Where are all the people?

A study on the integration of socio-economics in marine conservation planning.

By:

Lindsey Feldman

Dr. Michael Orbach, Advisor

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Abstract:

The Northwest Atlantic Marine Ecoregional Assessment, designed by The Nature Conservancy, is a marine spatial planning process which strives for an integrated management approach to marine conservation design. As ecosystem based management gains momentum, non-governmental organizations and federal agencies have realized the need to consider socio-economic objectives for and impacts of management plans and conservation strategies on coastal and marine-related communities.

This report reviews the application of three methods for the integration of socio-economics in marine conservation planning: market and non-market economic valuation and social impact assessment. Market and non-market economic valuation can be used by marine managers to make informed decisions on conservation alternatives while social impact assessments evaluate the social consequences of specific conservation or management actions. Each of these methods can be represented in a geographic information system (GIS) and integrated with biophysical data in marine spatial planning processes. This report shows how market and non-market economic values and local ecological knowledge can be mapped both onshore and offshore and be used in designing marine conservation strategies.

The findings presented here demonstrate that although there are defined methods for socio-economic analysis and some techniques for integrating socio-economics into marine spatial planning, marine conservation planners are not applying them when making management decisions. This report is a guide for conservation organizations and marine managers on how to set biophysical and socio-economic objectives and use clearly defined methods to incorporate social science into marine conservation and spatial planning.
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**Introduction:**

The Northwest Atlantic Marine Ecoregional Assessment is an integrated management approach to marine conservation designed by The Nature Conservancy. The goal of the Assessment is to integrate “geophysical, biological, and socio-economic data that will reveal conservation priorities and empower partners to develop strategies for long-term sustenance of ecological services” (TNC 2008). The Nature Conservancy uses an Ecoregional approach to terrestrial and marine conservation planning. In a joint partnership with the World Wildlife fund they developed 232 marine Ecoregions to aid in setting place-based conservation action priorities (TNC 2009). Ecoregion boundaries were drawn based on defining characteristics of the environment such as bathymetry, hydrography, productivity, and trophically dependent populations (Spalding et al. 2007). The Northwest Atlantic Marine Ecoregion extends from the Bay of Fundy to Cape Hatteras, North Carolina, from the high tide mark in rivers and estuaries to the continental shelf or 200 meter isobath and encompasses both the Gulf of Maine/Bay of Fundy and Virginian Ecoregions (Figure 2) (Spalding et al. 2007).

**Figure 1:** 232 Marine Ecoregions of the World defined by oceanographic characteristics (Spalding et al. 2007).
The Assessment is made up of 11 technical science teams which are responsible for identifying conservation target species, threats to target species, areas of biological significance, and providing biophysical information on the Ecoregion for conservation strategy design. Technical science teams include pelagic, demersal, forage and diadromous fish, coastal areas, marine mammals, sea birds and shore birds, sea turtles, benthic habitats, nearshore shellfish assemblages, and oceanographic processes. In addition to the technical science teams, there are four internal working groups: economics, database design, communications and priority setting. The economic internal working group is responsible for defining important economic parameters of the Ecoregion and designing strategies to incorporate economic information into the Assessment process.

The Northwest Atlantic Marine Ecoregional Assessment is unique in that it is one of the first Eco-regional Assessments at The Nature Conservancy which uses an ecosystem based management approach and incorporates biological, physical and economic information into the conservation planning process. The need to integrate socio-economic information into conservation planning has become increasingly more apparent in the marine conservation community. Dr. Michael Orbach (2006), in testimony to the U.S. Senate Committee on Commerce, Science and Transportation stated that “all public policy for coastal and ocean resources has biophysical, economic and social objectives, and when implemented has attendant biophysical, economic and social impacts.” Marine conservation, management, and policymaking can be viewed as a tradeoff between environmental preservation and development or among the objectives and impacts of various conservation strategies or action plans.
**Figure 2:** The Northwest Atlantic Marine Ecoregion extends from the Bay of Fundy to Cape Hatteras, North Carolina and from the high tide mark in rivers and estuaries to the continental shelf or 200 meter isobath.
A Scientific Consensus Statement on Marine Ecosystem Based Management was released in 2005 that strengthened the support for ecosystem based management in decision making. The authors defined ecosystem based management in part as the “integration of ecological, social, economic, and institutional perspectives and recognition of their strong interdependences” (McLeod 2005). Ecosystem based management is less about a goal and more about the process of incorporating all relevant factors into the conservation of the environment. Orbach (2006) described the process of ecosystem based management as “the policy towards, and management of, human behaviors (human ecology), through a specific governance structure (institutional ecology), that affect, or are affected by, a defined biophysical environment (biophysical ecology).”

This report will act as a guide for conservation organizations and marine managers on how to incorporate the human component into conservation strategies and programs. It gives an introduction to economic and social impact analysis as they are currently used and how their use can be expanded in the future. There are three sections will discuss the theory and application of using market economic valuation, non-market economic valuation, and social impact assessments in coastal and marine conservation planning and policymaking. I will also highlight how the use of socio-economic information can be improved to ensure the sustainability of coastal and marine resources for future generations.

This report will also identify how to incorporate socio-economic data and information in marine spatial planning. Marine managers and policymakers are increasingly making use of spatial planning in the design of conservation strategies,
action plans, and programs. Biological objectives which are inherently spatial and
temporal in nature easily fit into spatial analysis programs but so far socio-economic
information has been largely absent (St. Martin and Hall-Arber 2008). The Nature
Conservancy’s Northwest Atlantic Marine Ecoregional Assessment is primarily a marine
spatial planning project and incorporating socio-economic data into the spatial planning
process is critical to accurately representing the total ecology of the Ecoregion. Ideally,
this report will act as a reference document for federal, state, local, and non-governmental
conservation agencies and organizations when designing place-based ecosystem based
conservation objectives and strategies in the future.

Relevant Legislation:

Legislation regarding the use of socio-economic analysis in marine conservation
in the Northwest Atlantic Marine Ecoregion spans both federal and state jurisdictions and
applies to a wide variety of marine species and ecosystems. The following legislation
requires the use of socio-economic information in guiding regulatory decisions, federal
action, and management plans:

1) The National Environmental Policy Act (NEPA);
2) Magnuson Stevens Fisheries Conservation and Management Act (MSFCMA);
3) Marine Mammal Protection Act (MMPA);
4) Endangered Species Act (ESA);
5) National Marine Sanctuary Act (NMSA);
6) Regulatory Flexibility Act (RFA); and
7) Executive Order (EO) 12898.
Each piece of legislation approaches using socio-economic information differently, but they all require considering socio-economic impacts of regulatory action. For each of the above policy instruments, I will describe the basic character of the instrument and the methods used to provide social and economic data for their processes.

1) The National Environmental Policy Act (NEPA) is the overarching environmental legislation of the federal government and requires federal action to review potential negative effects on the “human environment” by completing an environmental impact assessment (EIS). Environmental impact assessments ensure federal action “fulfills the social, economic, and other requirements of present and future generations of Americans” (40 U.S.C. § 4321). NEPA suggests cost-benefit analysis, which measures whether the socio-economic benefits derived from a development action outweigh the environmental costs, as a tool for federal agencies to consider the environmental and socio-economic impacts of federal actions. Marine policymakers and managers tend to use more informal methods for considering socio-economic information because time and funding resources are not usually allocated towards completing a full cost-benefit analysis. NEPA also requires that in addition to economic analysis, all environmental impact assessments include a social impact assessment that analyzes the potential socio-cultural impacts a federal action may have on an individual or community. Social impact assessments and integration of individual and community characteristics into marine conservation planning will be discussed in the social impact assessment section of this report.

2) The Magnuson Stevens Fishery Conservation and Management Act (MSFCMA) requires socio-economic analysis in the development of Fisheries
Management Plans (FMPs). The New England and Mid-Atlantic Regional Fisheries Management Councils are responsible for developing FMPs for the federal jurisdiction of the Northwest Atlantic Ecoregion. National Standard 8 states that FMPs must “take into account the importance of fishery resources to fishing communities in order to (A) provide for the sustained participation of such communities, and (B) to the extent practicable, minimize adverse economic impacts on such communities” (16 U.S.C. § 1801).

The MSFCMA requires that FMPs include fishery impact statements (FIS) which “assesses, specifies, and describes likely effects of conservation and management measures on participants in the fishery, fishing communities, and participants in neighboring fisheries” (16 U.S.C. § 1801.303(a)(9)). Fisheries impact statements address how regulations may affect fishing communities and are often incorporated into the social impact assessment required under NEPA. However, each FMP fulfills the FIS requirement differently. For example, Draft Amendment 16 to the New England groundfish management plan includes a section that generally states that regulations will have “substantial short-term negative impacts as a result of lost fishing revenue” but positive impacts due to increased fish stocks in the long term (50 C.F.R. § 648.80). The scallop management plan includes a more formal and detailed socio-economic analysis where the costs and benefits of a variety of different management alternatives are presented and the alternative with the greatest benefit to fish recovery and least cost to fishing communities is chosen (50 C.F.R. § 648).

Socio-economic analysis gained more attention in the most recent re-authorization of the MSFCMA, which in addition to FIS requires an in-depth analysis of economic and
social impacts of limited access privilege programs to fishing communities before they are implemented (16 U.S.C. § 1801). Although the MSFCMA requires economic analysis and social impact assessments, it does not require the use of a particular methodology or provide detailed guidance on how socio-economic information should be integrated with biophysical information in either fisheries management plans or limited access privilege programs. While economic analysis and social impact assessments may be completed for each FMP, they are usually not actually incorporated into the FMP design process.

3) The Marine Mammal Protection Act also requires measuring the potential socio-economic impacts of marine mammal regulations on fishing communities. Section 118(f) of the Act states that “The long term goal of the [take reduction] plan shall be to reduce…the incidental mortality or serious injury of marine mammals incidentally taken in the course of commercial fishing operations…taking into account the economics of the fishery…” (16 U.S.C. § 1387). However, as with NEPA and the MSFCMA, there is no methodology specified and little guidance on how the “economics of the fishery” should be considered. Potential marine mammal regulations go through a detailed review process which outlines the impacts of regulations on marine mammal species and analyzes the cost and feasibility for fishermen to adapt to regulations (Atlantic Large Whale Take Reduction Plan 2008). Take Reduction Teams, which develop management plans to reduce the “incidental serious injury and mortality” of marine mammals, may also issue a Finding of (No) Significant Impact Statement, which states how regulations may impact fishers (NMFS 2006). Take Reduction Plans for marine mammals vary in
their use of socio-economic analysis but like FMPs rarely use social or economic information when deciding between regulation alternatives.

4) The Endangered Species Act (ESA) and 5) National Marine Sanctuary Act (NMSA) similarly require socio-economic analysis for decision making, but fail to outline how the analysis should be conducted. The ESA applies to a variety of coastal and marine species such as whales, marine and diadromous fishes, crabs, snails, other invertebrates, and endangered sea birds within the Northwest Atlantic Marine Ecoregion. Regarding socio-economics, the ESA states that “…(2) The Secretary shall designate critical habitat… after taking into consideration the economic impact, and any other relevant impact, of specifying any particular area as critical habitat” (16 U.S.C. § 1531-1544). After a lawsuit regarding socio-economic analysis of ESA violations, the U.S. 10th Circuit Court of Appeals instructed the US Fish and Wildlife Service to conduct a full analysis of all of the economic impacts of critical habitat designation, regardless of whether those impacts are attributable to other causes (New Mexico Cattle Growers Association v. U.S.F.W.S 2001). The National Marine Sanctuary Act likewise states that “the Secretary shall consider…the negative impacts produced by management restrictions on income-generating activities such as living and nonliving resources development…and the socioeconomic effects of sanctuary designation” (16 U.S.C. § 1431). Socio-economic analysis was successfully integrated with biophysical information in the establishment of the Florida Keys and Channel Islands National Marine Sanctuaries.

6) The Regulatory Flexibility Act (RFA) and 7) Executive Order (EO) 12898 apply to all regulatory making bodies of the federal government and require analysis of
economic impacts of federal action. The RFA addresses minorities and EO 12898 addresses low-income groups that are directly affected by a proposed federal action (5 U.S.C. §601-602, 59 C.F.R § 7629). Any proposed rulemaking must provide a description of the steps the agency has taken to minimize significant economic impact, and why each alternative to the rule considered by the agency which impact small entities was rejected (5 U.S.C. §601-602). Both the RFA and EO 12898 suggest that the preferred method for using socio-economic information is to measure the costs and benefits of a variety of alternative federal actions or management plans.

This brief review of federal legislation regarding socio-economic analysis in coastal and marine management sheds light on two major problems:

1) Socio-economic analysis methods and techniques are not clearly outlined in federal legislation; and

2) There is no guide on how marine policymakers and managers should incorporate socio-economic information into the policymaking or conservation planning process.

It is clear from the information presented here that there is a major gap in the application of socio-economic information in Environmental Impact Assessments, Fisheries Management Plans, Marine Mammal Protection Act regulations, Endangered Species listings and critical habitat designations, and the creation of National Marine Sanctuaries.

As the marine conservation community moves towards an ecosystem based approach to coastal and marine management, proper guidance and standardized methods on how to integrate biophysical and socio-economic information will be crucial to the successful conservation of marine ecosystem goods and services. The following sections
will outline three methods marine managers in federal, state, local, or non-governmental organizations can use in conservation planning, management strategy design, and policymaking (market economic valuation, non-market economic valuation, and social impact assessments) and how these three methods can be used in a marine spatial planning process using geographic information systems (GIS).

**Economic and Social Impact Analysis:**

It is important to distinguish between economic and social impact analysis when setting socio-economic objectives for marine conservation strategies and management plans. Economic analysis centers on economic valuation which is the total economic value of coastal or marine ecosystem goods and services (Costanza et al. 1997). Economic value estimates are used to help marine managers and policymakers make more informed decisions on conservation strategies, action plans, and regulations. Social impact analysis on the other hand defines and monitors the human landscape of a particular ecosystem or location. It focuses on understanding how communities function and how people are related to or dependent on the biophysical properties of the marine environment (Pollnac et al. 2006). While economic analysis is often quantitative, social impact analysis can be either quantitative or qualitative and descriptive in nature. Socio-economic assessments can utilize either economic or socio-cultural analysis methods but when they are used together marine managers have the ability to measure the combined value people place on the coastal and marine environment and the human implications of conservation action plans or policies.
Economic valuation:

The total economic value of coastal and ocean goods and services is made up of direct and indirect use values, option values, existence (non-use) values, and bequest values. Direct use values capture the market value of a particular ecosystem good or service that is directly used for consumptive purposes. Indirect use values measure the role of external forces in consumptive markets such as wastewater recycling. Option value is the potential value of an ecosystem good or service that is yet unknown or undiscovered. Existence value is the value society places on an ecosystem good or service regardless of its use value; existence value often measures society’s aesthetic, ethical, cultural, or religious value of a particular good or service. Research has shown that much of the conservation value in marine ecosystems for example, is the existence value that can only be measured using non-market valuation techniques (Stevens 2005). Lastly, the bequest value is the willingness to pay for the conservation of a resource for future generations (Sumaila 2005). Goods and services that are directly traded in traditional markets can be easily measured by what economists call market valuation techniques. Goods and services not traded in the marketplace are measured by non-market valuation techniques.

The U.S. Ocean Commission on Policy (U.S. Commission on Ocean Policy 2004) found that society has yet to fully comprehend the true economic value of its ocean and coastal resources. While the agricultural industry and relevant federal agencies spend over $100 million a year on economic research, ocean and coastal agencies have not yet considered economic research as a high priority. The U.S. Ocean Commission partnered with the National Ocean Economics Program (NOEP) to emphasize the contribution the
nation’s coastal and marine environment makes to the national economy. An economic impact analysis found that the U.S. ocean sector was worth $117 billion, and supported over 2 million jobs and nearshore coastal areas were worth nearly $1 trillion and 16 million jobs (U.S. Commission on Ocean Policy 2004). Oceans and costs provide an enormous value to the U.S. economy from marine transportation and ports, marine fisheries, offshore energy, minerals, telecommunication cables, medical resources, biodiversity, tourism and recreation, and coastal real estate. The ocean and coasts also provide us with functional habitats, have cultural significance, and have provided inspiration to countless vacationers, fishers, writers, artists, and philosophers.

Even though coastal and marine resources contribute a large sum to the total economy, they are becoming increasingly threatened in the face of continuing development and exploitation pressure (Pauly et al. 1998, Worm et al. 2006) and marine managers are forced to choose between competing uses of the coastal and marine environment. With the advent of wind, wave, and tidal energy, as well as aquaculture facilities, these management decisions will become even more difficult in the future.

Measuring the total economic value of ecosystem goods and services allows managers and policy makers to make more informed decisions (Wilson et al. 2002). In order to make difficult decisions on resource use and allocation, marine managers and conservation planners need to gather as much scientific information as they possibly can to define and measure progress towards their conservation and management objectives (Wiley 2003). However, the majority of scientific information collected and available to date is biological and physical, and the decision making process does not include adequate economic information. Economic valuation is based on the idea that people
make trade-offs or sacrifices of market goods to ensure the conservation of the environment or improve environmental quality. This can be seen when people pay more for houses, accept lower paying jobs, or travel further to visit areas of higher environmental quality (Loomis 2005). Economic valuation can be used to determine how user behavior will be altered by a particular management plan or conservation action and measure the economic impact of that change.

The use of economic valuation in marine conservation and policymaking can be difficult because traditional markets do not capture the total economic costs or benefits of coastal and marine ecosystem goods and services (King and Mazzotta 2009). This stems from the fact that environmental amenities are public goods and services and are enjoyed by society without the responsibility of protecting or conserving them (Hardin 1968). Only recently are we realizing the lost benefits provided to society by public environmental goods and services.

Some people argue the economic value of the coastal and marine environment is infinite and can not be given a dollar value. The argument against estimating the value of coastal and marine amenities is largely a product of not understanding the role of economic valuation in marine conservation (Champ et al. 2003). As long as people make tradeoff decisions, which they do on a daily basis, they are estimating their personal preference or value for an ecosystem good or service (Costanza et al. 1997). When someone purchases their home or pays for a vacation to the beach, they are making a value based decision that can be measured using economic valuation methods.

Natural resource managers face a variety of alternatives when designing conservation strategies and policies based on the value of a particular ecosystem good or
When the total economic value of coastal and marine ecosystem goods and services is not estimated, the benefits provided by those ecosystem amenities are left out of the decision making process (Champ et al. 2003). For example, building on or directly adjacent to a beach or wetland ecosystem may have large economic benefits to the community. If the building is a hotel, it will create jobs and revenue for members of the regional economy and bring tourists to the area that will boost the economy by spending money on tourism related activities including eco-tourism, restaurants, and shopping. However, the economic costs of environmental impacts must also be measured. Building construction may have dramatic impacts on the coastal and marine environment such as removal of beach or wetland ecosystem, influx of sediment, pollutants, and sewage waste into the neighboring waterways. It may also change the social fabric of a community. Damage to the environment may have a major impact on nearshore commercial and recreational fisheries, beach recreation, and marine related tourism. Because we have yet to value and quantify the benefits of all ecosystem goods and services, it is likely that policy and management decisions using market-based economic analysis will favor environmentally degrading activities (Johnston, personal communication). Measuring the total economic value (the market and non-market value) can help marine managers and policymakers realize the value of the benefits provided by the coastal and marine environment and to determine the value of conservation actions. Estimating the total economic value of ecosystem goods and services allows them to be compared to non-environmental goods and services traded in traditional markets.
Market Valuation:

The most readily available method for measuring the dollar value of a natural resource or ecosystem service is by calculating its market value. Market value is the net economic benefit from an environmental good or service traded in the market or the price people are willing to pay for a coastal or marine related good or service (Wilson et al. 2002). The price of a market good captures the amount of money spent on a particular good or service and represents the amount of money that was not spent on something else: a trade-off of one good for another (Champ et al. 2003). Market values of environmental goods and services are measured through revealed consumer preference in economic markets. Economists can calculate how people value the environment through their actions which affect or are affected by the natural environment (Kolstad 2000). Such actions are diverse and may include gaining revenue in a marine dependent industry, spending money to enjoy the coastal and/or marine environment, or raising funds to research and study coastal and marine ecosystems. Each of these activities is not only dependent on the marine environment, but contributes money to the economy which allows economists to measure the direct dollar value people spend on the marine environment through their actions.

There are both direct and indirect effects that market spending can have on the economy and the environment (Wiley 2002). Coastal and marine ecosystem goods and services are considered to have direct effects on the local economy when their benefits accumulate directly to people (Champ et al. 2003). Direct effects from the marine environment come from spending on whale watches, scuba diving, beach fees, or fishing which provides an immediate boost to the local or regional economy. The marine
environment can also provide many indirect effects to the economy which include spending on hotels, restaurants, gifts, and other items that are not directly related to the marine environment but are located in a coastal county within the Ecoregion.

It is worth noting that although there are a variety of economic tools that can be used to measure the market economic value of environmental amenities it is important for marine managers to carefully phrase their economic questions to be sure they use the right tools that help them meet their objectives (Johnston et al. 2002). Measuring the market value of a particular coastal or marine region is only the first step in measuring the total economic value. Non-market evaluation methods and case studies will be discussed in the next section.

**Market Economic Valuation Methods:**

When environmental economists measure market value of a marine ecosystem, they usually refer to changes in the income of people employed in marine related sectors or revenue generated by marine related industries (Hoagland et al. 2008). The most common method of market economic valuation is a cost-benefit analysis (also called a tradeoff analysis) for a particular management action (Wilson et al. 2002). Analyzing biological, economic and social impacts of a management action is necessary to understand the full range of impacts that particular action will have (Lipton et al. 1995). Economic analysis of market transactions in the marine environment may include measuring revenue generated by marine sectors, GDP of coastal economies, or market value of marine-dependent industries and industry employees. The market value of an environmental good or service can be measured using three primary methods which
capture the dollar value of market transactions: cost-benefit, cost-effectiveness, and economic impact analysis.

Cost-benefit analysis:

Cost-benefit analysis is used to compare the net economic benefits with net costs of a project to determine the policy or management outcome. It can be used to evaluate the favorable effects as well as the opportunity cost of a particular policy or conservation strategy. Cost-benefit analysis recognizes that not all groups or industries will be affected equally. It primarily uses market based economic values, but more recently has started to incorporate non-market economic values as economists have recognized the importance in capturing the total economic value. However, marine managers often choose not to complete full cost-benefit analysis because they deem them to be too labor intensive and expensive (Holland et al. 2008) Whether the cost and time commitment of cost-benefit analysis is actually too expensive or whether the spending priorities remain in biophysical research is often not discussed in the literature but requires further research. Even when cost-benefit analyses are completed they often only measure a portion of the benefits and costs associated with the policy or program in question. For regulatory action that may impact the environment, leaving out environmental benefits not captured in the market can emphasize the benefits of the action without fully disclosing the environmental costs. It is important to realize the full extent of the project or policy and account for as many variables that may influence or be influenced by the outcome as possible.
Cost effectiveness analysis:

Cost-effectiveness analysis is used to identify the most efficient management action when the objectives are preset by legislation, regulation, or other means (Holland et al. 2008). One example is measuring the cost effectiveness of a variety of new regulations or conservation strategies for the North Atlantic Right Whale. The top priority is always going to be protection of the Whale, but cost effectiveness analysis allows managers and policymakers to determine the most economically cost effective method of doing so. While cost-benefit analysis measures all of the costs and benefits of a particular action, cost effective analysis focuses on the costs only. Cost effectiveness analysis does not measure which policy alternative will be the most socially acceptable since the policy objectives or conservation goals have already been predetermined. This type of analysis uses the same methods as cost-benefit analysis but since it does not formally calculate benefits it is faster and less expensive to conduct (Holland et al. 2008). When management outcomes and goals have already been decided, this is the best method to determine the most effective way to go about meeting those goals.

Economic Impact Analysis:

Economic impact analysis measures the impact of spending between various economic sectors or to measure change in economic activity within certain industries (Holland et al. 2008). It is used to measure the change in income and employment from a particular policy or management decision (Lipton et al. 1995, Hoagland et al. 2005). When used by coastal or marine managers it can be an effective tool for expressing the importance of the coastal or marine dependent economy in relation to the total economy.
of a certain state or region. However, it cannot be used to measure the most socially beneficial or cost effective policy or management decision (Holland et al. 2008). Economic impact analysis shows how the distribution of income and employment changes over time but does not measure the benefits or costs of a particular project like a cost-benefit analysis does. Economic impact analysis does not capture the lost existence value of an ecosystem good or service (Lipton et al. 1995). For example, an economic impact analysis can be used to estimate the economic impact of marine recreational fishing expenditures on a regional economy, but does not represent the value of fishing to participants (Huppert 1983).

Economic impact analyses are conducted using input/output (I-O) models. The commercial software package IMPLAN (IMpact Analysis for PLANning Software) uses an I-O model to estimate changes to a broad range of sectors in regions across the United States (Hoagland et al. 2008). The Nature Conservancy contracted the Woods Hole Oceanographic Institution to conduct an I-O analysis of coastal counties from Maine to North Carolina using IMPLAN software (Hoagland et al. 2008). They valued the total marine dependant economy of the Ecoregion at $362 billion and marine related industries to support the employment of nearly 3 million people. From 2000 to 2008 the regional economy dependent on marine related industries increased by 17% and increased employment by 23%. These results show how important the marine environment is to the regional economy. When represented spatially (see Marine Spatial Planning section) it is clear that the marine environment contributes more to the regional economy in some coastal counties than others. Economic impact analysis can act as a first step towards
“elucidating geographic areas that warrant closer attention with more specialized economic models and data” (Hoagland et al. 2008).

*Case studies of market valuation used in marine conservation planning:*

Market valuation methods have been primarily used to estimate the damage of natural disasters or human-caused events on the coastal and marine environment. Newspapers often report the economic damages from a hurricane, tornado, or forest fire in terms of lost jobs, infrastructure, and cost of rebuilding. The same concept can be used for environmental change. It is essential to measure the market value of coastal and marine related industries before and after regulation or management so that managers can understand the economic implications of certain actions. Change in market-based dollar value in response to environmental management can be measured using available data from the Bureau of Labor and Statistics. Such change may be similar across communities and industries and it is therefore important for marine managers to look towards previous examples of environmental change to help guide their decision making. This is especially true if marine managers allocate little funding towards economic analysis in the marine conservation planning process. This section highlights a few case studies where market valuation has been used to measure economic impact in marine conservation planning.

*Methods:*

In attempting to search for cases of market economic analysis used in coastal and marine resource planning in the Northwest Atlantic Marine Ecoregion, I used several
sources. The National Ocean and Economics Program has a searchable database of market based economic information that can be accessed by marine managers. Market values include information from the Bureau of Labor Statistics and National Marine Fisheries Service (NMFS) on the economic activity within coastal and marine industries. Although there is a plethora of market information available, the NOEP database does not include case studies of successful implementation of market based economic valuation in marine conservation planning or policymaking. The NOAA Coastal Services Center provides a detailed overview of environmental economics, valuation methods, and implementation of socio-economics in coastal restoration and highlights a few case studies on using market economic values in developing marine management strategies. The majority of market valuation studies have been conducted by governmental organizations for federal Fisheries Management Plans under NEPA and the MSFCMA and under the National Marine Sanctuary Program. Non-governmental market valuation studies conducted in the Ecoregion were located using a Google scholar search of combinations of the following words and phrases: marine, ocean, coastal environment, market valuation, and economic analysis. The literature search yielded a mere 3 market valuation studies in the Ecoregion. Outside the Ecoregion, the literature consisted of market analysis of a variety of different marine conservation objectives such as the creation of marine reserves, the value of the live fish trade for aquarium and food markets, and the value of coastal and marine related tourism. It is clear after the Google scholar search yielded so few results in the Ecoregion that market valuation studies are predominantly non-peer reviewed gray literature found on various governmental and non-governmental organization’s websites. Time constraints associated with this project
precluded searching through the gray literature on websites of government agencies and non-governmental organizations to find a large number of studies which applied market valuation to marine conservation in the Ecoregion. A few of the studies found through the Google search are presented below as an example of how market values are used in marine conservation planning.

**Results:**

1) Athearn (2007) used both regression models and I-O analysis (IMPLAN) to determine the economic impact of temporary closures on the coastal Maine shellfish economy. The study measured the impact of red-tide and flood closures on the soft-shell clam, mahogany quahog, and mussel industries in Maine at $6 million for harvesters, $14.8 million in lost sales, and $7.9 million in lost income. Coastal managers in Marine can use these values to emphasize the importance of the shellfish industry to the total Maine economy. The impacts of temporary closures due to semi-natural events can show the impact of similar types of regulations if they were to be imposed. The results from this study also may provide the impetus for funding restoration efforts for shellfish habitat and coastal pollution which triggers red tide events.

2) Federal government agencies are required to complete economic analysis under NEPA for Environmental Impact Statements. Most agencies incorporate strictly market based analysis into their decision making as the data is easily accessible and the methods are well established. The National Oceanic and Atmospheric Administration (NOAA), Water Resources Council and the Environmental Protection Agency (EPA) use economic analysis to measure the potential or actual impacts of a particular policy or regulation.
(Lipton et al. 1995). Both NOAA and the EPA have established guidelines for cost-benefit analysis economic impact analysis, and equity assessment that incorporate ecosystem valuation (Lipton et al. 1995). NOAA’s Coastal and Ocean Resource Economics program (CORE) conducts socio-economic research in a variety of locations and ecosystems. Their research to date includes estimating the socio-economic impacts of marine reserves through a socioeconomic monitoring program in the Florida Keys National Marine Sanctuary, measuring the economic value of beach recreation in Southern California, the value of artificial and natural reefs in southeast and northwest Florida, and a national survey on the value of marine recreation (NOAA Coastal and Ocean Resource Economics 2009).

The National Marine Fisheries Service (NMFS) is also required to consider the economic impacts of fishing regulations and conducts economic analysis as a regular part of their Environmental Impact Assessment (EIS). Economic analysis for Fisheries Management Plans (FMP) as discussed above ranges from detailed calculations of economic impacts for each management alternative to general statements on the economic conditions of a particular fishing community.

3) Kite-Powell (2005) used a I-O model (PortKit software) which applied economic data from the US Maritime Administration and estimated that each vessel which uses Boston as their home port contributes around $1 million per port call to the gross state product. He also estimated each port call to support 10-30 full time employees. Kite-Powell (2005) used the market value estimates to determine potential economic impacts to the shipping industry and the Massachusetts economy from a change in shipping lanes or a reduction in port calls which would reduce ship strike
incidents of the North Atlantic Right Whale. He considered four different scenarios where major vessels that call in to the Port of Boston change their sailing schedule and estimated the economic impact on the Massachusetts economy and the number of potential jobs that would be lost. Kite-Powell and Hoagland (2002) also estimated the increase in shipping operating costs from Maine to Florida due to Right whale ship strike management measures. Both of these studies could be used by marine managers to integrate the economic and biophysical impacts of various management alternatives into their decision making process.

4) Lipton et al. (1995) presented eight hypothetical case studies of using economic analysis in marine conservation planning and policymaking. They included oyster restoration, coastal barrier island preservation, fisheries management, National Marine Sanctuary designation, habitat restoration, and control of non-point source pollution. In the case study of oyster restoration in Chesapeake Bay the economic value (both benefits and costs) of introducing a more disease resistant non-native oyster (C. gigas) were discussed. Lipton et al. (1995) emphasized that incorporating analysis of potential biological and economic benefits and costs will lead to an effective and socially beneficial management outcome.

5) The I-O model results from Hoagland et al. (2008) can be used as an effective method for emphasizing the important role of coastal and marine dependent industries in the overall economy of the Ecoregion. The results can be used to identify high priority conservation sites based on economic impact of the coastal and marine ecosystem on the economy but it is important to clarify the difference between the economic effects and the

1 Maryland, Virginia, and the Army Corps of Engineers have recently decided not to introduce non-native oysters into the Bay but the decision was made on primarily biological reasons (http://www.nature.org/wherewework/northamerica/states/maryland/press/press3971.html)
economic value during the analysis process. The I-O model should not alone be used to make explicit conservation strategy decisions or as a guide in developing conservation action plans. It is important for federal, state, and local agencies and non-governmental conservation organizations to utilize additional economic valuation information when designing site specific conservation goals and objectives.

**Conclusions:**

Although data for estimating market economic values of coastal and marine ecosystem goods and services is available it is not translated into application by marine managers in decision making. Coastal and marine conservation organizations have the ability to utilize market economic data available to measure the economic benefits and costs of particular management options or conservation strategies using the methods described above. Marine managers and policymakers should look towards the case studies presented here on how to gather and actually use market economic information when designing conservation action plans.

It is important for marine managers to recognize which market valuation methodology is appropriate for their particular conservation goals and objectives. Cost-benefit and cost-effectiveness analysis can use economic valuation to help marine managers choose between alternative management strategies. Economic impact analysis should be used to highlight the importance of the marine environment to the regional economy or understand how changes to the environment may impact marine related industries. Economists such as Dr. Robert Johnston have emphasized the need for increased market valuation in coastal and marine conservation and for marine managers
to learn how to choose the right economic tool to accurately integrate economic information into the ecosystem based management process (Johnston et al. 2002).

**Non-market valuation:**

Market valuation reflects only part of the economic value of marine industries and ecosystem services. There are many goods and services provided by the coastal and marine environment that are not bought and sold in traditional markets and therefore have no observable price tag (Wilson and Carpenter 1999). Non-market valuation is the other part of the total economic value of an environmental amenity, species, or habitat type, and allows economists to put a dollar value on these goods and services.

There is a subtle difference between ecosystem goods and services, and recognizing the value of both is necessary to capture total economic value of a particular ecosystem. Ecosystem goods are products derived from the coastal and/or marine ecosystem for human use which include fish, shellfish, seaweeds, oil and gas, algae used to make biofuels, genetic diversity, and medicinal properties from marine organisms (de Groot et al. 2002). Ecosystem services are defined as “the conditions and processes through which natural ecosystems and the species that make them up, sustain and fulfill human life” (Daily 1997). Marine ecosystem services can include easily measurable functions such as nutrient recycling and water filtration or functions more difficult to measure including aesthetic and cultural benefits, biodiversity value, habitat infrastructure and the satisfaction society receives from knowing a particular ecosystem or species exists (Wilson and Carpenter 1999). Ecosystem services can occur at a variety of scales: carbon sequestration occurs at a global scale while water filtration and
drainage, flood protection, and nutrient cycling occur at either regional or local scales. However, because the values of such environmental goods and services are not included in market interactions at any scale, the social benefits or potential costs of these goods is often overlooked or drastically underestimated.

Unlike market goods where the economic value can be calculated using readily available data including income, revenue, and by generating supply and demand curves, non-market valuation requires a significant amount of data collection and is more complex (Boyd et al. 2004, Pendleton et al. 2007). While market values are calculated using revealed preference methods, non-market values use revealed and stated preference methods. Revealed preference measures the actual price people pay for environmental amenities such as how much people spend on coastal and marine tourism, the price of boating and fishing equipment for marine recreation, the price of fish in the grocery store, and the added real estate value of owning waterfront property. Environmental economists use revealed preference values to make inferences about the benefits associated with ecosystem good or services (Boyd et al. 2004).

Non-market values are also calculated using stated preference techniques. Stated preference methods measure economic values not regularly expressed in traditional markets. They rely on both users and non-users of a resource to affirm what they believe a particular good or service is worth. Stated preference methods are often used to value aesthetic, recreational, cultural, and emotional services provided by the marine environment. Non-market values are revealed through a carefully constructed survey which asks the respondent their willingness to pay for a particular level of environmental quality, to know that a species exists, or for a certain coastal or marine conservation
project or management action (Loomis 2005). Surveys may also ask the respondent their willingness to accept compensation for diminished environmental quality (Huppert 1983). One critique of using stated preferences to measure non-market economic value is that the value estimates revealed in surveys have not been tested in real markets (Stevens 2005). Studies have shown that although stated preference surveys are designed so that the survey respondent feels obligated to state the true amount he/she would pay it is nevertheless a hypothetical payment. Some analysis has found that mean hypothetical values are 2.5-3 times greater than actual cash payments (Stevens 2005). Nevertheless stated preference methods are the only methods available to estimate the dollar value of environmental goods and services not captured in traditional markets.

There are a variety of different methods for estimating non-market values using revealed and stated preference methods. Travel cost and hedonic pricing are the most common revealed preference methods for estimating non-market ecosystem values. The travel cost method measures the value of an ecosystem or species by estimating the travel costs incurred by a trip to a particular coastal or marine destination. Research has shown that people make decisions to travel based on travel time, entrance fees, lodging rates, and environmental quality (Pendleton et al. 2007). Therefore, economists can use travel expenses as a proxy estimate of the willingness to pay and estimate non-market economic value for an environmental good or service (Wilson and Carpenter 1999). Travel cost methods can also be used to measure the value of a change in environmental quality (either positive or negative) as people will often spend more to travel to a coastal or marine destination they view as more pristine.
Hedonic pricing measures the non-market value of an environmental amenity by estimating the relationship of an environmental amenity with the price of a good for which there is actually a market (Wilson and Carpenter 1999). The most common method for using hedonic pricing is to link coastal or marine amenities with the valuation of property—either housing or land values (Pendleton et al. 2007). The underlying assumption is that real estate values increase with access to coastal and marine amenities such as beach access, boat docks, ocean or coastal views, parks and recreation. Conversely, real estate values will decrease with negative environmental amenities such as polluted waterways. Economists can measure the value of a particular environmental good or service by estimating the portion of the housing cost which is linked to the environment—whether positive or negative (Pendleton et al. 2007). They can also use hedonic pricing to measure the value of a change in environmental quality by calculating the change in real estate prices that are the result of an increase or decrease in environmental quality.

There are also a variety of stated preference techniques for estimating the non-market value of ecosystem goods and services. Stated preference techniques include contingent valuation, random utility models, conjoint analysis, and productivity method. Contingent valuation is the predominant stated preference technique and is used to estimate both use and non-use values of the coastal and marine environment. It is a valuable tool for economists and marine managers that has been in use in government agencies since the 1970’s primarily been used in natural resource damage assessments (Arrow et al. 1993). It consists of a highly structured social science survey which asks
participants what they are willing to pay for environmental improvements or to protect a particular marine resource (Boyd et al. 2004).

The most famous case of contingent valuation was under the Oil Pollution Act of 1990 where NOAA recommended its use to measure the lost recreation and existence values from the Exxon Valdez oil spill. A panel of expert economists deemed contingent valuation an appropriate measure to calculate damage estimates and it was used to estimate the damages Exxon was responsible for paying after the spill (Loomis 2005). Non-market valuation techniques have also been used for quantitative assessment of damages by other oil spills and boat groundings on coral reefs (Leeworthy and Bowker 1997).

There are many other potential uses of non-market valuation for ecosystem based management and sustainable development initiatives. One example is a study that might estimate a household’s willingness to pay to hook up a centralized sewer system in order to reduce non-point sources of pollution. Using the non-market valuation estimates the municipality could examine the benefits and costs of certain levels of action. They could also use the willingness to pay values to raise money for the new sewer system by additional city taxes. Non-market valuation can also be used to set recreational user fees. Bhat’s (2003) study found that the marine recreational benefits of the Florida Keys National Marine Sanctuary were enough to justify a user-financed marine protection program. If people are willing to pay an average of $10 for access to a clean beach, scuba diving, snorkeling, or other ecotourism opportunity, marine managers can confidently charge a $10 user fee which would go towards conservation and management of the ecosystem/environmental amenity. The method of such a program may vary but
can include access fees or taxes on tourism related activities dependant on the marine environment.

**Non-market valuation used in marine conservation planning:**

Peer reviewed non-market valuation publications of coastal and marine resources have been in the literature since the 1970s yet the frequency of publication in recent years appears to be declining (Pendleton et al. 2007). Non-market valuation studies can be conducted on a local, regional, national, and global scale. Like market valuation studies, although local studies in the location of interest to marine managers would be ideal, non-market valuation can be expensive and time-consuming to conduct on a case by case basis. It would therefore be beneficial for marine managers and policymakers to use valuation studies which have already been completed to help guide decision making and conservation strategy design.

There is substantial debate among environmental economists over the legitimacy of using non-market values estimated in one location as a proxy for values in another location. This type of analysis has developed in a new field called benefit transfer and is often the focus of regional, national, or global meta-analysis that either combines non-market economic values of a particular ecosystem good or service or transfers those values from one location to another (Lindhjem and Navrud 2007). Benefit transfer uses non-market economic values from one place and time to make inferences about the non-market economic value of environmental goods and services at another place and time (Wilson and Hoehn 2006). The use of benefit transfer has increased as the need for
integration of non-market information became more apparent and organizations have had little time or funding to complete new non-market valuation studies themselves.

Benefit transfer has been recognized as a viable approach for estimating the non-market value of environmental goods and services. However, as Wilson and Hoehn (2006) suggest, there is still a need for standardization of transfer techniques, finding solutions to decrease measurement error, and more non-market valuation studies that can be used for future benefit transfers. Despite increased use of benefit transfer as a practical policy making tool, few benefit transfer practitioners seem fully satisfied with the state of the science and continue to strive for agreement on best practice standards (Troy and Wilson 2006, Wilson and Hoehn 2006). Meta-analysis transfers not only transfer the non-market economic values from one location to another, but also transfer the measurement error associated with each non-market valuation study. Since meta-analysis consists of multiple studies, the associated error of the compiled results may be too high to reliably present the findings. Another critique of benefit transfer is that the biophysical characteristics and species composition is never going to be exactly the same at different locations. Salt marsh in coastal North Carolina does not have the same ecosystem structure and function as salt marsh in coastal Brazil or European countries and benefit transfer assumes that it does. There is evidence that transfer errors tend to be smaller when the two goods are located in the same geographic region (Ready and Navrud 2005). This may be because the goods themselves are more similar, or it may be because the user populations are more similar.

The most famous benefit transfer study was by Costanza et al. (1997) which estimated the global value of ecosystem services. The coastal and ocean ecosystem
services included open ocean, estuaries, seagrass/algae beds, coral reefs and the continental shelf. Global or other large scale ecosystem valuation estimates like Costanza et al. (1997)’s study can allow international conservation agencies and organizations to identify priorities based on goods or services that have the largest economic impact. Although it is informative to measure both market and non-market value on a global national or regional scale to identify conservation priority regions using economic analysis—these types of studies are not applicable to development of conservation strategies or action plans on smaller scales (Lindhjem and Navrud 2007). As Turner (1998) affirmed in criticisms of the Costanza et al. (1997) paper: “Apart from raising policy maker, scientist, and citizen awareness of the environment’s economic value and the possible significance of the loss of value over time, the global value calculations do not serve to advance meaningful policy debate in efficiency and in practical conservation versus development contexts.” In a global scale analysis, ecosystem values do not describe values experienced by people or describe a certain place (Toman 1998). It is important for coastal and marine managers to consider the scale of both ecological and economic assessments and ensure that the needs of both are aligned so that they can be mutually informative for conservation strategies.

Pendleton et al. (2007) conducted a literature review of non-market evaluation publications in the National Ocean Economics Program (NOEP) database and suggested that without improvement, the non-market literature database would be insufficient for effective policy-making. Nevertheless he recognized the importance of non-market valuation literature in providing marine managers with baseline information on how
particular ecosystem goods or services have been valued in the past and may be valued in the future (Wilson and Carpenter 1999).

A review of non-market economic valuation studies conducted within the Northwest Atlantic Marine Ecoregion will be able to provide a baseline estimate of the non-market value of particular ecosystem goods and services and endangered species within the Ecoregion. In light of some of the evidence against benefit transfer, non-market values from previously conducted studies within the Ecoregion may serve as a guide to designing conservation or management plans or as a starting point for future non-market valuation studies that government agencies or non-governmental organizations may consider conducting themselves.

**Methods:**

I conducted a literature review of non-market economic valuation publications within the Ecoregion extending from Maine to Cape Hatteras, North Carolina and predominantly from the mean high tide line seaward. I also included non-market valuation studies on wetland ecosystems that were conducted in major estuarine systems within the Ecoregion—primarily Chesapeake Bay and the Albemarle-Pamlico sound.

Many economic valuation literature databases have been created recently to provide policy makers better access to sources and in an effort to provide economic information to better inform public policy decisions. The National Ocean Economics Program (NOEP) database was created in an effort to sample all of the other databases for ocean and coastal economic valuation publications and therefore has the most comprehensive online database of marine valuation publications. Because NOEP is
currently updating their database and is absent of more recently published papers and publications recently added to other databases I conducted searches of all relevant economic valuation online databases. I reviewed non-market valuation studies located within the NOEP database, Environmental Valuation Reference Inventory (EVRI), Envalue the valuation database created by the Environmental Protection Agency of New South Whales, Australia, and AgEcon a database created by the University of Minnesota to catalog agricultural economic studies. I searched each database for valuation studies that calculated non-market value of a coastal or ocean ecosystem service or marine dependent activity within the Ecoregion. Additional papers were collected from citations in publications collected through the database search or that were cited in literature reviews and meta-analysis. While Pendleton et al.’s (2007) study included only peer reviewed literature, this review includes both peer reviewed and gray literature. Because of the low number of valuation studies completed in the Ecoregion I believe that it is important to consider all relevant studies.

Results:

All studies reviewed measured the non-market economic value using consumer surplus (willingness to pay) values per person or household per day (or per trip) and all non-market values were converted to 2008 dollars using the Consumer Price Index. 49 non-market valuation studies from 1977 to 2005 were reviewed in an effort to create a baseline estimate of the economic value of coastal and ocean ecosystem goods and services (see Appendix 1 for complete table of valuation estimates). The majority of publications were from the NOEP database and EVRI (Figure 3).
Figure 3\textsuperscript{2}: Almost 50\% of non-market valuation publications were collected from the National Ocean Economics Program database.

82\% of publications reviewed used either the travel cost or contingent valuation method for estimating non-market value (Figure 4). Four papers used the random utility model which is a combination of both contingent valuation and travel cost and three used hedonic pricing. Non-market value estimates using the travel cost method were higher in dollar value than those using contingent valuation for a particular ecosystem good or service. The value of a recreational fishing trip across the Ecoregion was at an average of approximately $40 using contingent valuation and approximately $400 using the travel cost method (Appendix 1). Hedonic pricing value estimates also varied from those elicited by contingent valuation, travel cost, and random utility methods as they were based actual real estate prices. Non-market value estimates from publications using

\textsuperscript{2} The original goal of this report was to present methods for only non-market valuation in the Northwest Atlantic Marine Ecoregion. Therefore, I spent more time collecting non-market publications than studies on market valuation or social impact assessment. The availability of a large number of publications on non-market valuation in the Ecoregion allowed analysis and presentation of the results in the graph format seen here.
travel cost, contingent valuation, and random utility ranged from under one dollar to nearly $700 per person/household per day or per trip while hedonic pricing estimates using real estate values ranged from just over $1000 to nearly $300,000 (Appendix 1).

Figure 4: The majority of non-market economic valuation publications were conducted using either contingent valuation or travel cost methods.

<table>
<thead>
<tr>
<th>Non-market economic valuation method</th>
<th>Number of Publications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contingent Valuation</td>
<td>20</td>
</tr>
<tr>
<td>Travel Cost</td>
<td>20</td>
</tr>
<tr>
<td>Random Utility Model</td>
<td>4</td>
</tr>
<tr>
<td>Hedonic Pricing</td>
<td>3</td>
</tr>
<tr>
<td>Unknown</td>
<td>1</td>
</tr>
<tr>
<td>Productivity Method</td>
<td>1</td>
</tr>
</tbody>
</table>

61 percent of publications valued beaches and recreational fishing (Figure 5). This estimate is similar to Pendleton et al.’s (2007) nation-wide literature review which found the majority of publications to be concentrated in these two areas. Estimates of non-market value of beaches ranged from less than $1 to just over $100 and were calculated using both contingent valuation and travel cost techniques (Figure 6). Contingent valuation surveys were diverse and measured the value of removing marine debris, beach re-nourishment, less crowded beaches, beach access, and water pollution control.
programs. Travel cost estimates of beaches focused on willingness to pay for beach access and improvements in water quality by decreasing pollution inflow. The majority of recreational fishing non-market values were estimated using the travel cost method (Figure 6) and measured the value of a recreational fishing trip or the change in value of a fishing trip from either increased fish catch or water quality which implied an increase in fish catch. Non-market value estimates of recreational fishing ranged from less than $1.50 (pole fishing on a beach) to nearly $700 per trip (all day head boat charter) (Appendix 1).

**Figure 5:** 61% of non-market economic valuation studies valued beaches and recreational fishing.
Figure 6: Beach valuations studies were conducted using both travel cost and contingent valuation while recreational fishing studies used predominantly the travel cost method.

The other 40 percent of publications valued water quality/pollution, endangered species, wetlands, wildlife viewing, habitat restoration, and scuba diving. Many coastal and marine ecosystem goods and services within the Ecoregion were missing from the literature such as visits to National Parks and Wildlife Refuges, motor-boating and sailing, the ecosystem value of entire watersheds, estuaries, species habitat, and many endangered species. Considering the level of conservation effort and funding it was surprising that there were no valuation publications on the value of the North Atlantic Right Whale (Eubalaena glacialis) in the U.S. Rudd (2007) conducted a survey where respondents expressed a willingness to pay of $6 - 43 for a Right whale conservation program in Canada however it was not formally included in the literature review analysis because it was outside the Ecoregion boundary. There is also a large private boating industry in the Ecoregion ranging from small dinghies to large yachts in the Gulf of
Maine, Boston Harbor, Narragansett Bay, Chesapeake Bay, and the Albemarle-Pamlico Sound which was not represented in the valuation literature.

Non-market economic valuation publications spanned the entire Ecoregion but were disproportionate regarding study location (Figure 7). Almost 25% of the studies valued North Carolina ecosystem amenities and 18% were in Massachusetts. Some states such as New Hampshire, Delaware, and Maryland were entirely absent from the literature except for multi-state valuation estimates. Many of the studies were multi-state encompassing the entire Ecoregion from ME to NC or focused on a particular area such as the New England region or the Chesapeake Bay.

Figure 7: Most publications were conducted on North Carolina and Massachusetts coastal and marine ecosystems.

Conclusions:

Pendleton et al. (2007) found that the non-market economic valuation literature was in need of four major improvements: a complete database, more use of gray
The results here show that the National Ocean and Economics Program database (NOEP) has the potential to be a comprehensive database of coastal and ocean non-market economic valuation publications. In addition to providing a list of coastal and ocean non-market valuation publications NOEP also lists the valuation estimates by subject and location on their website. This allows potential users to easily peruse the database and get a general idea of the valuation studies and value estimates on their subject and in their location of interest. However, as a potential resource for marine managers and policy makers NOEP lacks some of the amenities that other databases have. Although NOEP lists citations for all references many of the publications can only be accessed with expensive journal subscriptions. This leaves the manager or policy maker dependent on the results presented on the NOEP website and without access to the full articles.

Since the non-market valuation literature in the Ecoregion consisted of only 49 articles over the past 30 years, every research study has the potential to be valuable for marine managers and policymakers. The concentration of valuation studies in recreational fishing and beaches indicates a need for non-market economic valuation research on other coastal and marine sectors. For marine managers to use the non-market valuation literature as a reference economists must move away from valuing recreational fishing and beaches in predominantly North Carolina and Massachusetts and look into other environmental sectors and locations of interest to conservation planners. In addition, future non-market economic valuation studies should be presented as more applicable to coastal and marine conservation, management, and policymaking. This
may mean concentrating on particular methods or expanding research to a wider variety of ecosystem services and locations.

The variety of non-market economic valuation methods can be difficult for marine managers to interpret because of the difference in non-market value estimates. Travel cost and contingent valuation methods on a similar ecosystem good or service yielded very different results. While researchers using the travel cost method would estimate the value of a trip to view an endangered species, contingent valuation may ask how much people are willing to pay to know that the species exists. Although these two methods assign a dollar value to the same subject matter, the studies and the value estimates may not be easily compared. In this case, the marine manager is faced with a difficult decision—which estimate is correct? Unfortunately the answer is not straightforward and the answer has not yet been clarified within the non-market economic valuation literature (Stevens 2005). It is even more difficult to make comparisons between travel cost or contingent valuation and hedonic pricing estimates. Leggett and Bockstael (2000) found that a change in water quality in Chesapeake Bay from decreasing fecal coliform discharge levels was valued between $6,394.07 - 12,283.02 per land parcel using hedonic pricing. In a similar study using contingent valuation, the value of an increase in water quality in the Chesapeake Bay was found to have a use value of $250.74 and non-use value of $78.74 (Bockstael et al. 1989). Clearly these non-market values are at different scales and it is difficult to interpret which one should be used for defining policy decisions, especially by marine managers not explicitly trained in economic analysis.
The majority of the studies in the literature review focus not on application of the non-market values in marine conservation and management but instead on non-market valuation methodologies. Although this is standard in the development process of a particular field in the literature, environmental managers are looking for applied economic analysis and need the results of economic analysis to be easily transferable to their project needs. This can be difficult because economists are used to speaking their own language. When marine conservation agencies or organizations attempt to utilize economic analysis for conservation management plans they need to contract economists who fully understand the requirements of the organization. It is not only important for economists, marine managers and policymakers to work more cooperatively to increase the non-market economic valuation studies being conducted it is necessary for those studies to meet the needs of the marine conservation community. “Government agencies, coastal commissions, foundations, and other funding sources need a more structured and well-defined plan of research support so that future non-market economic valuation research provides a more solid, consistent, and comprehensive foundation for coastal management” (Pendleton et al. 2007).

Boyd et al. (2004) reviewed use of non-market economic valuation techniques by the National Marine Fisheries Service (NMFS) for establishing Essential Fish Habitat (EFH) under the Magnuson Stevens Fisheries Conservation and Management Act (MSFCMA). He found that the majority of regulatory decision making does not incorporate non-market values in the economic analysis. He suggests one reason this is the case is that NMFS does not use non-market valuation because other government agencies do not use it either. If NMFS were to use non-market economic values in the
decision making process it might be controversial among the other agencies it partners with because they do not use non-market techniques. This type of mentality ensures that government managers of coastal and marine resources will never use non-market valuation. One agency needs to take the first step, whether government follows the lead from or acts as a role model for non-governmental organizations depends on who makes the first step into non-market valuation. It appears from the studies reviewed here that non-governmental organizations are taking the lead in incorporating non-market valuation into their decision making and conservation planning. Although marine conservation managers should not undertake a non-market economic valuation study on their own and should work closely with or contract work to a trained economist, it is necessary for marine managers to understand the importance of non-market valuation and how it can be used to further the organization’s coastal and marine conservation priorities and goals.

Social impact assessments:

Marine managers need to fully comprehend the people that use or depend on the coastal and marine environment including their use patterns, perceptions of ecosystem goods and services, and institutional and management structure which defines the community. Socio-economic assessments can be used to value the marine environment, estimate the impacts of marine management actions on stakeholders and marine dependent communities, and incorporate stakeholders into the marine management process (Bunce et al. 2000). Although the need to incorporate socio-economic information into marine conservation planning is becoming increasingly more apparent,
how marine managers should do so is not. The previous section emphasized the role of economic valuation in marine conservation planning and policymaking and methods for conducting economic valuation studies. However, social impacts are not synonymous with economic impacts (NMFS 2009). This section focuses on the process of estimating factors such as stakeholder perception, resource use patterns, and social structure —the sociological part of socio-economic assessments. Not all socio-economic assessments must include formal economic analysis and valuation; many conservation programs using an ecosystem based management approach are successful at incorporating the human component using only social factor information gathered through social impact assessments.

Social impact assessments specifically “assess or estimate, in advance, the social consequences that are likely to follow from specific policy actions and specific government actions” (Interorganizational Committee on Guidelines and Principles for Social Impact Assessment 1994). Social consequences may include a change to marine dependent business and employment, families and social institutions, or the norms, cultural values, and beliefs that guide people’s lives (NMFS 2009). Social impact assessments are conducted either by a secondary review of the social science literature which describes affected populations or social survey research that gathers data on social factor values, perceptions, and beliefs. Both methods include a variety of social indicators such as: ethnic and racial diversity, mean population size, outflow of residents or change in seasonal residents throughout the year, institutional and community structure such as volunteer organizations and religious groups, the distribution of power and authority within a community, and factors that influence daily family life and
communication networks (Interorganizational Committee on Guidelines and Principles for Social Impact Assessment 1994).

Social scientists at the National Marine Fisheries Service and World Wildlife Fund have decided to use social well-being as the main indicator for social impact assessments (Pollnac et al. 2006, Stephanson and Mascia 2009). Social well-being is defined as “the degree to which an individual, family, or larger social grouping can be characterized as being healthy (sound and functional), happy, and prosperous” (Pollnac et al. 2006). Well-being is not just than economic welfare and therefore cannot be measured by only economic indicators. Well-being can be measured by job satisfaction which has been liked to mental health and longevity, decreases in family violence, and increased job performance (Pollnac et al. 2006). Conservation or management actions can have either a positive or negative on job satisfaction/well-being. Ideally, management actions should have the most positive biological impact while maintaining a positive impact on the socio-economic condition of the community.

It is important for marine managers to measure the impact of conservation actions on social well-being regardless if those impacts are negative. When conflict arises over management decisions or conservation action plans, people’s perceptions of the issue are likely to define their view or side in the controversy (Interorganizational Committee on Guidelines and Principles for Social Impact Assessment 1994). Understanding all perceptions and views of a policy issue would allow marine managers to be more perceptive of potential conflict. They can then work with communities and individuals on controversial issues before they become controversies to make informed management decisions (Stephanson and Mascia 2009). If marine managers are aware of the
perceptions held by relevant stakeholders they will be more prepared for conflict and can develop strategies for conflict resolution.

Unfortunately, many conservation action plans or government regulations specify only biological targets and do not include specific socio-economic objectives as a part of their marine planning process. This is a fundamental part of marine conservation planning which needs to change in order to ensure the conservation of marine resources. Social scientists have argued that to integrate social, economic, and biophysical impact assessments there is a need to develop a social impact assessment model for fisheries that is compatible to economic and biologist’s models (NMFS 2009). Some social scientists have recommended social impact assessment models present their results quantitatively instead of qualitatively so that they can be more readily compared to and integrated with biophysical and economic models (Pollnac et al. 2006). Sociological objectives can be measured using specified parameters including changes in employment, crime rates, domestic violence, shifts in household relationships and production. Demographic parameters include changes in populations including gender, ethnicity, age, and religion ratios (Mascia 2004).

Socio-cultural impacts from management action or inaction can be similar to those on the biophysical environment. Both social and biophysical impacts can vary in scale and in duration—some impacts may last a short period of time and some may last a lifetime. Biophysical impacts can vary in intensity or severity such as damage to a localized population of an endangered species or loss of a regional or entire population. The same is true of social impacts; management or the lack thereof may affect people in a specific location, throughout an entire country, or across the globe (Interorganizational
Committee on Guidelines and Principles for Social Impact Assessment 1994). Social impact assessments can therefore be completed on a variety of scales. Conservation organizations or managers could use a regional social impact assessment in combination with the biophysical and economic assessments to define high priority conservation areas and a local social impact assessment to define on the ground conservation strategies and action plans.

Socio-cultural assessments can be either participatory or extractive in approach. Participatory assessments include stakeholders and relevant community members in the assessment process while extractive assessments use secondary resources by a research team outside the stakeholder community (Bunce et al. 2000). In either case, it is important for the organization or team conducting the assessment to have some level of communication with stakeholders relevant to the marine conservation action plan. Communication with stakeholders may range from informing them about the goals and objectives of the assessment to full participation in the assessment process, analysis, and application of results. It is up to the assessment team to decide which communication level fits in line with the goals of the project. For example, if conservation action plans will likely have a high level of impact on stakeholders, it would be beneficial to marine managers to have the stakeholders as involved in the project as possible (Pomeroy and Douvere 2008).

Participatory planning and stakeholder engagement was recognized as a “fundamental prerequisite to the achievement of sustainable development” at the Earth Summit in Rio De Janerio in 1992. It is described as more of a ‘bottom-up’ rather than a ‘top-down’ approach to marine conservation as it allows stakeholders to be engaged
throughout the planning process. Participatory planning increases stakeholder’s role in the conservation process from an advisory capacity to a role of empowerment in the planning process (Kearney et al. 2007). It also encourages ownership of the management plan or conservation strategy and increases the likelihood that stakeholders will agree and comply with the management decision (Pomeroy and Douvere 2008).

Involving the public in the planning process is widely accepted as a positive contribution to the management process which benefits the public (Dalton 2006). Participatory planning is regarded as more “effective and equitable than usually possible through representative government and administration by inviting citizens to a deep and sustained participation in decision making” (Kearney et al. 2007). Involving stakeholders in the management process allows managers to better understand the complexity of the ecosystem, the human influence on the ecosystem and how it is managed, gain a mutual understanding about the issues at hand, and generate solutions that may not have been considered otherwise (Pomeroy and Douvere 2008).

The National Marine Fisheries Service and other social scientists have been working on the development of social impact assessment standards for marine fisheries since the 1980’s which can be applied to a variety of fisheries and non-fisheries marine conservation projects (Pollnac et al. 2006). The guidelines summarized below outline the 10 steps for completing a social impact assessment.
The National Marine Fisheries Service guidelines are not the only ones for conducting social impact assessments although guidelines are relatively similar elsewhere. The Global Coral Reef Monitoring Network (GCRMN), in collaboration with The World Conservation Union (IUCN), Australian Institute of Marine Science (AIMS), and NOAA, produced the Socioeconomic Manual for Coral Reef Management (the Manual) which acts as a field guide for marine managers conducting both social and economic impact assessments. The Manual (Bunce et al. 2000) provides five case studies on socio-economic assessments in coral reef communities around the world. Even though the ecosystem structure and function is clearly different from that of the Northwest Atlantic, important lessons can be learned in socio-economic assessment.

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<td><strong>NMFS Guidelines for Social Impact Assessment (Interorganizational Committee on Guidelines and Principles for Social Impact Assessment 1994)</strong> recommend 10 steps for completing a social impact assessment which include:</td>
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<td>1.</td>
<td>Identify potentially impacted groups and individuals and involve them in the planning process (social factor analysis)</td>
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<td>2.</td>
<td>Describe the proposed conservation action plan or management strategy and include a variety of potential alternatives.</td>
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<td>3.</td>
<td>Investigate and describe the human ecology associated with the project and outline their relationship to the biophysical environment.</td>
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<td>4.</td>
<td>Define the social impact variables necessary for a thorough social impact assessment that will guide the conservation planning process.</td>
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<td>5.</td>
<td>Estimate the potential impacts on the stakeholders identified in the above steps.</td>
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<td>6.</td>
<td>Outline the likely responses by all affected parties and be aware of potential problems and conflict associated with the conservation action.</td>
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<td>7.</td>
<td>Define potential cumulative and indirect impacts possible from action plans or management strategies which may occur in the reasonably foreseeable future.</td>
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<td>8.</td>
<td>Assess each alternative to determine the most feasible alternative that will have the most positive or least negative social impact on relevant stakeholders.</td>
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<td>9.</td>
<td>Develop a plan to mitigate negative impacts that may occur regardless of social impact assessment process.</td>
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<td>10.</td>
<td>Monitor and evaluate the success of the conservation plan in achieving both the biophysical and social objectives.</td>
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methods and application from these case studies. The case studies cover a variety of management issues including socio-economic analysis of a fisheries co-management project, the effect of tourism on fishing communities, the use of marine resources, perceptions of both traditional and non-traditional marine management, how much users were dependent on the marine resource, and conflict over marine resources both within the community and between the community and the management authority (Bunce et al. 2000).

It is impossible to measure all of the social factors of a community but there are key characteristics that can be studied to understand how social structure and behavior will change over time. Stephanson and Mascia (2009) stress that marine managers do not need to “reinvent the wheel” and should use secondary data that is accessible and reliable. Social impact assessments of environmental change in one community can be used as a reference for other similar communities. Although no two communities will react in the same exact manner to environmental change or regulation, there will often be common social factors found between similar communities (Interorganizational Committee on Guidelines and Principles for Social Impact Assessment 1994). After a socio-economic assessment is conducted it should be followed by continued socio-economic monitoring at regular intervals to measure change in socio-economic conditions. Marine managers can use socio-economic monitoring to assess whether they are meeting their conservation or socio-economic targets (Bunce et al. 2000). The Global Socio-economic Monitoring Initiative for Coastal Management is setting up socio-economic monitoring programs in coastal and marine related communities around the world. They have published detailed socio-economic monitoring guides specific to
marine regions around the world (ex. Southeast Asia, Western Indian Ocean, Caribbean, Red Sea, and Pacific Islands) (SocMon 2009).

**Social Overview of the Northwest Atlantic Marine Ecoregion:**

The first steps in a social impact assessment are identifying potentially impacted groups and outlining the human ecology of the ecosystem using social factor analysis (Interorganizational Committee on Guidelines and Principles for Social Impact Assessment 1994, Bunce et al. 2000, Stephanson and Mascia 2009). This section describes the social structure of the Northwest Atlantic Marine Ecoregion as it applies to marine conservation and management. Outlining the various sectors and stakeholders allows marine managers to review potential affects to the social structure or social well-being of a particular region or community from management actions, policies, or regulations.

The human ecology of the Northwest Atlantic Marine Ecoregion can be broken down into three sectors: the scientific community, stakeholders relevant to the problem issue, and managers and policy-makers. Marine managers and policy-makers can be located in state or federal government agencies or non-governmental organizations. Marine managers and policy-makers are responsible for managing or conserving the marine environment following the objectives and guidelines from the governing institution. Federal and state agency staff must follow guidelines from law and policy while non-governmental organizations set conservation objectives based on the particular goals of the organization. The scientific community in the Northwest Atlantic Ecoregion consists of predominantly social scientists including economists, geographers,
anthropologists, political scientists, and sociologists whom focus on issues related to the natural and social environment contained within the Ecoregion boundaries. Social scientists may be located in federal, state, or local agencies, within conservation non-governmental organizations or within advisory organizations such as the NOAA Coastal Services Center.

Although there are many stakeholders in the Ecoregion this section will focus on those that have the largest economic input into the overall economy—fishing, shipping, coastal real estate development, and tourism. In the future, the energy industry may also become a large stakeholder in the marine environment as the offshore wind, wave, and tidal energy increase but it will not be discussed in detail here. This section will give an overview of fishing, shipping, coastal real estate development, and tourism within the Ecoregion and review who is responsible for managing each sector. Any conservation action strategy or management planning process should take into account the stakeholders as described below to increase the likelihood of project implementation and success.

The fishing industry:

The fishing industry in the Ecoregion consists of fishermen, fish dealers, fishing boat builders and fishing gear suppliers. The Northwest Atlantic Marine Ecoregion contains the most historic and most productive fishing grounds in the United States and the world—George’s Bank. Fishing communities and associated industries in the Ecoregion are not only valued for their cultural and historical ties to the region but also for the revenue they contribute to the overall regional economy. Commercial fishing,
including aquaculture, fish dealers, and processing brings over $4 billion into the regional economy of the Ecoregion (Hoagland et al. 2008). The fishing industry is managed at two levels within the Ecoregion—federal and state. At the federal level, the National Marine Fisheries Service (NMFS) is responsible for writing and enacting regulations of the Magnuson Stevens Fisheries Conservation and Management Act (MSFCMA). There are two regional fisheries councils within the Ecoregion that are responsible for writing fisheries management plans. Both the Northeast and Mid-Atlantic Regional Fisheries Council have responsibility for maintaining fish populations within the Ecoregion, however as many fish species cross the jurisdictional boundary between the Northeast and Mid-Atlantic the fisheries council’s collaborate and often jointly write and implement fisheries management plans. Under the MSFCMA both Councils are required to write social impact assessments (fisheries impact statements) which include the effects of a particular management plan on the relevant fishing community. On the state level, each state in the Ecoregion is responsible for writing fisheries management plans which apply to fisheries in state waters. The majority of these plans are guided by the Atlantic States Marine Fisheries Commission which works with the Division of Fisheries in each state to write inter-state fisheries management plans (ASMFC 2009).

Tourism:

The coastal and marine related tourism industry is concerned with both development of infrastructure such as hotels, restaurants, and beach facilities and conservation of the coastal and marine environment for beach-going, wildlife viewing, and eco-tourism. Major tourism activities in the Northwest Atlantic Marine Ecoregion
include whale watch boats, recreational fishing/charter boats, kayaking/canoeing, beaches, hiking in wetlands, scuba diving, surfing, and swimming. Tourism and tourism infrastructure has been estimated to contribute about $115 billion to coastal county economies within the Ecoregion and is therefore a significant part of the regional economy (Hoagland et al. 2008). Tourism is managed under the Tourism Office for each state which lies within a different government office depending on the state. In Massachusetts, the Office of Travel and Tourism is located within the Executive office of Housing and Development and under the Department of Business Development. In North Carolina, the tourism office offers the same amenities but is located in the North Carolina Department of Commerce (NC Dept. of Commerce 2008). The primary role of the Tourism Office is to provide information about the State for travel industry professionals, researchers, tour operators and travel journalists and to bring revenue to the state through increased tourism. Although Tourism Offices have an interest in protecting the marine environment in order to generate revenue for the overall state economy, they do not have any regulatory or management authority.

Coastal real estate:

Although tourism brings a significant amount of revenue into the Ecoregion, the marine dependent industry with the largest economic impact is coastal real estate development. Real estate accounts for $193 billion in coastal counties within the Ecoregion (Hoagland et al. 2008). Coastal real estate values are high due to their proximity to coastal and marine ecosystems however values are dependent on the aesthetics of the environment and not necessarily ecosystem function.
The office that regulates real estate development and zoning differs for each state, but each state’s Coastal Zone Management (CZM) program has the authority to approve or deny development permits. In North Carolina, development in any of the 20 coastal counties is required to obtain a permit from the Division of Coastal Management (DCM) under the state CZM program (DCM 2008). In Massachusetts, not only are coastal developers required to obtain a permit from the state CZM program, but they also must receive a permit to build from a variety of other environmental management authorities within the state (MA CZM 2008). The process within each state for obtaining development permits differs, but there is always a regulatory body (usually CZM and/or others) within each state in the Ecoregion that considers the environmental and socio-economic implications of each coastal development project.

*Shipping:*

In the Northwest Atlantic Ecoregion shipping as transportation alone brings $10 billion into the economy, shipping related industries such as boat building, repair, search and navigation equipment bring an additional $25 billion. While shipping is not directly dependent on the health of the marine ecosystem, many components of the marine environment are directly impacted by shipping activities. Shipping lanes can overlap marine mammal migration and feeding areas, and shipping contents, especially oil barges, have the potential to have severe negative consequences on the oceans in the case of a ship grounding or leakage (Kite-Powell 2005). Conservation strategies involving the shipping industry may include, as they did recently in Boston harbor, changing shipping lanes to minimize ship passage through known species migration routes. Understanding
the economic impact shipping has on the local economy is important for designing conservation measures which may involve the shipping industry.

The relationship between the shipping industry and the marine environment is managed by the Coast Guard. The Coast Guard’s responsibility is to regulate shipping, mitigate potential spills, adequately manage waste disposal, regulate anti-fouling on commercial and recreational boats, ballast water, hazardous materials standards, safe boating practices, and marine debris. In New England, the Coast Guard worked with NOAA and the NMFS to change shipping lanes entering Boston Harbor to protect critical Right whale migration routes. Hauke Kite-Powell at the WHOI Marine Policy Center conducted a socio-economic analysis and found that although changing shipping lanes would cost the shipping industry anywhere from $10-15 million per year it would reduce the risk of a Right whale ship strike by nearly 40% (Carlowicz 2008). The Coast Guard, however, is not the only player in the shipping industry—port authorities (ex. Massport) for each major port within the Ecoregion are responsible for managing shipping behavior within ports, and private shipping companies have to comply with both port and Coast Guard regulations. Private shipping companies entering the Ecoregion could potentially come from anywhere in the world and may be more difficult to collect socio-economic information on.

Each of these industries and their employees as well as many others could potentially be impacted by management regulations or conservation action plans. As discussed above, outlining the structure and function of each marine related industry and community and their relationship to the marine environment is important in the design of management plans. When marine managers fully comprehend the effects of management
actions on the local community then they can make more informed decisions on which management alternative will make the least impact.

**Case studies of social impact assessments and social factor analysis used in marine conservation planning:**

Social impact assessments help marine managers understand individuals or communities related to the ecosystem and evaluate the impact of management actions on the social well-being of those particular communities. As with market and non-market valuation studies it is beneficial for marine managers and policymakers to look towards the literature for social impact assessments that have already been done in the community of interest or similar communities. This section highlights a few case studies where social impact assessment has been used to understand public perception of coastal and marine regulations or conservation action and well as potential public support for future actions.

**Methods:**

There are no databases of social impact assessments or social factor analysis like there are for non-market valuation studies. Therefore, finding examples of social impact analysis on coastal and marine related communities in the Ecoregion was difficult. The majority of social impact assessments in the Ecoregion were conducted for federal Fisheries Management Plans under NEPA and the MSFCMA. Social factor studies of coastal and marine dependent communities can also be found on the coastal zone management program websites for each state in the Ecoregion (ME-NC). NOAA’s
Coastal Services Center also provides social assessments of coastal communities (3 out of 7 are within the Ecoregion). Their social assessments are ethnographic studies which characterize the communities related to a particular ecosystem and focus on history, current status, and potential future of historical fishing communities.

Non-governmental publications on social impact assessments and social factor studies were located using a Google scholar search of combinations of the following words and phrases: marine, ocean, coastal environment, social impact assessment, social survey, socio-economic assessment, social factor, and each state in the Ecoregion. The majority of social surveys and social impact assessments in the literature search were conducted in developing world countries on coral reef communities. Because of the recent push towards managing coral reef communities using traditional management schemes and local ecological knowledge, it is not surprising that many social and economic studies have been published on coral reef dependant communities. Economic valuation studies such as those in the previous sections often include some degree of social factor analysis and present demographic information and community perceptions on environmental change. However the socio-cultural information is often presented but not integrated into the analysis as the studies are focused on quantititative economic variables. The literature search yielded only 2 social impact assessments in the Ecoregion. All of these were gray literature sources that had not been peer reviewed. It was beyond the scope and time limitations of this paper to review every document related to socio-cultural issues on the websites of coastal zone management programs from all 11 states and every social impact assessment for FMPs in the Ecoregion. The following
section presents a few case studies on social assessments in the Ecoregion as examples of studies that may be conducted in the future.

**Results:**

1) Ditton et al. (1998) used a social survey to understand more about the winter Bluefin tuna fishery and its participants and showed that recreational fishers supported a fisheries development plan. Understanding the socio-economic characteristics of the recreational Bluefin fishery provided an alternative to the current plan used by NMFS to allocate the U.S. Bluefin tuna quota among five fisheries. The survey included demographic characteristics, level of participation in the fishery, management preferences, fishing expenditures, and job satisfaction questions. The authors found that recreational fishers were supportive of a catch and release based recreational fishery instead of a ‘one fish per boat’ quota. Even if the catch and release based fisheries management plan was not developed by NMFS the survey clarified the recreational fishermen’s perspective on current Bluefin regulations and helped fisheries managers become more aware of the management issues within the fishery.

2) Massachusetts coastal zone management program also aimed to identify gaps in their knowledge on state coastal resources and communities. They assessed the biological, physical, chemical, social, and economic features within Gloucester harbor, a historically important fishing community (Wilbur 2004). The study reviewed the history, culture, and economic condition of lobstering, fishing, and general use of the coastal and marine environment by local community members and watermen. The author suggested that the results could act as a tool to support resource management strategies and
interdisciplinary planning in the MA coastal zone. Although direct application of the research results were not presented in the paper, Massachusetts coastal zone management program has expressed that one of their top priorities includes local citizen involvement in the management process (Wilbur 2004).

3) Social impact assessments (fisheries impact statements) required by NEPA and MSFCMA for the creation of a Fisheries Management Plan (FMP) are detailed overviews of both the socio-cultural attributes surrounding a particular fishery. Since social impact assessments are required to outline the potential impacts of the FMP on the “fishing community” the assessment is focused on the community members who are involved in fishing for a particular species. There are specific guidelines for social impact assessment which outline both how to complete an assessment and how to integrate results into an “interdisciplinary process of fisheries management” (NERFMC 2001). The social impact assessment for Skate Amendment 3 gives a detailed analysis of the social impacts to the skate fishery from the FMP regulations (NERFMC 2009). The report identifies key fishing communities that are likely to be affected by new regulations using secondary data and 37 interviews with port agents, skate and lobster vessel owners, fishing association staff, dealers and processors. It also highlights fishermen’s perspective on the new FMP regulations and the fishermen’s preferred management alternative. The guidelines for social impact assessments published by NMFS (NERFMC 2001, NMFS 2001) note that although social scientists conducting the assessments should be involved in developing management alternatives on the FMP Plan Development Team (PDT), NMFS Regional Councils do not usually employ them. From personal communication with scientists at National Marine Fisheries Service social impact
assessments are not readily factored into the FMP. Although impacts to fishing communities are outlined in detail, they are often written after the regulations have already been established based on biological characteristics and fish stock assessments.

**Conclusions:**

Social impact assessments using established methodology described here are one way of representing social along with biological and economic data. The key to successful use of social impact assessments is twofold: defining social objectives when designing conservation actions and using models that can be compared to and integrated with biological and economic ones. This literature review found few social impact assessments outside of the NMFS and state CZMA programs and clarifying how those studies have been integrated into coastal and marine policymaking was challenging. The authors implied that the results of their study could be used for marine conservation or regulation but there were few indicators that social impact assessments were actually integrated with biophysical or economic information to develop management strategies or conservation action plans. Written communication with top sociologists, anthropologists, and economists indicate that both social and economic information are largely absent from marine conservation planning and policymaking. Dr. Jim Wilson (Wilson, personal communication) could not think of a single situation in the entire New England region where socio-economic information played a significant role in the fisheries management process.

Social factor programs within conservation organizations and government agencies are expanding as the need for socio-economic information for ecosystem based
management increases. The socio-economic program of NMFS began in the late 1990’s and although it is expanding it will need substantially more funding and staff to collect the data necessary for thorough socio-cultural analysis. Marine managers should be aware that social factor analysis, social impact assessments and economic analysis are just as important as biophysical assessments and should be treated as equal and not supplementary to them in the creation of conservation and management plans (Pollnac et al. 2006).

**Marine Spatial Planning and socioeconomics:**

The use of geographic information systems in marine decision making and policy development is steadily increasing within the marine conservation and management community. Ecosystem based management is inherently place based where social, economic, and political attributes overlay ecological features of the environment (Martin 2004). Spatial approaches to marine management are necessary for addressing the complex relationships between these sectors and implementing effective management strategies (Crowder and Norse 2008). Marine spatial planning is a process for addressing multiple, cumulative, and potentially conflicting uses of the coastal zone and marine environment (Ehler and Douvere 2007). It uses place-or area-based objectives to meet biophysical and socio-economic conservation goals by providing a mechanism to achieving consensus among user groups in a certain location (Pomeroy and Douvere 2008). Spatial planning gives marine managers the tools to visualize the seascape and highlights ecosystem processes as more analytically important than single species (Martin 2004).
Environmental legislation has incorporated spatial planning into the management process for coastal and marine species, ecosystems, and industries. The use of fishing communities in National Standard 8 of the Magnuson Stevens Fisheries Conservation and Management Act (MSFCMA) inherently implies a switch to place-based management of fisheries (16 U.S.C. § 1801). Fishing communities have thus far been defined as distinct places which differ depending on the species of concern (Clay 2007). The MSFCMA also requires the designation of Essential Fish Habitat (EFH) which is a spatial mechanism for protecting important fisheries habitat. The Endangered Species Act also requires the designation of critical habitat for every listed species (16 U.S.C. § 1531-1544). This ensures spatial representation of that species along with a place-based recovery plan (Martin 2004). Marine spatial planning has also been used by governments around the world for the creation of marine protected area networks. Australia’s Great Barrier Reef Marine Park and California’s Channel Islands National Marine Sanctuary (Figure 8) are the most successful cases of marine spatial planning processes leading to a well-managed network of marine reserves.

While the availability and use of spatial information on biophysical properties is widespread, the use of socio-economic information in GIS is a relatively new field. The social landscape is not often represented alongside the biophysical seascape in marine spatial planning (St. Martin and Hall-Arber 2008). Scientists and managers have started to reevaluate methods and practices that have long been barriers to GIS (Martin 2004). One of those barriers is the use of socio-economic information in marine spatial planning. While much attention has focused on the use of biophysical information in a spatial context, substantially less attention has been paid to the inherently spatial nature of socio-
cultural characteristics and economic values (Troy and Wilson 2006). As the field of marine spatial planning and ocean zoning moves forward in the policy arena there will be an increasing need to incorporate socio-economics into the process (Smith and Wilen 2003). Integration of socio-economic information into geographic information systems (GIS) for spatial planning is a new but rapidly expanding field. Marine researchers and managers have started to incorporate socio-economic information into marine spatial planning for the creation of marine protected areas, stakeholder engagement processes, documenting local ecological knowledge, economic benefit transfer, and regional planning initiatives (St. Martin and Hall-Arber 2008).

**Figure 8:** Channel Islands National Marine Sanctuary: an example of marine spatial planning in the creation of a multiple use network of marine reserves. Source: http://channelislands.noaa.gov/marineres/main.html
Spatial information can be used to understand the relationship between human societies and behavior and ecological processes (Ehler and Douvere 2007). Socio-cultural data used in marine spatial planning is often called local (or traditional) ecological knowledge. There have been numerous studies on the integration of local ecological knowledge into a GIS based marine spatial planning process. Calamia (1999) integrated local ecological knowledge of fishing in the Pacific islands to aid in the success of marine resource management. Social information collected from informant interviews and participant observation was overlayed in a GIS with biophysical information to accurately depict interrelationships between people and the natural environment.

The most prominent use of socio-cultural data in marine spatial planning has been through ‘sensitive area analysis’ which uses surveys, interviews, and local participation in the management process to identify coastal and marine areas of particular concern to people (Calamia 1999). Sensitive area analysis has been used in coral reef ecosystems but its use is increasing throughout temperate regions as well. The California Marine Life Protection Act used this type of analysis in the design of the Channel Islands National Marine Sanctuary marine reserve system which used participatory planning and stakeholder involvement (Scholz et al. 2004). Incorporating local ecological knowledge data into marine spatial planning not only creates a complete representation of the entire ecosystem including humans but also involves stakeholders in the management process. As discussed in the previous section, participatory planning can be enormously valuable in the success of a marine conservation action plan or management strategy (Pomeroy and Douvere 2008). Mapping local ecological knowledge using participant interviews
before and after management plans can incorporate GIS into the social impact assessment process. Marine managers can measure the place-based (or spatial) change in local people’s perceptions of the marine environment after a particular management action. For example, important fishing locations may change after a management action has been implemented which can be spatially represented in a GIS. Local ecological knowledge is not currently being used in this way and is mostly used for designing marine reserve networks or stakeholder engagement. Although using local ecological knowledge in a GIS is one method to incorporate individual or community knowledge and perceptions into the conservation planning process, it is not a replacement for social impact assessment that measures the impact on social well-being of marine related communities.

Smith and Wilen (2003) note that economically driven behavior can frequently determine outcomes of marine conservation or management actions. Economists have only recently begun to think about how to geographically represent economic information and consider the economic implications of spatial diversity within marine ecosystems (Troy and Wilson 2006). While the use of marine spatial planning for designing marine reserves is widespread there have been few examples of using economic information in the marine spatial planning process for other conservation or management strategies. Economists have started to use spatial approaches to represent non-market economic values of coastal and marine ecosystems and industries.

Eade and Doman (1996) used non-market economic value benefit transfer to spatially represent the distribution of natural capital in a forested area of Belize. They created non-market economic value maps by multiplying the observable quantity or estimated strength of an environmental good or service by its total non-market economic
value. This GIS technique relies on benefit transfer or the transfer of measured non-market economic values from the location in which they were measured to another similar location. Errors inherent in this process were discussed in the non-market valuation section. The most important factor in eliminating error in the benefit transfer process is transferring values a limited distance. For example, it would be possible to use the regional non-market economic values I reviewed which are presented in Appendix 1 to create a non-market economic value map for the Northwest Atlantic Marine Ecoregion using benefit transfer. Errors would be less for this type of transfer than if non-market values for coastal and marine ecosystem goods and services were gathered from throughout the US or globally.

Troy and Wilson (2006) also used a spatial approach to non-market economic benefit transfer by spatially representing ecosystem values for coastal areas in Massachusetts, Washington, and California (Figure 9). They classified LANDSAT satellite imagery by the total non-market economic value in order to create the non-market economic value map. This is a useful approach for coastal ecosystems but becomes extremely difficult for marine ecosystem goods and services. Unfortunately there is no easy method of using satellite imagery to classify marine ecosystems. Spatial representation of marine ecosystem goods and services either consists of point data for species and polygon datasets of marine habitats that could be linked to non-market economic values simply do not exist for many areas and habitat types.
Marine spatial planning in the Northwest Atlantic Marine Ecoregion:

There are four options for integration of socio-economic information into the marine spatial planning process in the Northwest Atlantic Marine Ecoregion.

1. Mapping coastal and marine related market revenue and employment within the Ecoregion by coastal county.
2. Mapping coastal and marine related market revenue by industry sector or ecotype.
3. Mapping non-market economic values of coastal and marine ecosystem goods and services by ecotype.
4. Mapping local ecological knowledge to integrate societal perceptions and information on the coastal and marine ecosystem attributes that they are dependent on.

I mapped coastal and marine related market revenue and employment within the Ecoregion by coastal county using I-O analysis completed by Hoagland et al. (2008). I-O model outputs using IMPLAN software represented the total revenue and employment generated by marine related industries in 2006 in coastal counties from Maine to North Carolina. Using a publicly available shapefile of US counties from USGS, it is easy to spatially represent the economic value of industries and ecosystems within the Ecoregion by coastal county. I-O model outputs of total revenue for each marine related industry were joined to a coastal county shape file of the Ecoregion. (industries represented by SIC codes, refer to: Hoagland et al. (2008)). Figure 10 shows the total marine related revenue generated in the Northwest Atlantic Marine Ecoregion but separate maps were also made for each industry type (such as fishing, coastal real estate, tourism, etc.) which are not included here. This type of map (Figure 10) can help marine managers
understand the relationship between coastal and marine ecosystems and the nearby economy. The map shows that the impact of marine ecosystems on coastal economies varies throughout the Ecoregion. As a marine manager, it is important to maximize ecological benefits and minimize socio-economic costs of any management action. Spatially representing the differences in economic impacts across the Ecoregion allows marine managers to choose priority conservation sites based not just on biological characteristics but on socio-economic objectives as well. As discussed in the market economic valuation section, the I-O model results should not be interpreted as economic value or benefit but only as an indicator of the economic activity related to coastal and marine ecosystems.

Although total economic revenue and employment can be represented spatially, it is only accurate for those industries that occur predominately along the coast such as beach tourism or recreational fishing. Industries that occur offshore such as commercial fishing, shipping, and wildlife viewing (primarily whale watching) are clearly not depicted in a map of industries by coastal county. It is possible, although difficult, to use geospatial data to accurately represent the spatial distribution of total economic revenue offshore for some marine-related industries.

The main barrier to mapping the spatial distribution of revenue from the mean high tide line seaward is that there is a lack of spatial data on offshore marine related industries. There is spatial data available for some of the marine industries in the Ecoregion such as commercial fish catch, shipping routes, telecommunication cables, pipelines, whale watch vessel tracks, and liquefied natural gas (LNG) sites but it is difficult to link this spatial data to economic information in a reliable manner. Much of
the spatial data from these marine industries is not available for the entire Ecoregion and is only represented for a few states (MA has one of the largest spatial datasets in the Ecoregion). With complete spatial datasets and shapefiles for each of these industries it would be possible to map the total economic revenue of each of these industries offshore. The commercial fishing sector is the only marine industry in which spatial data spans the entire Ecoregion and it is feasible to spatially represent the distribution of economic revenue.

I used geospatial analysis to map the geographic distribution of market fish catch price (fishermen revenue) throughout the Northwest Atlantic Marine Eco-region. This is the first time that market revenues have been mapped offshore for any marine related industry. I requested fish catch data from Vessel Trip Reports from the National Marine Fisheries Service for the most recent year available which was 2007. I wrote a Python script which linked current market price data for commercially important fish species to the geographic distribution of fish catch for each species throughout the Ecoregion. The python script linked fish catch locations to market price data on the National Marine Fisheries Service Fisheries Statistics “Fish Market News” website (http://www.st.nmfs.noaa.gov/st1//market_news/doc31.txt) which is updated daily with fish prices from New England based fish auctions such as Boston, New Bedford, Portland, and Gloucester. Figure 11 represents the spatial distribution of fishing revenue as it applies to fish catch for one species, Atlantic cod, an extremely important commercial fish species in the North Atlantic and Ecoregion. The map clearly shows the varied distribution of fishing revenue throughout the Ecoregion. Managers could ideally overlay this map of fisheries revenue data with biological data on fish habitat such as
spawning and nursing grounds, or fish distribution and use the combined overlay of
economic and biological information to decide where to put a marine reserve or closed
area. Ideal marine reserve locations would be in oceanic regions that maximize
biological conservation objectives while minimizing economic costs to fishermen.
Further analysis should include linking the offshore spatial distribution of fishing revenue
with onshore locations or fishing communities. The next step in this process would be
mapping fish dealer locations where commercial fish are landed and fishing communities
that are associated with a particular landing location (St. Martin and Hall-Arber 2008).
This would allow marine mangers to link potential changes in social well-being or
revenue from management actions offshore to the fishing communities onshore (St.
Martin and Hall-Arber 2008).

There are a large number of assumptions and limitations to this approach of
spatially representing fishing revenue. Since I used fish catch location data from all of
2007 and daily updated fish market price, it is not accurate because the data are at
dramatically different time scales. Ideally, I would use either current fish catch location
and market price data or use yearly fish catch location data with the average yearly
market price. I have the market price text files for all 365 days of 2007. One next step
(although tedious one) would be to loop through each text file and calculating the average
yearly market price for each fish species. The script only inputs the fish market price for
those species where the name of the fish is the same in both the attribute table and the
website. Those fish include: Cod, Cusk, Pollock, and Haddock. In order to correct this
problem and include all the fish, another next step would be to go back to the original
data source in the Microsoft Access database and change the species names so that they
are the same as the species names in the website. This may be difficult as not all of the species are on the website at the same time because of the seasonal nature of fish catch. If it this map is used as a tool by marine managers as described above, they should be aware that it is likely that oceanic regions of high revenue will overlap with regions of high biological productivity. Nevertheless, this type of analysis is informative and can act as a baseline analysis of fishing revenue throughout the Eco-region.

Mapping non-market economic values by ecotype using benefit transfer was discussed above in reference to work by Eade and Doman (1996) and Troy and Wilson (2006). I compiled non-market economic values from publications in the Ecoregion in Appendix 1 that could be used to create a non-market value map similar to that presented in Figure 9. The majority of non-market valuation studies were conducted on beaches and recreational fishing. While it would be possible (although perhaps difficult) to obtain or create GIS shapefiles of beaches throughout the Ecoregion spatially representing recreational fishing would be extremely challenging. Recreational fishers can launch boats from probably tens of thousands of locations throughout the Ecoregion. Therefore mapping non-market economic value of recreational fishing may not be feasible.

The last method for integrating socio-economic information is the use of local ecological knowledge in a marine spatial planning process. Stakeholder engagement and marine spatial planning have been increasing in small island communities around the globe for the creation of marine reserve networks. Integrating local ecological knowledge into spatial planning involves using spatially oriented questioning and in-person interviews in order to create maps which accurately describe the fishermen’s knowledge in a spatial context. Local ecological knowledge is usually collected through
semi-structured interviews. For fishermen they would include questions about income, fish catch, how long they have been fishing, fishing methods, fishing gear type, where they fish, descriptive characteristics about the environment in which they fish, and characteristics of the habitat in which certain fish appear to prefer. Fishermen are asked to designate critical fishing areas and habitat types on a either a paper map or aerial photo. These areas are then hand digitized into a GIS for use in the spatial planning process (Scholz et al. 2004).

Conclusions:

As shown here there are a variety of methods for the integration of socio-economic with biophysical information in marine spatial planning. Market economic values, non-market economic values, and socio-cultural information can all be mapped in a GIS. The most challenging issue is mapping these parameters offshore from the coast to the continental shelf. I gave one example here of how it is possible to map market revenue offshore using fish catch location data, however there is a limit on the number of ecosystem goods and services that can be mapped offshore. Mapping ecotypes offshore should be a research priority for marine spatial planners. Many conservation organizations rarely use socio-economic information in marine spatial planning and if they do they only use the spatial representation of market economic values. This is predominantly due to lack of staff capacity, funding, and time and because they may not be aware of the methods presented in this report. However, as shown here it is possible to spatially represent market revenue mapped by coastal county and offshore for certain
industries as well as non-market economic value for coastal and potentially marine ecosystems if the necessary data is available.

**Figure 9:** Troy and Wilson (2006) show average yearly ecosystem service flows per hectare by tributary basin for Massachusetts in 2001 dollars. Ecosystem service flows were calculated using satellite imagery classification and benefit transfer of non-market economic values.
Figure 10: Total market revenue in coastal and marine related industries by coastal county. Coastal counties with the highest revenue include those in northern Massachusetts, southern Connecticut, Long Island, southern NJ, and counties within the Chesapeake Bay watershed.
Figure 11: Variability in fishing revenue for Atlantic cod geographically represented throughout the Northwest Atlantic Marine Ecoregion.

Potential Fishing Revenue for Atlantic Cod 12-12-08
**Figure 12:** Fishermen knowledge of important fishing locations off the coast of Massachusetts (St. Martin and Hall-Arber 2008).
Where are all the people?

This report has shown that there are a variety of methods for conducting socio-economic analysis so that economic and social objectives and information can be integrated into the marine conservation and management process. This report can act as a guide for conservation organizations and marine managers on how to incorporate the human component into conservation strategies and management programs. The use of an ecosystem based management approach to marine conservation recognizes the need for biological, social, and economic goals. Economic valuation methods along with social impact analysis can be used to measure the combined human value of the coastal and marine environment as well as the human implications of conservation action plans or policies. Not only does gathering socio-economic information about a particular issue allow marine managers to make more informed decisions, it also elicits participation from all relevant stakeholders and involves them in the conservation and management process.

Based on my review of The Nature Conservancy’s Northwest Atlantic Marine Ecoregional Assessment I would recommend that all federal, state, and local government agencies and non-governmental conservation organizations invested in the coastal and marine environment use the three methods presented in this report to integrate socio-economic with biophysical information in the marine conservation planning process: market valuation, non-market valuation, and social impact assessment. The use of these three methods can occur at two stages in the conservation planning process; conservation planners can incorporate market and non-market economic values and socio-cultural information using a combination of marine spatial planning and tradeoff analysis. In the
marine spatial planning process both socio-cultural and economic information can be used to designate priority conservation areas. Economic information in the form of market and non-market economic values and socio-cultural information gathered as local ecological knowledge can be spatially represented and overlayed with biophysical information in a GIS. Spatial based conservation planning software programs such as Marxan can be used to define priority coastal and marine conservation areas based on biophysical, social, and economic objectives. Once areas of high conservation priority have been identified socio-economic information should be used in a tradeoff analysis to determine the most effective conservation action plan for each particular location. Trade-off analysis can be in the form of a cost-benefit, cost effectiveness, or economic impact analysis using market and non-market economic information or social impact assessment using socio-cultural information. Market and non-market values and socio-cultural information can be used independently or in combination with each other for the development of successful coastal and marine conservation strategies.

Understanding how market and non-market valuation and social impact studies have been integrated into coastal and marine management and policy making thus far has been difficult. Although authors of the majority of publications implied that the results of their study could be used for marine conservation or regulation there were few indicators that economic valuation studies or social impact assessments were actually integrated with biophysical or economic information to develop management strategies or conservation action plans. Non-market economic valuation studies were concentrated on only recreational fishing and beaches and in primarily North Carolina and Massachusetts. Their lack of variety in environmental sector and location indicates that the non-market
economic literature is inadequate for use by marine managers in marine conservation planning. Written communication with top sociologists, anthropologists, and economists indicate that both social and economic information are largely absent from marine conservation planning and policymaking.

Some people argue that socio-economic and biophysical information have not been integrated because of high costs and time constraints of conducting socio-economic analysis and uncertainty in analysis methods. Although economic valuation, social impact assessments, and tradeoff analysis can be time consuming and expensive, they can be just as or even less time consuming and expensive than biophysical assessments. Considering the long time scale, complexity, and cost of scientific research conducted on species abundance, population dynamics, trophic cascades, habitat, climactic variation, and oceanographic characteristics in the Ecoregion, cost and time constraints are not adequate excuses for why social and economic assessments are not conducted or integrated into the management process. Although there is some uncertainty in socio-economic analysis methods, the same is true for ecological characteristics of an ecosystem. It is not often that we fully comprehend entire food webs, population dynamics, or ecosystem processes, yet marine managers use a precautionary approach which does not allow the presence of uncertainty to limit marine conservation and management (Botsford and Parma 2005). Marine managers and conservation planners should use a precautionary approach to socio-economic analysis as well.

Social science should be recognized as parallel to biophysical science, and just as necessary as data to the management and conservation planning process. Social scientific analysis should be accorded equal status, personnel, and monetary resources. As marine
managers continue to embrace an ecosystem based approach to marine conservation they have the opportunity to start using the most assimilated, efficient, and effective approach possible. This includes developing not only biophysical but social and economic goals and using stakeholder engagement and participatory planning to achieve those objectives. Marine managers can use research and case studies presented in this report as a guide to integrating socio-economic information for marine conservation planning.

The entire marine conservation community needs to embrace a paradigm shift towards the widespread use of socio-economic information to ensure the successful conservation of the coastal and marine environment. Although the marine conservation community has realized the necessity of an ecosystem based approach in designing conservation strategies, there are few organizations and agencies that have actually used such an approach. One barrier to ecosystem based management and the integration of socio-economic and biophysical objectives is that many marine managers come from a biological or ecological background and have not been trained in socio-economic analysis methods. One solution is bringing more trained social scientists into the marine conservation and management community in either government agencies or non-governmental organizations. This guide is one solution to that problem: marine managers can use this guide to learn about market and non-market based economic theory and analysis, socio-cultural research and social impact assessments, and the use of socio-economic information in marine spatial planning.
References:


NMFS, Finding of No Significant Impact for Actions Analyzed In: "Environmental Assessment and Regulatory Impact Review for Measures to Protect Right Whales in their Southeast U.S. Calving Habitat., Last Accessed On: at


Sumaila, U. R. 2005. Differences in economic perspectives and implementation of ecosystem-based management of marine resources: Politics and socio-economics

TNC. 2008. NW Atlantic Marine Ecoregional Assessment Core Team Charter. The Nature Conservancy, Boston, MA.


References used in non-market economic valuation literature review:


Lipton, D. W. and R. Hicks. 1999. Linking water quality improvements to recreational fishing values: The case of Chesapeake Bay striped bass. Fisheries Centre Centre Centre Research Reports Research Reports 7:105.


Federal legislation and legal case references:

Executive Order 12898 59 C.F.R. § 7629.


### Appendix 1: Non-market economic valuation literature review compiled results (Studies are included multiple times when they address multiple states or ecosystems – studies were not counted twice in results presented in the non-market economic valuation section).

<table>
<thead>
<tr>
<th>Database</th>
<th>Project/Paper Name</th>
<th>Date</th>
<th>Study Area</th>
<th>Ecosystem or Industry</th>
<th>Valuation Method</th>
<th>Non-market Value (2008$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NOEP</td>
<td>McConnell</td>
<td>1977</td>
<td>RI</td>
<td>Beach</td>
<td>Contingent Valuation</td>
<td>$1.57 - 7.09</td>
</tr>
<tr>
<td>NOEP</td>
<td>Kline and Swallow</td>
<td>1998</td>
<td>Gooseberry Island, Cape Cod MA</td>
<td>Beach</td>
<td>Contingent Valuation</td>
<td>$4.32 weekdays and $5.91 for weekends</td>
</tr>
<tr>
<td>NOEP</td>
<td>Binkley and Hanemann</td>
<td>1978</td>
<td>MA (Boston)</td>
<td>Beach</td>
<td>Contingent Valuation</td>
<td>$8.04/household/trip</td>
</tr>
<tr>
<td>NOEP</td>
<td>Hanemann</td>
<td>1978</td>
<td>MA</td>
<td>Beach</td>
<td>Travel Cost</td>
<td>$1.15</td>
</tr>
<tr>
<td>NOEP</td>
<td>Meta Systems Inc.</td>
<td>1986</td>
<td>MA</td>
<td>Beach</td>
<td>Travel Cost</td>
<td>$22.40</td>
</tr>
<tr>
<td>NOEP</td>
<td>Huang and Poor</td>
<td>2004</td>
<td>NH and ME</td>
<td>Beach</td>
<td>Contingent Valuation</td>
<td>$3.98/household/day</td>
</tr>
<tr>
<td>NOEP</td>
<td>Bin et al.</td>
<td>2004</td>
<td>NC</td>
<td>Beach</td>
<td>Travel Cost</td>
<td>$24.09 - 84.66/person/day</td>
</tr>
<tr>
<td>NOEP</td>
<td>Leeworthy and Wiley</td>
<td>1991</td>
<td>NJ</td>
<td>Beach</td>
<td>Travel cost</td>
<td>$34.67/trip</td>
</tr>
<tr>
<td>NOEP</td>
<td>Author</td>
<td>Year</td>
<td>Location</td>
<td>Method</td>
<td>Description</td>
<td>Cost Range</td>
</tr>
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<td>------</td>
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<tr>
<td>NOEP</td>
<td>McConnell</td>
<td>1992</td>
<td>MA</td>
<td>Beach</td>
<td>Travel cost</td>
<td>$1.16 - 1.87</td>
</tr>
<tr>
<td>NOEP</td>
<td>McConnell and Weaver</td>
<td>1977</td>
<td>RI</td>
<td>Beach</td>
<td>Contingent Valuation</td>
<td>$6.33</td>
</tr>
<tr>
<td>NOEP</td>
<td>Parsons et al.</td>
<td>1999</td>
<td>NJ-VA</td>
<td>Beach</td>
<td>Random Utility Model</td>
<td>$0.08 - 14.00/trip</td>
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<td>NOEP</td>
<td>Smith et al.</td>
<td>1997</td>
<td>NC and NJ</td>
<td>Beach</td>
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<td>$32.81 - 110.77</td>
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<td>NOEP</td>
<td>Feenberg and Mills</td>
<td>1980</td>
<td>Beach</td>
<td>Random Utility Method</td>
<td>$5.11/person/year</td>
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<tr>
<td>NOEP</td>
<td>Bockstael, Hanneman, and Kling</td>
<td>1987</td>
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<td>Beach</td>
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<td>Silberman and Klock</td>
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<td>NJ</td>
<td>Beach</td>
<td>Contingent Valuation</td>
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<td>NOEP</td>
<td>Silberman et al.</td>
<td>1992</td>
<td>NJ</td>
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<td>$29.68 existence value for the beach</td>
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<td>NOEP</td>
<td>Silberman et al.</td>
<td>1992</td>
<td>NJ</td>
<td>Beach</td>
<td>Contingent Valuation</td>
<td>$31.29 user value, $19.19 existence value</td>
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<td>NOEP</td>
<td>Hicks et al.</td>
<td>2004</td>
<td>Chesapeake Bay</td>
<td>Habitat Restoration</td>
<td>Random Utility Model</td>
<td>Shore fishers: $0.09 - 0.23</td>
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<tr>
<td>EVRI</td>
<td>Author Unknown - U of Maryland Dissertation</td>
<td>1995</td>
<td>NY - FL Atlantic Coast</td>
<td>Recreational Fishing</td>
<td>Travel Cost</td>
<td>Two month benefit of a 10% increase in catch rate; $3.13-132.65/fisher</td>
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<td>EVRI</td>
<td>Author Unknown - U of Maryland Dissertation</td>
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<td>NY - FL Atlantic Coast</td>
<td>Recreational Fishing</td>
<td>Travel Cost</td>
<td>Two month benefit with a ban on fishing flat fish: $-493.11 - $-116.16</td>
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<td>Author Unknown - U of Maryland Dissertation</td>
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<td>NY - FL Atlantic Coast</td>
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<td>Travel Cost</td>
<td>Two month benefit with a closed area: $-265.66 - $-11.81</td>
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<td>1983</td>
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<td>NOEP</td>
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<td>DE, NJ, NY</td>
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<td>NOEP</td>
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<td>NOEP</td>
<td>McConnell and Strand</td>
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<td>Agnello and Han</td>
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<td>Kaoru</td>
<td>1991</td>
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<td>Lipton and Hicks</td>
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<td>Chesapeake Bay</td>
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<td>Random Utility Model</td>
<td>$96.01/trip, $7.19 for an increased catch rate of 0.5 fish, loss of $12.84 for decreased water quality</td>
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<td>Hicks et al.</td>
<td>1999</td>
<td>VA</td>
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<td>Contingent Valuation</td>
<td>$61.50</td>
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<tr>
<td></td>
<td>Hicks et al.</td>
<td>Year</td>
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<td>Activity</td>
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<td>Value</td>
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<td>$9.30</td>
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<td>EVRI</td>
<td>Whitehead, J.C.</td>
<td>1991</td>
<td>NC - Tar-Pamlico River</td>
<td>Recreational Fishing</td>
<td>Travel Cost</td>
<td>$23.06 - 120.25/ trip depending on the change in water quality</td>
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<td>Recreational Fishing</td>
<td>Travel cost</td>
<td>$49.25 - 50.41</td>
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<td>NJ</td>
<td>Recreational Fishing</td>
<td>Travel cost</td>
<td>$59.56 - 62.78</td>
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<td>Year</td>
<td>State(s)</td>
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<td>EVRI</td>
<td>Agnello, R.</td>
<td>1989</td>
<td>NY - FL Atlantic Coast</td>
<td>Recreational Fishing - bluefish, weakfish, and summer flounder</td>
<td>Travel Cost Bluefish: $2.58, Flounder: $17.51, Weakfish: $3.39</td>
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<td>EVRI</td>
<td>Kaoru, Y. V.K. Smith, and J.L. Liu</td>
<td>1995</td>
<td>NC - Albemarle and Pamlico Sounds</td>
<td>Recreational Fishing - Estuarine Fishes</td>
<td>Travel Cost $3.70 - 42.31</td>
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<td>EVRI</td>
<td>Smith, V.K. and R.B. Palmquist</td>
<td>1988</td>
<td>NC - Albemarle and Pamlico Sounds</td>
<td>Recreational Fishing - Estuarine Fishes</td>
<td>Travel Cost Increase in catch: Outer Banks: $158.30, Pamlico Sound: $20.95 Decrease in Phs loadings: Outer banks: $134.00, Pamlico Sound: $5.49</td>
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<td>Schuhmann, P.W.</td>
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<td>NC</td>
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<td>Travel Cost $3.57 - 4.91/trip for boat anglers $0.03 - 0.07/trip for shore anglers</td>
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<tr>
<td>EVRI</td>
<td>Bauer et al.</td>
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<td>Maine</td>
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<td>Type</td>
<td>Valuation Method</td>
<td>Valuation (per unit)</td>
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<tr>
<td>EVRI</td>
<td>Whitehead et al.</td>
<td>1998</td>
<td>NC Pamlico Sound</td>
<td>Water quality/Pollution</td>
<td>Contingent Valuation</td>
<td>$382.11/household/year</td>
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<tr>
<td>EVRI</td>
<td>Whitehead et al.</td>
<td>1995</td>
<td>NC Albemarle-Pamlico Sound</td>
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<td>On-site users: $117.17, Off-site users: $91.85, Non-users: $81.48</td>
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<tr>
<td>Leggett and Bockstael</td>
<td></td>
<td>2000</td>
<td>Chesapeake Bay</td>
<td>Water quality/Pollution</td>
<td>Hedonic Pricing</td>
<td>$6,394.07 - 12,283.02 per land parcel for a change in fecal coliform</td>
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<tr>
<td>Bockstael et al.</td>
<td></td>
<td>1989</td>
<td>Chesapeake Bay</td>
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<td>Users $250.74, Non-users (existence value) $78.74</td>
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<tr>
<td>EVRI</td>
<td>Udziela and Bennett</td>
<td>1997</td>
<td>CT</td>
<td>Wetlands</td>
<td>Contingent Valuation</td>
<td>$84.27/person</td>
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<tr>
<td>EVRI</td>
<td>Thibodeau and Ostro</td>
<td>1981</td>
<td>MA</td>
<td>Wetlands</td>
<td>Hedonic Pricing</td>
<td>Recreational Fishing: $437.34/user/year Increase in land value: $506, 846.77 - 627, 254</td>
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<td>EVRI</td>
<td>Johnston et al.</td>
<td>2001</td>
<td>NY</td>
<td>Wetlands</td>
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<td>Wetlands: $0.11, Shellfish: $0.10, Eelgrass: $0.17</td>
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<td>EVRI</td>
<td>Bauer et al.</td>
<td>2004</td>
<td>RI</td>
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<td>$0.64/person/acre</td>
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<tr>
<td>NOEP</td>
<td>Johnston et al.</td>
<td>2002</td>
<td>NY</td>
<td>Wildlife Viewing</td>
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<td>NOEP</td>
<td>Hoagland and Meeks</td>
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<td>Scuba Diving</td>
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<td>NOEP</td>
<td>Smith and Crowder</td>
<td>2005</td>
<td>NC</td>
<td>Water quality/Pollution</td>
<td>Productivity Method</td>
<td>$2.82 million increase in fishery rents per year</td>
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<td>NOEP</td>
<td>Kaoru</td>
<td>1993</td>
<td>MA</td>
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<td>$21.40 option value $85.54 existence value</td>
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