowledge on all topics. Both users and policy registered the least knowledge on CMSP and infrastructure and energy needs (Table 4).

Opinion on Long Island Sound: Ecology, Fisheries, and Conflict

For survey question 10, participants were asked to rate their opinion on a series of statements using a five-point Likert scale with "strongly disagree" on one end and "strongly agree" on the other (Table 5). The statements included a series on LIS's ecosystem health: water quality has improved over the past 25 years; ecosystem structure/function of coastal areas are in good shape; LIS has a healthy biodiversity; and LIS has a healthy food web or trophic structure. In addition, simple explanations of the scientific terminology were provided to survey participants. The next statement involved management, and read, "Reducing nutrient inputs has greatly improved ecological health in LIS." The last series of statements touched on fisheries and conflicts: "commercial fisheries will still be viable in 20 years;" "over the past 25 years, use conflicts have been a problem;" "currently, use conflicts are a problem;" and, "over the next 25 years, use conflicts will be a problem."

Again, there were significant differences between scientists and non-scientists, and policy makers and users (Table 5). Scientists and non-scientists significantly differed on their views of LIS having a healthy biodiversity ($p<0.05$) and food web ($p<0.01$), with scientists having a more

negative take on these. Scientists also significantly differed from non-scientists on whether or not reducing nutrient inputs had improved the health of LIS, with non-scientists registering a greater improvement. There was no significant difference between these groups on management satisfaction, views on ecological health of LIS, or prediction of conflicts.

However, when comparing users versus policy makers, there were significant differences on whether commercial fisheries would still be viable in LIS in 10 years ($p<0.048$), with users having a slightly more negative outlook (Table 5). Both users and policy had negative views on the ecosystem structure and function of coastal areas and believed that use conflicts were, are, and will continue to be a problem even more so in the future. They both also somewhat agreed that reducing nutrient input to LIS has improved its health. Furthermore, there was no significant difference in management satisfaction of LIS between users and policy, with both at neutral (Table 6). Also, they both thought the ecological health of LIS had slightly improved.

Ecosystem Services and Specific Uses

With regard to the valuation of ecosystem services, scientists and non-scientists significantly valued aesthetics ($p<0.05$), active recreation ($p<0.05$), overall provisioning services ($p<0.001$), property values ($p<0.01$), and historic significance ($p<0.01$) differently (Table 7). In general, non-scientists valued all of these ecosystem services higher than scientists. When asked about more specific uses of the marine environment, non-scientists also had a significantly more positive opinion of commerce/ports ($p<0.01$), waterfront industries ($p<0.001$), town and private marinas ($p<0.05$), and recreational boating ($p<0.05$). However, scientists significantly viewed scientific research and environmental education/stewardship as more positive. Non-scientists took a significantly more negative view on sewage effluent disposal ($p<0.05$), while scientists had a more negative view of dredging bays and harbors, and bulkheads or hardened shorelines ($p<0.001$).

In contrast, scientists had a stronger positive view of possible future LIS uses such as MPAs zoned for no-take, limited use, and consumptive use, and had a less negative view than non-scientists on marine areas zoned for industrial use ($p<0.01$) and the filling of borrow pits ($p<0.05$) (Table 8). However, non-scientists thought that there was significantly ($p<0.01$) more area already set aside in the open waters of LIS for habitat conservation, at 5-15%, compared to scientists at 0-5% (Table 9). Nevertheless, both groups believed that more area should be set

aside for conservation, along the lines of 25-50%. Likewise, users significantly believed there was currently more open water set aside for conservation in LIS than policy.

There were more significant differences between policy makers and users versus scientists and non-scientists in terms of valuing ecosystem services (Table 7). Similarly to science/non-science, there were significant differences for active recreation ($p<0.01$) and property values ($p<0.001$), with users valuing these services more than policy makers. Users also felt significantly ($p<0.01$) more neutral toward non-renewable energy development than policy, having a slightly less negative stance. Policy significantly valued tourism potential ($p<0.05$), coastal protection potential ($p<0.05$), environmental significance (i.e., biodiversity, trophic structure) ($p<0.05$), overall ecosystem functional value ($p<0.01$), coastal stability (i.e., climate control, nutrient buffer) ($p<0.05$), and spatial ecology (i.e., wildlife habit, restoration areas) ($p<0.05$) more than users. However, both groups did positively value these services.

Policy makers and users differed on many specific current and proposed future uses of LIS including: shellfish/aquaculture lease beds ($p<0.05$), dredge material disposal ($p<0.01$), party boats ($p<0.05$), recreational boating ($p<0.05$), motorized sports ($p<0.01$), passive recreation/beach access points ($p<0.05$), natural areas ($p<0.01$), and bulkheads and hardened shorelines ($p<0.001$) (Table 8). Similar to scientists, users had a more negative opinion on dredge material disposal, while policy had a more negative opinion on motorized sports/recreation and bulkheads/hardened shorelines. Policy had a stronger positive view on shellfish aquaculture and leased beds, passive recreation/access, and natural areas; while users had a more positive opinion of party boats, recreational boating, and motorized sports. Users also felt significantly less positive about all zoning of the marine environment for no-take, limited use, or consumptive use, but actually only felt negatively toward marine areas zoned for industrial use (Table 8). There were no other significant differences between users and policy in the future use category.

Both scientists/non-scientists, and policy/users supported a bi-state management and planning process for LIS, and agreed that CMSP should be implemented in LIS. However, non-scientists were slightly less likely to so support CMSP ($p<0.05$) than scientists. (Table 10)

6.5 Discussion

a. Management Priorities

Having agreed-upon management priorities can help shape objectives to guide a CMSP effort in LIS. Survey results clearly show compatibilities in management priorities among groups. When comparing the eight different user groups, managers, government, and NGOs ranked overfishing as a much lower priority than the rest of the user groups. Perhaps the priorities of managers, government and NGOs (all involved in policy making) were more focused on their top issues such as water quality, non-point source pollution, and habitat loss/coastal development (where together they equal 47%, 49%, and 53%, respectively). Overfishing was singled out by business and active recreation. Commercial fisherman fell into the business category, and recreational fishermen into active recreation. In general, fishermen have the most to directly lose from fisheries being poorly managed in terms of loss of profit and sport. For all groups, the top five management issues accounted for at least 60% of their priorities, with active and passive recreation, and NGOs falling closer to 70%. This could mean that NGOs and active/passive recreation have a narrower focus than some of the other user groups. Community, scientist, and business seem to have a broader focus of priorities with their top five accounting for only 61%, 60%, and 59% respectively. This could signal that scientists, business and community have their concerns spread out among many issues.

It is particularly noteworthy that scientists (out of the eight groups) were the only group that ranked climate change and invasive species in their top five, as well as gave a high score to lack of science. It is not surprising that scientists ranked these high; it is, however, surprising that none of the other groups did, especially managers, NGOs or government officials. Business even rated lack of science as their lowest priority. The fact that only scientists ranked climate change in their top five lends to the complexity of how climate change is viewed outside of the scientific community and how poorly it is communicated to the public. Do scientists have more of a long-term focus than the public? Is skepticism of climate change science too big for most user groups to tackle, or is it a symptom of economic insecurities (Scruggs & Bengal 2010)? Perhaps it is because it does not have easily measurable components or management deliverables. Or, is it too socially contentious of an issue? Unfortunately, these results are consistent with the way climate change is talked about in many media outlets and political circles

(Scruggs & Bengal 2010; Boykoff & Boykoff 2007, Christiansen 2003). It would be interesting to repeat this dissertation survey now to see if climate change has moved up on stakeholder groups' list of priorities, especially given recent devastating regional weather events such as Hurricane Irene (2011) and Superstorm Sandy (2012).

A 2010 Yale study (Leiserowitz & Smith 2012) found that most Americans do not have a adequate understanding of climate change science, and that those who rated themselves as having more knowledge were in general more apt to be concerned about its impacts. Those who did not have an in depth understanding were more likely to not believe in climate change. The study also pointed out many knowledge gaps between the experts and the public (Figure 2). Results from this dissertation chapter further support the notion.

Further investigation into LIS management priorities showed that by separating survey participants into just two groups of scientists vs. non-scientists, not only did non-scientists disagree with scientists that climate change should be one of the top five management priorities for LIS, but they actually ranked it on the lower side. This supports a national trend having to do with lack of effective scientific communication in the media and a misunderstanding of the scientific process (Boykoff & Boykoff 2007), especially on complicated issues such as climate change. Recent studies of the American public show a decrease in the number of people believing in climate change. A 2010 Gallup poll found the percentage of Americans who believed that reports of global warming are significantly exaggerated was the highest it's been, at 48%, since the poll started in 1997 (Newport 2010). Public opinion often supersedes sound science for many elected officials when making policy decisions. Lack of strong climate change policy in the US is a perfect example of this. Therefore, changing public opinion on climate change and climate science is crucial for policy change (Scruggs & Bengal 2010).

The reason climate change showed up in the top five for policy (vs. user) is most likely because scientists made up a large percentage of that category. Scientists were put in the policy category because part of their job is to provide the research that will influence policy and management. In the past, scientists shied away from getting involved in policy, but today, it is becoming more and more important for them to get involved (Bartlett 1954, Kaiser 1974). As can be seen from the muddled climate change debate, it is crucial that scientists learn to describe complex scientific concepts in a way that the general public would understand. As Alan Alda, of Stony Brook University's Center for Communicating Science, stated in a March 2012 editorial in

Science, "…clarity in communicating science is at the very heart of science itself." Effective communication of research and the scientific process to a wide range of audiences is a necessity. Too often important issues and policy decisions are being based on inadequate or misinterpreted science. It is the responsibility of scientists, to make scientific research count so it can be effectively translated into sound public policy decisions and guide the CMSP process.

b. Tradeoffs and Conflicts

It is important to have a tool bag of tradeoffs when entering into a planning process and a clear understanding of various motivations and perspectives. For example, if we know that fishermen are worried about losing profits but do value conservation, there may be conciliatory efforts that can be offered to assuage some of the impacts of conservation initiatives. Reviews of other CMSP efforts reveal various management tools that can be used to help alleviate conflict, including variations on the idea of transfer of development rights (TDR), or compensation for loss of services (Douvere et al. 2007, Ehler & Douvere 2010). This survey creates a quantitative means of assessing tradeoffs, as well as scientific, political and societal motivations. Survey results can be used to put everyone's motivations out on the table. For example, although it may seem intuitive, reminding the community that policy makers do have a larger vision to consider when evaluating environmental management tradeoffs (e.g., regional technological and energy needs) is important. Policy makers have to consider the bigger picture – looking at the greater societal needs, political concerns, etc. Scientists also have their own research motivations, including focusing only on the science instead of fully contemplating the social, cultural or economic aspects of a problem. Even though most people inherently know this, it is not talked about –which fosters distrust among users, policy makers, and scientists. Miscommunication and mistrust can lead to an "us versus them" approach in environmental management negotiations. Therefore, addressing some of these issues beforehand is necessary to reduce conflict.

This survey clarifies where knowledge gaps exist among policy makers, scientists, and society. Survey results can elucidate where scientists and policy makers need to do a better job of communicating complicated environmental issues and concepts to the public in order for them to make more informed decisions. For example, although all groups supported CMSP to some extent, there was a general lack of knowledge around EBM and CMSP. No matter how survey

participants were broken up, most groups rated themselves as having the least knowledge on infrastructure and energy needs. It is clear that there must be better communication of these issues from the government on federal, state, and local levels. Swanson and Conover argued in 2006 that piecemeal decisions regarding the development of energy facilities in the LIS are detracting from developing a regional energy policy. In 2013, we still do not have a comprehensive energy plan for NYS other than expanding our energy portfolio and acquiring certain percentages from natural or renewable sources. What does this specifically mean for LIS?

6.6 Conclusion

This research was intended to begin the process of involving stakeholders in the CMSP process by identifying their perceived issues and priorities, as well as to serve as a catalyst for involving different user groups. The survey provided stakeholders an opportunity to document their positions and values regarding LIS at an early stage, and will be useful in constructing a set of shared objectives for CMSP in LIS. However, taking into account the different stakeholder groups, opinions, motivations, and interests, compromises and tradeoffs inevitably must be made. Having an agreed upon set of objectives for CMSP creates a starting point on which to base decisions on more controversial ecosystem services or uses.

Chapter 6 Figures:

Figure 1. Top 10 Management priorities by stakeholder group. Percent importance of the top ten management priorities, relative to each other, by stakeholder group. Management priorities decrease in rank as you move from top to bottom along the y-axis (i.e., percentage).

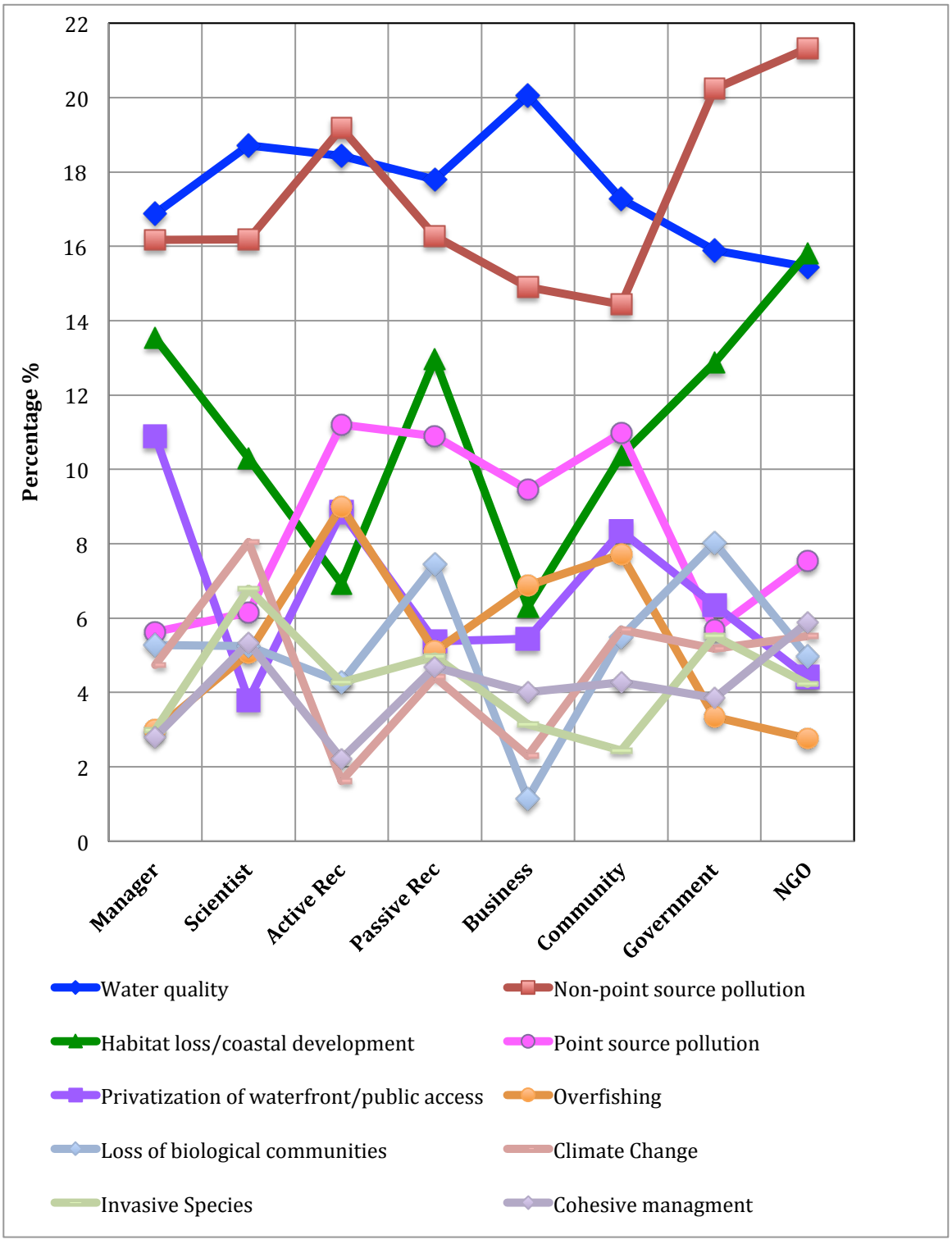
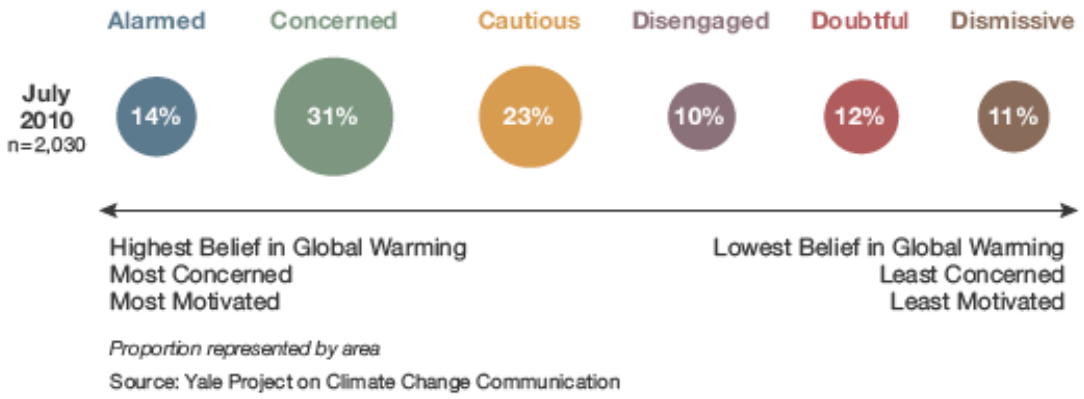


Figure 2. A national assessment on the American understanding of climate change science (causes, impacts and solutions) taken from the 2010 Yale Project on Climate Change Communication (Leiserowitz & Smith, 2010).



Chapter 6 Tables:

Table 1. Management issues and their ranking (by %) within each user group. Overall survey management priorities are listed on the left from 1 to 18. Top five management priorities for each user group are bolded and larger font; lowest are italicized and bolded. User groups across the top row are Managers, Scientists, Active Recreationalists, Passive Recreationalists, Business/Industry, Community members, Government officials, and NGOs.

Management Issues Overall Ranking	Mgr	Sci	Active Rec	Pass Rec	Buss	Comm	Gov	NGO
1. Water quality	**16.9**	**18.7**	**18.4**	**17.8**	**20.1**	**17.3**	**15.9**	**15.4**
2. Non-point source pollution	**16.2**	**16.2**	**19.2**	**16.3**	**14.9**	**14.4**	**20.2**	**21.3**
3. Habitat loss/coastal development	**13.5**	**10.3**	6.9	**13.0**	6.3	**10.4**	**12.9**	**15.8**
4. Point source pollution	**5.6**	6.1	**11.2**	**10.9**	**9.5**	**11.0**	5.7	**7.5**
5. Privatization of waterfront/ public access	**10.9**	3.8	**8.8**	5.4	5.4	**8.3**	**6.4**	4.4
6. Overfishing	3.0	5.1	**9.0**	5.1	**6.9**	7.7	3.3	2.8
7. Loss of biological communities	5.3	5.2	4.3	**7.4**	1.1	5.5	**8.0**	5.0
8. Climate change	4.7	**8.0**	1.6	4.4	2.3	5.7	5.2	5.5
9. Invasive species	3.0	**6.8**	4.3	5.0	3.2	2.4	5.5	4.2
10. Cohesive management	2.8	5.3	2.2	4.7	4.0	4.3	3.8	**5.9**
11. Dredging	3.7	0.5	2.7	1.8	**7.2**	1.8	2.7	2.6
12. Public involvement and perceptions	4.4	3.1	***0.6***	2.3	3.7	2.6	1.5	2.6
13. Lack of science	1.2	6.1	2.1	1.7	***0.9***	1.8	2.5	2.2
14. Alternative energy	2.5	1.2	1.2	2.3	4.3	2.0	1.5	0.7
15. Loss of working waterfront	2.8	0.5	4.9	***0.0***	2.6	0.8	1.8	0.6
16. Leasing of bottom lands	1.4	1.8	1.2	0.8	2.6	1.2	1.0	3.5
17. Economic development	***1.1***	*0.8*	0.9	0.6	3.7	***0.4***	***0.5***	***0.0***
18. Transportation	***1.1***	***0.4***	***0.6***	0.6	1.4	2.2	1.5	***0.0***
Total %	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*

Highest Ranked — Lowest Ranked

Scale 

Table 2. Management issues and their ranking for scientists and non-scientists (by %). Management priorities are listed on the left from highest rated (top) to lowest rated (bottom), with those marked by "*" being identified as the top five overall survey priorities. Top five management priorities for each user group are bolded and larger font; lowest are italicized and bolded.

Management Issue	Scientists	Non-Scientists
Water quality*	**17.4**	**17.7**
Non-point source pollution*	**16.4**	**18.0**
Habitat loss/coastal development*	**12.0**	**10.8**
Climate change	**7.8**	3.4
Point source pollution*	**6.3**	**9.4**
Invasive species	6.0	3.8
Loss of biological communities	5.7	5.3
Overfishing	5.1	5.4
Cohesive management	4.9	3.8
Lack of science	4.7	1.6
Privatization of waterfront/public access*	4.5	**7.6**
Public involvement/perceptions	2.5	2.6
Alternative energy	1.7	1.8
Leasing of bottom lands	1.5	1.7
Dredging	1.4	3.0
Loss of working waterfront	***0.7***	2.1
Economic development	***0.7***	**0.9**
Transportation	***0.5***	***1.0***

Table 3. Management issues and their ranking for those involved in policy vs. users of LIS (by %). Management priorities are listed on the left from highest rated (top) to lowest rated (bottom), with those marked with "*" being identified as the top five overall survey priorities. Top five management priorities for each user group are bolded and larger font; lowest are italicized and bolded.

Management Issue	Policy	User
Non-point source pollution*	**17.9**	**16.6**
Water quality*	**16.8**	**18.6**
Habitat loss/coastal development*	**12.5**	**9.9**
Climate change	**6.3**	3.7
Point source pollution*	**6.2**	**10.5**
Privatization of waterfront/public access*	6.0	**6.9**
Loss of biological communities	5.9	5.0
Invasive species	5.4	3.8
Cohesive management	4.6	3.8
Overfishing	3.9	**6.9**
Lack of science	3.5	1.8
Public involvement/perceptions	2.9	2.1
Dredging	2.1	2.9
Leasing of bottom lands	1.9	1.2
Alternative energy	1.5	2.1
Loss of working waterfront	1.3	2.0
Transportation	***0.7***	***1.0***
Economic development	***0.7***	1.1

Table 4. Comparison of means on perceived knowledge rating on different LIS topics, with 1=very well informed, 2=fairly well, 3=some knowledge, and 4=not informed. ANOVA was used to test for significance. The Sig. column represents level of significance where *=p<0.05, **=p<0.01, and ***=p<0.001.

Do you think you are well informed on the following in LIS (1=very well informed, 2=fairly well, 3=some knowledge, 4=not informed)	**Scientists vs. Non-Scientists**				**User vs. Policy (Pol)**			
	Sci	**Non-Sci**	**ANOVA p value**	**Sig**	**Pol**	**User**	**ANOVA p value**	**Sigs**
Management issues	2.03	2.38	0.000	***	1.98	2.56	0.000	***
Economic issues	2.52	2.57	0.539		2.48	2.64	0.064	
Fishery issues	2.22	2.53	0.001	**	2.35	2.48	0.175	
EBM	1.99	2.50	0.000	***	2.08	2.58	0.000	***
CMSP	2.53	2.91	0.000	***	2.56	3.01	0.000	***
Infrastructure and energy needs	2.69	2.77	0.413		2.68	2.80	0.204	
Community or stewardship	2.34	2.49	0.138		2.27	2.61	0.000	***

Table 5. Comparison of opinions on various statements regarding the status of LIS for scientists vs. non-scientists, and users vs. policy makers, where 1=strongly disagree and 5=strongly agree. ANOVA was used to test for significance. The Sig. column represents level of significance where *=p<0.05, **=p<0.01, and ***=p<0.001.

Please rate your opinion (1=strongly disagree; 5=strongly agree)	Scientists vs. Non-Scientists				User vs. Policy (Pol)			
	Sci	**Non -Sci**	**ANOVA p value**	**Sig.**	**Pol**	**User**	**ANOVA p value.**	**Sig.**
Water quality has improved over past 25 years	3.79	3.77	0.788		3.87	3.67	0.052	
Ecosystem structure/function of coastal areas are in good shape	2.46	2.57	0.252		2.47	2.59	0.187	
LIS has a healthy biodiversity	3.06	3.28	0.023	*	3.14	3.27	0.189	
LIS has a healthy food web or trophic structure	2.87	3.12	0.009	**	2.98	3.09	0.243	
Reducing nutrient inputs has greatly improved ecological health in LIS	3.53	3.78	0.012	*	3.68	3.70	0.842	
Commercial fisheries will still be viable in 10 years	2.77	2.74	0.785		2.85	2.64	0.048	*
Over the past 25 years, use conflicts have been a problem	3.98	3.94	0.622		3.94	3.97	0.746	
Currently, use conflicts are a problem	3.88	3.87	0.936		3.89	3.85	0.610	
Over the next 25 years, use conflicts will be a problem	4.09	4.10	0.914		4.12	4.07	0.533	

Table 6. Management satisfaction and opinion on ecological health for scientists vs. non-scientists, and users vs. policy makers, where 1=very satisfied, 5=very dissatisfied. ANOVA was used to test for significance. The Sig. column represents level of significance where *=p<0.05, **=p<0.01, and ***=p<0.001.

	Scientists vs. Non-Scientists				**User vs. Policy (Pol)**			
	Sci	**Non-Sci**	**ANOVA p value**	**Sig**	**Policy**	**User**	**ANOVA p value**	**Sig**
In general, how satisfied are you with the management of LIS (1=very satisfied, 5=very dissatisfied)	2.94	3.07	0.280		3.06	2.98	0.480	
Over the past 10 years, the ecological health of LIS is (1=much worse, 5=much improved)	3.38	3.48	0.312		3.50	3.38	0.248	

Table 7. Mean ecosystem service values for scientists vs. non-scientists, and users vs. policy makers, where 1=strongly value, 5=do not value at all. ANOVA was used to test for significance. The Sig. column represents level of significance where *=p<0.05, **=p<0.01, and ***=p<0.001.

How do you personally (i.e., not professionally) value the following ecosystem services/categories in LIS? (1=strongly value, 5=do not value at all)	**Scientists vs. Non-Scientists**				**User vs. Policy (Pol)**			
	Sci	**Non-Sci**	**ANOVA Sig.**	**Sig.**	**Pol**	**User**	**ANOVA Sig.**	**Sig.**
Overall Recreation/Aesthetic Value	1.32	1.20	0.085		1.28	1.20	0.235	
Aesthetics	1.40	1.24	0.017	*	1.34	1.25	0.208	
Recreational fishing/shellfishing	1.90	1.79	0.340		1.92	1.73	0.079	
Active Recreation (boating, jet skiing)	2.12	1.88	0.042	*	2.13	1.78	0.003	**
Non-consumptive recreation	1.33	1.25	0.214		1.29	1.26	0.607	
Public resource/accessibility	1.42	1.31	0.126		1.35	1.34	0.878	
Tourism potential	2.18	2.01	0.127		2.18	2.95	0.041	*
Overall Provisioning Services Value	2.21	1.81	0.000	***	2.02	1.88	0.157	
Property values	2.89	2.50	0.001	**	2.86	2.39	0.000	***
Fisheries potential	1.96	1.81	0.158		1.89	1.84	0.610	
Repository for discards	3.31	3.43	0.452		3.38	3.39	0.973	
Infrastructure development potential	3.49	3.38	0.425		3.47	3.37	0.452	
Energy development: non-renewable	3.79	3.57	0.114		3.84	3.43	0.002	**
Energy development: renewable	2.29	2.24	0.718		2.36	2.14	0.064	
Commerce/commercial development	3.29	3.21	0.515		3.27	3.21	0.649	
Overall Ecosystem Protective Value	1.43	1.41	0.763		1.41	1.43	0.730	
Coastal protection potential	1.69	1.57	0.198		1.53	1.71	0.047	*
Environmental significance (i.e., biodiversity, trophic structure)	1.31	1.37	0.424		1.28	1.42	0.039	*
Overall Ecosystem Functional Value	1.32	1.41	0.211		1.29	1.48	0.005	**
Coastal stability (e.g., climate control)	1.55	1.42	0.100		1.40	1.55	0.041	*
Spatial ecology (e.g., wildlife habitat)	1.33	1.35	0.736		1.28	1.42	0.036	*
Overall Historic/Educational Value	1.81	1.65	0.087		1.74	1.68	0.506	
Historic significance	2.04	1.76	0.006	**	1.92	1.79	0.184	
Stewardship/community	1.82	1.67	0.094		1.71	1.74	0.706	
Research/education	1.40	1.56	0.055		1.46	1.55	0.258	

Table 8. Opinion on current and future LIS uses, where 5=negative, reduce or remove, 4=negative, but willing to tolerate, 3=neutral, 2=positive, but at current level, and 1=positive, would like to see more. ANOVA was used to test for significance. The Sig. column represents level of significance where *=p<0.05, **=p<0.01, and ***=p<0.001.

What is your opinion of the following current/existing uses of LIS? (1=positive, would like to see more; 5= negative, reduce or remove)	Scientists vs. Non-Scientists				User vs. Policy (Pol)			
	Sci	**Non-Sci**	**ANOVA p-value**	**Sig.**	**Policy**	**User**	**ANOVA p value**	**Sig.**
Recreational fishing	2.19	2.11	0.472		2.23	2.03	0.248	
Commercial fishing (no trawls)	2.85	2.86	0.974		2.76	2.97	0.060	
Commercial fishing using trawls	4.14	4.18	0.718		4.12	4.22	0.073	
Commercial shellfishing	2.71	2.54	0.218		2.46	2.76	0.388	
Shellfish aquaculture/leased bed	2.32	2.28	0.784		2.20	2.42	0.022	*
Shellfishing areas - public	2.01	2.06	0.691		1.86	2.24	0.107	
Dredge material disposal	3.92	3.78	0.324		3.81	3.85	0.001	**
Sewage effluent disposal after secondary or tertiary treatment	3.63	3.92	0.024	*	3.73	3.92	0.814	
Runoff disposal	4.18	4.23	0.654		4.23	4.19	0.133	
Ferries/water taxis	2.32	2.27	0.676		2.27	2.32	0.702	
Shipping lane	2.32	2.27	0.134		2.69	2.81	0.603	
Commerce/port	2.85	2.55	0.006	**	2.60	2.74	0.182	
Waterfront industries	2.73	2.29	0.000	***	2.45	2.46	0.947	
Transfer stations	3.26	3.08	0.136		3.09	3.21	0.310	
Cables, pipelines (gas, etc.)	3.26	3.08	0.732		3.56	3.48	0.475	
Power plants	3.74	3.89	0.211		3.82	3.85	0.832	
Coastline development for business	3.98	3.81	0.190		3.90	3.85	0.700	
Coastline development for housing	4.15	4.05	0.412		4.15	4.02	0.302	
Working waterfront	2.70	2.54	0.207		2.59	2.61	0.911	
Party boats (fishing)	2.66	2.53	0.248		2.68	2.44	0.031	*
Marinas (town)	2.66	2.53	0.010	*	2.47	2.27	0.067	
Marinas (private)	2.99	2.73	0.031	*	2.91	2.72	0.105	
Recreational boating	2.35	2.14	0.045	*	2.33	2.09	0.020	*
Military use	3.30	3.23	0.555		3.31	3.19	0.320	
Passive recreation	1.38	1.34	0.586		1.32	1.41	0.214	
Non-motorized sports	1.39	1.35	0.587		1.33	1.41	0.280	
Motorized sports/recreation	3.21	3.06	0.297		3.31	2.87	0.002	**
Passive recreation/access points	1.38	1.42	0.640		1.31	1.51	0.012	*
Marine parks/protected areas	1.38	1.42	0.144		1.34	1.52	0.057	
Natural areas (wetlands, etc.)	1.17	1.27	0.153		1.15	1.33	0.009	**
Coastal habitat restoration	1.27	1.30	0.640		1.22	1.37	0.057	
Bulkheads/hardened shorelines	1.27	1.30	0.000	***	4.18	3.44	0.000	***
Dredging bays/harbors	3.74	3.12	0.000	***	3.44	3.23	0.116	

	Sci	Non-Sci	ANOVA p-value	Sig.	Policy	User	ANOVA p value	Sig.
Scientific research	1.13	1.50	0.000	***	1.30	1.43	0.077	
Environmental edu/stewardship	1.15	1.38	0.002	**	1.23	1.36	0.067	
Algal aquaculture	2.16	2.34	0.156		2.20	2.36	0.213	
Fish aquaculture	2.67	2.63	0.754		2.68	2.60	0.572	
Wind energy generation	2.36	2.54	0.247		2.49	2.46	0.808	
Wave/tidal energy generation	2.28	2.31	0.821		2.28	2.32	0.796	
Energy - nuclear	4.01	4.16	0.276		4.17	4.03	0.338	
Energy - natural gas	3.85	3.84	0.942		3.88	3.81	0.586	
Energy - waste-to-energy	3.13	3.38	0.104		3.37	3.20	0.254	
Mining (sand, minerals, etc.)	4.28	4.30	0.823		4.27	4.27	0.697	
Liquid natural gas facilities	4.24	4.28	0.755		1.63	2.15	0.995	
Marine areas zoned for no-take	1.54	2.06	0.000	***	1.66	2.01	0.000	***
Marine areas zoned -limited use	1.56	1.97	0.001	**	2.49	2.80	0.004	**
Marine areas zoned - consumptive use	2.40	2.78	0.009	**	2.49	2.80	0.031	*
Marine areas zoned for industrial use	3.11	3.59	0.002	**	3.23	3.62	0.008	**
Filling of borrow pits	3.08	3.37	0.031	*	3.20	3.33	0.304	
New energy pipelines/cables	3.57	3.70	0.419		3.73	3.56	0.308	
New telecommunication cables	3.47	3.62	0.376		3.59	3.53	0.740	

Table 9. Opinion on what percentage of LIS is currently or should be allocated toward either habitat/conservation or commercial/industrial activity, looking at both the coastline and open water using the scale: 0-5%=1; 5-15%=2; 15-20%=3; 25-50%=4;>50%=5. The Sig. column represents level of significance where *=p<0.05, **=p<0.01, and ***=p<0.001.

How much of LIS is currently or should be allocated for (0-5%=1; 5-15%=2; 15-20%=3; 25-50%=4;>50%=5)	**Scientists vs. Non-Scientists**				**User vs. Policy (Pol)**			
	Sci	**Non-Sci**	**ANOVA p value.**	**Sig.**	**Policy**	**User**	**ANOVA p value.**	**Sig.**
Current ocean: Habitat/conservation	1.47	1.78	0.002	**	1.53	1.83	0.002	**
Should be ocean: Habitat/conservation	3.30	3.36	0.002	**	3.28	3.41	0.338	
Should be coasts: Habitat/conservation	3.43	3.42	0.975		3.44	3.40	0.793	
Current ocean: Commercial/industrial activity	3.10	2.91	0.187		2.91	3.07	0.262	
Should be ocean: Commercial/industrial activity	2.65	2.50	0.237		2.49	2.64	0.210	
Current coasts: Commercial/industrial activity	2.80	2.77	0.838		2.72	2.86	0.272	
Should be coasts: Commercial/industrial activity	2.35	2.34	0.913		2.30	2.40	0.373	

Table 10. a) Support for CMSP by groups' mean score (1=yes; 1.5=not sure; 2=no), and significance between groups using ANOVA, $p<0.01$. b) CMSP support and involvement using mean scores within each group and ANOVAs to test the significance between them. The Sig. column represents level of significance where *=$p<0.05$, **=$p<0.01$, and ***=$p<0.001$.

CMSP Support A: 1=yes; 1.5=not sure; 2=no B: 1=very likely; 5=very unlikely	**Scientists vs. Non-Scientists**				**Users vs. Policy**			
	Sci	**Non-Sci**	**ANOVA Sig.**	**Sig**	**Policy**	**User**	**ANOVA Sig.**	**Sig**
A. (1=yes; 1.5=not sure; 2=no) Should CMSP be implemented for LIS?	1.12	1.19	0.056		1.14	1.19	0.195	
B. (1=very likely; 5=very unlikely)								
How likely are you to support CMSP for LIS?	1.58	1.89	0.018	*	1.70	1.87	0.183	
Support a NY and CT bi-state management effort (with implementation authority) for LIS?	1.64	1.86	0.085		1.73	1.83	0.414	
Support a comprehensive planning process for LIS?	1.52	1.60	0.484		1.51	1.64	0.228	
Be involved in a comprehensive planning process for LIS?	2.31	2.28	0.868		2.20	2.41	0.126	

Chapter 7. *Ecosystem Services*

Defining Factors Driving how Stakeholders Value Ecosystem Services in Long Island Sound Using Principal Component Analysis.

7.1 Abstract

The maintenance and conservation of ecosystem services is at the core of ecosystem based management (EBM) and coastal and marine spatial planning (CMSP). Previous research has shown that it is critical to understand how people view various ecosystem services to assure the best planning strategies. In this chapter, patterns among stakeholder valuations of the different ecosystem services in Long Island Sound (LIS) are explored. Long Island Sound is a critical regional resource with multijurisdictional issues and conflicting ecosystem services, and is surrounded by some of the highest population densities in the country (as discussed in Chapters 3 and 5). Ecosystem-based CMSP would be a timely initiative. As coastal populations in the LIS region continue to grow, so do their reliance on the marine environment. This can result in amplified conflicts among uses of different ecosystem services. Given future development needs, many ecosystem services will continue to be at odds in LIS (e.g., energy use and aesthetics). Using a survey targeting the various stakeholder groups in LIS, relative ecosystem service values were measured (as described in Chapter 2). In this chapter, principal component analysis (PCA) was employed to explore possible motivations behind how ecosystem services were valued in the survey. PCA revealed four major factors – ecology, industry, community, and education – together explaining 57% of variation in survey results. Biodiversity and ecosystem functional value are shown as the most important of all the ecosystem services. Conversely, renewable energy and property values contributed the least to the overall variance.

7.2 Introduction

Ecosystem-based management (EBM) is the current paradigm for environmental management in marine environments. It defines marine ecosystems based on the needs of people

and the services that it provides (Arkema et al. 2006). Guided by science, it views the ecosystem's structure, functioning, and key processes as services on which society relies (Christensen 1996; Grumbine 1994; Arkema et al. 2006). Coastal and marine spatial planning (CMSP) is recognized in both scientific and management communities worldwide as a key EBM tool in the long-term conservation and sustainability of marine resources, and is currently being assessed for regional implementation in the United States (US Commission on Ocean Policy 2004, Arkema et al. 2006, Foley et al. 2010a; McLeod et al. 2005; Trouillet et al. 2011). Based on the concepts of EBM, CMSP helps plan for and manage human activities and needs as part of the ecosystem including conservation of biological/ecological integrity, and economic and social welfare (Douvere & Ehler 2001, Villa et al. 2002).

Uses of the marine environment are often defined by economic factors, as it is difficult to attach a monetary value to how people value the social or historical component of working waterfronts or the ecological value of biodiversity. An economic analysis of extractive uses (e.g., fishing and dredging), passive uses (e.g., bird watching and beach going), management benefits and costs, and social value assessments are important when considering a CMSP plan (Ami et al. 2005; Carter 2003). Economic factors to be analyzed should include fisheries, tourism, recreational boating, commercial development, property values, and aesthetic values. However, a comprehensive assessment of marine services should include more than just commercial profits or a gross domestic product (GDP) calculation.

Coastal and marine spatial planning is based on the sustainability of ecosystem services (Foley et al. 2010b). Ecosystem services are all of the benefits we gain from the environment. They are the glue holding coupled human-natural systems together. The concept of ecosystem services was championed by the United Nation's Millennium Ecosystem Assessment (MEA): Ecosystem and Human Well Being, A Framework for Assessment (2005). The MEA framework provides a better understanding of the value, therefore importance, of diverse ecosystem functions that do not necessarily translate well into dollars, such as nutrient recycling. The framework provides both direct and indirect links between the ecosystem and human health and well-being, correlating conservation and environmental status with human wants and needs (Chapter 3, Table 2). Ecosystem services look at ecological systems and processes through a lens of how they affect human uses/expectations of the terrestrial and marine environments (MEA 2005), and are a key part of EBM and CMSP efforts. Specifically, ecosystem services

can help better assess the tradeoffs of various management decisions in the marine environment as required by ecosystem-based CMSP (Foley et al. 2010a). Use tradeoffs should be based on all factors affecting the marine environment – ecological, social, and economical. Ecosystem service assessments need to be based on more than just monetary values, and include historical, environmental, cultural, and educational standpoints.

Long Island Sound (LIS) is a highly urbanized estuary in the Tri-State Metropolitan area that plays a critical role in both the ecology and quality of life for the surrounding region (US EPA 2009). Many ecosystem services are extremely important in LIS including fisheries, nutrient recycling, effluent disposal, boating, and aesthetics. Yet today, this estuary faces unprecedented threats from intense coastal development and exploitation of local marine resources such as growing recreational stresses and competition to exploit its future energy potential (O'Connell 2006, Swanson & Conover 2006, Swanson 2011, TNC 2012). To date, there has been little comprehensive or collaborative planning to effectively coordinate and manage these varied uses and services (O'Connell 2006, Swanson & Conover 2006). For example, with increasing fuel costs and a developing focus on carbon dioxide emissions, car and truck transportation becomes less desirable, leading to increased ferry traffic and marine transportation (Swanson & Conover 2006). Implementing a CMSP for LIS might help address these and other issues associated with the growth of the marine transportation industry, such as dredging, dredge spoil disposal, and location of industrial transfer stations and ports.

The viability of a CMSP initiative in LIS relies on coupling conservation policies with local community needs, ecosystem service values, and regional economic development (Wolfe et al. 1991, Schubel 1997, Oracion 2005, O'Connell 2006). Stakeholder participation is crucial throughout the CMSP process – from creation to implementation (Christie 2005, Douvere et al. 2007, Ehler & Douvere 2009, 2012, Trouillet et al. 2011). CMSP would help bring together all of the relevant parties invested in or affected by the health and long-term sustainability of LIS (O'Connell 2006, Ehler & Douvere 2009). Specifically, when creating CMSP initiatives, addressing the different needs of each stakeholder group early-on in the planning process can help identify points of contention and alternatives (Salz 2004, Ehler & Douvere 2009). Defining how people value the different ecosystem services in LIS is essential to moving ahead with CMSP and justifying selected management strategies, goals, and objectives.

Evaluating ecosystem services can be even more challenging when dealing with an urbanized estuary like LIS, in that conflicting uses already exist and many marine resources have been damaged or over-exploited. In order to create an overall vision to guide CMSP efforts, both points of contention and corroboration on LIS ecosystem service values need to be considered.

7.3 Methods

a. Survey Development

A targeted user survey was developed and circulated to stakeholders in LIS to measure perceived ecosystem service values. Groups were targeted for participation based on their involvement with LIS and included commercial and recreational fishermen, educators, scientists, managers, government officials, NGOs, boaters, passive recreationalists (kayakers, bird-watchers, etc.), property owners, community members, and water-dependent businesses. Five different ecosystem service categories were used in this analysis (Figure 1), with 20 specific services (Figure 1). Survey participants were asked to respond to a question on how they valued individual ecosystem services and overall ecosystem service categories using a five-point Likert scale (Figure 1). The question was organized in a double-column format for efficiency, as displayed in Figure 1 (Patten 2001). Overall ecosystem service categories were included to provide additional information on responses (Patten 2001). The categories for the five-point scale are (from left to right): Do not value at all; Personally don't value, see societal value; Neutral: don't feel strongly either way; Some-what value; Strongly value. Participants were asked to mark the most appropriate circle. Detailed survey methodology is described in Chapter 2 (Figure 1).

b. Multivariate Analysis using PCA on Ecosystem Services

A correlation matrix for the 25 ecosystem services was created to look at whether there was consistency in relative valuation of ecosystem services (Figure 2). Multivariate factor analysis, specifically principal component analysis (PCA), was applied to further highlight patterns in the correlation matrix (Figure 2) and reduce the multi-dimensionality of the data. The computer program SPSS, Version 18, was used in much of the analysis. PCA can help identify both the mechanisms accounting for correlations in the data and factors that differentiate groups

based on ecosystem-value associations. Factor analysis was deemed appropriate in this case because the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy value is 0.896, which is considered very good (above 0.6), and the Bartlett's Test of Sphericity is significant (p=0.0), indicating that the variables are correlated enough to run PCA (Table 1) (Kaiser 1963, 1970, Pallant 2010).

Oblimin rotation (oblique rotation) was used over Varimax (orthogonal rotation) to account for possible correlations among the factors themselves. Orthogonal rotations don't allow for correlations between factor components, whereas oblique rotations assume that the variables constituting factors correlate across factors, not just within. Oblique rotation is appropriate for this data because it is likely that the individual questions making up different factors could be related to one another. The Component Correlation Matrix in Table 2 further supports the decision for Oblimin rotation as components 4 and 1 show correlations of greater than 0.3 (0.360) (Pallant 2010).

Principal component analysis revealed five factors with eigenvalues greater than 1.0, explaining a total of 61.7% of the variance – 31.2, 12.8, 7.9, 5.3, and 4.4%, respectively (Table 3). These components capture much of the variance based on the "elbow" in the scree plot at component number 4 (Figure 3). The scree plot suggests that 4 may be a cleaner solution, and the four factors hang together very nicely with little overlap among them.

Parallel analysis, used to further refine significant components, supports the decision to retain only the first 4 eigenvalues (Table 4) (Pallant 2010). The program MonteCarlo PCA for parallel analysis was used to calculate the average eigenvalues for 100 sets of randomly generated data, using the same sample size and number of variables as the original PCA. The randomly generated eigenvalues for the first 4 factors are less than from the original PCA, so they are retained (Table 4). However, for the 5th factor, the randomly generated eigenvalue from parallel analysis is greater than the PCA original, so it was rejected (Pallant 2010). PCA was then redone forcing a 4-factor solution. The four remaining components still account for the majority of the variance (57.26%) (Table 3).

7.4 Results

Responses to how participants valued the various ecosystem services are listed in Table 5. In general, the Overall Recreational/Aesthetic Value category scored very high, strongly

valued by 81.3% of respondents. There was only one participant that didn't value this category at all. Overall Ecosystem Functional Value scored the next highest, with 71.5% in the "Strongly value" category. Overall Ecosystem Protective Value scored the next highest at 67%. Although Overall Historic/Educational Value was not valued as highly, it still had half of the respondents, 50.1%, in the "Strongly value," category. Overall Provisioning Services had the lowest percentage in the "Strongly value," category at 39.5%. However, even though there were more mixed viewpoints, the majority of responses still registered in the "Strongly value" category.

The rotated PCA solution had a very clean structure, with at least six different ecosystem services strongly correlated with each of the four factors. In addition, all of the ecosystem services loaded significantly (above 0.3) on one factor or another in the Pattern Matrix, which shows each ecosystem service's factor loadings (Table 6) (Pallant 2010). The Structure Matrix (Table 6) shows the direct correlation between ecosystem services and factors.

The Communalities row shows how much of the variance within each ecosystem service is explained by the four-factor solution. Again, since all values are higher than 0.3, they are all considered significant (Pallant 2010). For the major loadings, Property Value and Overall Provisioning Services have the lowest communalities value, contributing only around 30-40% to the overall variance in factor 3. Renewable energy also has a low communality value, contributing to around 30% of the variance in both factors 2 and 4. Environmental significance (biodiversity), Overall ecosystem functional value, Coastal stability, Overall historic/educational value, Stewardship, and Spatial ecology have the highest communalities (respectively), all above 70%, and therefore explaining the most variance in their associated factors.

It was assumed that participant's values of different ecosystem services were probably somewhat related, and therefore Oblimin rotation was used instead of Varimax. However, there were four clear patterns of response among survey participants, answering questions based on an ecological, business, community or educational standpoint. These four tendencies are relatively independent of one another, with not much overlap in ecosystem services.

Factor 1 was labeled Ecological Significance due to the high loading by the following factors: Overall ecosystem functional value, Environmental significance (biodiversity), Coastal stability, Spatial ecology, Overall ecosystem protective value, and Coastal protection (Table 7). The variance explained by this factor was roughly 31% (Table 7). Factor 2, responsible for 13% of the variance, was labeled Industrial development, as it had high loadings from Infrastructure,

Energy non-renewable, Commercial development/commerce, and Repository for discards (Table 7). Factor 3 had high loadings from Community, Overall recreation/aesthetic value, Public resource/access, Aesthetics, Non-consumptive recreation, Recreational fishing/ shellfishing, and Active recreation, and was therefore labeled Community, and responsible for 8% of the variance (Table 7). Finally, Factor 4 was deemed Education, as its high loadings were dominated by Historic, Overall historic/educational value, Stewardship, and Research/education. Factor 4 only contributed to 5% of the variance (Table 7).

Factor 1, Ecological significance, is slightly negatively correlated with Factor 3, Community, and Factor 4, Educators (Table 2). Factor 2, Industry, is barely negatively correlated ($r = -0.14$) with Factors 3 and 4, Community and Educators. In addition, Industry is correlated with Factor 1, Ecological significance, even less so ($r = -0.062$). Factors 3 and 4 are slightly positively correlated with each other ($r = 0.319$) (Table 2).

7.5 Discussion

Principal component analysis helped to separate underlying factors in what influences peoples' values of the 25 different ecosystem services. This analysis shows that participants made decisions based on ecological, industrial/commercial, community, and educational factors. These four factors can be used to identify, separate, or categorize groups of people based on their responses, which will be very useful in assessing trade-offs among the services in LIS. For example, Factor 1, Ecological significance, contributes the most to the overall variance. Participant answers to the various ecosystem service values loading in this factor will influence how they value the rest of the ecosystem services.

In each overall ecosystem service category, the majority of survey respondents were in the "Strongly valued" column, demonstrating the importance of each of these categories to the LIS region. This even held true for Provisioning Services, which may be the most controversial category because nearly all the extractive and many active ecosystem services are found here (e.g., energy development, fisheries potential, and repository for discards). Overall Ecosystem Functional Value scored the highest among participants. This may be due to the fact that many of the other services rely on the ecosystem properly functioning. For example, if LIS's terrestrial buffers and wetlands were negatively impacted, there would be loss of spawning and nursery grounds for many fish species, which would in turn have negative effects on fisheries.

In addition, it is interesting that the Overall Provisioning Services category contributed the least to the overall variance. Perhaps people value the various provisioning services differently. For example "property value," "fisheries potential," and "repository for discards" all scored dissimilarly, having a very diverse distribution on the value scale (Table 5). As the majority of responses were in the "Strongly value," category for "fisheries," it is the provisioning service that is most favorable. However, the majority of responses for "repository for discards" skewed to the left of the scale (i.e., not valued), while "property value" falls somewhere in the middle, but closer to the right (i.e., somewhat valued).

In the other ecosystem service categories, responses tended to group together more, except for Overall Recreation/Aesthetic Value. Although there were differences in the distribution of answers for each ecosystem service, the majority of respondents were still in the "Strongly Value" category. The services that ranked the lowest in this category were recreation "fishing/shellfishing" and "active recreation" (e.g. jet skiing). These are two services that often disrupt the functioning of other ecosystem services. For example, jet skis can damage wetlands, interfering with its nutrient recycling capacities. In addition, jet skis often disturb more passive activities such as swimming or relaxing on the beach. Many forms of active recreation often go hand-in-hand with shoreline development. For example, ports and piers need to be built for boating. This coastal development can directly impact the Protective and Functional value categories. Furthermore, with loss of important wetland habitat, there will be indirect effects on other Provisioning services such as fisheries, as discussed earlier.

There are many ecosystem services that the general public strongly relies on. However, they do not necessarily know it. Many services are not in the public eye, unless something interferes with their functioning. For example, what would happen if LIS could no longer be used as a repository for effluent from sewage treatment plants (STP)? Some 595 million gallons of effluent per day goes into the western portion of LIS alone (Kaiser 1970). What else could be done with the 595 million gallons of effluent that is continually replenished? Where would it go? This would cause a logistical catastrophe for local, state and federal government, having long reaching political, social, and economic effects.

Principal component analysis is often used as a data reduction technique. By grouping correlated variables into smaller components, PCA takes a larger number of variables, and reduces them to something more manageable (Pallant 2010). In this survey, the Ecosystem

Service Valuation, with its 25 variables, was just one question on a 30-question survey, which took 20-30 minutes on average to complete. Because shorter surveys are preferred, using factor analysis to reduce the number of variables (i.e., ecosystem services) that respondents have to answer, would make the survey more palatable (Patten 2001).

There were only a few overlaps of variables in the different factors. These overlaps can help distinguish the variables that have significant cross-sectorial importance. For example, ecosystem services falling significantly within multiple factors demonstrate where the communalities exist, not just the differences. This can be an important starting point in use negotiations in an EBM or CMSP process, and for understanding the values of different services. For example, renewable energy had a significant positive value in both the Industry factor and the Community factor. Therefore, both Community and Industry see a benefit in renewable energy. However, it only has a small effect on these factors, contributing to around 36.0% of the factor loadings. The other ecosystem services in the grey zone were Tourism and Fisheries potential. Tourism has a 45.7% loading in Community as well as 35.0% loading in Education. This may be related to the historical and aesthetic variables influencing these factors. Fisheries potential had a loading of above 30.0% (considered significant) in three of the factors: Ecology, Industry, and Community. Again, this demonstrates the importance of fisheries across sectors. Using my proposed survey method for valuing ecosystem services, and then conducting a PCA, could be a useful and replicable tool for other areas trying to effectively implement EBM and assess tradeoffs among ecosystem services.

7.6 Conclusion

There are four clear factors that emerge in this analysis: Ecology, Industry, Community, and Education. They highlight patterns and correlations in the data by differentiating the responses. Each of the 4 factors plays a significant role in how people evaluate ecosystem services in LIS. These results would be especially useful in refining the ecosystem service value scale. Specifically, results suggest that a smaller sub-scale could be created for ecosystem service valuations that would reflect the larger number of services. This would aide in designing future surveys for EBM and CMSP initiatives elsewhere, and could be replicated for other estuaries or locations.

Chapter 7 Figures:

Figure 1. Question and response options in the survey for how participants valued individual ecosystem services in LIS.

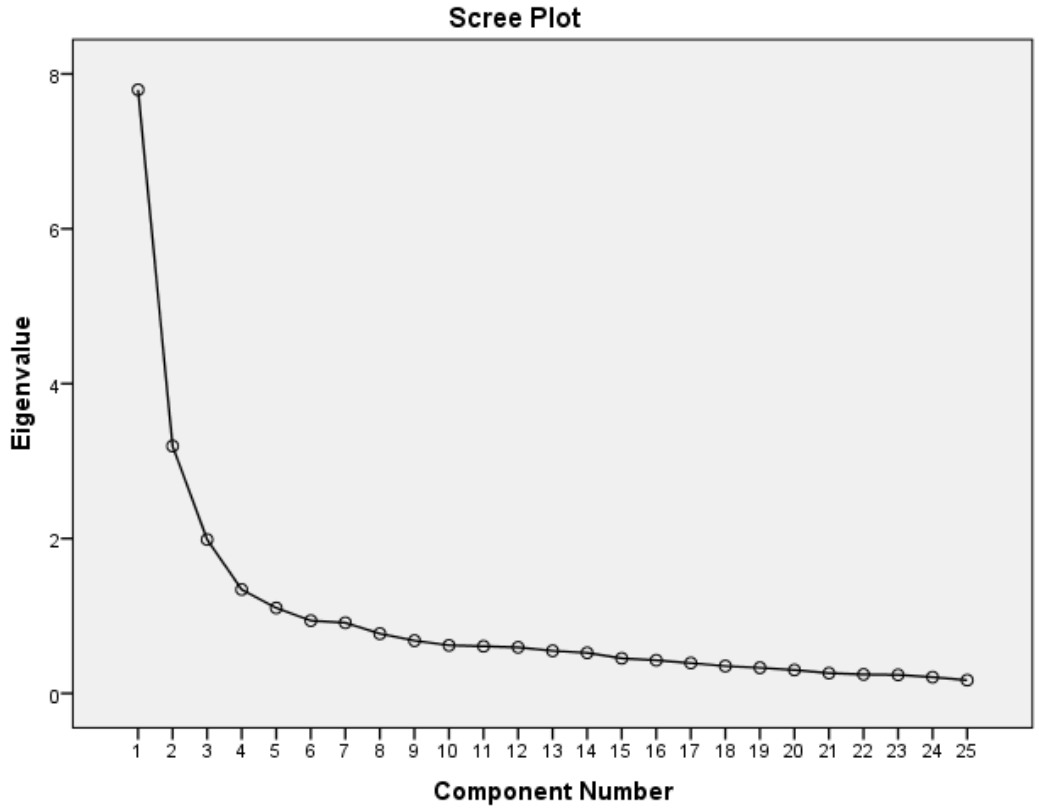
Survey Question: How do you personally (i.e., not professionally) value the following services/uses (a-v) in the following categories (I-VI) in LIS? For more info on marine ecosystem services visit: http://www.eoearth.org/article/Marine_ecosystem_services

	Do not value at all	Personally don't value, but see societal value	Neutral (don't feel strongly either way)	Somewhat value	Strongly value
I. Overall Recreation/Aesthetic Value	○	○	○	○	○
a) Aesthetics (scenic views, etc.)	○	○	○	○	○
b) Recreational fishing/shellfishing	○	○	○	○	○
c) Active Recreation (boating, jet skiing, etc.)	○	○	○	○	○
d) Non-consumptive recreation (bird watching, beach going, diving, swimming, kayaking, surfing, etc.)	○	○	○	○	○
e) Public resource/accessibility	○	○	○	○	○
f) Tourism potential	○	○	○	○	○
II. Overall Provisioning Services Value (i.e., how we value what LIS provides us with, or what we take from or develop in LIS)	○	○	○	○	○
g) Property values	○	○	○	○	○
h) Fisheries potential	○	○	○	○	○
i) Repository for discards (i.e. dredge material disposal, stormwater runoff, sewage effluent disposal)	○	○	○	○	○
j) Infrastructure development potential (cables, pipelines, etc.)	○	○	○	○	○
l) Energy development (non-renewable)	○	○	○	○	○
m) Energy development (renewable/green)	○	○	○	○	○
n) Commerce or commercial development potential	○	○	○	○	○
III. Overall Ecosystem Protective Value (regulating services)	○	○	○	○	○
o) Coastal protection potential (i.e., buffer wave energy, storm/flood protection)	○	○	○	○	○
p) Environmental significance (i.e., biodiversity, trophic structure)	○	○	○	○	○
IV. Overall Ecosystem Functional Value (supporting services)	○	○	○	○	○
q) Coastal stability (e.g., climate control, nutrient buffer, etc.)	○	○	○	○	○
s) Spatial ecology (e.g., wildlife habitat, restoration/natural areas)	○	○	○	○	○
V. Overall Historic/Educational Value	○	○	○	○	○
t) Historic significance (e.g., working waterfronts, traditional activities, etc.)	○	○	○	○	○
u) Stewardship/community	○	○	○	○	○
v) Research/education	○	○	○	○	○
w) Other (please specify below)	○	○	○	○	○

Figure 2. Ecosystem services correlation matrix. Scale: red-orange cells are the highest values and strongly positively correlated; green are smallest values and negatively correlated. Ecosystem services are listed in order (as per Figure 1) from left to right along the top axis, and from top to bottom along the left axis.

	Overall rec/ aesthetic	Aesthetics	Recreational fish/shellfish	Active rec.	Nonconsump-tive recreation	Public access or resource	Tourism	Overall provisioning	Property value	Fisheries	Repository for Discards	Infrastructure	Nonrenew-able Energy	Renewable Energy	Comm. Devt/ Commerce	Overall protective	Coastal protection	Environmental signifigance	Overall functional	Coastal stablty	Spatial ecology	Overall historic/edu	Historic	Stewardship	Research/ ed
Overall rec/aesthetic	1.00	.64	.32	.35	.60	.51	.27	.31	.16	.17	.05	-.01	-.08	.06	-.11	.40	.22	.36	.33	.35	.35	.36	.26	.27	.32
Aesthetics	.64	1.00	.30	.22	.47	.43	.28	.29	.22	.18	.00	-.01	-.10	.08	-.04	.37	.17	.37	.32	.34	.39	.42	.33	.37	.34
Recreational fish/shellfish	.32	.30	1.00	.36	.30	.32	.31	.30	.22	.55	.12	.15	.16	.06	.16	.21	.08	.18	.18	.21	.17	.25	.25	.19	.24
Active rec.	.35	.22	.36	1.00	.24	.27	.32	.22	.34	.19	.12	.16	.17	.00	.24	.06	.04	.01	.04	.06	.05	.20	.22	.12	.19
Nonconsump-tive recreation	.60	.47	.30	.24	1.00	.57	.30	.35	.12	.20	-.03	-.12	-.12	.13	-.07	.35	.29	.47	.39	.46	.44	.37	.25	.38	.41
Public access/ resource	.51	.43	.32	.27	.57	1.00	.42	.31	.14	.23	.05	-.01	-.02	.11	.05	.31	.16	.26	.27	.35	.30	.34	.31	.35	.34
Tourism	.27	.28	.31	.32	.30	.42	1.00	.33	.32	.32	.14	.12	.08	.26	.22	.20	.15	.14	.14	.24	.14	.36	.30	.28	.28
Overall provisioning	.31	.29	.30	.22	.35	.31	.33	1.00	.31	.36	.15	.09	.07	.19	.15	.38	.28	.35	.37	.38	.30	.33	.33	.39	.28
Property value	.16	.22	.22	.34	.12	.14	.32	.31	1.00	.18	.18	.19	.20	.06	.21	.03	.10	-.02	.02	.07	.03	.15	.19	.17	.16
Fisheries	.17	.18	.55	.19	.20	.23	.32	.36	.18	1.00	.17	.19	.12	.14	.24	.26	.22	.33	.29	.34	.26	.22	.30	.22	.21
Repository for Discards	.05	.00	.12	.12	-.03	.05	.14	.15	.18	.17	1.00	.50	.42	.22	.36	.00	.03	-.09	.00	-.01	-.09	-.01	.13	.02	.02
Infrastructure	-.01	-.01	.15	.16	-.12	-.01	.12	.09	.19	.19	.50	1.00	.58	.19	.45	-.08	-.05	-.09	-.06	-.07	-.11	-.03	.04	-.07	-.04
Nonrenew able Energy	-.08	-.10	.16	.17	-.12	-.02	.08	.07	.20	.12	.42	.58	1.00	.20	.46	-.06	-.05	-.13	-.06	-.11	-.15	-.03	.06	-.07	-.07
Renew able Energy	.06	.08	.06	.00	.13	.11	.26	.19	.06	.14	.22	.19	.20	1.00	.27	.21	.21	.19	.16	.22	.21	.25	.22	.19	.25
Comm. Devt/ Commerce	-.11	-.04	.16	.24	-.07	.05	.22	.15	.21	.24	.36	.45	.46	.27	1.00	-.03	.07	-.07	-.08	.01	-.06	.09	.20	-.01	.03
Overall protective	.40	.37	.21	.06	.35	.31	.20	.38	.03	.26	.00	-.08	-.06	.21	-.03	1.00	.52	.60	.65	.57	.56	.42	.32	.44	.40
Coastal protection	.22	.17	.08	.04	.29	.16	.15	.28	.10	.22	.03	-.05	-.05	.21	.07	.52	1.00	.53	.58	.66	.47	.39	.29	.40	.40
Environmental signifigance	.36	.37	.18	.01	.47	.26	.14	.35	-.02	.33	-.09	-.09	-.13	.19	-.07	.60	.53	1.00	.79	.72	.75	.48	.32	.48	.51
Overall functional	.33	.32	.18	.04	.39	.27	.14	.37	.02	.29	.00	-.06	-.06	.16	-.08	.65	.58	.79	1.00	.72	.70	.45	.31	.49	.46
Coastal stablty	.35	.34	.21	.06	.46	.35	.24	.38	.07	.34	-.01	-.07	-.11	.22	.01	.57	.66	.72	.72	1.00	.70	.56	.39	.55	.54
Spatial ecolgy	.35	.39	.17	.05	.44	.30	.14	.30	.03	.26	-.09	-.11	-.15	.21	-.06	.56	.47	.75	.70	.70	1.00	.52	.38	.50	.53
Overall historic/edu	.36	.42	.25	.20	.37	.34	.36	.33	.15	.22	-.01	-.03	-.03	.25	.09	.42	.39	.48	.45	.56	.52	1.00	.68	.64	.64
Historic	.26	.33	.25	.22	.25	.31	.30	.33	.19	.30	.13	.04	.06	.22	.20	.32	.29	.32	.31	.39	.38	.68	1.00	.59	.51
Stew ardship	.27	.37	.19	.12	.38	.35	.28	.39	.17	.22	.02	-.07	-.07	.19	-.01	.44	.40	.48	.49	.55	.50	.64	.59	1.00	.67
Research/edu	.32	.34	.24	.19	.41	.34	.28	.28	.16	.21	.02	-.04	-.07	.25	.03	.40	.40	.51	.46	.54	.53	.64	.51	.67	1.00

Figure 3. Scree plot of eigenvalue versus component/factor number. Eigenvalues are listed along the y-axis, and the components/factors are listed on the x-axis. The "elbow" in the scree plot can be seen around components four and five, as the slope of the line sharply changes. From the fifth factor on, each successive factor accounts for less and less of the total variance.



Chapter 7 Tables:

Table 1. Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity are listed below. Together these test for the appropriateness of PCA on the data set. KMO is a value from 0-1, where values closer to 1 are better. Variables are correlated enough to run PCA is KMO is > 0.600 and Bartlett's is significant.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.896
Bartlett's Test of Sphericity	Approx. Chi-Square	4172.90
	df	300.00
	Sig.	<0.001

Table 2. PCA component correlation matrix with Oblimin rotation with Kaiser normalization for each of the four factors. This matrix shows the correlations between each of the factors. Positive values are positively correlated with each other, and negative values, negatively correlated. Factors 4 and 1 show correlations of >0.3, indicating there is some correlation among variables and Oblimin rotation versus Varimax should be used in PCA.

Factors	**1**	**2**	**3**	**4**
1	1.000	-.062	-.260	-.360
2	-.062	1.000	-.143	-.147
3	-.260	-.143	1.000	.319
4	-.360	-.147	.319	1.000

Table 3. Total variance explained using the extraction method of PCA. The first column represents individual components/factors. The factors are listed from top to bottom in order of their contribution to the variance (i.e., factors that contribute the most variance are listed first). The next panel, Initial Eigenvalues, shows the eigenvalue for each factor ("Total") and the percent of variance explained by each, as well as the overall cumulative variance. The "Extraction Sums of Squared Loadings," only shows these values for eigenvalues that were greater than one. Values in the "Rotation Sums of Squares Loadings" panel represent the distribution of variance after Oblimin rotation.

Component	**Initial Eigenvalues**			**Extraction Sums of Squared Loadings**			Rotation Sums of Squares Loadings
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total
1	7.795	31.181	31.181	7.795	31.181	31.181	5.428
2	3.194	12.776	43.957	3.194	12.776	43.957	2.868
3	1.986	7.943	51.900	1.986	7.943	51.900	4.697
4	1.340	5.362	57.262	1.340	5.362	57.262	5.135
5	1.104	4.416	61.678	1.104	4.416	61.678	2.822
6	.939	3.757	65.435				
7	.912	3.648	69.083				
8	.771	3.086	72.169				
9	.681	2.723	74.892				
10	.620	2.481	77.373				
11	.608	2.433	79.806				
12	.595	2.379	82.186				
13	.549	2.197	84.383				
14	.524	2.096	86.479				
15	.452	1.810	88.288				
16	.427	1.710	89.998				
17	.392	1.566	91.564				
18	.352	1.409	92.973				
19	.331	1.322	94.295				
20	.302	1.206	95.502				
21	.260	1.041	96.543				
22	.245	.980	97.523				
23	.239	.957	98.480				
24	.210	.838	99.318				
25	.171	.682	100.000				

Table 4. Comparison of eigenvalues from PCA and criterion values from parallel analysis using the program Monte Carlo PCA that generates eigenvalues for a random set of data ("Criterion value from parallel analysis.") If the Actual eigenvalue is larger than the Criterion value, it should be retained for PCA (i.e., "Decision").

Component	Actual eigenvalue from PCA	Criterion value from parallel analysis	Decision
1	7.795	1.491	**accept**
2	3.194	1.409	**accept**
3	1.986	1.351	**accept**
4	1.340	1.301	**accept**
5	1.104	1.260	reject

Table 5. Survey responses to how participants valued individual ecosystem services (listed in the left column) and overall categories displayed as the percentage (% of Total N – upper value) and actual number of participants (n –lower value) who recorded that response.

	Do not value at all	Personally don't value, see societal value	Neutral: don't feel strongly either way	Somewhat value	Strongly value	*Total N*
Overall Recreation/Aesthetic Value	0.3 1	1.4 5	3.7 13	11.5 41	83.1 296	*356*
Aesthetics (scenic views)	0.3 1	1.4 5	3.3 12	17.8 64	77.2 277	*359*
Recreational fishing/shellfishing	0.8 3	10.0 36	11.7 42	26.5 95	51.0 183	*359*
Active Recreation (boating, jet skiing)	2.0 7	11.7 42	12.0 43	29.6 106	44.7 160	*358*
Non-consumptive recreation (beach going)	0.0 0	1.4 5	3.6 13	16.2 58	78.8 282	*358*
Public resource and accessibility	0.0 0	2.0 7	4.7 17	19.6 70	73.7 264	*358*
Tourism potential	1.4 5	9.7 35	20.0 72	32.5 117	36.4 131	*360*
Overall Provisioning Services Value	0.0 0	4.6 16	25.9 90	30.0 104	39.5 137	*347*
Property values	4.4 16	17.2 62	33.6 121	27.8 100	16.9 61	*360*
Fisheries potential	1.1 4	6.7 24	15.6 56	30.7 110	45.8 164	*358*
Repository for discards	29.4 105	23.0 82	17.9 64	16.0 57	13.7 49	*357*
Infrastructure development potential	19.9 71	32.5 116	24.9 89	15.4 55	7.3 26	*357*
Energy development (non-renewable)	35.0 125	24.4 87	18.2 65	15.7 56	6.7 24	*357*
Energy development (renewable/green)	4.5 16	10.6 38	20.4 73	35.5 127	29.1 104	*358*
Commerce or development potential	14.4 51	30.8 109	25.7 91	22.6 80	6.5 23	*354*
Overall Ecosystem Protective Value	0.0 0	1.1 4	6.6 23	25.4 89	67.0 235	*351*
Coastal protection potential	0.6 2	3.9 14	10.9 39	25.4 91	59.2 212	*358*
Environmental significance (biodiversity)	0.0 0	1.1 4	6.1 22	19.0 68	73.7 264	*358*
Overall Ecosystem Functional Value	0.0 0	0.8 3	7.3 26	20.3 72	71.5 253	*354*
Coastal stability (climate control)	0.0 0	1.4 5	8.1 29	26.4 94	64.0 228	*356*
Spatial ecology (wildlife habitat)	0.0 0	0.6 2	6.5 23	19.9 71	73.0 260	*356*
Overall Historic/ Educational Value	0.6 2	4.2 15	11.0 39	34.1 121	50.1 178	*355*
Historic significance	0.3 1	5.9 21	16.3 58	34.8 124	42.7 152	*356*
Stewardship/ community	0.8 3	2.5 9	13.4 48	34.7 124	48.5 173	*357*
Research/education	0.3 1	1.4 5	8.2 29	28.5 101	61.7 219	*355*

Table 6. Pattern and Structure coefficients showing factor loadings for each ecosystem service. Factors are labeled across the top rows, and ecosystem services down the left side. Major loadings for each ecosystem service are bolded (>0.3). The Structure Matrix shows the direct correlation between ecosystem services and factors. The Communalities row shows how much of the variance within each ecosystem service is explained by the four-factor solution (value > 0.3 are considered significant). Services that contribute the most to the variance of a particular factor are bolded and have a structure coefficient of above 0.6 (i.e., have > 60% correlation between the ecosystem service and the factor), however, anything >0.3 is considered significant. The Pattern Matrix shows the linear combination of variables loading on each factor.

Ecosystem Service	Pattern Matrix[a] Factor/Component				Structure Matrix Factor/Component				Comm-unalities
	1	2	3	4	1	2	3	4	
Overall ecosystem functional value	**.872**	.018	-.024	-.023	**.885**	-.029	-.260	-.347	.785
Environmental significance/ biodiversity	**.849**	-.062	-.058	-.048	**.885**	-.099	-.285	-.363	.792
Coastal stability	**.750**	-.008	-.058	-.209	**.841**	-.016	-.319	-.496	.753
Spatial ecology	**.721**	-.110	-.057	-.188	**.811**	-.119	-.289	-.450	.700
Overall ecosystem protective value	**.717**	.008	-.133	-.028	**.761**	-.013	-.330	-.330	.599
Coastal protection	**.686**	.092	.119	-.167	**.709**	.057	-.126	-.389	.541
Infrastructure	.009	***.792***	-.016	.128	-.082	**.775**	-.091	.004	.615
Energy non-renewable	-.036	***.775***	.042	.066	-.119	**.761**	-.039	-.021	.591
Commercial development commerce	-.092	***.708***	.048	-.180	-.083	**.733**	-.087	-.236	.565
Repository for discards	.017	***.681***	-.022	.025	-.029	**.680**	-.116	-.088	.463
Fisheries potential	**.368**	**.400**	**-.326**	.127	**.383**	**.405**	**-.439**	-.168	.424
Energy renewable	.189	**.367**	.177	**-.342**	.243	**.380**	-.034	**-.408**	.319
Overall recreation/ aesthetic value	.197	-.182	***-.762***	.074	.380	-.096	**-.764**	-.214	.659
Public resource/access	.058	-.110	***-.656***	-.130	.283	.000	**-.697**	-.345	.519
Aesthetics	.137	-.193	***-.632***	-.117	.356	-.094	**-.677**	-.339	.535
Non-consumptive recreation	.290	-.223	***-.624***	-.026	.476	-.147	**-.676**	-.297	.600
Recreational fish/shellfishing	.097	.245	***-.618***	.115	.201	.311	**-.642**	-.153	.475
Active recreation	-.266	.148	***-.610***	-.126	-.071	.271	**-.603**	-.246	.458
Tourism	-.129	.150	**-.457**	**-.346**	.105	.274	**-.556**	**-.467**	.443
Property value	-.235	.243	**-.375**	-.232	-.069	.345	**-.423**	-.303	.329
Overall provisioning service value	.295	.210	**-.347**	-.111	.412	.258	**-.490**	-.359	.386
Historic	.023	.053	-.082	***-.764***	.317	.175	-.339	**-.806**	.661
Overall historic/education value	.182	-.094	-.108	***-.746***	.484	.020	-.379	**-.832**	.748
Stewardship	.247	-.127	-.054	***-.700***	.521	-.032	-.323	**-.788**	.702
Research/education	.249	-.102	-.088	***-.654***	.513	-.009	-.347	**-.757**	.654

Extraction Method: Principal Component Analysis. Rotation Method: Oblimin with Kaiser Normalization.
a. Rotation converged in 8 iterations.

Table 7. List of ecosystem services contributing to the individual factors/components (bolded services the major factor loadings >0.6) and the percent of overall variance explained.

Factor	Ecosystem services
1. Ecology 31%	**Overall ecosystem functional value**
	Environmental significance (biodiversity)
	Coastal stability
	Spatial ecology
	Overall ecosystem protective value
	Coastal protection
	Fisheries potential
2. Industry 13%	**Infrastructure**
	Energy non-renewable
	Commercial development/commerce
	Repository for discards
	Fisheries potential
	Energy renewable
3. Community 8%	**Overall recreation/aesthetic value**
	Public resource/access
	Aesthetics
	Non-consumptive recreation
	Recreational fish/shellfishing
	Active recreation
	Tourism
	Property value
	Overall provisioning service value
	Fisheries potential
4. Education 5%	**Historic**
	Overall historic/education value
	Stewardship
	Research/education
	Tourism
	Energy renewable

Chapter 8. *Implications for Coastal and Marine Spatial Planning Research*

By considering aspects of marine, ecological, social, and political sciences, I developed a novel survey method to identify and measure the conflicts and compatibilities between stakeholders and regions, and explore the linkages among science, policy, and the public in LIS management. I employed this stakeholder survey to address the need for new methods to comprehensively and quantifiably evaluate ecosystem service values on which to base CMSP efforts. In addition, the survey addresses the lack of methodology on how to effectively involve stakeholders at the early stages of CMSP initiatives. Although the majority of articles on CMSP allude to the importance of incorporating stakeholders early on in the CMSP process, there is very little literature on how to effectively do this (Maguire et al. 2012). While the ecosystem-service framework affords a holistic way to envision marine systems, there is not an agreed upon quantifiable method in the literature to assess the value of various ecosystem services. Being able to quantify and compare stakeholder values on ecosystem services can help in addressing tradeoffs in the CMSP process and in building cooperative agreements among different stakeholder groups.

8.1 State of the Science

One of the biggest problems in public policy debates or initiatives (environmental, social, economic) is the public feeling left out of the process or that their ideas/concerns are not being adequately addressed. The marine planning and policy process is no different. After many stakeholder meetings and interviews, Gopnik et al. (2012) found that one of the main concerns among stakeholders regarding CMSP was feeling "meaningfully involved" in the decision making process from the start. Another concern was that politics and back–door deals would corrupt the process, favoring one stakeholder group over another (Gopnik et al. 2012). The survey used in this dissertation not only provides a robust analytical tool for assessing tradeoffs in resource use, but also provides a transparent and inclusive method to actively involve

stakeholders in the CMSP process. Using LIS as a model, I tested this innovative survey-based approach and identified relationships between the NY and CT regions, scientists and non-scientists, policy makers and users, and multiple stakeholder groups.

The success of CMSP initiatives is inherently tied to active stakeholder buy-in and involvement. Researchers must engage stakeholders to identify and prioritize ecosystem services, because this provides a more stable basis on which to build later stages of CMSP (Chan et al. 2012). As one of the main goals of CMSP is to maximize values while minimizing conflicts (Halpern et al. 2012), scientific tools are needed for measuring the success of CMSP initiatives in terms of alleviating conflicts. White et al. (2012) identify quantifying CMSP outcomes versus traditional sectorial management as one of the most pressing needs in moving forward. If stakeholders are skeptical as to the effectiveness of CMSP over more traditional management options, the CMSP process may become compromised (Gopnik et al. 2012). In fact, one of the biggest barriers to effective CMSP has been the slow development of scientific assessment tools for evaluating and communicating tradeoffs and mediation strategies (White et al. 2012, Chan et al. 2012). In general, policy initiatives have developed faster than the supporting science with regard to successful CMSP (White et al. 2012).

Scientifically vetted and accepted implementation and evaluation tools are lacking in CMSP research, leading to many reactive, rather than proactive, initiatives (White et al. 2012, Halpern et al. 2012, Gopnik et al. 2012). For example, adequate quantification of ecosystem services lags far behind CMSP implementation and supporting science. The ecosystem service framework is at the core of CMSP methodology, and recognizes the socioeconomic, sociocultural, and socioecological relationships in marine ecosystems. Therefore, a comprehensive assessment of the various ecosystem service values and tradeoffs between them is an important component of successful CMSP initiatives. Use-tradeoffs can be better planned and evaluated if there is an understanding of the values that drive stakeholder decisions for LIS, the breadth and depth of existing conflicts, and points of contention or agreement. Halpern et al. (2012) argue that CMSP plans should have a wide range of ecosystem services values represented, as well as a transparent process for assessing them. The ability to quantify and demonstrate how potential use-decisions affect human-well being is essential. However, more successful models and metrics for assessing tradeoffs among services are needed.

8.2 Ecosystem Service Valuations

Recent progress on quantitative assessments in CMSP research exists. For example, White et al. (2012) have developed an analytical model to assess tradeoffs between different sectors and uses. However, these models are not sufficient for decision-making as they are solely rooted in economic principals and perceived economic losses of service value to stakeholders. Ecosystem services valuations need to be based on more than economics. Although monetary assessments have many benefits, such as societal reliance on a strong economy and easy to visualize tradeoffs, they can also be limiting (Sanchirico et al. 2013). There is a gap in current CMSP research in adequately addressing cultural and social services in the decision-making and planning process (Chan et al. 2012). An economic focus on evaluating ecosystem services has left cultural services less characterized, or absent, in many CMSP debates (Chan et al. 2012). Sanchirico et al. (2013) argue that conservation values are also often underestimated. Values associated with cultural, environmental, educational, and historic services are far less tangible when compared to other services such as provisioning, and often are underrepresented in economic or monetary evaluations (Chan et al. 2012). Ecosystem service tradeoff decisions need to better address incorporating and quantifying public good values, versus just economic, requiring more sufficient tools to comparatively analyze the different services (Sanchirico et al. 2013).

My survey addresses this mismatch in ecosystem service valuations, providing a level playing field for the harder to quantify ecosystem services (e.g., cultural identity) with those that have an easily calculable monetary value (e.g. fishing, tourism). As my survey has demonstrated, the intangible services are often the most valued by society and need to be assessed accordingly (Chan et al. 2012). Cultural and ecological services consistently ranked high among all stakeholder groups as discussed in Chapter 4. The provisioning services are where significant disagreements start to emerge among the stakeholder groups. By using a relative value Likert scale, my survey provides a quantitative assessment method to assign values to ecosystem services based on what people actually care about, not just what is dictated by economics (Chan et al. 2012). The principal component analysis technique applied to the ecosystem service data in Chapter 7 provides a useful way to prioritize these services into what people actually value.

8.3 Stakeholder Involvement

What makes marine spatial planning especially challenging is that CMSP specifically calls for early-on and sustained stakeholder participation throughout the process. There is consensus within the scientific community that stakeholder involvement is necessary for the success of CMSP initiatives (Sanchirico et al. 2013, Gopnik et al. 2012, Halpern et al. 2012). The CMSP process requires clear communication with, and a transparent process to engage, various groups of stakeholders (Halpern et al. 2012). However, as of now, there is no one agreed upon tool or method for successfully doing this.

The intention of this study was to help move the CMSP effort forward in LIS by developing a method that assigns quantitative values to ecosystem services and incorporates stakeholder groups early on in the CMSP process in LIS. With the survey developed for this dissertation, I created a decision-making tool that can empower stakeholders from the very beginning of the CMSP process and quantitatively analyze use values and management priorities. This is a novel methodology that allows all parties to have equal input from the beginning.

With respect to economic models, decision makers and scientists tend to be responsible for assigning value to the ecosystem services based on their research or assessments. The process excludes the community. My survey provides a mechanism to directly engage stakeholders in the valuation of ecosystem services, and exposes them to the issues (Chan et al. 2012). Generally, there is limited literature focusing on the direct involvement of stakeholders in the CMSP process, including a lack of in-depth stakeholder analysis and methodology on how/when to best incorporate them (Maguire et al. 2012).

The survey provides a direct mechanism to incorporate stakeholder groups into the CMSP process and document opinions and values. As discussed in Chapter 4, the survey itself served as a catalyst to get stakeholders involved at the earliest stages of CMSP, a challenge for most management initiatives. My stakeholder survey provides a tool to guide the transition of sustained stakeholder involvement in the CMSP process from concept to practice.

Given the shifting policy focus toward marine EBM and CMSP, the development of tools to support the CMSP process is necessary and timely. The survey I created is a novel approach for guiding the CMSP decision-making process in a rational and functional way, providing a replicable tool to measure and address place-based stakeholder needs on which to initiate CMSP.

Such a tool could be used on a smaller spatial scale such as basin by basin, or implemented in a larger ecosystem such as Chesapeake Bay. It provides a global template that can be applied in a variety of settings to inform CMSP and involve stakeholders from the beginning of the process.

8.4 Quantifiable Methods and Assessments

One of my dissertation hypotheses was that conflicts and other issues regarding marine systems can be addressed in a quantitative way to create the foundation for an ecosystem based and multi-objective CMSP. I proposed a research tool and tested whether use of a targeted survey generated quantifiable data with respect to local needs and values and could be an effective tool to develop CMSP. These are the factors needed to develop a comprehensive vision on which CMSP can be based. The purpose of this investigation is to use LIS as a case study to implement such a tool and test its accuracy and effectiveness. Long Island Sound represents a challenge for CMSP due to its many levels of ecological, social and political complexity.

Survey results and analysis show that in fact local and regional issues and values are quantifiable using a broad based, inclusive method versus monetary evaluations. This is a significant advance in EBM and CMSP research as it bases use decision on a comprehensive array of ecosystem services values. A method that quantifies relative ecosystem service valuations sets a baseline for developing goals and principals around CMSP. Testing this approach in LIS demonstrates that even in a complex ecosystem such as LIS, key agreements do emerge on which a vision can be built. In addition, the emergence of historic regional conflicts between NY and CT in the results further supports the robustness of the survey.

This survey made progress on four of the ten steps in the CMSP process outlined by Ehler and Douvere (2009) (Figure 2, Chapter 1):

1. Identify need
4. Organize stakeholder participation
5. Organize the pre-planning process
    a. Define principles goals and objectives
6. Define existing conditions
    a. Identify spatial conflicts and compatibilities

However, I argue that the 10-step approach to CMSP should be expanded to include assessing conflicts and involving stakeholder in the first step – as these are crucial to defining

need and developing goals and objectives. In addition, all of these steps should be accomplished before establishing authority or obtaining financial support (Step 2), as they are crucial components in moving forward with CMSP. In order to identify need for CMSP, one must know if current management is working and if there are spatial conflicts that can be alleviated by CMSP in order establish the spatial conflicts and compatibilities. Furthermore, a stakeholder's perceptions and values of ecosystem services are important to define principals, goals, and objectives. Use conflicts and compatibilities can help define the ecosystem vision that informs the process.

A needs assessment, including ecosystem service valuations, and an evaluation of political will should be the first steps in the CMSP process, even before establishing authority or pre-planning, as suggested in Ehler and Douvere's model (2009). A preliminary needs assessment should include an analysis of stakeholder opinions, conflicts and compatibilities, and possible issues that might arise. Without knowing how different stakeholder groups value different ecosystem services and having a general understanding of opinions, the process could be much more biased toward individual sectorial objectives.

8.5 Discussion

Halpern et al. (2012) enlisted a group of 35 marine planning experts to develop a priority list of issues and near-term priorities for CMSP. Under the topic of "Tradeoffs and Valuation," the following points are emphasized:

> - Provide guidance and science-based approaches for how to evaluate the relative compatibility and incompatibility of existing or proposed uses in CMSP plans under alterative management schemes.
> - Develop or refine models and methods for assessing and optimizing tradeoffs among social, economic, and environmental objectives at multiple spatial and temporal scales.
> - Identify a currency (or currencies) for comparing outcomes of alternative CMSP plans, noting the critical need to include market and non-market benefits from nature in the overall assessment.
> - Recognize and develop methods for addressing diverse value systems within and among human communities that can lead to different core objectives within a single CMSP process.
>
> (Halpern et al. 2012)

The EBM survey and analysis methods explored in this dissertation address all of Halpern's points in some capacity. This method proved useful in evaluating conflicts and compatibilities regarding ecosystem service values, management priorities, knowledge gaps, and opinions of LIS. Results of this research demonstrate the usefulness and validity of such a survey tool in advancing the field of ecosystem-based coastal management, and, in particular, CMSP methodology. In addition, this dissertation helps to broaden ecosystem assessments beyond traditional ecosystem health indicators (e.g., dissolved oxygen and chlorophyll *a* levels), incorporating a more comprehensive methodology that draws from multiple disciplines including marine and social sciences.

With results of this dissertation, I can begin to craft a vision for LIS that answers the question, "how do people want to see LIS used?" This vision will be based on opinions from a comprehensive array of stakeholder groups, and a broad valuation of ecosystem services. Although there were many conflicts among the different user groups, there were more compatibilities on opinions of current and future uses and ecosystem service values. These compatibilities are the starting points for negotiation and evaluation of tradeoffs. I hope to share this vision with the different stakeholder groups involved in LIS, including the LISS, local municipalities, recreationalists, environmental groups, etc. In addition, the stakeholder survey can easily be standardized and replicated for other locations, serving as a model in other CMSP initiatives to help define motivations and values prior to initiation of the planning process.

Chapter 9. *Conclusions*

The main goal of this dissertation was to assess the need for and examine how an ecosystem-based coastal and marine spatial plan (CMSP) could be implemented in Long Island Sound (LIS) considering governmental, social, economic, and ecological factors. To achieve this goal, I developed and employed an innovative survey tool that allowed me to quantify issues including conflicts and compatibilities between regions and stakeholder groups, and ecosystem service valuations. Because ecosystem-based management (EBM) and CMSP are based on the ecosystem service framework and involve stakeholders in the process early on, this is where I focused much of my analysis. Once these issues are quantified, they can be compared to assess tradeoffs between the different uses/services. Understanding where the different regions and stakeholder groups agree and disagree on current and future uses of LIS and management priorities is necessary in order to develop an overall vision for the estuary. In addition, having a quantifiable way to address ecosystem services can help establish goals and priorities in a CMSP process.

Dissertation results clearly support the need for CMSP in LIS. In Chapter 3, "Literature Synthesis and Background," I outline a clear case and timely opportunities for a CMSP in LIS; my survey results further support this. While humans depend on coastal marine environments for many resources and services, our activities are threatening their continued health and productivity (Pew Oceans Commission 2003). Not only do we rely on LIS for recreation and commerce (e.g., fishing, transportation, energy, military use and homeland security buffers, manufacturing, and waste disposal), but the coastline also provides important buffering benefits (Swanson & Conover 2006). With the current rate of technological advances, land-based activities are moving off-shore and coastal waters are being targeted for new and historically unplanned for uses including siting for liquid natural gas facilities, tidal power, wind farms, and aquaculture. If not managed effectively, conflicts arise between new and old uses, and the ecology and biodiversity of the system are further stressed. Marine resources are finite. Freedom of the seas and laissez-faire policies can no longer effectively manage the breadth of

activities being proposed for our oceans (Swanson & Conover 2006, Trouillet et al. 2011), and in particular, for urbanized estuaries such as LIS.

One of the most valuable and applicable results of this dissertation was discovering that even though there are conflicts among stakeholder groups in LIS, there are more than twice the number of compatibilities. Furthermore, although historic conflicts between the NY and CT regions are evident in the survey, there seems to be a shared vision for how LIS should be used in the future. These findings have several implications for CMSP in LIS, the most important of which is a foundation on which to base planning and negotiations. In these last pages, I will address my findings and highlight opportunities and concerns for CMSP in LIS, and suggest a possible path forward.

9.1 Science, Policy, and the Public

As discussed in Chapter 3, EBM techniques such as CMSP are looked to more and more to help manage coastal and ocean environments (Trouillet et al. 2011). Future LIS management strategies should be centered around an EBM approach that reflects the coupled nature of human and natural systems, and addresses all of the ecosystem service values. The evaluation of ecosystem services is based on the premise that LIS's ability to sustain its current resources requirements depends on a healthy functioning ecosystem. It allows for comparison between the cultural and emotional values associated with marine environments, ecological attributes and ecosystem functioning, and the more tangible goods and services, such as food and energy. A CMSP based on the ecosystem service framework could help promote sustainable development while preserving biodiversity and ecosystem functioning in LIS. However, implementing an ecosystem-based CMSP for LIS would need to involve a comprehensive array of stakeholder groups and be based on a broad valuation of ecosystem services.

In Chapter 4 entitled "Conflicts and Compatibilities," I have shown that there were many significant differences among the seven different user groups: Scientists, Managers, Passive Recreation, Active Recreation, Government, Business, and NGOs. It is interesting that Active Recreation and Business often held similar views on ecosystem services and uses, significantly different from the rest of the groups. Active Recreation is very much attached to commerce and industry. For example, many active recreation activities involve boats, marinas, dock space, fuel, repairs, bait, fishing supplies, etc., all of which have business and financial stakes

associated with them. For many questions, Government sided with Business and Active Recreation. Policy makers are responsible to all stakeholder groups and therefore have a wider array of interests and priorities for the region, including increasing economic opportunities. This translates to being more supportive of using LIS as a repository for discards, commerce, and commercial development.

It is also curious that overfishing did not appear in the top five management priorities for managers; is this perhaps a non-issue or do we just not understand enough? The LISS made an active decision not to take fishery issues into account and leave them to the two states to handle (R.L. Swanson, personal communication). Since much funding comes through the LISS for independent scientific research, there may be a disproportionate amount of research monies and projects focused on LIS structure and functioning, and perhaps not enough on species interactions, and social and ecological interactions, such as fishing. Points of bias in the survey that must be taken into account in these analyses include the distribution method, and the targeted nature of the survey itself. Some user groups might not have ready access/ability to use a computer to fill out the online survey. This may be why a smaller number of fishermen filled out the survey versus scientists. Also, the survey itself was very long, which may have deterred some people from filling it out. The survey targeted groups/individuals who were actively involved any of LIS's ecosystem service – assessments of the entire population, including people who do not use or know much about LIS, might be very different. Working with the LISS for much of the distribution may also have created bias the population surveyed. However, many efforts made to reach out to groups and organizations apart from the LISS.

A particularly noteworthy result in Chapter 4 was that scientists (out of the seven groups) were the only ones that ranked climate change and invasive species in their top five management priorities for LIS. They also gave a high score to lack of science. It is not surprising that scientists ranked these high; it is, however, surprising that none of the other groups did, especially managers, NGOs or government officials. This is interesting from a scientific perspective, especially with regard to the prospects for continued funding of climate research in this country and the politics surrounding the issue.

We have a consensus of over 2,500 researchers worldwide (i.e., the Intergovernmental Panel on Climate Change) that the climate is warming due to increasing greenhouse gasses in the atmosphere, such as CO_2. However, there are still many who do not trust climate science and

believe that climate change is not happening, and therefore should not be a top management priority. It may be difficult to get the general public to focus on climate change because its effects are not necessarily concrete or visual. If there is no quick fix for an environmental problem, it is often brushed aside or attributed to something else. As a society, we react more to weather extremes (e.g., hurricanes, tsunamis) and sensationalism than what slowly evolving scientific data are routinely telling use. Unless people are personally affected by climate change, they can easily choose to remain ignorant to its effects.

As increased storm occurrence in the Northeast is attributed, in part, to climate change, it would be interesting to administer my survey again in the wake of destruction caused to many coastal communities around LIS from Superstorm Sandy. Would those affected have changed their views if they suffered personally tragedy or loss from the storm? How many more storms and losses will it take before they are open to considering the possibility of a human connection to climate change? How long will this awareness or concern last when we live in a society with a rapid news turnover cycle? There should be a more concerted effort to teach scientists how to communicate complicated scientific concepts and results in a way that is convincing to the general public. Scientific results and understanding need to have a reach far beyond the scientific community. The scientific process itself and the concept of uncertainty need to be better understood by society for coastal and environmental management to be effective in the long-term. Therefore, in order for CMSP to be most successful, it should have an outreach/marketing component. Stakeholders need to be educated on the values of the different ecosystem services, from energy/industry to healthy wetlands, in order to make sound policy judgments.

Survey results in Chapters 4 and 6 highlight significant discrepancies between what scientists believe and what the public, and therefore policy makers, think are high priorities in LIS. Chapter 6 also shows knowledge gaps regarding many LIS issues, including EBM and CMSP, between policy makers and users. These results may further demonstrate that scientific information is not being effectively communicated to the public.

If this is the case, what chance do we have for sound science-based policy decisions and management? Examples of mismatches between science and policy can be seen throughout government, including the many members of Congress who do not believe in climate change, or even evolution for that matter. When there are multiple members on the U.S. House Science

Committee who believe climate change is a huge scientific conspiracy, is science losing its place in governance (Plumer 2013)? Currently, there is draft legislation proposed by the Chair of the House Science Committee, Rep. Lamar Smith (R-TX) that would alter the scientific peer review process required by the National Science Foundation (NSF), and replace it with criteria decided on by Congress, not scientists (Mervis 2013), a chilling prospect indeed.

The role of science communication and outreach in promoting CMSP should be expanded. Effective science communication and outreach are necessary in fostering conversations among scientists, managers, policy makers, and the general public, as well as promoting meaningful stakeholder participation in EBM initiatives. Often, scientists underestimate the importance effectively communicate science beyond the confines of academia. Given the shifting policy focus toward marine EBM and CMSP, which stress active stakeholder involvement, the ability of scientists to speak clearly about their work and why it matters, in ways non-specialists can understand, is increasingly important. Society must be better informed in order to make sound scientific decisions that promote healthy marine systems, especially when assessing tradeoffs on ocean use/space and ecosystem services. The challenge for scientists is to be clear and engaging without oversimplifying. Some universities have begun using improvisational theatre exercises and other ground-breaking methods to teach researchers and educators how to effectively engage their audiences and effectively communicate their scientific message. Perhaps this method, pioneered by Stony Brook University's Alan Alda Center for Communicating Science, should be incorporated by scientists, managers, and policy makers involved in CMSP initiatives.

9.2 Regional Governance

Survey results in Chapter 5, "Regional Governance," reflected historic regional conflicts between NY and CT, such as dredging, infrastructure, and energy in LIS. The results also showed a clear negative consensus on LNG facilities in LIS, consistent with the Broadwater debate a few years ago. The clear presence of historic conflicts helps further validate the methods and approach in this dissertation. There are many examples of planning and zoning of marine environments in LIS, but they are not done with regard to other issues, often leading to inconsistent management. For example, dredging cannot occur during the spring and summer months because it might disturb spawning. However, dredging in the fall and winter is not

necessarily effective because there are many seasonal storms resuspending sediment and making dredging operations difficult. During certain seasons, areas of the beach and uses may be restricted because of nesting for birds such as the endangered piping plover. Further, much of the coastal zone around LIS has strict land use zoning. The north shore of LI, for example, has two-acre zoning put in place decades ago to protect water quality as many homes were on private drinking water wells.

As discussed in detail in Chapter 5, jurisdictional issues on the federal, state and local levels can pose problems for CMSP in LIS. For example, while the management of LIS involves the two states (i.e., CT and NY), there are multiple local zoning initiatives along the coast, some of whose jurisdiction extends into marine waters. Specifically, there are 78 coastal cities, towns, and villages that border LIS (Task Force on LIS 2002). Furthermore, local land use zoning initiatives are much more anthropocentric, strongly taking into account human uses and needs, and not touching the notion of ecosystems or ecosystem services.

Survey participants were asked in open-ended questions who they thought should be in charge of management (i.e., have authority to implement, enforce, govern) of a CMSP process for LIS. Although there were various answers, the most popular suggestion was a combination of the states, federal government, local municipalities, stakeholder groups, and the Long Island Sound Study (LISS) (Figure 1), appearing in 32.0% of the responses. However, the reality is that only the states, with some Federal approval (i.e., military, cables, etc.), have authority to implement CMSP in LIS. The next most suggested framework was regional management between the two states at 25.0%. Ironically, when participants were asked what they believed might be the biggest impediments/roadblocks to a CMSP process for LIS, regional conflicts between CT and NY came up the most, at 28.6% (Figure 2). If it is recommended that the states govern and implement CMSP, they would have to resolve their disputes. Results from the survey show that although there are regional conflicts, most are not extreme. Data also showed that, although there were conflicts, there were more than double the number of compatibilities. Specifically, the general agreement between the CT and NY regions on possible future uses (excluding waste-to-energy) can serve as the starting plant for the development of a shared regional vision on how LIS should be used. Both regions felt negatively toward liquid natural gas and natural gas facilities, nuclear plants, mining and industrial zones. However, they had

positive opinions of using LIS for wave and tidal energy, aquaculture, and limited use, no-take and consumptive use (e.g., fishing) MPAs.

Not surprisingly, the next most mentioned factor that could derail a CMSP process in LIS was politics (23.8%). In this regard, lack of cooperation, money, and stakeholder disagreements showed up in 17.8%, 16.9%, and 10.8% of responses, respectively (Figure 2).

Many of these conflicting use problems in LIS may be solvable through CMSP. For example, over time, LIS's bays and harbors have had to accommodate more and bigger boats. Bigger boats lead to the need for deeper channels, and deeper channels lead to more dredging. Instead of stopping dredging all together, a tradeoff might be putting spatial restrictions on dredging harbors to more than a certain depths; such is the case in Stony Brook Harbor, NY. Coastal and marine spatial planning could also impose limits on how harbors and ports are used (e.g., commercial or recreational), or restrictions on vessels.

However, as population density continues to escalate in the LIS region, historic conflicts over energy and infrastructure will continue. Unlike CT, coastal NY currently imports the majority of its energy using trucks, barges, cables, and pipelines (LIS 2003). Because NY has limited ability (space and sources) to produce its own electricity on a large-scale basis, it is more reliant on imported energy to meet its growing needs. Further, NY also ships much of its waste off island by truck. A growing population density means more municipal solid waste and increased truck traffic. Transporting municipal solid waste via barge or ferry across LIS is another viable shipping option.

Barging is much cheaper, more energy efficient, and releases less emissions than trucking. The trip from Port Jefferson, NY (on the southern side of LIS) to Bridgeport, CT (on the northern side) is roughly 161 km each way by car/truck. Taking the Bridgeport Ferry across LIS is only about 29 km. Looking at this with regard to both personal transportation and shipping, it is much more cost efficient (in terms of fuel) to take a ferry or barge than drive around. In fact, barge transportation is 8.7 times more energy efficient than trucking (Texas Transportation Institute 2009). The same one-ton of cargo shipped from Port Jefferson to Bridgeport versus being driven would use 0.15 liters of gasoline versus 6.34 liters. The barge would only emit 0.009 kg of hydrocarbons into the atmosphere, while the truck would emit 0.281 kg. The same one-ton shipment would emit 0.045 kg of nitrous oxide by barge and 4.85kg by truck.

Should trucking or barging be increased in response to the regional energy demands? Should the capacity of the pipelines and transmission cables in LIS be increased? Transportation costs and fuel efficiency are important factors to consider in a LIS CMSP. Gas prices continue to rise and the high population density will require the importing of many goods and services, as well of the exporting of waste products. Having alternative methods for importing and exporting of energy and waste may be of more value to NY than CT, perpetuating these historic conflicts. A CMSP could help plan for these disparities in state needs and changing values. Survey results showed a general lack of knowledge among all stakeholder groups on LIS economic issues and infrastructure/energy needs, which is of special concern given the expected future increase in value of these ecosystem services. These are clear issues that LIS management will have to address in the future, with a CMSP adapted accordingly.

9.3 Moving Forward with Coastal and Marine Spatial Planning

Results in Chapter 4 highlighted an overall agreement among stakeholder groups to implement CMSP in LIS. Results also showed there is not sufficient understanding of what EBM and CMSP are. Significant differences in EBM and CMSP knowledge among stakeholder groups strongly involved in policy making (Managers, Scientists, Government, and NGOs) versus those who are general users of LIS (Active recreation, Passive recreation, Business, and Community) may imply that knowledge on management issues is not being effectively translated to the public. Even among Managers, Scientists and NGOs, CMSP was the lowest ranked in terms of knowledge. Possible bias to consider here is that the survey measured "perceived" knowledge, not actual knowledge. These might be very different depending on the individual. Further research might incorporate a series of questions that "tests" the respondents knowledge on various topics to help validate the model.

A general lack of CMSP knowledge could adversely impact its process and ecosystem service valuations. If one sector redefines the definition of CMSP, it will not necessarily be based on the large spectrum of ecosystem service values. For example, industry could easily manipulate the process by proving justification for commercial uses that are not necessarily consistent with the overall societal vision for a particular marine ecosystem. Before we cut the rope and start the race to develop our oceans, we need to think about what should be there, not

just what could be there. We need to be proactive as a society to develop a shared vision for how we want to see our oceans used.

Over the past decade, definitions of what we now call CMSP have varied considerably. As is often the case with new management "buzz" words, CMSP too has evolved. When I began researching this topic in 2005, the term CMSP was not widely used, and CMSP-like efforts were referred to as marine zoning (O'Connell 2006). There were also CMSP similarities with integrated ecosystem assessments (IEAs), and adaptive or coastal zone management (Arkema et al. 2006). In the management community, the definition of marine zoning eventually became more streamlined to reflect the spatial or temporal separation of marine environments for different purposes/uses. The term marine zoning no longer necessarily included long-term planning or the EBM approach. The new term was now "marine spatial planning" or MSP. At some point, coastal (i.e., the "C") was added to MSP to incorporate land-sea connections. As it became clear that CMSP was being implemented differently around the world, terms such as single-objective vs. multi-objective began to emerge (Ehler & Douvere 2010). The "C" has also been defined as "comprehensive" which referred to multi-objective plans (CMSP or CCMSP). Further, the term "integrated" has been used as an adjective to describe coastal and marine spatial planning (i-MSP or i-CMSP).

Now a new adjective has emerged, "ecosystem-based" CMSP. Although there are many global CMSP efforts, they are not necessarily integrated, comprehensive, multi-objective, or ecosystem-based. Technically, in order to be crowned with these terms, a CMSP must be based in the principals of EBM, and include a broad definition of ecosystem services, not giving preferences to one sector such as conservation or industry. These adjectives are increasingly important in defining the type of CMSP process and expected outcomes.

The definition of ecosystem services has also evolved over the years to incorporate more of a social and cultural component. In the past, it was mainly referred to in terms of regulating or protective services. The current accepted definition of ecosystem services, in regard to CMSP, has been expanded to include provisioning, and aesthetic/cultural services, based on the United Nations' Millennium Ecosystem Assessment (MEA) definition (MEA 2005).

However, despite the different definitions, CMSP, in practice, is often just referred to as "CMSP," not appearing with a more descriptive adjective. The scientific, management, environmental, commercial, and political communities are talking about CMSP, but may have

very different definitions of what it actually means for a particular project or ecosystem. This can propagate mistrust and misuse within the CMSP process. For example, there may be consensus that CMSP should be implemented in LIS, but the expected outcomes may vary considerable by stakeholder group. This is why care must be taken with regard to how CMSP is defined. It is crucial to answer the question, "How should our oceans be used?" before embarking on any of the steps in the CMSP process; otherwise the process can easily be manipulated.

Some in the ocean advocacy community have expressed concern about how CMSP is being carried out. Ecosystem-based management and CMSP may be sound in theory, but if not implemented correctly, they can be driven by a few interested parties/stakeholders. Apprehension exists that CMSP will be corrupted by the political process and special interests, or will not reflect what the community values. In fact, when asked what might derail a CMSP for LIS, survey participants included politics, special interest, money, and greed among the top ten responses (Figure 1). Given the urbanized nature of and past conflicts in LIS, CMSP should be done in ecosystem-based, comprehensive fashion. If CMSP is not implemented properly in LIS, special interests could manipulate the process, with economics or emotion dominating the discussion.

Many existing CMSPs are often centered around one objective or sector such as siting for windfarms (e.g., in MA and the North Sea) or conservation efforts (e.g., the California marine reserve network). However, without EBM or CMSP, these projects would still be proposed, but development would be likely be done in a more ad hoc manner. With CMSP, even if it is initially single-objective, uses are planned for in a more holistic way, and industrial zones or accepted uses are already defined. If LIS had a CMSP in place in 2006 during the Broadwater proposal, the lengthy and expensive debate would probably not have occurred.

Even though many plans are limited in their objectives and inclusion of ecosystem services, they still can have positive effects on both society and ecological systems. The reality is that oceans are being eyed for more and more uses as economics and opportunity become more favorable to this environment. The cost of oil and political climate is making it more attractive for alternative energy options, such as wind farms, in our oceans. For example, there is currently planning at the state and federal levels regarding offshore wind farms in the NY Bight, creating a CMSP that would accommodate them. Although well intentioned, a truly multi-

objective ecosystem-based CMSP should be brought to the community before concrete steps are taken at the governing level to design the process. However, having a CMSP will allow for all intentions to be put out front, allowing management to address the compounded impacts of multiple stressors and developments.

Caution is needed moving forward with EBM and CMSP in this country so that it stays as comprehensive and ecosystem-based as possible. Coastal and marine spatial plans must represent all ecosystem services values, not just the easily quantifiable ones or those that align with government, business, or NGO priorities. As we can ensure a healthy functioning ecosystem in many ways, CMSP needs to incorporate a societal vision for how we actually want to see our oceans managed. This requires everyone having a sufficient understanding of the needs for a particular region, and what percent of those needs to fulfill by turning to marine systems/development. For example, wind farms in the Atlantic is a viable concept to encourage alternative energies, but is there a better way to look at a regional energy plan, such as solar installations, or energy efficiency measures? Unfortunately, as results in Chapter 4 showed, most groups recorded having only a little knowledge of infrastructure and energy issues for LIS.

9.4 Coastal and Marine Spatial Planning in Long Island Sound: Next Steps

If not done in a multi-objective, ecosystem-based manner, CMSP may cause more exploitation of the marine environment (e.g., dumping of dredge spoil). For an integrated ecosystem-based CMSP in LIS, all of the ecosystem services should be given equal weight and be subject to fair evaluation by all stakeholder groups. Results from this dissertation will help advance that process, having defined the relative values of ecosystem services and possible future uses. A CMSP must be adaptive to society's changing values and goals (e.g., gas prices). With evolving circumstances, there may be compromises and tradeoffs among some services that minimize impacts to others. An important question that must be addressed before moving forward with CMSP in LIS is "How do we want to see LIS used and what tradeoffs are we willing to make to keep to that vision?"

Long Island Sound is a unique place to study public outreach in CMSP and to experiment with the implementation of a multi-objective CMSP. It is an urbanized estuary with many existing uses and historic conflicts. As discussed in Chapter 3, as population density continues to increase in the NY and CT regions, so do the number of uses and use conflicts.

Encouragingly, LIS has mechanisms in place to create broad coalitions and involve stakeholders in a CMSP process. The Long Island Sound Study (LISS) and the revision of its Comprehensive Conservation and Management Plan (CCMP) provide an important starting point for a CMSP in LIS. The LISS helps in guiding management decisions and research in LIS. It is made up of a group of engaged stakeholders including community, managers, government officials, businesses, and scientists. The LISS can provide a mechanism for negotiations and involvement in the CMSP process, as well as making sure that process is informed by a shared vision. New federal and state EBM initiatives provide a timely opportunity to begin gathering information to serve as the basis for CMSP in LIS.

When asked about who should have authority to implement CMSP in LIS, 42.0% of survey respondents mentioned, in some capacity, the LISS. The LISS itself does not have legal authority to implement CMSP for LIS. However, the LISS could serve as a cohesive base for coordinating state authorities around a CMSP initiative and moderating the planning process. In addition, the current structure of the LISS might not be the most ideal/appropriate for promoting an ecosystem-based CMSP for LIS, as it is not necessarily equally representative of all LIS stakeholder groups. Currently, the LISS is made up of three stakeholder committees: the Management Committee, Citizens Advisory Committee, and Science and Technical Advisory Committee. There is also a Policy Committee and Executive Steering Committee, which, together with the three stakeholder committees, make up the Management Conference, a group of higher powered agency officials.

The CAC has a broad membership, including industry, local governments, NGOs, private citizens, recreational groups, etc. The current structure of the CAC demonstrates that people with different views can work together on LIS management. However, as this dissertation showed in Chapter 4, many of these groups do not have shared ecosystem service values.

To ensure that all views are represented in a CMSP process, I suggest that the three LISS stakeholder committees should be broken up into more defined groups, each with similar opinions on ecosystem services. Survey results showed clear patterns in how ecosystem services are valued in LIS. Using principal component analysis (PCA) in Chapter 7, four defined relationships emerged in the valuation of ecosystem services: Ecology, Industry, Community, and History/Education (representing 31%, 13%, 8% and 4% of the overall variance, respectively). Having classified issues by four factors leads to better understanding of how

stakeholder groups should be educated, and perhaps how outreach materials should be focused along these areas. In addition, these results underscore the importance of ecological principals guiding EBM, as the Ecology factor explains more of the variance that the other three factors combined. These factors could also serve as the basis for prioritizing use of marine space, and results could be used to designate new committees for a CMSP process, representing each of the four factors. Although this might initially create more fractures among stakeholder groups, it would help clearly define the important sectorial issues that would need to be adequately addressed for CMSP to be successful. This PCA method could be applied to other marine systems to designate committees or areas of focus for CMSP initiatives.

The EBM scientific consensus statement warns that "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). We are already seeing complex ecosystem-level management challenges in LIS due to human impacts and climate change (perhaps the lobster die-off). There are already significant conflicts among LIS stakeholder groups and between the NY and CT regions. Further, all user groups agree that conflicts will continue to increase in LIS. A CMSP can help with planning for these conflicts now, separating conflicting uses and providing a process to adapt management as conditions or ecosystem service values change.

Implementing CMSP in LIS will not be an easy process. I recommend taking a precautionary approach when addressing new uses of LIS. Coastal and Marine Spatial Planning will not replace current management strategies and regulations, but instead be used in conjunction with them. Furthermore, because CMSP can be implemented in different ways, there should be a deliberate process regarding how a CMSP in LIS is designed. The process must be transparent and inclusive. The LISS could be a mechanism to bring together a subset of political powers between the two states to begin the planning.

This dissertation can be used to help to develop a vision for LIS using survey results. A comprehensive vision will help ensure successful goals and objectives for a LIS CMSP initiative. My results will also provide the background information necessary for relevant agencies and organizations to develop a CMSP process. I have proposed a new framework for moving ahead with CMSP in LIS, including changing the organization of the LISS based on principle

component analysis results. In addition, as discussed in the previous chapter, I have developed a new method to measure how stakeholders value ecosystem services with regard to ecosystem-based CMSP. This method can serve as a model for other urbanized estuaries. My work will complement efforts by the New York Ocean and Great Lakes Ecosystem Conservation Council, which has developed a strategic plan to address EBM in New York's coastal waters, and is currently working on its implementation. Additionally, this research will enhance the efforts of the New York Ocean Policy Task Force and associated state initiatives to create regional CMSP frameworks.

The next phase of this project is to begin reaching out to the public with the results of this dissertation and crafting a vision for LIS based on my results. By focusing on scientific communication and public outreach, I will be proactive in moving this research forward to help shape a multi-objective, ecosystem-based CMSP for LIS. Dissemination of survey results is timely, as the US Environmental Protection Agency is currently in the process of revising the CCMP for LIS. I will work closely with the CAC to reach out to the community and speak with the LISS regarding publishing some results in *Sound Science*, a bi-monthly newsletter that has a broad reach. Results will be sent out to those who participated in the survey. In order to effectively communicate results of my dissertation to the general public, I will actively seek funding to write a general purpose publication that will aid in the first stages of the CMSP process. I will create a concise and concrete way to educate stakeholders as to the extent of ecosystem services in LIS and initiate discussion regarding the spatial allocation of resources and uses. It might also be useful to see if the way people value ecosystem services has changed since the destruction of Superstorm Sandy in November 2012.

Chapter 9 Figures:

Figure 1. Roadblocks for CMSP implementation. Roadblock categories are listed along the y-axis, and percentage of times it appeared in participants' responses along the x-axis. Participants were asked, "in your opinion, what might be the biggest impediments/ roadblocks to a bi-state (NY and CT) comprehensive marine spatial planning process for LIS?"

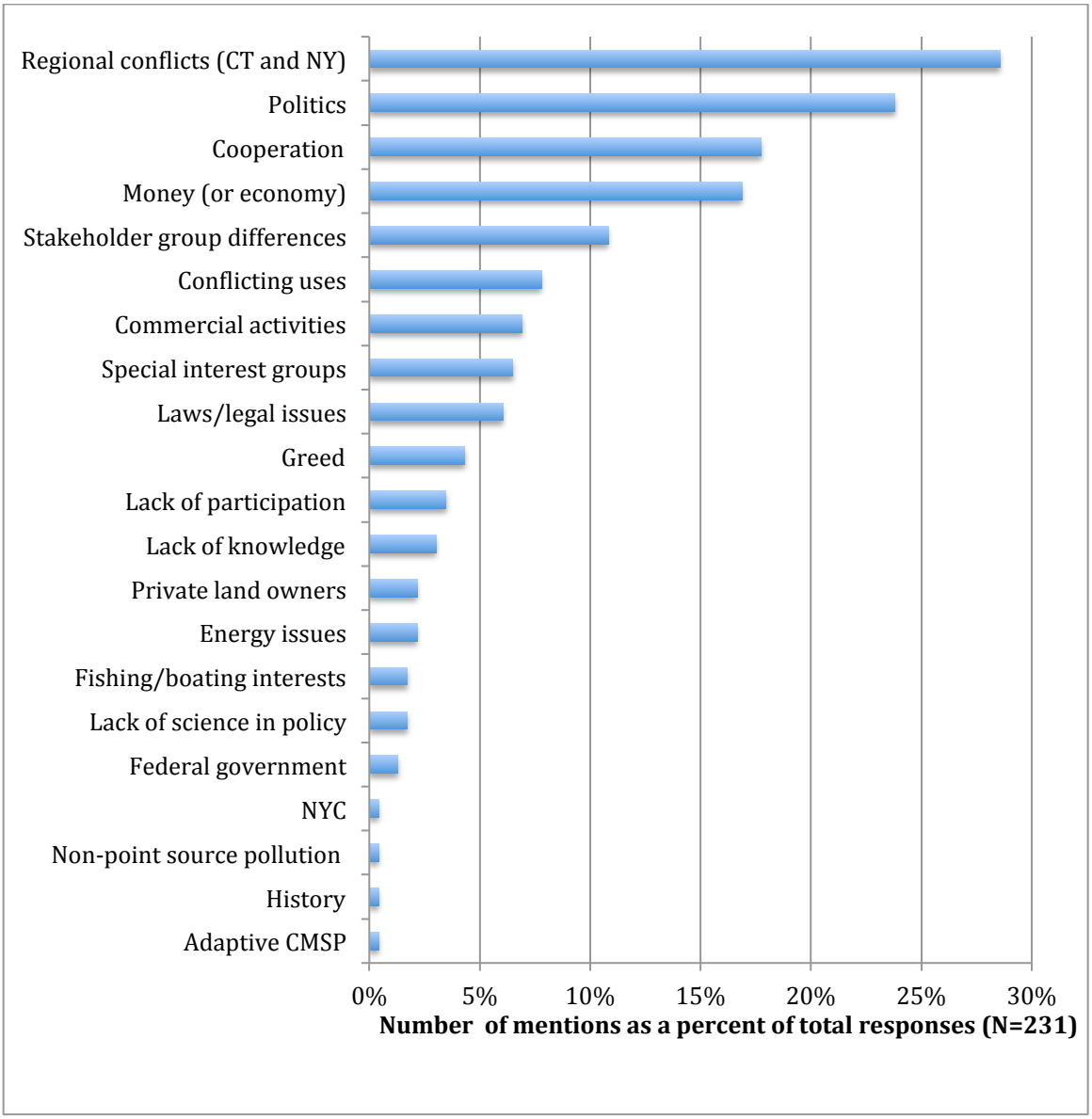
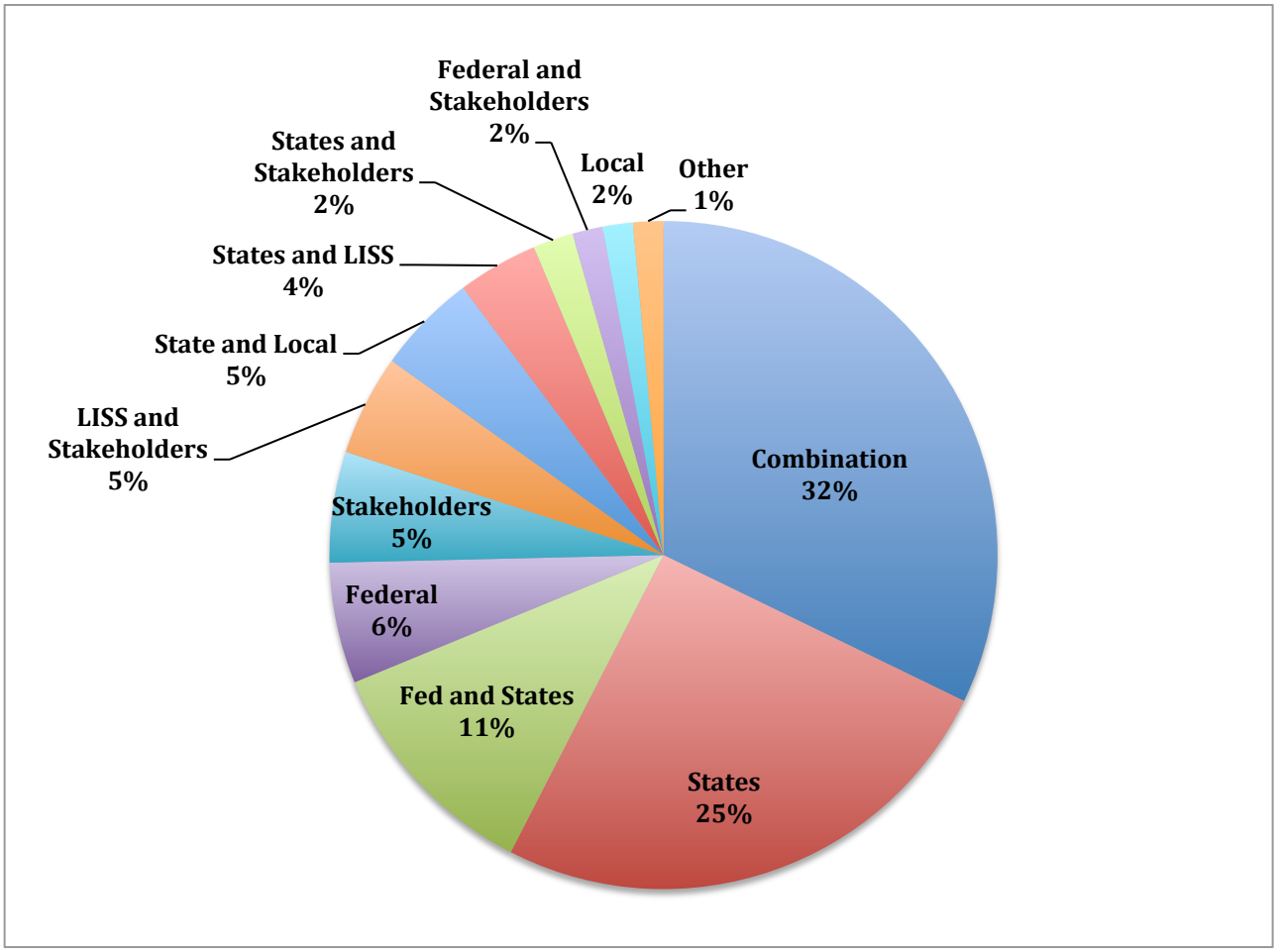


Figure 2. Governing structure suggestions for CMSP in LIS. Participants were asked "Who should be in charge of management (i.e., have authority to implement, enforce, govern) a coastal and marine spatial planning process for LIS (e.g., states, region, federal; specific agencies, organizations or stakeholder groups; the Long Island Sound Study; or any combination thereof)?"



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Appendix 1. *Long Island Sound Stakeholder Survey*

Long Island Sound Stakeholder Survey*

This survey is for research purposes only to identify attitudes, public perceptions, and management options on/of/for Long Island Sound (LIS). Results will be used as part of ongoing dissertation research at the School of Marine and Atmospheric Sciences, Stony Brook University. This survey is voluntary, and all responses/identifying information will be kept *completely confidential.*

Your input is very valuable to this project.

Please complete the entire survey *(approximately 15 minutes*).

If you can not complete the survey in one session, click on the link at the top of the page *"Save and Continue Survey Later*," which will allow you to resume at another time.

There are 5 sections (27 questions total):

I. Background information
II. How do you value LIS? (uses and services)
III. Management challenges in LIS
IV. What is your vision for LIS? (evaluation of specific activities)
V. Management: looking ahead

It is very important that you fill out each section. There are a few "required" questions that you must anwser to move onto the next section. If there is a question you don't know the answer to (e.g., one that is too technical), you may skip it (but first please try to answer as best you can).

Please feel free to leave comments/feedback along the way or at the end of the survey. If you have any further questions/comments, my contact information is at the end of the survey. I appreciate the time you are taking to help us with this important assessment.

Thank you!

Christine

*Even if you have already taken the previous paper version of this pilot survey in Fall/Winter 2010, we ask you to also participate in this online study. This survey has been modified and improved upon from the pilot version. When there is a red * next to a question, it signifies a "required" question.

1) Contact Information *(optional)*

First Name: _____

Last Name: _____

Title: _____

Organization/Company Name: _____

Address: _____

Apt/Suite/Office: _____

City: _____

State: _____

Zip: _____

Email Address: _____

Phone Number: _____

2) Have you taken a previous version (paper, not on-line) of this survey, that was administered this past Fall/Winter 2010? (i.e. the pilot version)*

( ) Yes

( ) No

I. Background Information

First page of questions. Unless otherwise stated, please answer ALL of the following questions to the best of your ability and from your own point of view (vs. your agency/organization's). Choose/identify the most appropriate answer.

3) What are the first 3 letters of your mother's maiden name?*
(for tracking purposes only)_____

4) In what state do you live/work?*
( ) NY
( ) CT
( ) NJ
( ) RI
( ) MA
( ) Other: _____

5) Approximately how many miles from LIS is your residence?
( ) 0-1 miles (waterfront or nearly so)
( ) 1-10 miles
( ) 10-25 miles
( ) 25-50 miles
( ) >50 miles

6) Approximately how many miles from LIS is your place of work?
( ) 0-1 miles (waterfront or nearly so)
( ) 1-10 miles
( ) 10-25 miles
( ) 25-50 miles
( ) >50 miles

7) What relationship do you most/best identify yourself as having with LIS?*
You can select up to 3 descriptors. Please rank in order of appropriateness. For example, category 1 being how you would most identify yourself, 2 being the next descriptor you would use, etc.
_____Manager
_____Scientist
_____NGO/Non-profit
_____Educator
_____Boater
_____Recreational fisherman or angler
_____Commercial fisherman
_____Recreationalist (kayaking, etc.)
_____Naturalist
_____Energy/infrastructure developer
_____Industry representative
_____Community resident
_____Government official
_____Political representative
_____Property owner
_____Business owner/operator

8) Do you think you are well informed on the following:*
Mark the most appropriate answer.

	Not informed	Some knowledge	Fairly well informed	Very well informed
Management issues in LIS	( )	( )	( )	( )
Economic issues around LIS	( )	( )	( )	( )
Fishery issues in LIS	( )	( )	( )	( )
Ecosystem-based management	( )	( )	( )	( )
Coastal and marine spatial planning (CMSP)	( )	( )	( )	( )
Regional infrastructure and energy needs	( )	( )	( )	( )
Community or stewardship efforts around LIS	( )	( )	( )	( )

9) Using the following map, please identify the areas of LIS that you most often visit, work (or your work impacts).* Check all that apply.
[ ] Area 1) The Narrows
[ ] Area 2S) Western Basin South
[ ] Area 2N) Western Basin North
[ ] Area 3S) Central Basin South
[ ] Area 3N) Central Basin North
[ ] Area 4S) Eastern Basin South
[ ] Area 4N) Eastern Basin North
[ ] Entire LIS
Map of different basins in Long Island Sound.
https://docs.google.com/document/d/1Qw-YtHlD2RPWrHhAGln_ak39STk-X4InuWOXg6iW3GI/edit?hl=en&pli=1#

10) Please rate your opinion of the following statements and indicate if you are only answering for a specific section(s) of LIS.

Please indicate whether you are answering the following set of questions for LIS overall, or referring to a specific section/basin of LIS: Eastern, Central, or Western (as per map in question 9).*
[ ] Eastern LIS
[ ] Central LIS
[ ] Western LIS (including the The Narrows)
[ ] Entire LIS

Please rate your opinion of the following statements.*

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Not applicable
Water quality in LIS has improved over the past 25 years.	( )	( )	( )	( )	( )	( )
The ecosystem structure and function of LIS's coastal areas are in good shape (e.g., suitable buffer areas for storms/ nutrient uptake, habitats, etc.).	( )	( )	( )	( )	( )	( )

LIS has a healthy diversity of plants and animals (i.e., biodiversity).	( )	( )	( )	( )	( )	( )
LIS has a healthy food web or trophic structure (i.e., how energy is passed, in the form of food, from one organism to another in a biological community/ ecosystem...who eats whom)	( )	( )	( )	( )	( )	( )
Reducing nutrient inputs into LIS has greatly improved its ecological health (e.g., upgrading sewage treatment plants to reduce nitrogen inputs, storm water control measures, sewering, etc.).	( )	( )	( )	( )	( )	( )
Given current conditions, commercial fisheries will continue to be a viable industry in LIS over the next 10 years.	( )	( )	( )	( )	( )	( )
Over the past 25 years, use conflicts (either spatial or temporal) between different stakeholder groups in LIS have been a problem.	( )	( )	( )	( )	( )	( )
Currently, use conflicts (either spatial or temporal) between different stakeholder groups in LIS are a problem.	( )	( )	( )	( )	( )	( )
Over the next 25 years, use conflicts (either spatial or temporal) between different stakeholder groups in LIS will be a problem.	( )	( )	( )	( )	( )	( )

11) Are you involved in a water dependent business on LIS?*

( ) Yes
( ) No

What type of business are you involved in?_____

Do you own the business?

( ) Yes
( ) No

In the next 5 years, what do you think the economic prospect is for the water-dependent business you are involved with?

( ) 5 Very Bad
( ) 4
( ) 3
( ) 2
( ) 1 Very Good

Any comments or further explanation?

12) Do you have any other direct economic stake in LIS (e.g., waterfront property owner, waterfront/view restaurant, investments, etc.)

( ) Yes: _____
( ) No

(Hidden Question – Only for Scientists)
Which submerged habitats in LIS are/could be particularly vulnerable to human activities (i.e., may require additional protections)?

	5. Not at risk or vulnerable	**4.**	**3.**	**2.**	**1. Very vulnerable or at risk**
Sandy bottom	( )	( )	( )	( )	( )
Mud bottom	( )	( )	( )	( )	( )
Clutch bottoms	( )	( )	( )	( )	( )
Eelgrass beds	( )	( )	( )	( )	( )
Boulder/gravel	( )	( )	( )	( )	( )
Open water/pelagic	( )	( )	( )	( )	( )
Bays/harbors	( )	( )	( )	( )	( )

Are there any unusual or rare benthic (bottom) habitats in LIS we should be worried about protecting? If yes, please specify.

II. How Do You Value LIS? (Uses and Services)

How do you value LIS and the various uses and services it provides us with.

13) How do you personally (i.e., not professionally) value the following services/uses (a-v) in the following categories (I-VI) in LIS?
For more info. on marine ecosystem services visit:
http://www.eoearth.org/article/Marine_ecosystem_services
Please mark the most appropriate circle.

	Do not value at all	**Personally don't value, but see societal value**	**Neutral (don't feel strongly either way)**	**Somewhat value**	**Strongly value**
I. Overall Recreation/Aesthetic Value	( )	( )	( )	( )	( )
a) Aesthetics (scenic views, etc.)	( )	( )	( )	( )	( )
b) Recreational fishing/shellfishing	( )	( )	( )	( )	( )
c) Active Recreation (boating, jet skiing, etc.)	( )	( )	( )	( )	( )
d) Non-consumptive recreation (bird watching, beach going, diving, swimming, kayaking, surfing, etc.)	( )	( )	( )	( )	( )
e) Public resource/accessibility	( )	( )	( )	( )	( )
f) Tourism potential	( )	( )	( )	( )	( )
II. Overall Provisioning	( )	( )	( )	( )	( )

Services Value (i.e., how we value what LIS provides us with, or what we take from or develop in LIS)					
g) Property values	( )	( )	( )	( )	( )
h) Fisheries potential	( )	( )	( )	( )	( )
i) Repository for discards (i.e. dredge material disposal, stormwater runoff, sewage effluent disposal)	( )	( )	( )	( )	( )
j) Infrastructure development potential (cables, pipelines, etc.)	( )	( )	( )	( )	( )
l) Energy development (non-renewable)	( )	( )	( )	( )	( )
m) Energy development (renewable/green)	( )	( )	( )	( )	( )
n) Commerce or commercial development potential	( )	( )	( )	( )	( )
III. Overall Ecosystem Protective Value (regulating services)	( )	( )	( )	( )	( )
o) Coastal protection potential (i.e., buffer wave energy, storm/flood protection)	( )	( )	( )	( )	( )
p) Environmental significance (i.e., biodiversity, trophic structure)	( )	( )	( )	( )	( )
IV. Overall Ecosystem Functional Value (supporting services)	( )	( )	( )	( )	( )
q) Coastal stability (e.g., climate control, nutrient buffer, etc.)	( )	( )	( )	( )	( )
s) Spatial ecology (e.g., wildlife habitat, restoration/natural areas)	( )	( )	( )	( )	( )
V. Overall Historic/Educational Value	( )	( )	( )	( )	( )
t) Historic significance (e.g., working waterfronts, traditional activities, etc.)	( )	( )	( )	( )	( )
u) Stewardship/community	( )	( )	( )	( )	( )
v) Research/education	( )	( )	( )	( )	( )
w) Other (please specify below)	( )	( )	( )	( )	( )

w) Other (please specify)_____

III. Management Challenges in LIS: current and potential

Congratulations! You are past the half way point on this survey! If you need to take a break and complete the survey at a later time, please click on the link at the top of this page "Click Here to SAVE and CONTINUE Survey Later."

14) In general, how satisfied are your with the management of LIS?*

( ) Very Satisfied
( ) Slightly Satisfied
( ) Neutral
( ) Slightly Dissatisfied
( ) Very Dissatisfied
( ) Not Applicable

15) What, in your opinion, are the top 5 most important management issues in LIS. Please rank from 1-5 using the following list. Only 5 choices are allowed.*

_____Point source pollution (e.g., oil spills, etc.)
_____Non-point source pollution (e.g. runoff, etc.)
_____Privatization of waterfront/public access
_____Leasing of bottom lands (e.g., for shellfish beds, cables)
_____Water quality
_____Overfishing
_____Invasive species (i.e., non-native plant, animal or other organism in a specific ecosystem/environment that causes or is likely to cause economic or environmental harm or harm to human health).
_____Alternative energy
_____Public involvement/perceptions
_____Climate change
_____Transportation
_____Loss of biological communities
_____Lack of science
_____Loss of working waterfront
_____Economic development
_____Habitat loss/coastal development
_____Cohesive management
_____Dredging (i.e., the removal of material from the bottom of harbors and other water bodies to maintain or deepen navigation channels, remove contaminated sediment, etc. Once sediments are dredged from the waterway, they are called dredged material.)
_____Other

Other (please specify)_____

16) In general, over the past 10 years, the ecological health of LIS is:*

( ) Much improved
( ) Somewhat improved
( ) Not changing
( ) Somewhat worse
( ) Much worse
( ) Not Applicable

17) What, in your opinion, are the main spatial or temporal (time, seasonal) conflicts in LIS? (e.g., what uses might interfere with how you use or would like to see LIS used)

Include up to 3 conflicts

List conflicting uses here

1. ___
2. ___
3. ___

18) Why is LIS important to you? Would you change anything about the management of LIS?

IV. Your Vision for LIS: Evaluation of specific activities/designations

You are almost done!!!! Please finish this section, it is very important. You are one page away from the end of this survey!

19) What is your opinion of the following <u>current/existing uses</u> of LIS?

	Negative, reduce or eliminate	Negative, but willing to tolerate	Neutral	Positive, but at current level	Positive, would like to see more
Recreational fishing	( )	( )	( )	( )	( )
Commercial fishing (no trawls)	( )	( )	( )	( )	( )
Commercial fishing using trawls (a conical fishnet dragged through the water or along the sea floor)	( )	( )	( )	( )	( )
Commercial shellfishing	( )	( )	( )	( )	( )
Shellfish aquaculture/leased beds (i.e., the farming of shellfish)	( )	( )	( )	( )	( )
Shellfishing areas (recreational/public)	( )	( )	( )	( )	( )
Dredge material disposal (for more info. on dredging visit: http://www.epa.gov/region2/water/dredge/)	( )	( )	( )	( )	( )
Sewage effluent disposal after secondary or tertiary treatment (for more info. on sewage effluent visit: http://www.green-ct.org/SEWAGE~1.HTM)	( )	( )	( )	( )	( )
Runoff disposal (for more info. on runoff visit: http://ga.water.usgs.gov/edu/runoff.html	( )	( )	( )	( )	( )
Ferries/ water taxis (transportation)	( )	( )	( )	( )	( )
Shipping lanes	( )	( )	( )	( )	( )
Commerce/ports	( )	( )	( )	( )	( )

Waterfront industries (boat building, repair, manufacturing)	( )	( )	( )	( )	( )
Transfer stations (i.e. for barge transportation or shipping)	( )	( )	( )	( )	( )
Cables, pipelines (gas, etc.)	( )	( )	( )	( )	( )
Power plants	( )	( )	( )	( )	( )
Coastline development for business	( )	( )	( )	( )	( )
Coastline development for housing	( )	( )	( )	( )	( )
Working waterfront (shops, restaurants, etc.)	( )	( )	( )	( )	( )
Party boats (fishing)	( )	( )	( )	( )	( )
Marinas (town)	( )	( )	( )	( )	( )
Marinas (private)	( )	( )	( )	( )	( )
Recreational boating	( )	( )	( )	( )	( )
Military use	( )	( )	( )	( )	( )
Passive recreation (beach going, birding)	( )	( )	( )	( )	( )
Non-motorized sports (kayaking, windsurfing, etc.)	( )	( )	( )	( )	( )
Motorized sports/recreation (jet skis, power boats)	( )	( )	( )	( )	( )
Passive recreation or beach access points	( )	( )	( )	( )	( )
Marine parks/protected areas (for more info. visit: http://www.mpa.gov/aboutmpas/)	( )	( )	( )	( )	( )
Natural areas (wetlands, etc.)	( )	( )	( )	( )	( )
Coastal habitat restoration	( )	( )	( )	( )	( )
Bulkheads/hardened shorelines (for more info. visit: http://coastalmanagement.noaa.gov/shoreline.html)	( )	( )	( )	( )	( )
Dredging bays/harbors (for more info visit: http://education.usace.army.mil/navigation/dredging.html)	( )	( )	( )	( )	( )
Scientific research	( )	( )	( )	( )	( )
Environmental education/stewardship	( )	( )	( )	( )	( )
Other (please specify below)	( )	( )	( )	( )	( )

20) Other (please specify 'other' here for previous question):_____

21) What is your opinion of the following possible future uses of LIS?

	Negative, should not be in LIS	Negative, but might be willing to tolerate if put in LIS	Neutral	Positive, might be ok with it in LIS	Positive, would definitely like to have/ implement in LIS
Algal aquaculture/ seaweed cultivation	( )	( )	( )	( )	( )
Fish aquaculture	( )	( )	( )	( )	( )
Wind energy generation	( )	( )	( )	( )	( )
Wave/tidal energy generation	( )	( )	( )	( )	( )
Energy - nuclear	( )	( )	( )	( )	( )
Energy – natural gas	( )	( )	( )	( )	( )
Energy – waste-to-energy	( )	( )	( )	( )	( )
Mining (sand, minerals)	( )	( )	( )	( )	( )
Liquid natural gas facilities	( )	( )	( )	( )	( )
Marine areas zoned for no-take (very limited use; i.e., just for research, marine preserves)	( )	( )	( )	( )	( )
Marine areas zoned for limited use (e.g., for recreation and other non-consumptive uses, recreational fishing, etc.)	( )	( )	( )	( )	( )
Marine areas zoned for consumptive use (i.e. commercial fishing, etc.)	( )	( )	( )	( )	( )
Marine areas zoned for industrial use (energy, cables, etc.)	( )	( )	( )	( )	( )
Filling of borrow pits (an area where material has been dug -- i.e. sand -- for use at another location)	( )	( )	( )	( )	( )
New energy pipelines/ cables	( )	( )	( )	( )	( )
New telecommunication cables	( )	( )	( )	( )	( )
Other (please specify)	( )	( )	( )	( )	( )

22) Other (please specify 'other' here for previous question):_____

V. Management: Looking Forward

LAST PAGE of Questions - you did it!!!! Thank you for your time, patience, and thoughtfulness. Please answer these questions to the best of your ability.

23) For the following questions, please use your opinion, best guess or rough estimate for % of area used.

	0-5%	5-15%	15-25%	25-50%	>50%	Other
How much of LIS (water, not land area) is currently allocated for habitat/biodiversity conservation/ protection (e.g. marine reserves/parks, limited use areas, protected areas, etc.	( )	( )	( )	( )	( )	( )
What % of LIS (water, not land area) should be allocated for habitat/biodiversity conservation/protection (e.g., marine reserves/parks, limited use areas, etc.)	( )	( )	( )	( )	( )	( )
What % of coastline around LIS should be allocated for habitat/biodiversity conservation/protection?	( )	( )	( )	( )	( )	( )
How much of LIS (open water, not coastline) is currently used for commercial/industrial activity? (e.g. shipping lanes, energy, dredging, cables/pipelines, etc.)	( )	( )	( )	( )	( )	( )
How much of LIS (open water) should be used for commercial activity?	( )	( )	( )	( )	( )	( )
How much of the LIS coastline is currently used for commercial/industrial activity? (e.g. shipping, powerplants, marinas, dredging, cables/pipelines, etc.)	( )	( )	( )	( )	( )	( )
How much of the LIS coastline should be used for commercial activity?	( )	( )	( )	( )	( )	( )

Please explain "Other"

24) Similar to land based zoning plans (spatial planning processes in cities or towns that designates how different area can be used in accordance with a community vision), do you think a comprehensive coastal and marine spatial (CMSP) plan should be implemented for LIS?

(Marine spatial planning is a public process of analyzing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic and social objectives that have been specified through a political process. www.unesco-ioc-marinesp.be/msp_faq)

( ) Yes
( ) No
( ) Not Sure: _____

25) Who should be in charge of management (i.e., have authority to implement, enforce, govern) a coastal and marine spatial planning process for LIS?
(e.g., states, region, federal; specific agencies, organizations or stakeholder groups; the Long Island Sound Study; or any combination thereof)

26) What, in your opinion, might be the biggest impediments/roadblocks to a bi-state (NY and CT) comprehensive marine spatial planning process for LIS?

27) How likely are you to:

	Very likely	Somewhat likely	Neutral	Somewhat unlikely	Very unlikely
Support a marine spatial planning initiative for LIS?	( )	( )	( )	( )	( )
Support a NY and CT bi-state management effort (with implementation authority) for LIS?	( )	( )	( )	( )	( )
Support a comprehensive planning process for LIS?	( )	( )	( )	( )	( )
Be involved in a comprehensive planning process for LIS?	( )	( )	( )	( )	( )

Any comments or feedback on survey? (optional)
Comments/Suggestions/Feedback:
Would you be willing to be involved in any survey follow-up that may include phone or in-person interviews, and more in depth questions?

If Yes, and you didn't include your contact information on the first page, please include it here (name, email or phone #).
( ) Yes: _____
( ) No

Thank You for your time and effort!
Survey Administered by:
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Ph.D. Graduate Student
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Phone: 631-632-8641 , Email: caoconne@ic.sunysb.edu

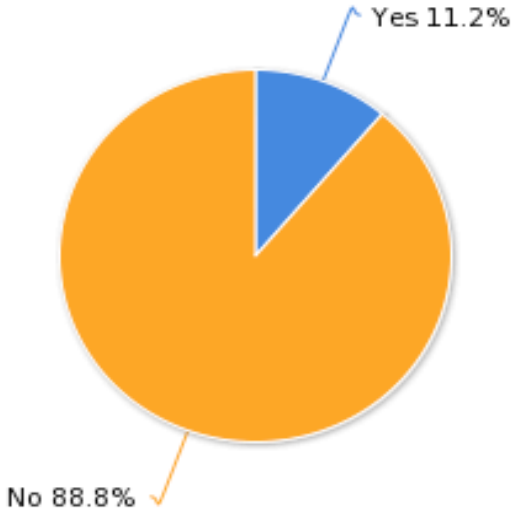
Please feel free to contact me with any comments/suggestions.
Also, if you need paper versions of the survey to mail/fax in please contact me directly.

Appendix 2. *Long Island Sound Stakeholder Survey Results*

2.1 Quantitative Questions

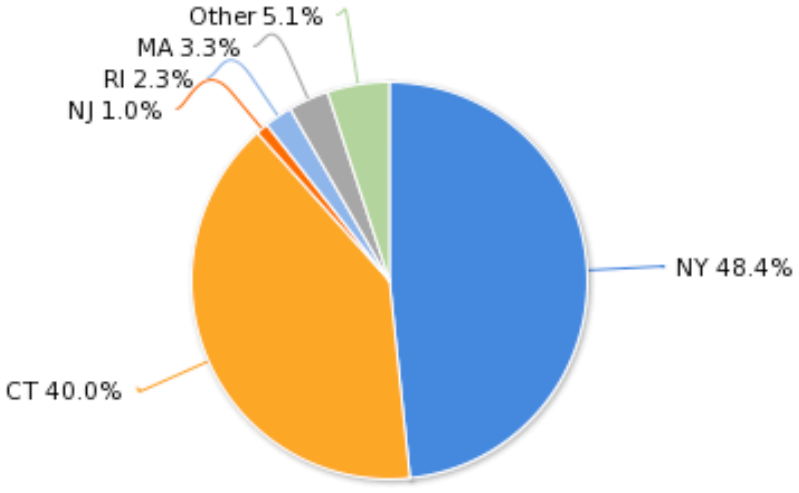
2. Have you taken a previous version (paper, not on-line) of this survey, that was administered this past Fall/Winter 2010? (i.e. the pilot version)

Value	Count	Percent
Yes	44	11.2%
No	349	88.8%
n	*393*	

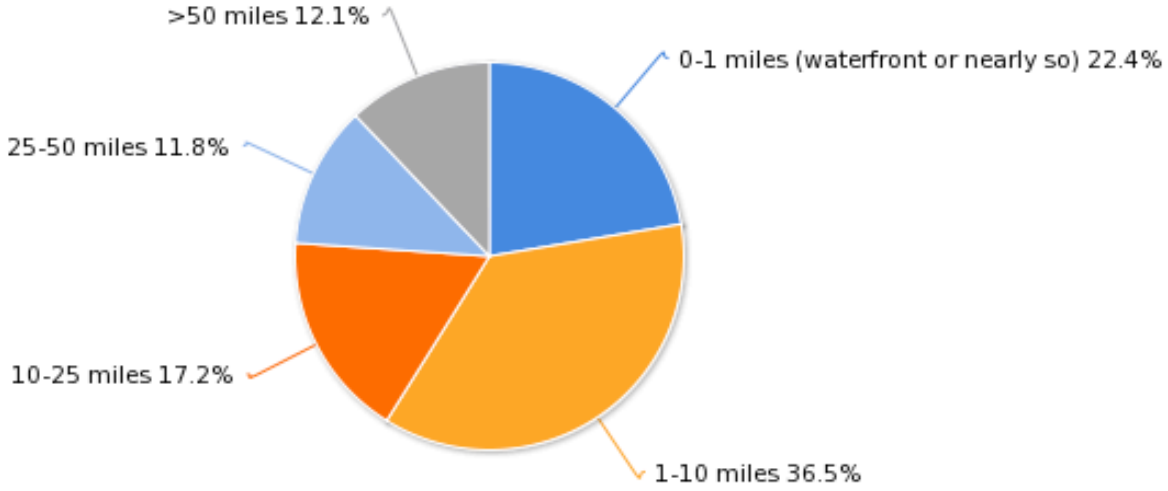


4. In what state do you live/work?

Value	Count	Percent
NY	191	48.4%
CT	158	40.0%
NJ	4	1.0%
RI	9	2.3%
MA	13	3.3%
Other	20	5.1%
n	*395*	

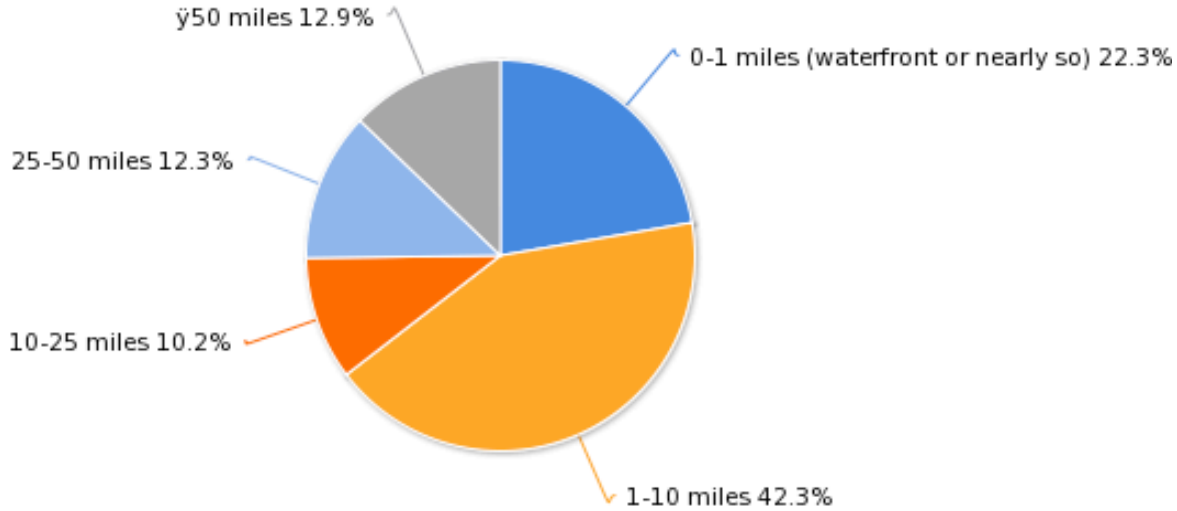


5. Approximately how many miles from LIS is your residence?



Value	Count	Percent	Statistics	
0-1 miles	87	22.4%	n	389
1-10 miles	142	36.5%	Sum	1,962.0
10-25 miles	67	17.2%	Average	7.7
25-50 miles	46	11.8%	StdDev	9.0
>50 miles	47	12.1%	Max	25.0

6. Approximately how many miles from LIS is your place of work?



Value	Count	Percent	Statistics	
0-1 miles	85	22.3%	n	381
1-10 miles	161	42.3%	Sum	1,726.0
10-25 miles	39	10.2%	Average	7.0
25-50 miles	47	12.3%	StdDev	9.3
>50 miles	49	12.9%	Max	25.0

7. What relationship do you most/best identify yourself as having with LIS?

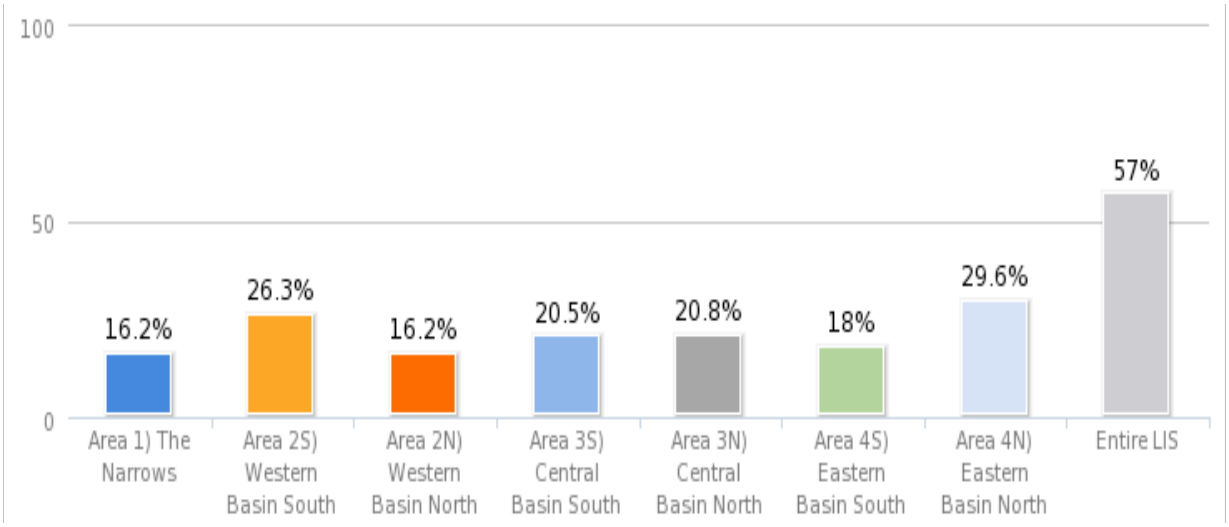
Item	Total Score[1]	Overall Rank
Scientist	352	1
Recreationalist (kayaking, etc.)	237	2
Community resident	226	3
Government official	218	4
Naturalist	190	5
Manager	184	6
Boater	172	7
Educator	152	8
Recreational fisherman or angler	148	9
NGO/Non-profit	139	10
Property owner	98	11
Business owner/operator	50	12
Commercial fisherman	22	13
Industry representative	10	14
Political representative	10	15
Energy/infrastructure developer	8	16

[1] *Score is a weighted calculation. Items ranked first are valued higher than the following ranks, the score is the sum of all weighted rank counts.*

8. Do you think you are well informed on the following:

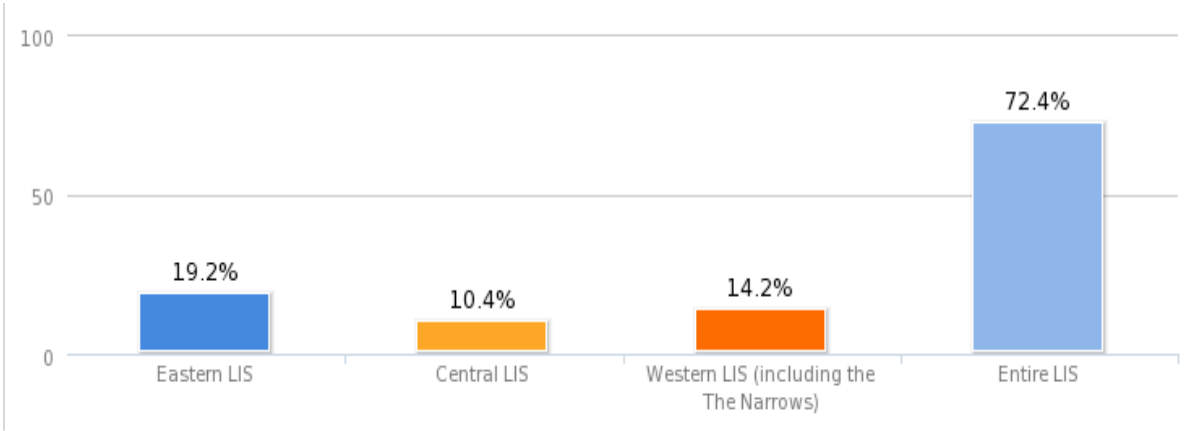
	Not informed	Some knowledge	Fairly well informed	Very well informed	*n*
Management issues in LIS	10.7% 42	28.2% 111	36.4% 143	24.7% 97	*393*
Economic issues around LIS	12.2% 48	42.2% 166	34.4% 135	11.2% 44	*393*
Fishery issues in LIS	11.5% 45	35.6% 140	35.6% 140	17.3% 68	*393*
Ecosystem-based management	11.5% 45	31.8% 124	33.1% 129	23.6% 92	*390*
Coastal and marine spatial planning (CMSP)	27.4% 107	33.8% 132	27.1% 106	11.8% 46	*391*
Regional infrastructure and energy needs	22.0% 86	40.2% 157	27.6% 108	10.2% 40	*391*
LIS community or stewardship efforts	13.8% 54	34.7% 136	32.4% 127	19.1% 75	*392*

9. Using the following map, please identify the areas of LIS that you most often visit, work (or your work impacts).



Value	Count	Percent
Area 1) The Narrows	64	16.2%
Area 2S) Western Basin South	104	26.3%
Area 2N) Western Basin North	64	16.2%
Area 3S) Central Basin South	81	20.5%
Area 3N) Central Basin North	82	20.8%
Area 4S) Eastern Basin South	71	18.0%
Area 4N) Eastern Basin North	117	29.6%
Entire LIS	225	57.0%
Total Responses	*395*	

10. Please indicate whether you are answering the following set of questions for LIS overall, or referring to a specific section/basin of LIS: Eastern, Central, or Western.



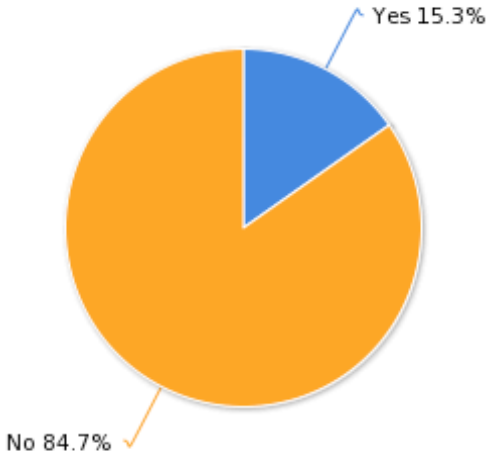
Value	Count	Percent
Eastern LIS	76	19.2%
Central LIS	41	10.4%
Western LIS (including the The Narrows)	56	14.2%
Entire LIS	286	72.4%
Total Responses	*395*	

10. Please rate your opinion of the following statements.

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	n
Water quality in LIS has improved over the past 25 yrs	2.1% 8	10.3% 39	16.6% 63	50.0% 190	21.1% 80	*380*
The ecosystem structure and function of LIS's coastal areas are in good shape.	5.7% 22	53.0% 206	24.2% 94	14.9% 58	1.3% 5	*389*
LIS has a healthy diversity of plants and animals.	1.5% 6	23.6% 92	32.6% 127	35.9% 140	5.4% 21	*390*
LIS has a healthy food web or trophic structure.	2.3% 9	28.5% 111	35.7% 139	27.5% 107	4.4% 17	*389*
Reducing nutrient inputs into LIS has greatly improved its ecological health.	1.3% 5	11.0% 43	21.8% 85	46.2% 180	17.4% 68	*390*
Given current conditions, commercial fisheries will be viable over the next 10 years.	9.8% 38	34.2% 133	28.5% 111	21.6% 84	3.9% 15	*389*
Over the past 25 years, use conflicts have been a problem.	0.8% 3	3.6% 14	17.2% 67	50.6% 197	22.6% 88	389
Currently, use conflicts are a problem.	0.8% 3	4.4% 17	21.1% 82	48.3% 188	20.1% 78	389
Over the next 25 years, use conflicts will be a problem.	0.8% 3	2.8% 11	14.7% 57	44.5% 173	31.9% 124	389

11. Are you involved in a water dependent business on LIS?

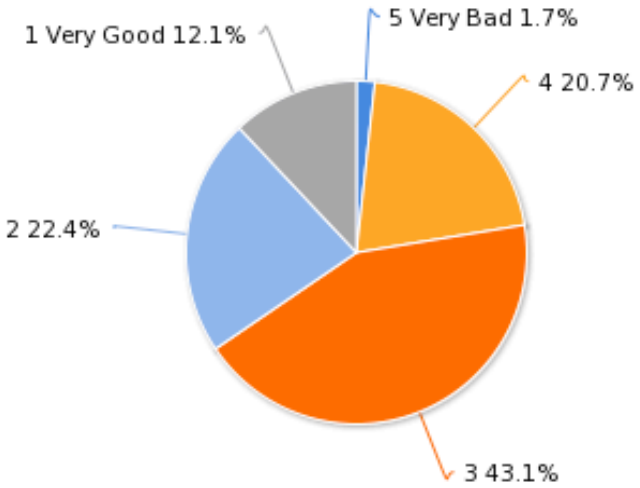
Value	Count	Percent
Yes	60	15.3%
No	333	84.7%
n	*393*	



Do you own the business?

Value	Count	Percen
Yes	26	43.3%
No	34	56.7%
n	*60*	

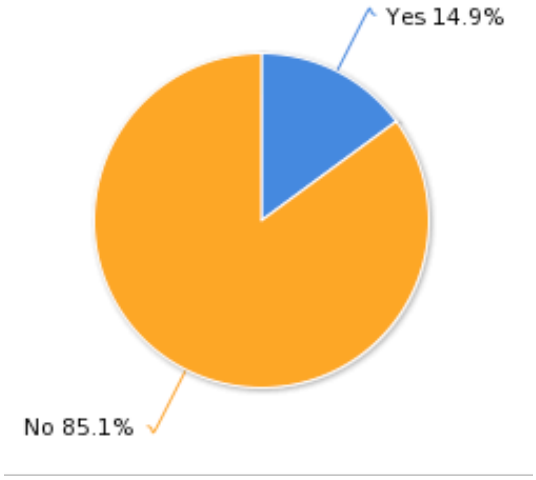
In the next 5 years, what do you think the economic prospect is for the water-dependent business you are involved with?



Value	Count	Percent	Statistics	
5 Very Bad	1	1.7%	n	58
4	12	20.7%	Sum	161.0
3	25	43.1%	Average	2.8
2	13	22.4%	StdDev	1.0
1 Very Good	7	12.1%	Max	5.0

12. Do you have any other direct economic stake in LIS (e.g., waterfront property owner, waterfront/view restaurant, investments, etc.)

Value	Count	Percent
Yes	58	14.9%
No	331	85.1%
n	*389*	



13. Which submerged habitats in LIS are/could be particularly vulnerable to human activities (i.e., may require additional protections)?

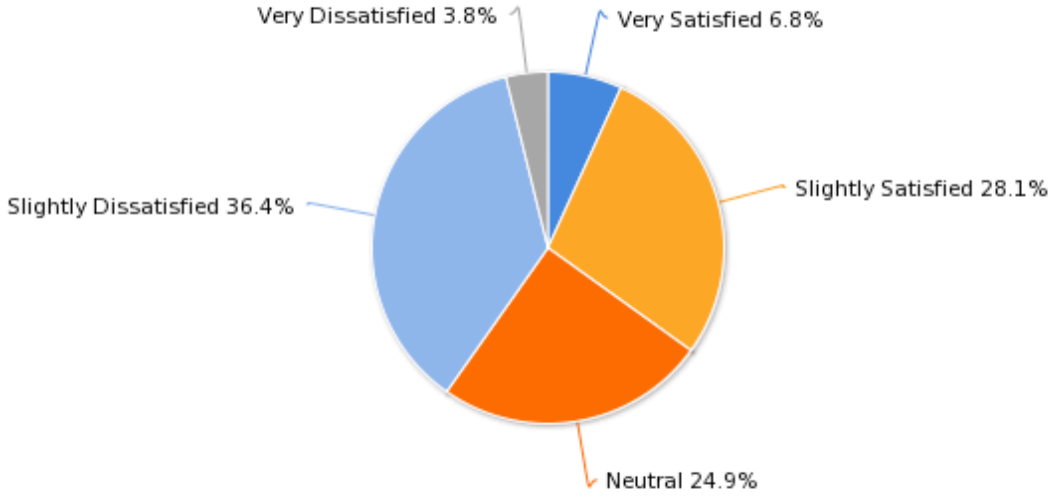
Bottom Type	5.Not at risk or vulnerable	4	3	2	1. Very at risk/ vulnerable	*n*
Sandy bottom	7.6% 12	18.5% 29	29.3% 46	26.1% 41	18.5% 29	*157*
Mud bottom	6.5% 10	19.6% 30	30.7% 47	28.1% 43	15.0% 23	*153*
Clutch bottoms	5.3% 7	9.0% 12	41.4% 55	24.8% 33	19.5% 26	*133*
Eelgrass beds	1.2% 2	0.6% 1	11.0% 18	18.3% 30	68.9% 113	*164*
Boulder/gravel	15.4% 23	30.2% 45	26.8% 40	17.4% 26	10.1% 15	*149*
Open water/pelagic	8.2% 13	14.6% 23	29.1% 46	25.9% 41	22.2% 35	*158*
Bays/harbors	1.8% 3	1.8% 3	12.0% 20	28.9% 48	55.4% 92	*166*

15. How do you personally (i.e., not professionally) value the following services/uses:

	Do not value at all	**Personally don't value, see societal value**	**Neutral: don't feel strongly either way**	**Some-what value**	**Strongly value**	***n***
I. Overall Recreation/ Aesthetic Value	0.3% 1	1.4% 5	3.7% 13	11.5% 41	83.1% 296	*356*
a) Aesthetics (scenic views)	0.3% 1	1.4% 5	3.3% 12	17.8% 64	77.2% 277	*359*
b) Recreational fishing/shellfishing	0.8% 3	10.0% 36	11.7% 42	26.5% 95	51.0% 183	*359*
c) Active Recreation (boating, jet skiing)	2.0% 7	11.7% 42	12.0% 43	29.6% 106	44.7% 160	*358*
d) Non-consumptive recreation (beach going)	0.0% 0	1.4% 5	3.6% 13	16.2% 58	78.8% 282	*358*
e) Public resource/ accessibility	0.0% 0	2.0% 7	4.7% 17	19.6% 70	73.7% 264	*358*
f) Tourism potential	1.4% 5	9.7% 35	20.0% 72	32.5% 117	36.4% 131	*360*
II. Overall Provisioning Services Value	0.0% 0	4.6% 16	25.9% 90	30.0% 104	39.5% 137	*347*
g) Property values	4.4% 16	17.2% 62	33.6% 121	27.8% 100	16.9% 61	*360*
h) Fisheries potential	1.1% 4	6.7% 24	15.6% 56	30.7% 110	45.8% 164	*358*
i) Repository for discards	29.4% 105	23.0% 82	17.9% 64	16.0% 57	13.7% 49	*357*
j) Infrastructure development potential	19.9% 71	32.5% 116	24.9% 89	15.4% 55	7.3% 26	*357*
l) Energy development (non-renewable)	35.0% 125	24.4% 87	18.2% 65	15.7% 56	6.7% 24	*357*
m) Energy development (renewable/green)	4.5% 16	10.6% 38	20.4% 73	35.5% 127	29.1% 104	*358*
n) Commerce or development potential	14.4% 51	30.8% 109	25.7% 91	22.6% 80	6.5% 23	*354*
III. Overall Ecosystem Protective Value	0.0% 0	1.1% 4	6.6% 23	25.4% 89	67.0% 235	*351*
o) Coastal protection potential	0.6% 2	3.9% 14	10.9% 39	25.4% 91	59.2% 212	*358*
p) Env. significance (biodiversity)O	0.0% 0	1.1% 4	6.1% 22	19.0% 68	73.7% 264	*358*
IV. Overall Ecosystem Functional Value	0.0% 0	0.8% 3	7.3% 26	20.3% 72	71.5% 253	*354*
q) Coastal stability (climate control)	0.0% 0	1.4% 5	8.1% 29	26.4% 94	64.0% 228	*356*

s) Spatial ecology (wildlife habitat)	0.0% 0	0.6% 2	6.5% 23	19.9% 71	73.0% 260	*356*
V. Overall Historic/ Educational Value	0.6% 2	4.2% 15	11.0% 39	34.1% 121	50.1% 178	*355*
t) Historic significance	0.3% 1	5.9% 21	16.3% 58	34.8% 124	42.7% 152	*356*
u) Stewardship/ community	0.8% 3	2.5% 9	13.4% 48	34.7% 124	48.5% 173	*357*
v) Research/education	0.3% 1	1.4% 5	8.2% 29	28.5% 101	61.7% 219	*355*
w) Other	13.7% 10	2.7% 2	50.7% 37	6.8% 5	26.0% 19	*73*

16. In general, how satisfied are your with the management of LIS?



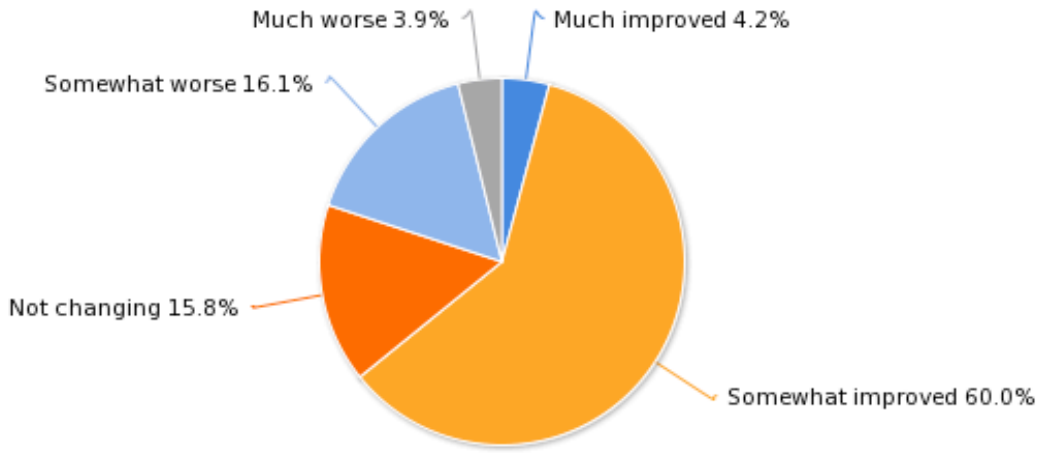
Value	Count	Percent	Statistics	
Very Satisfied	23	6.8%	n	338
Slightly Satisfied	95	28.1%	Sum	1,022.0
Neutral	84	24.9%	Average	3.0
Slightly Dissatisfied	123	36.4%	StdDev	1.0
Very Dissatisfied	13	3.9%	Max	5.0

17. What, in your opinion, are the top 5 most important management issues in LIS. Please rank from 1-5 using the following list. Only 5 choices are allowed.

Item	Total Score[1]	Overall Rank
Water quality	891	1
Non-point source pollution (e.g. runoff, etc.)	879	2
Habitat loss/coastal development	568	3
Point source pollution (e.g., oil spills, etc.)	417	4
Privatization of waterfront/public access	325	5
Loss of biological communities	277	6
Overfishing	268	7
Climate change	256	8
Invasive species	236	9
Cohesive management	214	10
Lack of science	139	11
Public involvement/perceptions	129	12
Dredging	122	13
Alternative energy	90	14
Leasing of bottom lands (e.g., for shellfish beds, cables)	82	15
Loss of working waterfront	82	16
Economic development	43	17
Transportation	43	18
Other	19	19

[1] Score is a weighted calculation. Items ranked first are valued higher than the following ranks, the score is the sum of all weighted rank counts.

18. In general, over the past 10 years, the ecological health of LIS is:



Value	Count	Percent	Statistics	
Much improved	14	4.2%	n	335
Somewhat improved	201	60.0%	Sum	1,154.0
Not changing	53	15.8%	Average	3.4
Somewhat worse	54	16.1%	StdDev	0.9
Much worse	13	3.9%	Max	5.0

21. What is your opinion of the following current/existing uses of LIS?

	Negative, reduce or eliminate	**Negative, willing to tolerate**	**Neutral**	**Positive at current level**	**Positive, would like more**	***n***
Recreational fishing	2.2% 7	5.4% 17	19.6% 62	49.8% 158	23.0% 73	*317*
Commercial fishing (no trawls)	6.7% 21	20.6% 65	31.4% 99	34.3% 108	7.0% 22	*315*
Commercial fishing using trawls	52.7% 165	22.4% 70	15.3% 48	8.0% 25	1.6% 5	*313*
Commercial shellfishing	6.4% 20	17.9% 56	24.3% 76	32.3% 101	19.2% 60	*313*
Shellfish aquaculture or leased beds	6.1% 19	10.2% 32	25.2% 79	24.3% 76	34.2% 107	*313*
Shellfishing areas (recreational/public)	2.9% 9	3.8% 12	23.7% 74	33.3% 104	36.2% 113	*312*
Dredge material disposal	36.8% 116	30.8% 97	17.8% 56	7.6% 24	7.0% 22	*315*
Sewage effluent disposal	31.5% 100	37.5% 119	16.4% 52	9.8% 31	4.7% 15	*317*
Runoff disposal	50.2% 158	31.1% 98	11.7% 37	3.8% 12	3.2% 10	*315*
Ferries/ water taxis (transportation)	0.6% 2	12.1% 38	27.0% 85	36.5% 115	23.8% 75	*315*
Shipping lanes	1.6% 5	16.8% 53	41.3% 130	35.2% 111	5.1% 16	*315*
Commerce/ports	2.2% 7	16.2% 51	35.6% 112	37.5% 118	8.6% 27	*315*
Waterfront industries	3.5% 11	12.1% 38	32.1% 101	31.1% 98	21.3% 67	*315*
Transfer stations	7.7% 24	30.1% 94	37.8% 118	17.9% 56	6.4% 20	*312*
Cables, pipelines (gas, etc.)	19.7% 62	33.8% 106	28.0% 88	15.9% 50	2.5% 8	*314*
Power plants	27.6% 86	40.7% 127	20.2% 63	10.6% 33	1.0% 3	*312*

Coastal development For business	38.5% 121	28.7% 90	17.5% 55	12.1% 38	3.2% 10	*314*
Coastal development for housing	47.6% 150	25.4% 80	17.1% 54	7.9% 25	1.9% 6	*315*
Working waterfront (shops, restaurants)	4.8% 15	20.8% 65	19.5% 61	39.6% 124	15.3% 48	*313*
Party boats (fishing)	2.2% 7	15.9% 50	32.7% 103	35.6% 112	13.7% 43	*315*
Marinas (town)	1.9% 6	11.7% 37	25.1% 79	44.4% 140	16.8% 53	*315*
Marinas (private)	6.0% 19	21.9% 69	28.3% 89	36.2% 114	7.6% 24	*315*
Recreational boating	1.9% 6	6.7% 21	22.4% 70	49.5% 155	19.5% 61	*313*
Military use	15.7% 49	19.9% 62	43.3% 135	16.3% 51	4.8% 15	*312*
Passive recreation (beach going)	0.3% 1	0.3% 1	5.8% 18	21.9% 68	71.7% 223	*311*
Non-motorized sports (kayaking)	0.0% 0	1.0% 3	6.1% 19	21.5% 67	71.5% 223	*312*
Motorized sports/recreation	15.4% 48	28.2% 88	17.9% 56	29.2% 91	9.3% 29	*312*
Passive recreation or beach access points	0.3% 1	1.6% 5	6.4% 20	21.5% 67	70.2% 219	*312*
Marine parks/ protected areas	1.9% 6	1.6% 5	7.0% 22	15.3% 48	74.1% 232	*313*
Natural areas (wetlands, etc.)	0.0% 0	1.0% 3	5.4% 17	9.6% 30	84.1% 264	*314*
Coastal habitat restoration	0.0% 0	1.9% 6	7.0% 22	9.3% 29	81.8% 256	*313*
Bulkheads/hardened shorelines	42.2% 132	21.7% 68	21.1% 66	8.3% 26	6.7% 21	*313*
Dredging bays/harbors	15.0% 47	38.7% 121	22.4% 70	14.1% 44	9.9% 31	*313*
Scientific research	0.0% 0	1.0% 3	7.7% 24	17.9% 56	73.5% 230	*313*
Environmental edu/ stewardship	0.3% 1	1.0% 3	5.1% 16	14.7% 46	78.8% 246	*312*

23. What is your opinion of the following possible future uses of LIS?

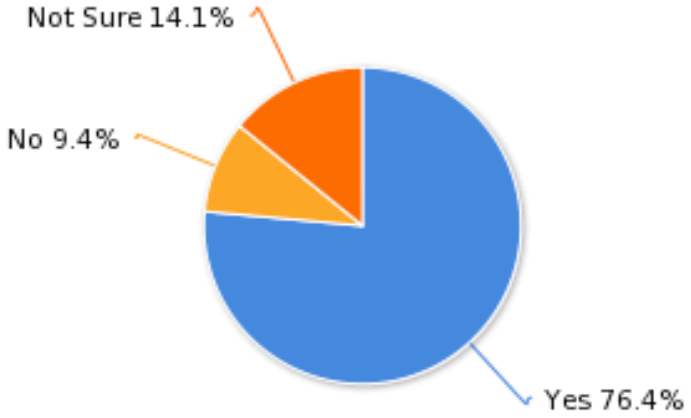
	Negative, not in LIS	Negative, but willing to tolerate	Neutral	Positive, might be ok with	Positive, would like to have	*n*
Algal aquaculture/ seaweed cultivation	5.8% 18	8.7% 27	18.8% 58	40.1% 124	26.5% 82	*30* *9*
Fish aquaculture	12.9% 40	13.2% 41	16.4% 51	40.5% 126	17.0% 53	*31* *1*
Wind energy generation	11.1% 35	13.4% 42	13.1% 41	36.6% 115	25.8% 81	*31* *4*
Wave/tidal energy generation	10.3% 32	8.1% 25	11.6% 36	41.0% 127	29.0% 90	*31* *0*
Energy: nuclear	57.4% 179	13.8% 43	14.4% 45	10.9% 34	3.5% 11	*31* *2*
Energy: natural gas	39.9% 124	27.3% 85	13.5% 42	16.1% 50	3.2% 10	*31* *1*
Energy: waste-to-energy	23.9% 74	22.3% 69	21.6% 67	23.2% 72	9.0% 28	*31* *0*
Mining (sand, minerals, etc.)	56.4% 176	24.0% 75	12.5% 39	6.4% 20	0.6% 2	*31* *2*
Liquid natural gas facilities	59.5% 184	17.8% 55	13.6% 42	7.8% 24	1.3% 4	*30* *9*
Marine areas zoned for no-take	5.8% 18	7.1% 22	11.3% 35	19.7% 61	56.1% 174	*31* *0*
Marine areas zoned for limited use	4.1% 13	5.1% 16	10.2% 32	29.6% 93	51.0% 160	*31* *4*
Marine areas zoned for consumptive use	8.9% 28	18.8% 59	20.1% 63	31.0% 97	21.1% 66	*31* *3*
Marine areas zoned for industrial use	23.9% 74	30.6% 95	19.4% 60	15.2% 47	11.0% 34	31 0
Filling of borrow pits	19.4% 59	16.1% 49	41.8% 127	16.4% 50	6.3% 19	30 4
New energy pipelines/cables	25.4% 49	35.2% 68	21.8% 42	14.5% 28	3.1% 6	19 3
New telecomm cables	23.3% 45	33.7% 65	21.8% 42	18.7% 36	2.6% 5	19 3
Other	12.9% 4	0.0% 0	80.6% 25	3.2% 1	3.2% 1	31

25. For the following questions, please use your opinion, best guess or rough estimate for % of area used.

	0-5%	5-15%	15-25%	25-50%	>50%	*n*
How much of LIS (water, not land area) is currently allocated for habitat/biodiversity conservation/protection	53.3% 154	30.1% 87	13.1% 38	2.4% 7	0.3% 1	*289*
What % should be allocated for habitat/biodiversity conservation	4.8% 14	16.2% 47	35.1% 102	27.5% 80	15.8% 46	*291*
What % of coastline around LIS should be allocated for habitat/biodiversity conservation?	4.2% 12	14.5% 42	33.6% 97	29.1% 84	18.0% 52	*289*
How much of LIS (open water, not coastline) is currently used for commercial/industrial activity?	9.0% 26	31.5% 91	23.9% 69	22.5% 65	12.5% 36	*289*
How much should be used for commercial activity?	12.5% 36	40.4% 116	28.6% 82	12.9% 37	4.5% 13	*287*
How much of the LIS coastline is currently used for commercial/ industrial activity?	9.0% 26	37.2% 107	27.1% 78	19.8% 57	6.6% 19	*288*
How much should be used for commercial activity?	16.3% 47	44.3% 128	28.0% 81	10.4% 30	0.3% 1	*289*

26. Similar to land based zoning plans (spatial planning processes in cities or towns that designates how different area can be used in accordance with a community vision), do you think a comprehensive coastal and marine spatial (CMSP) plan should be implemented for LIS?

Value	Count	Percent
Yes	227	76.4%
No	28	9.4%
Not Sure	42	14.1%
n	297	



29. How likely are you to:

	Very likely	Somewhat likely	Neutral	Somewhat unlikely	Very unlikely	*n*
Support a marine spatial planning initiative for LIS?	56.4% 171	23.8% 72	10.6% 32	4.6% 14	4.6% 14	*303*
Support a NY and CT bi-state management effort (with implementation authority) for LIS?	52.8% 160	30.0% 91	7.9% 24	5.3% 16	4.0% 12	*303*
Support a comprehensive planning process for LIS?	64.6% 195	22.8% 69	7.6% 23	1.3% 4	3.6% 11	*302*
Be involved in a comprehensive planning process for LIS?	29.7% 89	34.7% 104	19.7% 59	8.7% 26	7.3% 22	*300*

30. Would you be willing to be involved in any survey follow-up that may include phone or in-person interviews, and more in depth questions?

Value	Count	Percent
Yes	158	61.5%
No	99	38.5%
n	*257*	

2.2 Qualitative Questions

17. What, in your opinion, are the main spatial or temporal (time, seasonal) conflicts in LIS? (e.g., what uses might interfere with how you use or would like to see LIS used)
Include up to 3 conflicts

- Access to water front / lack of public lands
- Aquaculture with recreational boating
- Broadwater redux
- Coastal Development
- Cable pipeline construction
- Climate change and variability
- Coastal development
- Coastal development conflicts with public access and water-dependent use
- Commercial development and energy development and habitat protection and conservation
- Commercial fishermen spatial/temporal conflict with recreational uses
- Commercial fishing
- Commercial netting of any fish species
- Commercial vs. recreational
- Commercial vs. recreational fishing
- Commercial overfishing

- Conflict between humans and wildlife use during key nesting times
- DEP arbitrary fish spawning dates- would like scientific data for backup
- Development of waterfront vs. habitat and public access
- Difficult to reduce nitrogen loadings in effluent from WPCPs (Water Pollution Control Plants)
- Dredge material management restrictions
- Dredging
- Ecological Disasters
- Energy facilities locations
- Energy issues - pipelines, proposed Broadwater project defeated
- Federal management vs. the health of the species
- Fishing access vs. privatization
- Hardening of the coast/loss of beach and public access
- Heavy poorly regulated barge traffic - particularly night time boating
- High nitrogen discharges causing algal blooms
- Hypoxia
- I am opposed to anything that would reduce shorebird/waterfowl use of LIS.
- Impact of adjoining land uses and ecological health of sound
- It is a long distance from my home.
- LG terminal
- LIS as a receiving water body for wastes vs. most other uses
- Major economic players (Electric Boat, Pfizer, Sub Base) relatively unregulated
- NIMBY and shellfish aquaculture
- Nutrient loads
- Pollution
- Poor water quality so I can't swim or harvest shellfish during certain times of year
- Private development
- Private ownership of waterfront vs. Public access
- Privatization of water front
- Privatization of waterfront/public access
- Public access/private property
- Public vs. private access (would like to see public access increased)
- RESIDENTIAL DEVELOPMENT OF WATERFRONT PROPERTY
- Recreation and ecological conservation of sensitive coastal resources
- Residential and commercial development
- Residential and commercial vs. water-dependent coastal development
- Residential docks
- Responses to sea level rise, e.g. natural or man-made adaptation methods
- Sewage plant discharge
- Sewage runoff
- Sewage treatment and eutrophication
- Spring increases in use versus wildlife/fishery spawning periods.
- Spring through Fall recreational boating
- Swimming/bathing water
- Tapping into the natural gas below the LIS would have a negative impact.
- Use of LIS as a "universal lagoon" for disposing of non point source pollutants.
- Use of intertidal & shallow sub tidal zone
- Use of the Sound as a borrow area for beach nourishment
- WIND FARMS
- Waste water processing (poor quality)
- Water Quality
- Waterfront access to public trust resources such as intertidal zones
- Waterfront community NIMBY
- Waterfront homeowners and recreational users (anglers, hunters, shellfish harvesters, etc.)

- Access
- Algal blooms
- Between waste reception and water quality
- Bi-state control
- Boaters and fishers
- Climate change
- Coastal development vs. habitat protection
- Commercial harvesting of shellfish that we release for restoration purposes
- Commercial vs. recreational fishing
- Commercial fishing within LIS needs to be monitor more, e.g. spot-checking and quote.
- Continued waterfront development - condominiums etc.
- Creation of LNG facility in LIS
- Development pressure vs. public access
- Development pressures and nonpoint source pollution
- Dredged material disposal and public perception
- Dredging
- Economic interests often conflict with ecologic ones
- Energy development
- Energy development and/or infrastructure
- Energy facilities
- Energy siting
- Fisheries
- Fishery management vs. dredging (accurate windows)
- Fishing and other uses
- Fishing/hunting
- Flood caused by climate change
- Habitat loss
- Habitat protection vs. recreational uses
- Habitat protection/conservation
- Hypoxia late summer
- Inability of NY and CT to get on the same page
- Increased wind probably caused by climate change
- Industrial development
- Industrialization
- Kayaks vs. motor boats
- Lack of coordination of cohesive management of LIS
- Land use conflicts
- Land-use-waterfront construction
- Larger oil tankers requiring offshore transfer of loads, increasing opportunity for spills
- Leasing bottom and recreation
- LIS still polluted in queens area
- Lobster fishery
- Motor boaters/jet skis vs. more passive LIS recreational uses (e.g., birding)
- Near-shore and shallow-water development impacting nursery & forage habitat, water quality
- Need secure access to NYS wetlands for waterfowl hunting during hunting season
- Nesting habitat, beach goers
- Non point source pollution vs. ecological diversity
- Non-renewable energy development
- Off road vehicles and ATVs
- Over development vs. natural habitats
- Overfishing
- Pathogens and swimming - i.e., beach closures in Huntington Bay
- People viewing it from a utilitarian point of view vs. keeping it healthy for its own sake

- Personal watercraft intrusion in sensitive marsh areas
- Pipe line issues
- Pollution runoff
- Power lines
- Private shoreline development restricting access
- Private tourist development and public access
- Privatization limiting access
- Privatization of coastline
- Property values rising to cut off access
- Public vs. private access
- Public vs. private use
- Receiving runoff and effluent, especially CSO's
- Recreation in coastal embayment's and tidal rivers
- Reduction of nutrients
- Run off is still an issue
- Runoff from lawns introduce nitrogen leading to reduced oxygen levels and hypoxia
- Shellfish bed leasing
- Shorefront development vs. habitat protection
- Shoreline development, including development in floodplain and storm surge areas
- Shoreline development/area for wetland retreat
- Summer
- Too much congestion
- Too much privatized development
- Transportation of hazardous materials (oil spills, etc.)
- Upland development disconnection from LIS resources by decision makers
- User conflicts
- Very limited access to the resource
- Water pollution from point and nonpoint sources
- Waterfront access
- Waterfront development and coastal resource protection
- Waterfront development and habitat areas
- Important habitats are not respected by the general public. More protections are needed, such as marine zoning.
- Oil spills would significantly interfere with my use and others regarding enjoyment of beaches not to mention the havoc such an event would cause on entire coastal ecosystems.
- Public access to coastal properties for recreational use (both passive and active recreational use vs. private property inaccessibility.
- Campers or visitors to islands leaving filth conflicting with other visitors/campers who do not. Debris removal is a huge problem.
- Loss of recreational opportunities with loss of biological communities from declining water quality; use of LIS as a dump for residential/municipal wastewater
- Overdevelopment of coastal residences threatens to displace all other uses of LIS, particularly coastal resources, water-dependent uses, and public access.
- Commercial entities given priority, lack of recognition of importance for other than commercial purposes
- Wastewater effluent increases and water quality degradation vs. public recreation (swimming/shell fishing)
- Watershed /coastal land preservation and greening in order to increase value of ecosystem services provisioning
- Obnoxious recreational users (jet skis, loud fast powerboats with non-obnoxious users (bathers, sailors, swimmers, divers, fishermen).
- Receiving sink for Connecticut sewage treatment plant effluents and poor flushing capacity "lake-like"
- More water transportation - ferry (area wide) & water taxi (local park systems, even between towns)
- The leasing of areas for energy staging (LNG) or energy production (wind) will conflicting with just about anything. I'll take wind.
- Much of the coastline is restricted access; i.e., a small relative percentage of the shoreline is publicly accessible.

- Decision makers involved with outer ring development of upland watersheds that are disconnected from impacts to LIS
- Commercial fishing and marine trades (marinas, boat repair and storage) are in danger of being spatially removed to build condos and water-view restaurants.
- Too many nitrogen containing chemicals dumped in the watershed area for the western and central LIS
- Restriction of access resulting from the closure of public facilities due to poor economic conditions
- Dredging not being done timely because of limited windows (conflict with supposed habitat protection)
- Impact of development on groundwater hydrology and quality, reducing the clean water discharge that sustains stream base flow and nutrient cycling - and affects water quality and aquatic habitat quality
- Hypoxia conflicting with the maintenance of marine life, e.g. lobster and finfish populations/utilization
- Impact of development on water quality and its impact to chemical and biological habitat characteristics
- Using LIS as a waste repository rather than as an ecosystem capable of providing sustainable biological diversity
- Aquaculture e.g. fish and oyster farming in contained cages, as had been proposed in Westport several years ago
- Privatization through development, etc. of limited/finite shoreline and near shore areas and resulting impairments/losses of public access to resources and functions and values of resources of
- Non-point source discharges in LIS (I didn't list this above since it is included as a water quality issue) will continue to increase and place greater stresses on an already stressed environment
- Go to a 1$ store and find pesticides for sale, people "need" their green grass but terrible for water.
- Breeding & reproductive periods of wildlife during the spring/summer, the busy season for activity on the LIS
- ANY USE THAT EXCLUDES THE PUBLIC USE OF LIS, GAS TERMINAL
- Alternative energy uses such as windfarm being created in LIS
- Boat use, fishing, with resulting pollution and trash
- Boating
- Cable/pipeline corridors
- Coastal property owners conflict with natural erosion
- Commercial Fishing versus sustainable fisheries and ecological balance.
- Commercial uses
- Conn. needs to be heavily managed; NYS seems to be leading the efforts.
- Cost of water treatment
- Cumulative impacts of multiple activities
- DEC not interested in best management practices, or scientific input on better management
- Desire for waterfront property vs. impacts on the health of the Sound
- Development and habitat protection
- Development in the watersheds v loss of habitat & increase of non-point source pollution
- Development of coastal areas that lead to pollution
- Development of renewable energy and competing uses
- Development vs. loss of habitat & non-point pollution
- Discharge of polluted water, etc. vs. ecological health of sound
- Dragging - dangerous to recreational boaters (and destroys habitats)
- Dredging (unsure best approach, but this topic causes much controversy)
- Dredging/dredge material disposal
- Energy development
- Energy development vs. ecosystem health
- Fisheries Management
- Gentrification of the working waterfront
- Hard armoring of shoreline to protect property vs. keeping beaches and wetlands from disappearing
- I am opposed to anything that would reduce breeding success of shorebirds and waterfowls in LIS.
- I do not have a problem with cables or with LNG plants
- Increase in summer population/public use versus water quality effects (stagnation)
- Intensive private property development
- LNG PLATFORMS
- Lack of access

- Lobstermen and Vector Control agencies
- Motorized uses vs. more passive uses.
- Naive environmental enthusiasm
- Over fishing
- Over use of LIS waters and sediments
- Overharvesting
- Poor management of the Bureau of Aquaculture
- Public access and development
- Recreational and residential use vs. commercial and water dependent uses
- Reducing nutrients in eastern LIS does not help reverse eutrophication in western LIS
- Runoff
- Sea level rise adaptation -- demand for sea walls
- Storm water and local runoff into streams and rivers from inland communities
- Too many recreational boaters
- Transportation corridors (i.e., access blocked by railroad)
- Transportation infrastructure
- Uninformed public about LIS protection conflicts with sustaining healthy ecosystems
- Unrealistic expectations of nitrogen management to cure summer hypoxia
- Zoning that restrict public access to beaches
- Active vs. passive recreational boating
- Aquaculture
- Availability of public vs. private waterfronts
- Between energy needs and habitat quality
- Boating vs. aquaculture
- Budget cuts vs. sewage control
- Coastal development
- Commercial fishing
- Commercial vs. public fishery
- Commercial vs. recreational uses (e.g. areas for aquaculture vs. public recreation
- Development or degradation of habitat
- Development pressure vs. habitat loss
- Development vs. preservation
- Disposal and water quality
- Economic development
- Economic opportunities vs. public access
- Energy development
- Energy pipelines/cables development on in-water resources
- Energy uses that limit access and may jeopardize LIS viability
- Excessive watercraft on holidays and weekends
- Exploitive corporations
- Fish farming vs. natural systems
- Fixed fishing gear
- Government (NYSDEC) resistance to restoration efforts, instead of assistance
- Habitat for non-native ocean plant life
- Habitat restoration
- Hardened coastline
- If the fishing get bad
- Incomplete sewage treatment
- Increased nonpoint source pollution
- Increased stormwater flow discharges vs. changes in inshore habitat/ecosystem water parameters
- Increasing population
- Insufficient water treatment to control runoff
- Lack of long term monitoring data

- Lack of respect for environment-people and corporate
- Limited public access
- Limited public water access for fishing
- Long-term sea-level rise with the maintenance of certain biological communities
- Need for dredging but lack of disposal area
- Non-point pollution reduction
- Non-renewable energy and cables vs. fishery/public access/shellfishing
- Pipelines
- Polluted coastal areas
- Pollution from runoff
- Pollution/water quality
- Preservation of open space and access to that open space (e.g. birds versus people).
- Preservationist agenda to close access to public
- Private ownership vs. public access, especially with State budget cuts
- Private/municipal restrictions on public access
- Public access to The Sound
- Public benefits (cable, pipes, etc.)over uses of sea floor and sustainable ecosystem
- Public perception that the water is dirty when beaches are closed after significant rain
- Red tide in Huntington Bay/Northport complex
- Runoff from roads introduces sand and sediment that choke out shellfish
- Shipping
- Shoreline hardening
- Spring
- Stormwater management (lack of)
- Tourism/views/aesthetic
- Unleashed dogs
- Urbanization
- Use of jet skis, cigarette and other fast motor boats
- Water quality
- Water quality and pollution
- Water quality, shellfish harvesting
- Waterfowl hunters vs. more passive LIS recreational uses (e.g., birding
- Wildlife observation/study
- Commercial tanker and barge travel with up the north shore of Long Island into all Harbors. There discharge
- Climate change and sea level rise will cause loss of resources directly or by prompting a shoreline armoring response
- Transportation corridors that spread invasive species, both on land and marine terminals (roads and ports vs. ecosystem health)
- Increased desire to use LIS for non-water-dependent uses (Broadwater LNG in past, wind energy facilities, tidal energy (similar to Verdant in NYS/East River), etc.
- Internal conflicts among extraction industries: (all fisheries -esp. with fixed gear, sand/gravel) and other commercial uses (energy, transportation)
- Sewage treatment plant discharge into LIS puts ecosystem, fishing and recreational uses in danger unless it is perfect.
- Future energy needs and energy infrastructure placement in LIS (i.e. wind or tidal turbines and cable lanes) impacting shellfish beds and other benthic habitat.
- Lack of incentives for towns on Long Island to improve enforcement of their Local Waterfront Revitalization Plans
- Limited access due to people being given rights to block off access beach in front of their homes or businesses
- Conflict between maintaining healthy benthic habitats and making siting decisions for projects such as energy infrastructure, aquaculture, commercial/recreational boat use
- Watersheds are near capacity and all that can be done should be to minimize the upland effects on water quality.
- Receiving sink for NYC raw sewage discharges from combined storm/sanitary sewers during storm events

- Overfishing of bunker and other lower chain foods, reducing stocks of larger sports/game/predator fish
- Continued development and 'hardening' of the LIS shoreline in lieu of preserving existing developing shoreline capable of allowing in the inland migration of natural communities as sea levels rise
- Urban, transportation, and industrial infrastructure that is ecologically damaging and/or non-sustainable
- High saltwater bacteria counts now presently close many CT beaches in the summer and impact thousands during this short season.
- Development must be well planned to ensure the continuance of sufficient public access to the waterfront for recreation
- Use of sound to discharge sewage and to dump contaminated materials with recreational, fisheries and habitat uses.
- Potential sea-level rise and conflicts that will arise to protect shoreline property will result in filling and hardening of increasing amounts of shoreline

25. Who should be in charge of management (i.e., have authority to implement, enforce, govern) a coastal and marine spatial planning process for LIS? (e.g., states, region, federal; specific agencies, organizations or stakeholder groups; the Long Island Sound Study; or any combination thereof)

Response
- A separate authority/entity
- Multi-state agency for LIS
- A broad compact
- A combination of all of above mentioned groups
- A combination of all these groups.
- A commission consisting of the relevant states, federal agencies, LISS
- A non-profit similar to TNC or Save the Bay.
- All of the above with local agencies having the controlling vote.
- An organized group made up of stakeholders, state authorities and scientists from the region
- Any combination
- Any management needs to be done on a regional basis.
- Bi-state regulatory agency
- Both CT and NY state coastal zone management agencies
- CT DEP and NY equivalent jointly.
- CT and NY state gov't
- Coalition of all parties
- Combination of Federal, state, local
- Combination of State, Federal, and LISS
- Combination of state and region.
- Combination of users
- Combination. Lead by states or feds with seats for regional, stake holder and NGOs
- Coordination by Federal and State governments, but everyone should be involved.
- DEC or EPA
- DEEP and EPA and USFWS and NOAA
- DEEP/EPA
- DEP
- Federal
- Federal and stakeholder groups
- Federal government. Maybe USF&WS or NOAA
- Federal or specific marine agencies
- Feds
- Feds or someone who can't take campaign contributions.
- Feds with stakeholder groups input. The State & Region govt would probably just screw it up.
- Fisheries management councils
- IF it happens the states should manage

- If we must...a combination.
- It would need to be combination of state local and federal agencies in both CT and NY
- Joint venture for state bodies
- Jointly by state, federal and regional agencies + stakeholder groups like LISS + individuals
- LIS study
- LISS
- LISS I don't see how you are suppose to enforce a planning process?
- LISS & States
- LISS in conjunction with all of its partners
- LISS, due to their broad partnership with other interested parties
- LISS; state or federal to avoid parochial special interests
- Local governments in coordination with the Long Island Sound Study.
- Local/region
- Long Island Sound Study
- Long Island Sound Study + Regional government group
- Long Island Sound Study, with state and federal involvement
- Long Island Study + stakeholder groups
- Most agencies have there own agendas that benefit their own interests and not those of everyone.
- NOAA
- NY, CT and federal agencies
- NY, Conn., Federal. Coordinate with LISS
- Need a regional council made up of representatives from each of the groups mentioned above.
- Organization groups, not NYS.
- Panel of state, federal and private stake holders
- Parks Services
- Primarily municipalities
- REGION
- REGIONAL AUTHORITY FROM NY AND CT
- RFA
- Region
- Region, specific agencies and stakeholder groups
- Regional
- Regional (CT+NY)
- Regional Agency with power to implement
- Regional Commission including state & federal
- Regional authority composed of local, state, and federal partners.
- Regional management board consisting of all of the above
- Regional or federal agencies; regional management authority comprised of various stakeholders.
- Regional organization
- Regional stakeholders group
- STATE
- Should be a combination of all stakeholders
- Specific agency
- Stakeholders
- State
- State Coastal Management Programs
- State DEC agencies in coordination with stakeholder groups
- State DEEP
- State and Federal
- State and Federal regulatory agencies
- State governments
- State with input from local and federal
- State, not local towns. LIS is a state resource not shore town privilege

- State/Federal/LISS
- State/Federal/Regional/LISS
- States
- States and regional agencies
- States and stakeholder groups
- States both NY and CT in harmony with each other or forget it.
- States if they can all get together and agree on regulations.
- States or region, depending on the shared coastlines.
- States with LISS, science and stakeholder group input
- States coordinated by LISS.
- States, federal.
- States, feds
- States, region and DEP
- States, specific agencies (i.e., Nature Conservancy), LIS Study
- States/federal Gvmt
- That is the scary part---Who????
- The Coastal States (NY & CT) and the Federal Government.
- The states along with federal agencies with local and regional input.
- Towns and states
- Working Group Fed/States/stakeholder groups ala LISS
- Wouldn't know who to trust
- A combination of all of the above
- A consortia of stakeholders
- A fed state authority
- A type of regional harbor management agency
- All interested agencies coordinated at the federal level
- All of the above
- All of the above in varying degrees - form a coalition representing all entities
- All of the above.
- Bi-state (CT/NY) commission
- Bi-state management agencies with federal oversight
- Combination
- Combination of all of the above
- Combination of all stakeholder groups managed by a board made up of representatives from each.
- Combination of fed, regional, LISS, state and org.
- Combination of federal & state agencies.
- Combination of organizations, stakeholder groups, long island sound study, region
- Combination of state and LIS study
- Combination of states in the region
- Combo of LISS, states, and stakeholders
- Combo of fed, state, and NGO / stakeholder groups
- Combo of state, federal & citizenry groups all working together
- Commission of federal (i.e., EPA), state, and local representatives
- Don’t know enough to weigh in right now.
- Each state
- Federal State Partnership
- Federal
- Federal (NOAA); stakeholders; academic scientists
- Federal and state level
- Ideally combination of federal, regional, state managers plus LISS with input from stakeholders
- Intrastate compact
- Local environmental groups, county, federal
- Local governments using guidance from the LI Sound Study and states

- Long Island Sound study with federal oversight
- More importance given to habitats, natural areas.
- More scientists should be consulted and fewer industrial interests accommodated
- One agency which has stakeholder members from both states bordering the sound
- Organizations and stakeholder groups in conjunction with specific agencies
- Organizations or stakeholder groups; the Long Island Sound Study
- Oystermen
- Recommendations by LISS, enforcement by States.
- Region
- Region
- Region and the Long Island Sound Study
- Region group
- Regional authority
- Shoreline town residents under a state regulatory agency e.g. DEP, Public Health
- Some combination
- Stakeholder committee including states/region/federal + specific agencies + non-profit + LISS
- Stakeholder group
- Stakeholder groups
- State level
- States
- States LIS Study
- States and federal government
- States and feds
- States and local governments
- States have responsibility but the LISS could be a good forum to do it
- States with significant input from stakeholder groups/LISS
- States,
- States, region, federal -- a combination
- The local chapter of the nature conservancy
- Whoever funded this market research? Ahem.
- Commission consisting of Federal, State, Town and at-large representatives (say non-profit/NGO, conservation organizations and Universities).
- LIS CMSP should be a bi-state collaborative runs through the LISS, but each state must have ultimate control over activities in its state waters.
- Possibly the regional planning agencies with towns adjacent to LIS (although they are mostly transportation based); spatial planning does not stop at State lines, and we should be planning with NY and RI too.
- The states of CT and NY should be in charge of developing, implementing, overseeing, and enforcing a coastal and marine spatial plan for LIS.
- Federal regulation would be the only means of overcoming parochial interests of the states, I suspect.
- See NY Coastal Management Program/LIS Coastal Management Program. Also see existing legislation (municipal, State, federal) regarding means for implementing "ocean space utilization", or plain old "planning and zoning 101 on the water", which folks now refer to as "marine spatial planning and zoning". NY and its municipalities already have the authorities to do this (see NYS Executive Law article 42, in its entirety, and NYCRR Part 603, relating to "harbor management plans" - which can be extended all the way to the NY and CT state lines in mid-Sound - and structures and uses in areas offshore of the shoreline. Bear in mind that every state with water quality classifications and standards has already "zoned" its waters to some degree - as they include "use" standards that should but have not been applied properly to achieve the desired results of those classifications. For example, a new marina, whether it pollutes or not, does not belong in a Class SA body of water (that classification and its "best use" is for shellfishing and marketing and direct consumption of shellfish from that area) because the area encompassed by and adjacent to the marina must be shut down to shellfishing. Those are two competing uses, and when in the same area result in conflicts between those important uses. They must be separated to achieve the may benefits achieved by both, with neither impairing the other. Add municipal and NYS vessel speed and anchoring and general operating restrictions in certain areas, and existing dredged channels and "marked" navigation and other lanes offshore, and existing "corridors" for transmission

lines/pipelines/cables, and dredged materials disposal areas (to be eliminated over time), and swimming and other recreation area....and you'll see many areas have already been zoned for specific uses. This is NOT new. The task is help folks in government, academia, industry; special interest groups, etc. understand this and make more sense of it. DO NOT try to "reinvent" it, as that alone is and will take years. Instead get folks to understand this and apply it. Properly. It's been tested and has succeeded. GO with it...

- LISS and outside stakeholder groups (outside of the LISS CAC-- I do not think that group fully represents LIS stakeholders)
- I think states, region, and federal agencies should have authority to implement, enforce, govern, but all the organization mentioned above should be involved in the development of a coastal plan.
- Difficult to say. State, county and local governments have poor history of working collaboratively. At this point, probably only the two states have enough authority to implement and enforce. However, in NY, there is not enough trust between state and town governments and some towns don't really want to actually enforce anything - particularly if they have to shoulder cost of implementation. Most politicians in office right now are too responsive to the people owning waterfront property who pay the highest taxes AND don't make connection between their actions and the impacts of those actions on the estuary. As long as waterfront property owners are the biggest "rate-ables" in local towns, they will hold sway over actual implementation of any estuary protection strategy.
- Consortium of all of the above. Federal, State and local agencies/scientists and engineers, with organizations and stakeholder groups, Universities doing research, and the LISS.
- Note: can't answer % questions above because that is not a reasonable criteria for establishing/ not establishing those activities. Spatial planning should be undertaken by state and regional planning agencies who are given the resources to carry out the process thoroughly and
- Regional organization (e.g. Cape Cod Commission that has authority to enforce rules). All towns need to be in agreement - difficult to create.
- The states of New York and Connecticut, the NOAA/EPA/WFS/USGS, Waterkeeper, & Stony Brook University should all be included in the process
- Partnership of all the above. Prefer state+tribe+ fed authority & Regional entity implementation plus extensive dialogue with organizations, stakeholders, and municipalities.
- A collaborative group of local, state, federal and non-profit partners with significant input from the public stakeholder groups.
- A new federally created Commission, similar to the California Coastal Commission or the San Francisco Bay Commission should be established, that would have the authority to override bad local zoning decisions-- the ones that gave us the current problems we are now dealing with.
- If there was an elected board from all the user groups, that might work. Then again, we've tried that at the Federal level, and obviously it doesn't!
- Combination; key is that management be science-based, transparent, accountable to stakeholders and public
- Should come under a federal or regional authority (e.g., LISS) with approvals by states and wide stakeholder involvement
- Not sure, you would need someone with a non-boating back ground to be correct and not abuse issues
- Combination of NY & CT representatives from LIS border communities with organizations and stakeholders including LIS Study. NOT selected by Hartford and Albany.
- Not sure, there is too much agenda driven money being given to some many stakeholder groups that it is hard to say at this point who should be in charge
- Federal and state with long island sound study consultation in collaboration with stakeholder groups
- Something like the Peconic Estuary Program - partnership between federal, state, county, and stakeholder groups.
- A combination of user groups including states, federal, specific agencies, organizations and stakeholder groups
- Scientists, specific organizations and the LIS Study - working together for the best possible planning and implementation of such plans for the use of the Sound, and its protection and sustainability for the future.
- First, UCONN should be in charge of mapping all the uses; then all the stakeholders should "zone" it like a Town Plan and then DEEP should be in charge of administration and enforcement.
- Since LIS is state water (NY and CT), the lead for a plan must have strong support and commitment from states, LISS can provide support for the planning process.

- A combination of states, federal, NGOs, universities and stakeholder groups. The only way to get buy-in from competing users is the bring them all to the table.
- State or region, with input from groups that have done research on the biological and economic activities in Long Island Sound
- A combination of local government, NGO, residents, business owners to develop plans that address all needs. Voting rights to the area residents most impacted by the proposed use of the land.
- Region and Federal - stakeholder groups are ill-defined, and usually mean that commercial entities who shout the loudest get sway
- Guidelines should be established on state level; coastal planning should be conducted on local (municipal) level; marine planning should be implemented on state level.
- Everyone should have a say, but local businesses that depend upon the sound and state residents who use the sound need to be a major part of the decision process. As American citizens, the sound is ours.
- It NEEDS to be a stakeholder driven process on a shared base of facts not feelings. The tow states need to agree on how to best manage the vast majority of open water and there should be a set upon MOU early on between the two states. There should be some federal support to moderate and help fund the process.
- Such a plan would need to be multi-tiered and would need to have all levels of gov't involved in planning (also coastal property owners), management and enforcement.
- All these groups need to be involved - key item though is having the science and necessary data products to be able to develop scenarios that can be assessed and hopefully decided on
- Federal as the overall manager and the region as more local manager- region should get a constant feedback from others and potentially implement suggested changes or actions
- I think for it to be acceptable and able to implement, it would have to be a combination of LISS, states, federal...good luck!
- Public sector lead including feds and 2 states. Must have an open and transparent planning process.
- A combination of local and state agencies including the State's Coastal Management Program, with the close interaction of citizens. Consider the Long Island Sound Coastal Management Program as a model for engaging the public in the planning process - http://nyswaterfronts.com/initiatives_longisland.asp
- It should be apolitical and without possibility of conflicts of interest -- including funding prospects for contributing scientists or input from self-serving bureaucrats or politicians, state and federal.
- Coalition of state agencies - there should be a single decision making authority for Long Island Sound that is comprised of the wide variety of stakeholders involved. It should also have the ability not just to make decisions but to enforce them.
- State (Dept. of State, DEC) and local municipalities at the town and county level, with external stakeholder input.
- I don’t know much about the long island sounds study but it seems like a good organization to task with this responsibility. I also think local governments should play a significant role
- A regional organization with significant input. NY would want similar efforts in all marine waters and not have different planning bodies taking care of the bi-state waters.
- States in partnership with federal agencies including EPA, NOAA, Dept. of Interior, US Coast Guard.
- Anyone that does not have a significant financial, political or other agenda that impairs the natural ecological function of LIS
- Due to the unique position of LIS between two states, there should be a board to direct a planning process comprised of multiple state, federal and local entities, along with commercial, conservation, and agency groups.
- Consortium of local, state and federal agencies along with stake holders, e.g. regional associations.
- A multi-stakeholder organization, with federal, state, and local government and NGO representatives like the LISS would be appropriate.
- Keep the governmental agencies out of it. Something along the line of a Land Trust Organization might be the way to go.
- States; any organization given management/regulatory authority must be subject to electoral oversight
- States since all of LIS is in state waters. Federal agencies have a role. Local towns should be involved too. Perhaps there are lessons in the Long Island South Shore Estuarine Reserve effort.
- Combination of federal, state, organizations and stakeholder groups would have to develop it. I think the State should enforce it.

26. What, in your opinion, might be the biggest impediments/roadblocks to a bi-state (NY and CT) comprehensive marine spatial planning process for LIS?

Response

- Ability to get politicians to the table
- Agreeing on a plan
- Albany. Hartford.
- Boating industry
- COMMERCIAL INTERESTS
- COULD WORK ,
- CT and NY have different priorities because of their different resources.
- Commercial interests and state budgets
- Commercial interests who do not want limits imposed on their activities.
- Commercial issues, energy development
- Competing interests of States
- Conflicting uses
- Conflicts among users, such as commercials and recreational fishers
- Conflicts with big industry/business as well as 'tea party' mentality
- Cooperation
- Cooperation and enforcing b/n the two states.
- Corporate interests with a lot of $$ to spend
- Current relationship between CT and NY regarding stewardship of LIS.
- DIFFERENT POLITICAL AGENDAS BETWEEN THE STATES
- Developers/builders/consumers/scientists with differing opinions
- Differences in state's needs.
- Differences of state regulatory structure and methodology and funding
- Different agendas
- Different goals for resources and different regulations.
- Different needs
- Different political agendas
- Differing regulations between states.
- Differing views on use of LIS that may impact respective NY/Ct economic interests.
- Disagreement among stakeholder groups.
- Disagreements regarding appropriate usage.
- Don't know
- EGOS!!!!!!!!! Good Luck!!!!!!!
- Each State wanting more than the other
- Each state having its own issues to deal with which will be different then the other state.
- Eco-fanatics
- Excessive bureaucratic red tape, financial issues
- Fear of Gov't.
- Funding, and authority/power and ability to implement plans.
- Funding, information, political will
- General lack of ability of people in area to cooperate/see the other guy's point of view
- Getting the groups to coordinate appropriately
- Government Policy Makers inability to implement a plan
- Governmental management is a guarantee of mediocracy.
- Greed
- Hartford and Albany, since they are too far removed from LIS.
- Historic enmity
- How to finance it. Money issues
- How would you get agreement between the two?

- Impending bankruptcy?
- Interest groups
- It is difficult to get agreements between States.
- Lack of an ecosystem perspective.
- Lack of appreciation of the value of science.
- Lack of cooperation.
- Lack of coordination among agencies/organizations
- Limiting access
- Money
- Money.
- NEW YORK CITY
- NY & CT agencies
- NY Congressional Delegation
- NY and CT can't agree on anything
- NY and CT trying to work together, different priorities
- NYSDEC, CTDEP, politicians, over eager USEPA officials
- Need Federal decision as states cannot agree
- Non Source Point Pollution
- POLITICS
- Parochial interests
- Passage through two state legislatures.
- People with something to lose.
- Perceived use conflicts - Loss of certain areas for traditional or other uses.
- Permitting process, geography
- Politics/ funding
- Political barriers at the state level.
- Political parties
- Politicians
- Politicians and competing interests
- Politicians. Let the voters have a direct vote on issues facing the environment.
- Politics
- Politics - special, interests - desire to maintain local control
- Politics and budgetary constraints.
- Politics and influence by commercial and monitory activities
- Politics and special interests
- Politics and special interests.
- Politics of greed
- Politics- who will have to most to lose
- Politics.
- Politics. Planning budgets.
- Politics/difference in goals
- Private land owners
- Relations between CT and NY
- Resistance by stakeholders
- Resistance from commercial/industrial interests States' conflicting priorities over zones
- Stakeholder conflicts & Politics
- Stakeholders can't reach consensus, will block
- State politics and conflicts between private and public use and access to The Sound
- States unwilling to cede management authority to a bi-state commission
- The capacity for the states to develop the plan
- The goal of such a program.
- There shouldn't be inhibitors, but politics and administrative will be an impediment as usual
- Too little information and the inability to provide adequate enforcement.

- Who has more jurisdiction.
- Willingness to share decision making power
- Agreeing on specific goals
- Agreement on common goals
- Agreement on use and percent allocated to conservation/restoration
- Any industry that could potentially make money from the endeavor
- Balancing short and long term needs, scale of needs and issues from NYC compared to CT
- Bureaucracy stakeholder conflicts
- Bureaucratic hurdles with NY and CT state governments; conflicting stakeholder priorities
- Coming to a mutual agreement
- Commercial interests would object
- Commercial/political interests
- Commercial/private industry interests
- Competing bureaucracies
- Concern over conflicts in regulations, economic impacts
- Conflicting interests funding disputes
- Conflicting interests among stakeholders
- Cooperation and compromise
- Coordination
- Different politics and different priorities of users in CT and NY
- Difference of opinion between states
- Different concerns
- Different energy and coastal needs
- Different goals and pressures from constituents
- Different ideals in how the sound should be managed
- Different needs, budgets, desired outcomes
- Different priorities
- Don't know
- Economic competition
- Economy in toilet; conservatives will call this socialism (which they think is BAD)
- Economy?
- Ego and my way is the high way.
- Failure of leadership to lead.
- Finding objective, well-intentioned people to be members
- Fishing community energy producers lack of public interest/knowledge
- Funding and political posturing
- Funding levels and legislative differences and conditions
- Funding!
- Funding, adequate stakeholder involvement, process transparency, regulatory uniformity
- Funding; wherewithal, public & government support, cooperation difficulties
- Governance and funds
- Greed
- Greed/corruption
- Greed; corruption of state, local, and federal officials by special interest groups
- Implementation
- Individual state politics
- Lack of focus and commitment
- Lack of understanding of how beneficial shellfishing is to the local economy
- Maybe financial sharing
- Meeting coordination and participation.... video conferences a must for the diverse locations
- Money
- Multiple jurisdictions
- Naive environmentalism

- Opposing laws and points of view on several key topic areas
- Our politicians, its all about them! How the money would be managed.
- Overlaps or gaps in jurisdiction, different tax structure
- Parochial attitude
- People viewing it as a means to get what they need as humans
- Policy
- Political and economic conflicts
- Political influence of business interests
- Political turf
- Politicians
- Politicians / political appointees
- Politics
- Politics money
- Politics of different groups
- Politics! Finding the congruence with who is paying and who is benefitting
- Politics
- Responsibilities are divided between different agencies at the different states
- Shoreline and in water development and "rights" attached thereto
- Special interests
- Stake holder engagement
- State governments and autonomy
- States different agendas
- States having different opinions like being about to dump waste from boats or not.
- The environmental industry and state politics
- The federal government
- The feds
- The lack of cooperation/working relationship between CT and NY
- The reluctance of local governments to give up control over their local waters.
- The threat of change and lack of political leadership. There is no perception of urgency
- Time, energy, money
- Turf protection and percentages allocated to various uses
- Working together and balancing commercial versus recreational versus environmental interests
- The ability of a bi-state coalition to work - so many different stakeholders and the two states will make it difficult to make decisions that are actually enforced.
- Lack of staff and necessary resources (access to existing data; generating necessary new data) and legal or policy barriers
- Commercial, recreational and conservation objectives are different and frequently in conflict with each other.
- Vocal private individuals who base their stance on their own individual want, in other words, politics. Use of facts, determined through good science, by qualified persons, is the first step to crafting a comprehensive plan.
- Connecticut has one coastline that runs the complete length state, NY has North Shore, South Shore, LIS a small percentage of overall state border
- Different agendas and different economies. LI residents are probably wealthier and less dependent on commercial use of LIS
- I think it is a new concept for people and the public would have to be educated about it. I think there could be great opposition from stakeholders and public who don't understand it and the goals.
- Lack of political will/consensus. Suspicion that one group of stakeholders will dominant the process and freeze the others out.
- Opposing from commercial and industrial interests that currently benefit from use of these areas at very low or no cost to them.
- Each state will obviously want what is best for their own citizens. There may be many points of contention on coastal issues as coastal needs differ between states. Coastal issues should remain within the jurisdiction of the state being affected

- Two states with two different visions. 2. Multiple jurisdiction issues closer to land and within harbors (town and county level). 3. Getting all stakeholders to agree upon a baseline set of facts. 4. Getting those stakeholders to continue to agree even after an agreement was made (11th hour freak-outs).
- Differing priorities of commitment of resources (lack of) to LIS of each state. Differing goals of coastal development for each state. Differing energy needs of Long Island and Westchester County citizens vs. Connecticut's needs.
- Wealthy waterfront landowners will lobby heavily to enact strong legislation to protect LIS, but their primary interest is to protect their privacy and keeping the general public away from what they feel is "their property"
- Conflicting legislation regarding management would need to be resolved. Second roadblock would be special interest groups whose interests don't align with goals of a comprehensive marine spatial planning process.
- Different standards and processes within governments, "what's in it for me" attitude between states.
- Differing objectives for the use of overlapping resources, and lack of agreement on technology or methods to achieve objectives.
- The illogical and short sighted, legally indefensible position of "home rule". This is especially true in N Y State, where politicians oftentimes seek refuge from making tough decisions by claiming-"NY is a home rule state". This is not legally true. The power to zone was granted to local municipalities by the State. And they have overridden local opposition to the Tidal Wetlands and Freshwater wetland laws as well as SEQRA- which most local governments opposed.
- Different priorities between the states, and different priorities of stakeholders as you move west to east across the Sound.
- Lack of political will. Inefficient government bureaucracy. Most regulations are written by lawyers who have no clue how their regulations will actually be interpreted by the civil servants/elected officials charged with issuing the permits. Many civil servants/elected officials mean well but they don't understand how to translate regulatory guidelines into clear, understandable prose. For instance, no one in the regulatory structure, e.g. NYSDEC< will tell you how to remove invasive Japanese knotweed from 100 feet of shorefront. You are told to submit a permit application but are given no guidelines. Who has unlimited money and time to deal with months of second-guessing by officials who are afraid, it seems, to issue a clear guideline about preferred ways to remove invasive...Anyone wanting to "do the right thing" is treated the same as the developer who wants to do the wrong thing. It is a sad commentary on the current state of government. And, I say this after working nearly 30 years in the public sector.
- Lack of interest/understanding by politicians, lack of funding, lack of public support, dredging disputes between CT and NY in that order.
- Lack of information about LIS necessary to CMSP, lack of people asked to participate in this that have knowledge pertinent to CMSP in LIS, an organizational framework that includes managers and scientists and stakeholders
- Economic interests 2. Private property interests. 3. Gov't turf issues (i.e. competing and often conflicting goals such as economic development vs. coastal preservation)
- Probably political. I suspect that the citizens of both NY and CT have strong concern for the Sound and would be willing to cooperate.
- Different states have different interests and I am not sure how willing either side will be to compromise
- Politics and political expediency. The process should be based in good science, not how best to pack the pork barrel.
- The plan needs to be flexible and revisited yearly. The problem with land zoning is that regs were put in place and it is difficult to change them now.
- CT coastline has large urban centers all along its coast while LI is far more rural so pollution sources and resources to address issues are very skewed.
- Politics of getting agreement from large number and diversity of stakeholders on how and who to regulate and implement such a plan.
- Competing interests like shellfishing and protection of the resource from gas lines or LNG facilities
- We as a society have lost the ability to work together and compromise. Differing points of view from constituents in both states make gaining meaningful consensus unlikely.
- Political inertia. Entrenched local interests who become single issue voters at the local and state levels.
- Allocation of funds. Both states must contribute equally otherwise issues will probably come up about which state is paying for what and where and who it is really benefitting.

- Existing riparian rights, inability for strong benevolent dictatorial leadership required to execute, implement & enforce in a democratic society (Robert Moses syndrome)
- Concern that it will result in dredging policies and/or recreational access policies that are against current interests.
- Disparity between N coast and S coast population's use of LIS & relative impact of LIS on economies of NY & of CT.
- Most of the issues are local, something that might work for the economy of NY won't necessarily work for CT.
- Industrial lobbies; pressure on congress to eliminate environmental protections; federal energy policies may disregard environmental impact
- The current regional framework for CMSP in which NY and CT are in different regions. Difficulties in collaborating with agencies in other states.
- Costs and distrust by each state of each other. Prime example is the Marine fishing license reciprocity.
- Energy concerns, wealthy landowners unwilling to concede to plans they feel may undermine their property values, and typical politics-as-usual.
- The ability of any group of people to manage wisely. Too much effort made to make sure all (which really means a few) stakeholder groups are included. LIS is a general resource belonging to all people - not just those who have a financial stake or are organized.
- Differences of opinion between the two states on the relative importance or impact of different uses (e.g., sewage disposal, dredged material disposal).
- "The Dredging and Dredged Materials Disposal Issue". Both states appear to agree on everything else. And don't forget to include RI, as the eastern portions of LIS adjacent to NY and CT are also in RI. From my perspective NY and CT can resolve the problem, but major financial and related technical and other assistance/cooperation is required at the federal level - especially because the issue transcends each state....
- Inability of state governments, business and environmental interests to agree on best practices for LIS.
- Special interests - local businesses may want more privatization to boost their local economies and may not see conservation as the best way to utilize these lands
- State agencies are poorly funded and if it is a bi-state group what if one state loses staff. Also state laws etc., can be roadblocks to work together.