CHAPTER 13

Humans Within Northwest Atlantic Ecosystems: An Overview of Uses & Values

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Introduction

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Each of the assessment's habitat and species focused chapters (2-12) includes a "Human Interactions" section summarizing the environmental stresses and impacts of specific human uses. Review of these sections reveals some common themes – pollution, climate change effects, fishing, coastal habitat loss, energy production, recreational activities, and waterborne transportation can all have negative impacts on multiple habitats and species.

However, eliminating *all* of these impacts is not a sensible or realistic goal – management goals need to encompass both socio-economic and ecosystem conservation objectives. Ecosystem based management approaches offer promise for simultaneous achievement of goals for sustaining living marine resources, consumptive human uses, and human health and well-being. However, in addition to detailed information on marine habitats and species, ecosystem based management requires detailed information on how different human communities (geographic and sectoral) perceive, use and value natural resources.

It is now widely held that the focus of natural resource management is people rather than natural resources as it is primarily human behavior rather than nature that is being "managed". Experts continually recommend "...an integrated approach to management that considers the entire ecosystem, **including humans**...to maintain an ecosystem in a healthy, productive and resilient condition so that it can provide **the services humans want and need**... (emphasis added)" (SCS 2005). The assessment has been developed with a goal of furthering understanding on how human activities, both existing and proposed, are linked to natural resources--but much more work remains to be done.

The Conservancy's Marine Ecoregional Assessments have recently begun to include more socio-economic information. The field of socio-economics is concerned with a broad range of issues involving the interaction between society, politics and culture and the relationship between individuals, the choices they make and the economic market.

Environmental Impact Assessments measure anticipated changes in natural resources and Social Impact Assessments describe the effects of social changes. "Although economic analysis can be considered as one part of social science analysis, economic impact analysis addresses how efficiently investments of capital and other resources are returned in present and future benefits to society (i.e., whether the economic benefits of an action or policy outweigh the costs). Economic impact analysis focuses on resource supply and demand, prices, and jobs, while social impact analyses consider how public or private actions may alter the ways in which people live, work, play, relate to one another, organize to meet their needs and generally cope as members of society. The term also includes cultural impacts involving changes to the norms, values, and beliefs that guide and rationalize their cognition of themselves and their society (NMFS, 1994).

The Northwest Atlantic region is densely populated and includes coastal communities that are tightly linked to and highly dependant on coastal and marine ecosystems for commerce, recreation and aesthetic amenities. Accordingly, there are significant economic incentives for increased private use and profit from use of public trust resources. Consequently, local, state and federal agencies seek to minimize natural resource impacts and maximize sustainable use using a variety of regulatory tools. Although, some of our environmental laws such as the National Environmental Policy Act and the Magnuson-Stevens Fishery Conservation and Management Act require social impact assessments on local communities, available data needed to inform such assessments is often quite sparse when compared to the volume of information on natural resources.

Similarly, this assessment does not provide enough socio-economic information and spatial data on human uses to fully describe the linked social-ecological system within the Northwest Atlantic planning area. High quality socio-economic data can be used to develop better management alternatives and more appropriate mitigation packages. The Social Impact Assessment methodology (NMFS, 1994) emphasizes the need for information on a wide range of indicators including:

- **Population Characteristics** (Population Change, Ethnic and racial distribution, Relocated populations, Influx or outflows of temporary workers, Seasonal residents)
- **Community and Institutional Structures** (Voluntary associations, Interest group activity, Size and structure of local government, Historical experience with change, Employment/income characteristics, Employment equity of minority groups, Local/regional/national linkages, Industrial/commercial diversity, Presence of planning and zoning activity
- **Political and Social Resources** (Distribution of power and authority, Identifications of stake holders, Interested and affected publics, Leadership capability and characteristics);
- **Individual and Family Changes** (Perceptions of risk, health, and safety, Displacement/relocation concerns, Trust in political and social institutions, Residential stability, Density of acquaintanceship, Attitudes toward policy/project, Family and friendship networks, Concerns about social well-being
- **Community Resources** (Change in community infrastructure, Native American tribes, Land use patterns, Effects on cultural, historical, and archaeological resources).

Socio-economic information can inform decisions on individual site-specific projects and is also needed to support the comprehensive marine spatial planning approaches being developed worldwide. Marine spatial planning can reduce conflicts by providing a blueprint for aligning human uses with their socially and ecologically compatible times and places. These approaches require analysis of tradeoffs between different uses and maintenance of ecosystem services. The data contained in this assessment is designed to help support marine spatial planning processes but tradeoff analyses need to developed in stakeholder driven and very transparent public contexts and are beyond the scope of our work.

There are many approaches for acquisition of the socio-economic data that is needed, including:

- Ethnographic research
- Focus groups and interviews
- Cost-benefit analysis
- Non-market valuation
- Network/power analysis
- Opinion polls and surveys
- Input-Output economic models (market valuation)
- Mapping human use patterns
- Community/participatory mapping

Accurate and verifiable socio-economic information is very difficult to acquire and it is costly to develop new data sets; a comprehensive socio-economic analysis was well beyond the scope of this assessment. However, information was collected using three of the approaches listed above: an opinion survey, an economic model and preliminary human use mapping. For each approach, this chapter summarizes: (1) what we measured, (2) how we measured it, (3) whether or not it can be illustrated spatially, and (4) limitations of the tool.

Stakeholders Survey

In early 2008, the Conservancy conducted a regional survey of marine stakeholders to gain a better understanding of marine resource stakeholder's priorities and concerns and their thoughts on effective strategies for coastal and marine conservation in the region. Survey questions were designed to reveal stakeholders' views about the current status of the region, data gaps, and how assessment data products might be designed to maximize their utility. Despite the limitations noted below, survey results were useful for informing early stages of assessment work plan development. The survey was used as a communications tool to stimulate interest and participation from potential technical team members, peer reviewers and data providers.

What did we measure?

Information collected included stakeholder opinions on which region-wide stressors were of the greatest concern: Coastal development and related effects (32 percent); Global climate change (21 percent); Fishing-related threats including overharvest, bycatch and habitat damage (20 percent); Pollution, including non-point, point-source, sediments, nutrients and toxins (16 percent). Specific threats to habitats and species included: non-point source pollution, nearshore habitat loss, benthic habitat impacts, and energy development.

How did we measure it?

The survey was conducted in January and February 2008 with an online survey tool (SurveyMonkey.com). The survey invitation was sent by email on January 30, 2008, and sent a second time on February 7 to those who had not yet responded. A total of 279 recipients received the email invitation. This report summarizes results from 139 respondents (49 percent response rate); please see Appendix 13-1 for survey results.

Could we illustrate it spatially?

While it is possible to extract geographic locations based on respondent affiliation, a spatial illustration would be of low utility. In addition, respondents were answering each question through a regional lens, rather than through their individual state or town.

Limitations

Survey respondents were identified by Conservancy staff who sought to achieve balanced representation from state and federal agencies, universities and research organizations, non-profit and conservation organizations and maritime industry groups (commercial fishermen and/or members of fisheries related associations or trade groups). Industry groups were underrepresented but a large comprehensive survey of all identified stakeholders was not feasible given time and budget constraints.

Input-Output Economic Model

The Conservancy contracted with the Woods Hole Oceanographic Institution's Marine Policy Center to produce a "Regional Economic Analysis of the Northwest Atlantic Marine Eco-Region", completed in August 2008. This analysis utilized the IMPLAN Input-Output Model to assess the impact of the coastal and marine economy in the Northwest Atlantic region. Some of the key findings from the report are reproduced or summarized below; please refer to Appendix 13-2 for the full report, glossary of terms, IMPLAN tables and NAICS Industry Codes.

What did we measure?

The analysis was based on an economic input-output (IO) model of an economy comprising the coastal counties from Maine to North Carolina. Primary and secondary industry sectors that depend on the ocean were identified, and the economic significance of those sectors to the regional economy was assessed. The model measured the value of industries in coastal and marine economies for 2006, the most recent year of available coastal county data. The model also measures the contribution of those sectors to state and region (dollar values generated and numbers of employees generated). While this analysis did not include data from a time series, the authors described trends by comparing results of the 2006 model to those from a similar study completed in 1995.

How did we measure it?

The Input–Output model was developed using the industry standard software, Impact Analysis for Planning Software (IMPLAN). IMPLAN is a commercially available input-output model (IO) which is widely used to characterize a snapshot of the linkages between different industrial sectors in an economy. It is constructed of linear algebraic equations that describe how the products of sets of industries are used in the manufacture of other goods, to satisfy consumer demands and to supply export markets. Specific industrial sectors (labeled as "ocean sectors") were identified that depend upon the ocean as a source of natural resources, as a sink for wastes or nutrients, for transportation, or as an aesthetic resource. The IO model yields estimates of direct output and labor impacts (*i.e.*, sales revenues and employment) from the ocean sectors, and indirect and induced impacts, which are summarized in the form of economic "multipliers." These multipliers are a measure of the connectedness of an industrial sector to the rest of the relevant economy. Changes in the production of goods in an industry will affect other sectors to which it is linked, either through changes in the purchase of goods from those sectors or through changes in the sale of its products to other industries or consumers.

Once constructed, an IO model yields information about direct, indirect, and induced output and labor impacts and value-added. Value-added is a measure of the net value (roughly the value of labor or total wages) created when products are purchased from some industries and combined using a technology and labor into another product in the economy. Importantly, value-added is the measure used to construct estimates of gross domestic product (GDP), and estimates of value added from the Northwest Atlantic coastal county model can be used to measure the contribution of that economy to the regional or national economy. Please see Appendix 13-2 for a full description of methods.

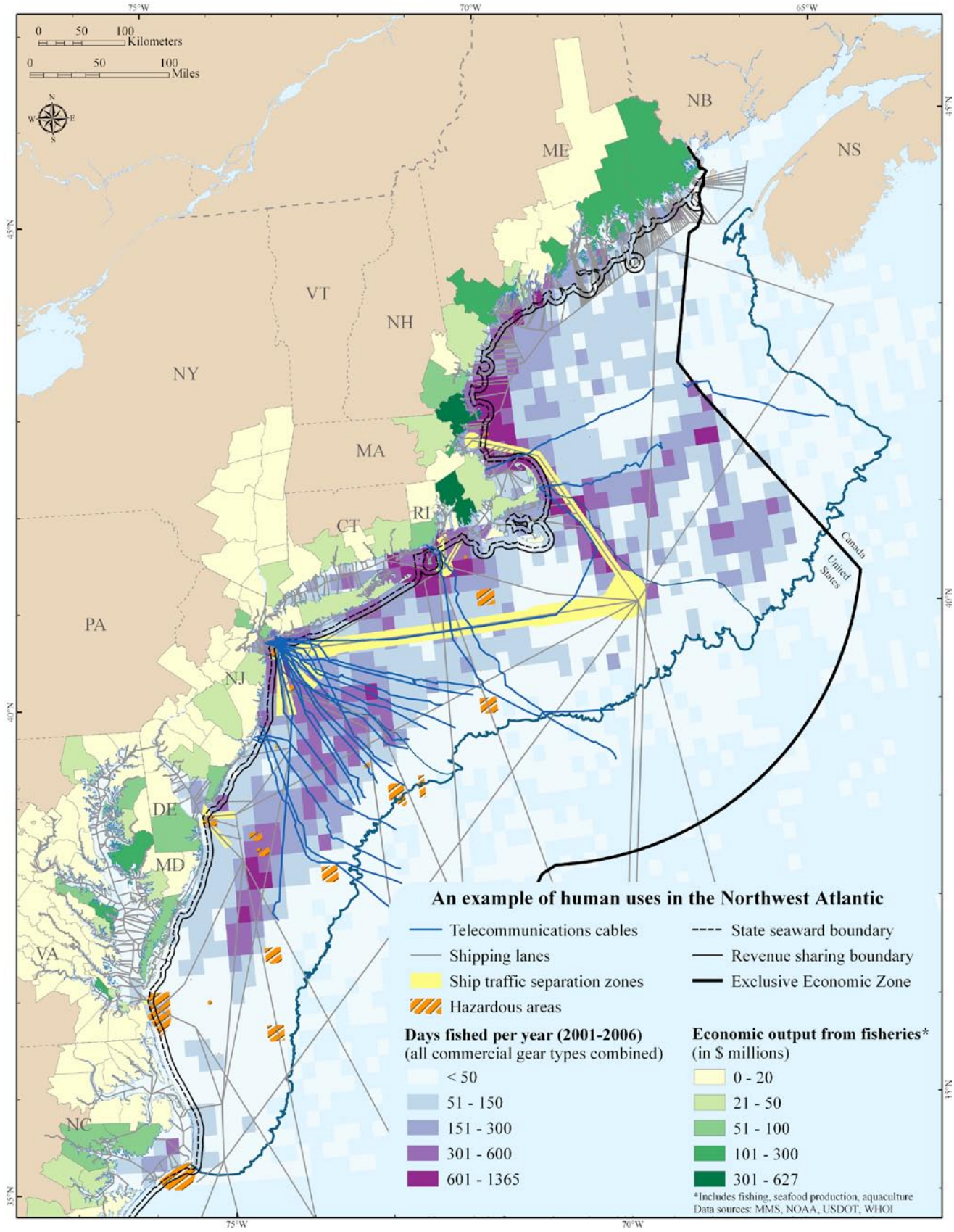

Figure 13-1. Selected spatial data illustrating some of the human uses of the Northwest Atlantic region.

Results

A brief summary is presented here; please refer to Appendix 13-2 for detailed results. Annual coastal-and ocean-related economic output in the Northwest Atlantic region is estimated at $362 billion. Corrected for inflation, there has been a 17% increase from 1995 to 2006 in direct output in the region's broadly defined (primary and secondary) ocean sectors. Annual ocean-related employment in the Northwest Atlantic region stands at almost 3 million persons. There has been a 25% increase from 1995 to 2006 in employment in the region's broadly defined ocean sectors.

Can we illustrate it spatially?

Economic activity for each sector can be mapped to the resolution of counties (Figure 13-1.) Additional IMPLAN model outputs have been mapped by coastal county, including maps for revenue output for each industry and one map of all the industries combined (IMPLAN totals). Spatial data on human uses in the ocean cannot be related to IMPLAN outputs without additional work to develop data and modeling approaches to explicitly link the spatial distribution of ocean and shore based activities.

Limitations

- Marine and coastal industries are often hard to extract in aggregate categories
- Economic impacts may be inflated and exaggerate the value of a sector
- Data is binned at state or county level making higher resolution spatial illustration difficult.
- Coastal county data is not linked to spatial data on offshore activity. Unless there is data describing the geographic distribution of human activities in the ocean, it is not possible to distribute data on outputs, employment or value-added over the ocean.
- Traditional IO models do not yield estimates of net economic value, as represented by consumer and producer surpluses.
- With IMPLAN results, only one part of the marine/coastal market was measured. For example, a cost-benefit analysis that looks at the economic values between strategies would involve consumer and producer surplus data.
- The IMPLAN model does not measure non-market values or ecosystem services values (i.e. resources that are "unpriced"). Non-market benefits comprise consumer surpluses for environmental amenities that are not traded in established markets, and, therefore, are not produced by an industry.

Further research to evaluate spatial linkages between socio-economic and ecological data is needed to inform marine spatial planning processes. This work could include linking economic data to the relevant places where resource uses occur, and quantifying the market values of for specific human uses at varying intensities. Additionally, non-market valuation methods are needed to inform ecosystem based management decisions to meet goals for long-term sustenance of ecosystem services that have no direct market value (e.g. erosion and pollution control, cultural, aesthetic).

Human Use Mapping

Coastal and marine spatial planning to support ecosystem based management requires high quality and high resolution spatial data on human uses. During the course of this assessment, spatial data was acquired on human uses with the data on coastal and marine habitats and species.

Map layers from diverse sources were obtained that contained data on pollution, shoreline development, coastal sand mining, recreational and commercial fishing, shipping lanes, telecommunications cables, energy development, hazardous waste dump sites, shipwrecks, military use areas, and administrative boundaries.

Unfortunately, nearly all of these map layers had limitations that precluded their utility for full integration and analysis with geophysical and ecological data within the assessment. Several of the human use spatial data layers did not cover a substantial portion of the planning area and layers had little to none of the metadata needed to evaluate spatial data accuracy and appropriate use. Therefore, spatial data on human uses is not being distributed with the assessment.

However, Figure 13-1 is included to illustrate some of the human activity within the assessment study area using some of the more credible and authoritative data on human uses. The source data used to create this image includes Fishing Vessel Trip Report data information kindly provided by NOAA Fisheries, binned by ten minute square to provide a general regional scale sense of the distribution and intensity of commercial fishing activity and also shows fishery related (including seafood processing and aquaculture) economic activity by coastal county from the report described above and included as Appendix 13-2. Additional map layers are overlaid on this image depict shipping lanes, hazardous waste dump site locations, and a subset of existing telecommunications cables. The Conservancy looks forward to working with state and federal agencies and other interested parties to develop marine spatial data on human uses that is robust enough to support marine spatial planning approaches.

LITERATURE CITED

NMFS (National Marine Fisheries Service). 2004 Operational Guidelines – Fishery Management Process, Appendix 2(g), Guidelines for Assessment of the Social Impact of Fishery Management Actions, http://www.nmfs.noaa.gov/sfa/reg_svcs/social_impact_guide.htm Accessed March 20, 2010

SCS (Scientific Consensus Statement on Marine Ecosystem-Based Management) 2005. http://www.compassonline.org/pdf_files/EBM_Consensus_Statement_v12.pdf Accessed March 20, 2010.

Northwest Atlantic Marine Ecoregional Assessment

Stakeholder Survey Results

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Northwest Atlantic Marine Ecoregional Assessment
Stakeholder Survey Results

INTRODUCTION

The Nature Conservancy is conducting a Marine Ecoregional Assessment of the Northwest Atlantic, spanning from Cape Hatteras in North Carolina to the Gulf of Maine in Canadian waters. The Assessment will include a database and maps of integrated information on marine ecosystems, habitats, target species and human uses at the Northwest Atlantic regional scale to support decision making at all levels.

In early 2008, the Conservancy's NW Atlantic Marine Assessment's Core Team conducted a regional survey of marine stakeholders to solicit the latest thinking about priorities, concerns, and strategies for coastal and marine conservation in the region. The Conservancy envisions that the Ecoregional Assessment will provide a foundation for partner coalitions or individual agencies to develop an ecosystem-based management framework that reflects the Northwest Atlantic's ecology as well as human uses of the marine environment.

Goals in conducting the survey were to seek feedback from stakeholders in order to help guide development of Assessment products and improve awareness of the Ecoregional Assessment process ongoing in 2008. The survey was designed to learn stakeholders' views about the status of the region, data gaps, stakeholder use of Assessment tools and products and interest in participation as peer reviewers and providers of data.

Survey Administration and Response Rate

Survey respondents were identified by Conservancy staff and included representatives from state and federal agencies, universities and research organizations, non-profit and conservation organizations and marine and fishery industry groups. The survey was not intended to be a comprehensive assessment of all identified stakeholders, but to provide general feedback about the region and the Ecoregional Assessment process.

The survey of eighteen questions was conducted in January and February 2008 with an online survey tool (SurveyMonkey.com).[1] The survey invitation was emailed on January 30, 2008, and sent a second time on February 7 to those who had not yet responded. A total of 279 recipients received the email invitation. This report summarizes results from

[1] Two methods of distributing the survey were used: SurveyMonkey distributed the survey via individualized links to TNC's list of recipients via an email from a TNC staff member. An alternate, generic "web link collector" was emailed to eight respondents who reported technical difficulties accessing or completing the survey, which can be due to spam or server settings on individual computers.

139 respondents[2], for a response rate of 49 percent, which compares favorably with average response rates for email surveys (40 percent).[3]

The following Summary of Results section outlines major survey themes, while the Detailed Results reviews responses for each question. The survey questionnaire is included in Appendix A.

SUMMARY OF RESULTS

Coastal development, climate change and fishing were identified as the top three rated threats facing the Northwest Atlantic marine and coastal environment. Respondents overwhelmingly identified an integrated approach between land-based activities, estuaries and the health of the oceans as the right approach to marine conservation. They thought the Conservancy's NW Atlantic Marine Ecoregional assessment will add value to implementing Regional Ecosystem Based Management. Respondents also identified improved maps depicting human uses, habitat classification and the sea floor, plus better access to data as essential to making better, more informed coastal and marine management decisions.

I. Survey Respondents

The survey's 139 respondents were spread geographically throughout the region, representing each of the Northwest Atlantic's sub-regions, including the Gulf of Maine, Southern New England and Mid-Atlantic Bight.[4]

Most respondents identified themselves as having government affiliations, with 34 percent from states and 26 percent from federal agencies. Other organizations represented include academia with 17 percent, Non-Governmental Organizations with 12 percent, industry at 4 percent and "other" 7 percent.

II. Region-Wide Threats

There was broad consensus among respondents about the "most important" threats facing the Northwest Atlantic marine and coastal environment, as these same categories[5] appeared repeatedly throughout respondents' lists of the top three threats. The following categories were listed most often as the **number-one threat** to the region:

- **Coastal development and related effects** (32 percent)**;**
- **Global climate change (**21 percent);

[2] Responses counted in the results included complete surveys (respondent clicked "Done" after the last question) and those who answered at least seven questions.
[3] Sheehan, K. (2001). E-mail Survey Response Rates: A Review. Journal of Computer Mediated Communication, Vol. 6 (2).
[4] See Map.
[5] See Detailed Results for Question 8 for more about the groupings of responses by category.

- **Fishing-related threats including overharvest, bycatch and habitat damage** (20 percent);
- **Pollution, including non-point, point-source, sediments, nutrients and toxins** (16 percent).

In addition to open-ended questions about region-wide threats, the survey included a series of six questions based on habitat type asking respondents to rate the seriousness of "potential threats" to marine and coastal habitats and groups of species, by selecting "Very Serious," "Serious," and "Not Serious," as well as a fourth option of "Don't Know."

Threat Assessments by Respondents' Affiliation
Survey results were also filtered by respondents' selection of an affiliation for their organization, which in some cases created very small samples, but revealed some patterns in the data. On a few questions, sub-groups of respondents answered slightly differently than the larger sample as a whole.

State and Federal Respondents: The management focus of the respondents' organizations may have affected individual's perceptions of the most important threats facing the region. For example, the large proportion of state-affiliated respondents (about one-third of the sample), many of whom work in the coastal zone[6], may have influenced the ranking of coastal development as the region's most important threat (half of the 45 state respondents ranked coastal development as the top threat). Meanwhile, the 36 federal respondents were more evenly divided in selecting the region's top threat, with 10 respondents listing climate change; 10 pollution; 6 fishery-related issues; and 5 coastal development.

Academic Respondents: Among the 24 academic respondents, 7 selected **Sand/gravel mining** as a "Very Serious" threat to benthic habitats, while another 7 described **Sand/gravel mining** as "Not Serious." Academic respondents were much more evenly dispersed among "Serious" threats to shellfish beds than in the larger sample group, perhaps reflecting recognition of multiple environmental stresses. Among academics, 7 of 23 chose coastal development, and 7 of 23 chose fishery-related issues, as the region's top threats.

NGO Respondents: In identifying top threats to the region, 7 of 15 NGO respondents listed fishing related threats. This group also expressed a strong interest in the need for human use maps (92 percent).

Industry Respondents: In assessing threats to Fisheries resources, 3 of the 4 industry respondents rated **Pollution** as a "Very Serious" threat, while 2 of 4 rated **Unsustainable harvest** as "Very Serious". Three out of 4 also rated as "Serious" both **Habitat loss/non-fishing related** and **Dams and other barriers to migration**. All four rated **Habitat loss related to fishing gear** as "Not Serious". Industry respondents' top threats facing the

[6] The "coastal zone" is generally defined by state NOAA-approved coastal programs as a portion of the terrestrial coastal area extending seaward generally to 3 miles; longer where bay enclosure lines exist.

Northwest Atlantic region focused on threats from coastal development. Other threats mentioned by this group included "Ineffective management strategies such as DAS (Days At Sea) and daily catch quotas," "Pesticides" and "Oversaturation of man's presence in estuary habitats. Turbidity, prop wash, noise, oil."

III. Cross-Cutting Themes: Threats to Habitats and Species

All 139 respondents answered the series of six questions rating the seriousness of "potential threats" to specific habitat types and groups of species. Threats were tailored to habitat type, but in some cases, the same threats were applicable to more than one habitat or group of species.

Non-Point Source Pollution Considered a Threat: Examining the results across these questions, **non-point source pollution** emerged as a significant threat to both nearshore and offshore habitats among the respondents. According to the Environmental Protection Agency, non-point source pollution is a factor in 90 percent of all impaired water bodies (incidents where water quality is below standards for recreation, water supply or aquatic life).[7] Large percentages of respondents identified **Non-point source pollution** as a "Very Serious" Threat to nearshore communities including shellfish, sea grass, and estuarine habitats. Moving offshore, **Nutrients/sediments/non-point pollution** was also identified as a Serious threat to benthic habitats by 53 percent of respondents.

Nearshore Habitat Loss: **Non-fishing related habitat loss or damage** was another frequently identified threat across nearshore habitat types, with large percentages of respondents choosing "Very Serious" to describe the threat of **Habitat loss/damage** or **Coastal development** to shellfish beds, submerged aquatic vegetation and estuarine habitats.

Lower Perceived Threats to Benthic Habitats: In evaluating threats to benthic or sea-bottom habitats, respondents were less likely to describe threats as "Very Serious," and the largest percentages of respondents instead described the following threats as "Serious": **Fishing-related habitat loss** selected by 52 percent, **Invasive species** by 48 percent and **Point-source pollution** by 41 percent. **Aquaculture** was also considered "Not Serious" as a potential threat to benthic habitats by 40 percent of respondents, and "Not Serious" to shellfish beds by 46 percent of respondents, although 24 percent also selected "Don't Know" regarding potential threats of **Aquaculture** to shellfish.

Energy Development Less Threatening: With proposals for alternative energy development becoming more common, there were several noteworthy findings related to these activities. Many respondents considered potential threats from energy development activities as "Not Serious" to benthic or sea bottom habitats, including 54 percent for **Wind energy generation facilities**, 45 percent for **Wave energy generation facilities** and 35 percent for **Liquefied Natural Gas (LNG) terminals**. However, a significant proportion of respondents reported an apparent lack of knowledge regarding the potential

[7] U.S. Commission on Ocean Policy. (2004). An Ocean Blueprint for the 21st Century. p. 213.

threats to benthic habitats from **Wave Energy** (40 percent chose "Don't Know") and **Wind Energy** (20 percent "Don't Know"); (21 percent also picked "Don't Know" relating to **LNG terminals**).

Knowledge Gaps: Other areas in which large numbers of respondents selected "Don't Know" included: potential threat of **Invasive species** to sea grass beds (32 percent); potential threats of **Noise pollution** (29 percent) and **Ocean infrastructure (aquaculture/energy development)** (25 percent) to marine mammals; and of **Shoreline armoring** to sea grass beds (23 percent).

IV. Fisheries Resources: Threats, Gaps and Conservation Actions

Several important themes related to the health of fisheries in the Northwest Atlantic were reflected in the survey results. In the question in which respondents were asked to rate the relative seriousness of threats to fisheries from "Very Serious" to "Not Serious," the largest numbers of respondents selected **Unsustainable harvest/bycatch** (67 percent) and **Habitat loss/damage (non-fishing related)** (45 percent) as "Very Serious" threats. In the middle tier of "Serious" threats, **Pollution** was identified by 63 percent, **Dams/barriers to migration** by 50 percent, and **Global climate change** by 44 percent.

When asked to list the most important threats to the Northwest Atlantic, more than half of respondents listed fisheries management issues. Many comments centered around threats to food chain dynamics, including the depletion of species such as herring and menhaden, that sustain marine mammals and predators higher up the food chain. One respondent expressed concern about: "Fishery removal of old growth fish and cascading effect on biological community structure and function." Failure to apply adequate management techniques was another theme, including the need for "science-based fishing regulations," lack of management applied to "non-migratory resources – bivalves and crustaceans," and concern about mid-water and bottom trawling.

Respondents reported data gaps related to fisheries including the need for better observer data on bycatch, species recruitment data and stock assessments, "comprehensive trip-level data" on commercial and recreational fisheries, species life history data and biological sampling. One called for the need to assess the effect of temperature change on the distribution and abundance of marine resources, as this effect may be "out of sync with the allocation of fishery quota along the East Coast."

Respondents' priorities for conservation action related to fisheries included removal of dams that create barriers to migration, restoration of Atlantic salmon runs, involving fishermen in ocean observing systems and establishment or expansion of Marine Protected Areas (66 percent said their organization might use the Assessment data to "inform marine spatial area management").

V. Marine Mammals

Among the discrete threats facing marine mammals, respondents rated **Entanglement in fishing gear** (41 percent) and **Ship traffic** (38 percent) as "Very Serious," followed by **Bioaccumulation of pollutants** (50 percent) and **Noise pollution** (45 percent) as "Serious" threats. Under research needs, one respondent listed "acoustic impacts to marine mammals," and a recommended conservation action was "slower speed limits for commercial vessels to protect whales."

VI. Marine Data Gaps: Maps, Models and Ecosystem Research

In open-ended responses identifying gaps in data for the region, respondents clustered around the need for improved maps of the sea floor, including sediment types and species distribution within benthic habitats; comprehensive marine habitat maps including biological communities; and improved models of ocean circulation and sea level rise including erosion, sediment transport and distribution of species in light of higher sea levels.

Respondents also reported a broad range of research needs to improve scientific understanding of the marine environment including monitoring of marine ecosystems and processes, measurement of cumulative stressors to habitats and species and monitoring over time in order to assess the nature and magnitude of ecosystem change. Many respondents also identified the need for "multispecies models" that incorporate species' life cycles and enhance understanding of overall ecosystem linkages, population dynamics and predator-prey relationships.

In general comments, a few respondents also expressed concern that the Northwest Atlantic Marine Assessment should not replicate geospatial mapping and data collection efforts of other organizations or agencies. One respondent felt the Assessment is "reinventing the wheel at a very high cost-benefit ratio," but another observed that while there is much ongoing geospatial mapping activity, "these are static maps…that do not provide information about how the ecosystem processes and structure are changing."

These respondents encouraged collaboration with other ongoing government and marine research initiatives, including the "emerging" regional Integrated Ocean Observing Systems (IOOS), the EPA Atlantic Ecology Division (National Coastal Assessment), Duke University's OBIS-SEAMAP, the Northeast Regional Association of Coastal Ocean Observing Systems, and the Restore America's Estuaries National Strategy to Restore Coastal and Estuarine Habitat.

Access to and Action on Information: Rather than a lack of existing data, some respondents pointed to the need to improve access to it. One sought habitat maps that "are freely available to resource managers" and could be provided with "information from USGS, EPA, and NOAA as a component of a National Water Quality Monitoring Network for Coastal Waters and their Tributaries (NWQMN)." Others said the Conservancy can play an important role by providing "unbiased, quality" information and

broadly disseminating Assessment results, and that, "An important issue is making people aware of the data already available and how to obtain that data."

Other comments reflected the challenges of spurring action based on existing knowledge: "Although research is very important, one of the more critical pieces is to avoid getting hung up on overstudying issues and to ensure that on-the-ground implementation activities are taking place, "and, "I think the data are actually quite good; the problems will be the usual ones—conflicts between user groups, political will, costs, etc."

VII. Ecosystem-Based Management

Respondents expressed strong interest in **Ecosystem-Based Management** with 85 percent saying their organization might use the Northwest Atlantic Marine Ecoregional Assessment in order to support this work. Habitat maps and distribution of human uses were the highest needs in order to move toward EBM, followed closely by maps showing distribution of key species and oceanographic data. Models that integrate data on ecosystem and economic trends was also listed as a data need.

VIII. Conservation Actions at Many Levels

Asked to list specific conservation actions that would advance the overall health of the Northwest Atlantic**, a common theme was the relationship between land-based activities, estuaries and the health of the oceans.** Specific recommendations related to this theme were restoration of forests to protect water quality, planting of native vegetation along shorelines, and conservation of "landward retreat paths for lagoons and estuaries" in preparation for climate change and sea level rise. Another focus of respondents was education of "people who do not live near the ocean on their effects on ocean environment" including the effects of impervious surfaces on stormwater runoff, and discharges from septic systems and sewage treatment plants and other effluents.

In addition to policy approaches such as ocean zoning and marine protected areas, several respondents suggested grass-roots approaches to involving communities in conservation, such as businesses adopting a beach or island, and each county or municipality designating a coastal/marine area for conservation.

IX. Public Education and Policy

Though the survey did not include a specific question about public involvement in the Northwest Atlantic marine environment, an undercurrent of comments relating to public education and marine policy emerged from open-ended questions about threats and conservation actions. Several respondents opined an "uninformed public," a "lack of knowledge/political will/awareness to address existing threats," and "decisions driven by global market forces, rather than human ecological constraints."

The following comment reflects the need for improved understanding of the importance of marine resources: "We know enough on the natural science side to act (and I am a

conservation biologist). We need social science and policy experts to get the public to wake up to the problems."

Other respondents viewed the lack of an integrated, holistic approach of managing human uses of the marine environment as a threat, as reflected in these descriptions of the problem: "Continued sector-by-sector "silo" approach to managing human uses of the oceans," "Top-down, fragmented, resource management entities working at inappropriate scales," and "Lack of transdisciplinarity and conflict resolution mechanisms."

DETAILED SURVEY RESULTS

Question 1: Respondents' Affiliation

1. Please select the type of organization with which you are affiliated.

	Response Percent	Response Count
Academia	17.4%	24
Federal Government	26.1%	36
State Government	**34.1%**	47
Non-Governmental Organization	11.6%	16
Industry	3.6%	5
Other (please specify)	7.2%	10
answered question		**138**
skipped question		**1**

After an introduction explaining the Marine Ecoregional Assessment process and the goals of the survey, the first question asked respondents to identify the type of organization with which they are affiliated. The largest proportion of respondents identified themselves as affiliated with state government at 34 percent, followed by respondents from federal government at 26 percent and those from academic institutions at 17 percent. Representatives from NGOs made up 12 percent of the sample and those from industry were 4 percent. The 7 percent of respondents who identified their affiliation as "other," ranged from an aquarium and a party boat skipper to a non-profit research group and an inter-state organization.

Assessing Threats to the Northwest Atlantic's Habitats and Species

A series of six questions asked respondents to rate the seriousness of "potential threats" to marine and coastal habitats and groups of species, by selecting "Very Serious" with a

weight of 3; "Serious" with a weight of 2; and "Not Serious" with a weight of 1.[8] A fourth option of "Don't Know" was given a weight of 0. Threat options were tailored for each question in this section based on applicability to the particular habitat type. This was done to avoid bias against a threat that does not realistically occur in a particular habitat type.

Question 2: Shellfish Beds

2. Please rate the seriousness of the following potential threats to shellfish beds in the Northwest Atlantic study area.						
	Not Serious	Serious	Very Serious	Don't Know	Rating Average	Response Count
Aquaculture	**46.3% (63)**	25.0% (34)	4.4% (6)	24.3% (33)	1.45	136
Invasive species	7.3% (10)	**44.5% (61)**	31.4% (43)	16.8% (23)	2.29	137
Harvest	21.6% (29)	**45.5% (61)**	18.7% (25)	14.2% (19)	1.97	134
Disease/pathogens	2.9% (4)	35.8% (49)	**48.9% (67)**	12.4% (17)	2.53	137
Habitat loss/damage (fishing-related)	16.8% (23)	**41.6% (57)**	26.3% (36)	15.3% (21)	2.11	137
Habitat loss/damage (non-fishing related)	6.6% (9)	40.9% (56)	**43.1% (59)**	9.5% (13)	2.40	137
Nutrients/sediments/non-point pollution	6.5% (9)	37.4% (52)	**48.9% (68)**	7.2% (10)	2.46	139
Point-source pollution	23.2% (32)	**54.3% (75)**	12.3% (17)	10.1% (14)	1.88	138
Climate change effects (i.e. ocean temperature)	7.3% (10)	37.2% (51)	**38.7% (53)**	16.8% (23)	2.38	137
					answered question	**139**
					skipped question	**0**

The top four potential threats to shellfish beds rated as "Very Serious" include: **Disease/pathogens** with 49 percent; **Nutrients/sediments/non-point pollution**, with 49 percent; **Habitat loss/damage (non-fishing related)** with 43 percent; and **Climate change effects (i.e. temperature)** with 39 percent.

Under "Serious" threats to shellfish beds, more than half of respondents (54 percent) selected **Point-source pollution**, while **Harvest** and **Invasive species** closely followed with 46 and 45 percent respectively. **Habitat loss/damage (fishing related)** was chosen as a "Serious" threat by 41 percent. The potential threat rated by the most respondents as "Not Serious" was **Aquaculture**, with 46 percent.

[8] The rating average for each threat provides a measure of the position of the threat on the scale between 1 (Not Serious) and 3 (Very Serious) and is based on the following calculation: Sum of frequency (number of respondents that selected each rating) times the column weight, divided by the sum of the respondents in the weighted columns.

Question 3: Submerged Aquatic Vegetation (Sea Grass Beds)

3. Please rate the seriousness of the following potential threats to submerged aquatic vegetation (sea grass beds).						
	Not Serious	Serious	Very Serious	Don't Know	Rating Average	Response Count
Shoreline armoring	11.7% (16)	**39.4% (54)**	25.5% (35)	23.4% (32)	2.18	137
Invasive species	19.6% (27)	**32.6% (45)**	15.9% (22)	31.9% (44)	1.95	138
Point source pollution	20.1% (28)	**46.8% (65)**	13.7% (19)	19.4% (27)	1.92	139
Coastal infrastructure (docks, marinas, etc.)	15.2% (21)	**47.1% (65)**	26.8% (37)	10.9% (15)	2.13	138
Nutrients/sediments/non-point pollution	0.7% (1)	28.3% (39)	**58.0% (80)**	13.0% (18)	2.66	138
Habitat loss/damage (fishing-related)	26.1% (36)	**39.1% (54)**	17.4% (24)	17.4% (24)	1.89	138
Habitat loss/damage (non-fishing related)	2.9% (4)	42.8% (59)	**45.7% (63)**	8.7% (12)	2.47	138
					answered question	**139**
					skipped question	**0**

Potential threats to sea grass beds rated "Very Serious" included: **Nutrients/ sediments/non-point pollution**, with 58 percent and the highest rating average for the question of 2.66; **Habitat loss/damage (non-fishing related)** with 46 percent (87 percent of those answering the question selected either "Very Serious" or "Serious" for this threat). Other frequently selected "Serious" threats to sea grasses included **Coastal infrastructure (docks, marinas, etc.)** and **Point source pollution** with 47 percent each.

Question 4: Estuarine Habitats

4. Please rate the seriousness of the following potential threats to estuarine habitats in the Northwest Atlantic study area.						
	Not Serious	Serious	Very Serious	Don't Know	Rating Average	Response Count
Shoreline armoring	8.6% (12)	**44.6% (62)**	33.1% (46)	13.7% (19)	2.28	139
Invasive species	5.0% (7)	**54.0% (75)**	26.6% (37)	14.4% (20)	2.25	139
Coastal development/habitat loss	1.4% (2)	23.0% (32)	**72.7% (101)**	2.9% (4)	2.73	139
Point-source pollution	20.1% (28)	**52.5% (73)**	19.4% (27)	7.9% (11)	1.99	139
Sea level rise/storm surge	7.2% (10)	**49.6% (69)**	37.4% (52)	5.8% (8)	2.32	139
Non-point source pollution (urban/suburban runoff)	2.9% (4)	30.9% (43)	**63.3% (88)**	2.9% (4)	2.62	139
					answered question	**139**
					skipped question	**0**

Coastal development/habitat loss was the highest rated threat to estuarine habitats with 73 percent of respondents describing it as "Very Serious" (highest rating average with 2.73; another 23 percent rated it "Serious"). In addition, 63 percent rated **Non-point source pollution (urban/suburban runoff)** as a "Very Serious" threat to estuaries. Under the "Serious" rating, 54 percent selected **Invasive species**, and 53 percent chose **Point-source pollution**, followed by **Sea level rise/storm surge** (50 percent) and **Shoreline armoring** (45 percent).

Question 5: Benthic Habitats

5. Please rate the seriousness of the following potential threats to benthic (sea bed/bottom) habitats.

	Not Serious	Serious	Very Serious	Don't Know	Rating Average	Response Count
Aquaculture	**40.3% (56)**	38.1% (53)	7.9% (11)	13.7% (19)	1.63	139
Oil/gas drilling/exploration	29.5% (41)	**37.4% (52)**	18.7% (26)	14.4% (20)	1.87	139
Liquified Natural Gas (LNG) terminals	**35.3% (49)**	33.1% (46)	10.1% (14)	21.6% (30)	1.68	139
Wind energy generation facilities	**54.0% (75)**	20.1% (28)	5.0% (7)	20.9% (29)	1.38	139
Wave energy generation facilities	**44.6% (62)**	12.2% (17)	2.9% (4)	40.3% (56)	1.30	139
Invasive species	11.6% (16)	**47.8% (66)**	23.9% (33)	16.7% (23)	2.15	138
Habitat loss/damage (fishing-related)	10.8% (15)	**51.8% (72)**	30.2% (42)	7.2% (10)	2.21	139
Nutrients/sediments/non-point pollution	10.1% (14)	**52.9% (73)**	29.0% (40)	8.0% (11)	2.20	138
Point-source pollution	37.4% (52)	**41.0% (57)**	10.8% (15)	10.8% (15)	1.70	139
Sand/gravel mining	18.0% (25)	**38.8% (54)**	27.3% (38)	15.8% (22)	2.11	139
					answered question	**139**
					skipped question	**0**

Respondents were less likely to identify "Very Serious" threats to Benthic or sea bed/bottom habitats, and instead, responses clustered under the "Serious" rating. The largest number of respondents, 53 percent, selected **Nutrients/sediments/non-point pollution** as a "Serious" threat, followed by 52 percent selecting **Habitat loss/damage (fishing related)**, which also had the highest rating average of all the benthic threats at 2.21. **Invasive species** was selected as a "Serious" threat by 48 percent.

Benthic threats considered "Not Serious" by large percentages of respondents include **Wind energy generation facilities** with 54 percent; **Wave energy generation facilities** with 45 percent; **Aquaculture** with 40 percent and **Liquefied Natural Gas (LNG) terminals** with 35 percent.

Question 6: Fisheries Resources

6. Please rate the seriousness of the following potential threats to fisheries resources in the Northwest Atlantic study area.						
	Not Serious	Serious	Very Serious	Don't Know	Rating Average	Response Count
Pollution	12.9% (18)	**62.6% (87)**	18.0% (25)	6.5% (9)	2.05	139
Unsustainable harvest/bycatch	3.6% (5)	25.2% (35)	**66.9% (93)**	4.3% (6)	2.66	139
Habitat loss/damage (fishing-related)	13.8% (19)	**39.9% (55)**	38.4% (53)	8.0% (11)	2.27	138
Habitat loss/damage (non-fishing related)	7.2% (10)	41.7% (58)	**45.3% (63)**	5.8% (8)	2.40	139
Global climate change	5.0% (7)	**43.9% (61)**	39.6% (55)	11.5% (16)	2.39	139
Dams/other barriers to migration	5.8% (8)	**50.4% (70)**	36.7% (51)	7.2% (10)	2.33	139
					answered question	**139**
					skipped question	**0**

The highest rated "Very Serious" threat to fisheries in the study area was **Unsustainable harvest/bycatch** identified by 67 percent of respondents. Another 25 percent also identified **Unsustainable harvest** as a "Serious" threat; this threat had the highest rating average of 2.66. **Habitat loss/damage (non-fishing related)** had the second highest rating average with 2.4, and was rated "Very Serious" by 45 percent of respondents. Among the potential threats to fisheries most frequently rated "Serious," were **Pollution** with 63 percent, **Dams/other barriers to migration** with 50 percent, and **Global climate change** with 44 percent.

Question 7: Marine Mammals

7. Please rate the seriousness of the following potential threats to marine mammals in the Northwest Atlantic study area.						
	Not Serious	Serious	Very Serious	Don't Know	Rating Average	Response Count
Noise pollution	10.1% (14)	**44.6% (62)**	16.5% (23)	28.8% (40)	2.09	139
Ship traffic	10.1% (14)	36.0% (50)	**38.1% (53)**	15.8% (22)	2.33	139
Entanglement/bycatch in fishing gear	9.4% (13)	36.7% (51)	**41.0% (57)**	12.9% (18)	2.36	139
Ocean infrastructure (aquaculture, energy development)	30.4% (42)	**33.3% (46)**	11.6% (16)	24.6% (34)	1.75	138
Bioaccumulation of pollutants	6.5% (9)	**49.6% (69)**	26.6% (37)	17.3% (24)	2.24	139
					answered question	**139**
					skipped question	**0**

The two most frequently selected "Very Serious" threats to marine mammals included **Entanglement/bycatch in fishing gear**, with 41 percent of respondents, and

Ship traffic, with 38 percent. Potential threats rated as "Serious' to marine mammals by the largest numbers of respondents included **Bioaccumulation of pollutants** (50 percent), **Noise pollution** (45 percent) and **Ocean infrastructure** (33 percent).

Question 8: **Most Important Threats to Northwest Atlantic Region (Open-Ended)**

Respondents were asked to list the "three most important threats to coastal and marine ecosystems in the Northwest Atlantic region." The following groupings of responses were used to categorize similar threats in order to illustrate the open ended responses.

The region's top (number-one listed) threats identified by survey respondents were:

1. Development and Related Effects (32 percent): Many respondents grouped together threats from coastal development, habitat loss or degradation from human uses, and land use changes associated with human population growth. Of 134 respondents to the question, 32 percent listed themes related to human development of the coasts as the most important threat to the Northwest Atlantic region (with 11 percent emphasizing resultant habitat loss, and 6 percent emphasizing population growth in coastal and other areas). Responses describing these threats ranged from, "Coastal development of adjacent uplands and watershed areas" to "Over development…within 3 miles" of the coast, and "Incremental small-scale habitat alterations i.e. 'death by 1000 cuts'."

Coastal development was listed as the second most important threat to the region by 24 percent, and as the third most important threat by 18 percent. Human development/habitat loss was included in the top three threats by 73 percent of respondents.

2. Global Climate Change (21 percent): Climate change or a related effect, such as sea level rise, increasing ocean temperatures or ocean acidification, was listed somewhere in the top three threats by 54 percent of respondents. Climate change was listed as the top threat to the region by 21 percent; and as the second and third most important threats by an equal 16 percent of respondents. Various descriptions of the climate change threat included, "Lack of understanding about migration of habitats associated with sea level rise," "More frequent storm surge events," and "…resultant changes to prevailing ocean currents," as well as "associated temperature/chemistry changes."

3. ***Fishing-Related Threats (overharvest, bycatch, habitat damage) (20 percent):*** Counting responses related to unsustainable harvest and fishing-related alteration of habitats and biological communities, 20 percent listed a fishing-related issue as the number-one threat (second most important by 18 percent and third most important by 17 percent). Overall, 54 percent of respondents included fishing-related issues in their list of most important threats. One respondent aimed the threat at a specific gear type, "mid-water trawlers," while others focused on challenges to fisheries management including: lack of data to recognize unsustainable harvest; and "single species fishery management."

4. Pollution (non-point, point-source, sediments, nutrients and toxins) (16 percent): Pollution, including non-point "runoff," and "nutrient enrichment," as well as point-

source pollution from wastewater treatment plants, toxins, pesticides and "bacteria/pathogens," were listed as the top threat to the region by 16 percent. Another 27 percent listed pollution threats as second most important to the region, while 17 percent listed them as third most important. Of 134 people answering, 60 percent listed a form of pollution somewhere on their list of threats. Comments included, "Nutrient loading to estuarine systems," "Flux of contaminants that can move up through marine food chains, and flux of pathogens into coastal waters," and "Harmful algal blooms."

Other Region-Wide Threats: Invasive species were listed most frequently as the third most important threat with 8 percent of respondents. About 15 percent of respondents included invasives somewhere on their list (4 as the top threat).

Research related "threats" included: "No understanding of the cumulative impacts of biogenic activity and little research of same," and "Bolts from the blue – such as plastic's potential as epi-genetic mimic."

Other threats mentioned included, "Coastal and open ocean alteration (construction, dredging)," "proliferation of vessel traffic," "underwater noise," "marinas, moorings and power boat abundance in estuaries and harbors," and "tidal restrictions to salt marsh."

Questions 9-10: Gaps in Scientific Data (Management, Ecological Status, Species and Habitats)/ Research Gaps

There were 117 responses to Question 9 asking respondents to identify gaps in scientific data for the region, and 111 responses to Question 10 regarding research needs. Because responses were not demarcated between these two topics (some answers dealt with data gaps in Question 10 and some with research gaps in Question 9) the results of this pair of questions are presented together. The sections below summarize broad areas of gaps identified by numerous respondents.

Maps and Models

The need for improved maps of the Northwest Atlantic was identified by many respondents, reflected in this comment: "There is a serious paucity of fundamental geospatial data for our coastal and marine environments."

Benthic Mapping: In describing the need for benthic/sea floor mapping, one respondent called for "subaqueous soil and benthic mapping creating a seamless map (morphology, soils, bathymetry) from terrestrial to marine environment." Other respondents listed the need for "seabed maps showing geology, faunal distribution, and habitats," "…pelagic-benthic coupling and circulation assessments," and "high resolution shallow bathymetric and coastal topographic data."

Habitat maps: Respondents requested, "inventories at a meaningful scale along with use maps," and inclusion of a layer of biological communities or biotopes, or development of a "marine cadastre." One noted, "Virtually no data exist on habitat functions and values with sufficient resolution to assess impacts. Very little spatially and temporally

comprehensive data exists to describe habitat use…" Another said these maps would be useful for infrastructure development planning.

Sea level rise: Several respondents listed the need for improved modeling of sea level rise, including changes to surface processes such as erosion and sediment transport, and migration rates for flora and survivability of fauna. One suggested filling gaps in LIDAR data and another asked: "Where will…refugia for key species (be) in 2025, 2050 and 2100? What are the benefit-cost of protecting today's habitat versus planning for and protecting future habitats?"

Monitoring of Marine Ecosystems

Another common theme was the need for more comprehensive monitoring and measurement of marine ecosystem processes. Specific suggestions included: nutrient (nitrogen) budgets and cycling, including atmospheric deposition; cause and effect related to loss of seagrass beds; impacts of unmeasured contaminants, such as pharmaceuticals and pesticides including "breakdown in saltwater environment with sunlight catalyst," and impact on habitat by salmon pens in Gulf of Maine and other vulnerable habitats "that should be protected in advance of aquaculture proposals…" Other respondents sought to "better combine monitoring and assessment information from Federal and State agencies, to better inform…decision making affecting coastal ecosystem services," as well as to link research between human and ecosystem health.

Species/Ecosystem Research

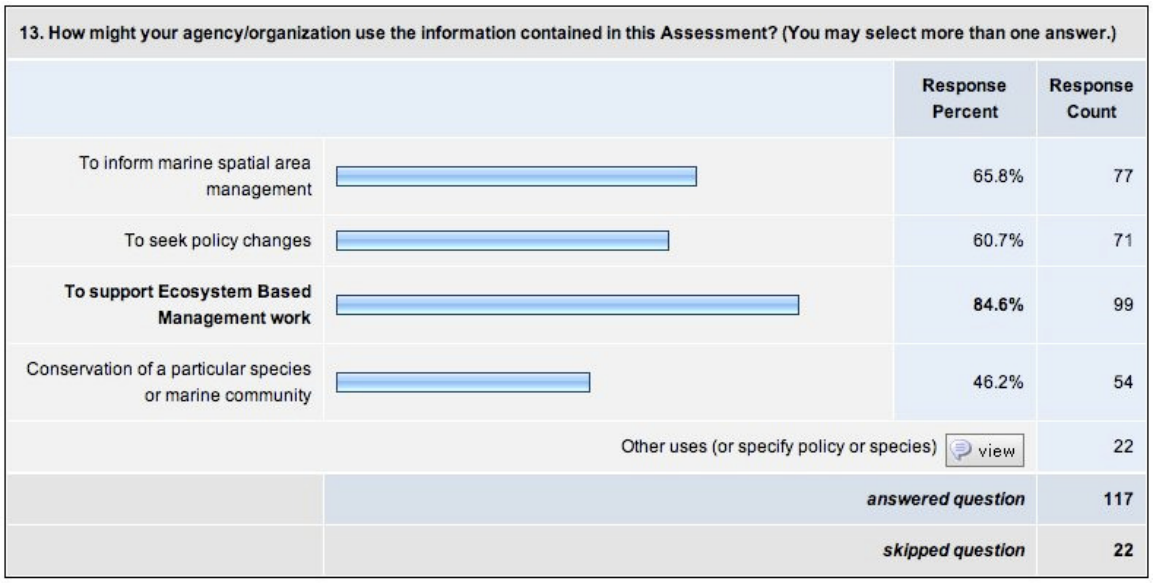
Several comments dealt with the need for more research and data on species interactions and ecosystem dynamics of key community types (benthic, pelagic, estuarine), as well as trends for "keystone species and focal watersheds." Others called for greater understanding of the relationship between invasive and native species; the role of nearshore nursery habitats in life cycles of harvested fish and invertebrates; and the ecological impacts of biomass removal.

Comments included: "Fishes that utilize the upper estuaries are understudied (smelt, tomcod, white perch, lamprey eels, American eels) and are in peril," "Need a better understanding of offshore bird migration corridors and…better data that indicates locations of 'blue infrastructure'" for protection, and, "Establish reference areas to measure natural v. anthropogenic change."

Questions 11-12: **Data to Share with the Assessment Team**

A total of 57 respondents (54 percent), answered "yes" to having "data or metadata for the Northwest Atlantic region" that they would be willing "to share with the Assessment team for consideration and possible inclusion in the report." A table of the responses that includes a description of the data and public Web sites containing data (29 responses), as well as names and contact information of people knowledgeable about specific data sets (48 responses), was shared with the Data Team in February 2008.

Question 13: Stakeholder Use of Northwest Atlantic Assessment

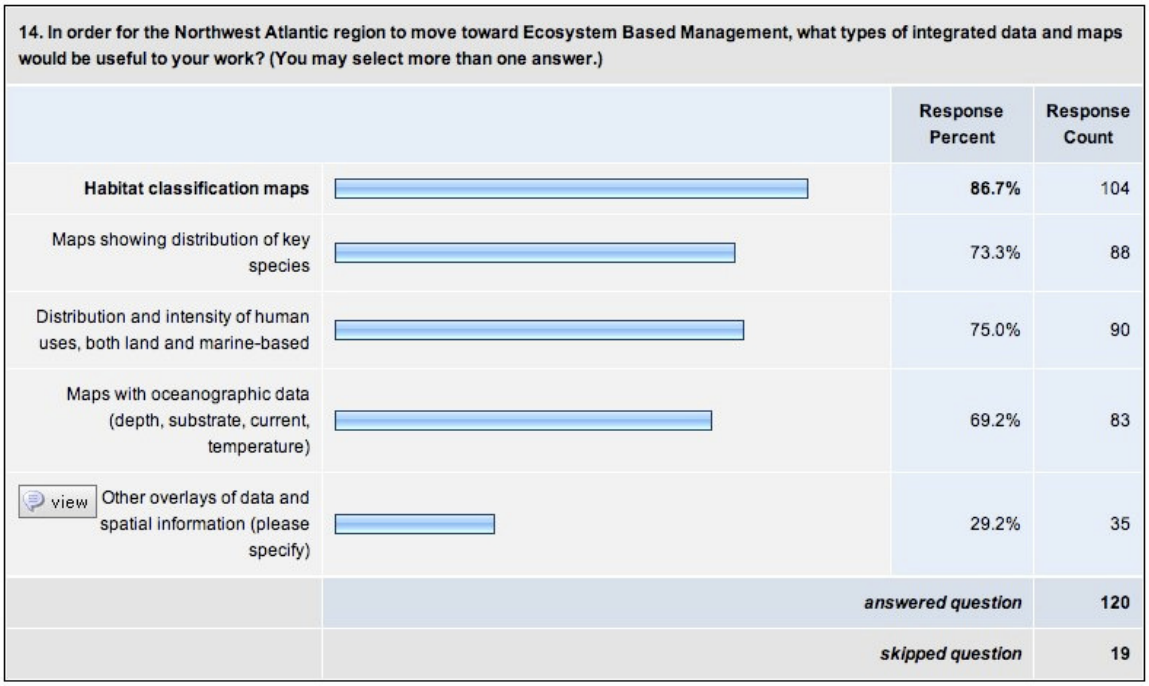


13. How might your agency/organization use the information contained in this Assessment? (You may select more than one answer.)	Response Percent	Response Count
To inform marine spatial area management	65.8%	77
To seek policy changes	60.7%	71
To support Ecosystem Based Management work	**84.6%**	99
Conservation of a particular species or marine community	46.2%	54
Other uses (or specify policy or species) view		22
answered question		117
skipped question		22

When respondents were asked how their agency or organization might use the information contained in the Assessment, the most popular use selected was **To support Ecosystem Based Management work** with 85 percent, followed by **To inform marine spatial area management** with 66 percent.

Among the "other uses," filled in by 22 respondents were: support for research funding; formulation of state offshore renewable energy policy; and "education of our constituents; better technical review of projects; more targeted research efforts." Other comments included: "To teach students, conduct research projects," to "develop comprehensive legislation to codify needs and activities," and "to foster a more strategic approach towards coastal landscape conservation acquisition and restoration."

Question 14: Integrated Data and Maps to Support Ecosystem Based Management



14. In order for the Northwest Atlantic region to move toward Ecosystem Based Management, what types of integrated data and maps would be useful to your work? (You may select more than one answer.)

	Response Percent	Response Count
Habitat classification maps	86.7%	104
Maps showing distribution of key species	73.3%	88
Distribution and intensity of human uses, both land and marine-based	75.0%	90
Maps with oceanographic data (depth, substrate, current, temperature)	69.2%	83
view Other overlays of data and spatial information (please specify)	29.2%	35
answered question		120
skipped question		19

Of 120 respondents, 87 percent selected **Habitat maps** as integrated data that would be useful to their work. Distribution of land and marine-based **Human uses** was selected by 75 percent of the respondents, while 73 percent selected **Maps showing distribution of key species** and 69 percent chose **Maps with oceanographic data**.

A total of 35 respondents typed in other overlays of data and spatial information that they would find helpful. Some examples include: intertidal maps; time series data from satellites and fixed stations; salinity and fishing effort maps; eelgrass and benthic infauna relative to nutrient data; water quality maps, flood maps, open space parcel maps; and measures of primary production. Other comments included: "Need more than maps, need ecosystem models that link physical, geology, chemistry and biology," "Watershed land-use zoning (what's commercial/ industrial, current condition, near and long-term planned status)," "Deep-time to present trawl/surf clam fishing effort overlaid on rocky substrate charting."

Question 15: Northwest Atlantic Marine and Coastal Conservation Actions

Asked to "list one or two specific conservation actions that would help to advance the overall health of the Northwest Atlantic," 98 respondents did so. The responses ranged from policy approaches, such as ocean zoning and establishment of protected areas, to focused management strategies in specific locations. Several responses dealt with the effects of development and land-based activities on the health of marine ecosystems, including concern that sewering can increase impervious surfaces in watersheds and increase nutrient loading into estuaries, and calls for smart growth, stopping municipal use of pesticides in coastal communities, and best management practices for stormwater.

Perhaps reflecting the economic ramifications of diminished fisheries, one respondent wrote: "Build Toyota plants with lots of jobs in Gloucester and New Bedford," while another commented: "Recognize that humans are here to stay and shift our paradigms." Other unrelated suggestions included a call for "stricter thermal limits on coastal power plant discharges," "regional actions designed to slow the rate of greenhouse gas increases [and] conservation actions that will help us adapt."

Question 16: Participation in the Northwest Atlantic Marine Assessment

Asked "Would you or your organization be interested in participating" in the Assessment, 84 percent said "yes," and 61 individuals specified how. Respondents expressed broad willingness to participate, for example, by providing scientific review, "access to data, and computation tools that help inform the decision making process," and offering to "beta-test products for utility for managers." Other respondents expressed interest in "Funding Special Conservation Initiatives, working with private and public landowners to implement conservation," working "to develop common ecoregional monitoring programs with other states," and serving as a "sentinel site for in-depth assessment."

Questions 17-18: Follow-up Contact about the Survey; Contact Information

Of 114 respondents, 84 percent gave permission to be contacted about the survey, while 16 percent said "no" to being contacted. In the follow-up question, respondents were given the opportunity to enter contact information, and 92 did so.

Question 19: Final Comments

General comments about the Assessment or the survey were entered by 32 respondents. Critiques included concern that "Questions were too black and white and simplistic," and "questions in the early section of the questionnaire mix apples and oranges—activities and impacts. The focus should be on the impacts, not activities as with good regulations the impacts of many activities can be minimized." Another wrote: "Surveys, by nature grossly simplify complex issues…I hope your organization is interested in working cooperatively at solutions instead of using survey results to promote an agenda."

Others advised that "rarity" is not addressed well in marine policy, but should be in the Assessment; and that for such a complex system, the team should try a de-centralized "'ecosystem' approach that starts small and builds up, instead of the reverse…We cannot know enough, or know what is important when we try too large a scale." Others focused on anticipated outcomes of the Assessment: "…I am hopeful that the process will yield sufficient data and analyses to allow development of realistic research and conservation recommendations that can be moved forward…The final product must be substantive and capable of inspiring positive political action."

REGIONAL ECONOMIC ANALYSIS OF THE NORTHWEST ATLANTIC MARINE ECO-REGION

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We construct an economic input-output (IO) model of an economy comprising the coastal counties from Maine to North Carolina (*i.e.*, those coastal counties relevant for the Northwest Atlantic Marine Eco-Region Assessment [NAM-ERA]). We identify primary and secondary industry sectors that depend on the ocean, and we assess the economic significance of those sectors to the regional economy. We find that the ocean sector as a whole has grown significantly during the last decade, as reflected in a 17% increase in output (now valued at $362 billion) and a 23% increase in employment (now numbering 3 million persons). Value-added now stands at nearly 8% of the gross state product (GSP) for the NAM-ERA coastal states. This growth is driven by expansion in the real estate sector, which relies critically upon coastal water quality. The commercial fishing and seafood processing sectors have grown as well, although we find changes in the product mix, from finfish to shellfish, that may affect employment in these sectors. We identify limitations to the use of the results from an IO model in understanding the welfare implications of policy options. We present recommendations for extensions of the model, including the possibilities of coupling the IO model to an ecosystem model, linking the IO model to models of other markets, and distributing the model results spatially. With these potential extensions, the assessment of economic impacts developed through the IO model can provide useful information for making decisions about the allocations of ocean habitat and resources in the Northwest Atlantic Marine Eco-Region.

1. Introduction

In this chapter, we develop an estimate of the regional economic significance of the Northwest Atlantic Marine Eco-Region as one component of the Nature Conservancy's Northwest Atlantic Marine Eco-Regional Assessment (NAM-ERA). In order to accomplish this, we develop an economic input-output (IO) model of an economy comprising the coastal counties of the US North Atlantic states from Maine to North Carolina. We identify industrial sectors that depend upon the oceans, and we estimate the contribution of these ocean sectors to the larger economy.

An IO model is a static description of the linkages among the different industrial sectors in an economy. It is constructed of linear algebraic equations that describe how the products of sets of

[1] We thank The Nature Conservancy and the WHOI Marine Policy Center for sponsoring the work presented in this chapter. We acknowledge the valuable ideas and suggestions provided by Sally Yozell, Kate Killerlain-Morrison, Jennifer Greene, and Lindsey Feldman.

industries are used in the manufacture of other goods, to satisfy consumer wants and the demands of government, and to supply export markets.[2] The IO framework is analogous to an ecological food web-type model, with groups of related industries ("industrial sectors") taking the place of trophic levels. We identify those specific industrial sectors (which we label "ocean sectors") that depend upon the ocean as a source of natural resources, as a sink for wastes or nutrients, for transportation, or as an aesthetic resource. The ocean can be thought of as an unpriced factor of production for the economy's ocean sectors, and, in this sense, the ocean can be said to provide "ecosystem services."

The IO model yields estimates of direct output and labor impacts (*i.e.*, sales revenues and employment) from the ocean sectors, and estimates of indirect and induced impacts[3], which are summarized in the form of economic "multipliers." These multipliers are a measure of the connectedness of an industrial sector to the rest of the relevant economy. Changes in the production of goods in an industry will affect other sectors to which it is linked, either through changes in the purchase of goods from those sectors or through changes in the sale of its products to other industries or consumers. The analysis of small (marginal) changes—especially through measures of their scale in monetary units—is called an "economic impact assessment." In principle, the model

[2] Economists typically represent the production of a good or service as the combination, using a technology, of capital, labor, and natural resources. This approach is known as a production function. The IO model employs a modification of the production function approach, in which the goods or services from a set of industries (or industrial sectors) are combined, using a technology, to produce the goods or services for a specific industry (or industrial sector). These modified production functions are augmented with information about demands from consumers and government agencies and exports of goods from the economy. Production functions for each industry (or industrial sector) in the economy are arranged into a system of equations that comprise the complete IO model.

[3] "Indirect impacts" represent the effects of a change in one industry on the other industries to which it is linked (either through changes in the purchase of goods and services from those other "upstream" industries or through changes in the sale of the affected industry's goods to other "downstream" industries or to consumers). "Induced" impacts represent the effects of a change in one industry on spending by employees in that industry and in the other linked industries, both upstream and downstream.

can be employed to assess the economic impacts of changes in the quality or quantity of the ecosystem services provided by the ocean.[4]

Once constructed, an IO model yields information about direct, indirect, and induced output and labor impacts and value-added. Value-added is a measure of the net value (roughly the value of labor or total wages) created when products are purchased from some industries and combined using a technology and labor into another product in the economy. Value-added is the measure used to construct estimates of gross domestic product (GDP), and estimates of value added from the North Atlantic coastal county model can be used to measure the contribution of that economy to the regional or national welfare.

Where information is available about the geographic distribution of the uses of the ocean, such as for commercial fishing or shipping, then the description of the economy provided by the coastal county IO model can be distributed spatially. This application of the IO model may permit a greater resolution of the importance of specific ocean areas or regions to the coastal, regional, or national economies. Moreover, a spatial understanding of ocean ecosystem services may facilitate decisions about allocating ocean space for alternative uses, such as conservation.

A glossary of input-output terms and several tables detailing the results of the NAM-ERA coastal county model are located at the end of this chapter.

[4] Undertaking the assessment of the economic impacts of changes in the ocean's ecosystem services may require the development of complementary models. For example, the degradation of coastal water quality as a consequence of excessive macronutrient inputs (nitrogen and phosphorous) could lead to reduced demand for adjacent coastal real estate. The real estate market would be modeled separately to estimate the scale of these effects. The results from the analysis of the real estate market could be used as an estimate of a change in the IO model's real estate industry sector. By changing direct output in that sector, one can understand changes in the rest of the economy.

2. Methodology

A regional input-output (IO) model provides one of the most practical ways to assemble essential economic information associated with a wide range of economic activities occurring in the NAM-ERA region. An IO model gives one an understanding of the effects of activities in a particular industry sector on all other sectors from which it purchases and to which it sells goods or services. Thus, we can use the model to understand the economic "influence" of the ocean industries in the NAM-ERA region on the other sectors of the economy to which they are linked.

An IO model is constructed as a system of linear algebraic equations that relate the production of goods and services ("outputs") in individual industry sectors to purchases of goods and services from other industry sectors, to final consumer and government agency demands, and to exports for that sector's output. The principles of linear algebra are used to solve the system of equations. Of crucial importance to this model are parameters (mathematical constants)[5] that describe the technology of producing the goods or services in each industry sector. These parameters are used to assess economic impacts and to measure the connectedness of each industry sector to the rest of the coastal county economy.

We use the IMPLAN[6] IO model with its 2006 database and parameters to estimate the economic activity of ocean-related industry sectors in the coastal counties of the North Atlantic US states (from Maine to North Carolina) bordering the NAM-ERA region. To accomplish this task, we construct a North Atlantic coastal county IO model (*i.e.*, we set up and solve a system of equations for those counties as a unified, self-contained economy). North Atlantic coastal counties are those counties from Maine to North Carolina whose populations are used by NOAA to

[5] In the parlance of IO modeling, these parameters are known as "technical coefficients." The technical coefficients are provided by IMPLAN.

[6] IMPLAN is a commercially available IO model (MIG 2008). The most recent coastal county data are for 2006.

calculate funding under section 306 of the Coastal Zone Management Act.[7] Because of their location in the coastal zone and their proximity to ocean resources and amenities, data from coastal counties result in a better estimate of ocean-related economic activity than data from coastal states.

The IMPLAN database is compiled initially using data from 19,171 individual industries. Related industries are grouped into 509 distinct industry "sectors".[8] Analogous to a food web-type model, individual industries can be thought of as individual species; industry sectors can be thought of as trophic levels. We define an aggregate "ocean sector" as comprising six broad ocean industry groups: fisheries, shipbuilding, shipping, water quality, tourism, and real estate. These six broad industry groups are made up of 13 IMPLAN ocean industry sectors, which in turn are made up of 824 individual industries. The Appendix provides a table of individual industries that comprise each of the 13 IMPLAN ocean industry sectors.

Some of the IMPLAN ocean sectors provide direct evidence of economic activity associated with the ocean environment. These sectors include commercial fishing and processing, ship- and boat-building and repairing, and water transportation. We describe these sectors as "primary" ocean sectors. (The individual industries comprising these primary sectors are listed in the Appendix.)

All other industry sectors that combine ocean-related industries with many other non-ocean related industries we identify as "secondary" ocean sectors. For example, the broad industrial sector "Animal Production" includes aquaculture and fish hatcheries as two ocean-related industries among its many individual industries. Similarly, the very broad industrial sector "Other Amusement, Gambling, and Recreation Industries" includes public beaches, yacht

[7] 16 U.S.C. §1455 (2008).

[8] The aggregation of industries into industry sectors is necessary for model tractability. In other words, it is computationally much too costly and complex to construct an IO model with 19,171 individual industries.

clubs, and marinas as its ocean-related industries. Note that, because of the inclusion of arguably non-ocean-related industries, estimates of impacts in the secondary ocean sectors will overstate ocean-related economic activity. (The individual industries comprising these secondary sectors are listed in the Appendix. Those industries with gray highlighting are included in the secondary ocean sectors but are not ocean-related industries.)

Tables 1a and 1b compare the relevant primary and secondary ocean industry sectors in 2006 and 1995 (*cf*., Hoagland *et al*. 2005 for the original 1995 analysis). In these two tables, the primary (1º) and secondary (2º) ocean industry sectors are identified and cross-referenced with the IMPLAN industry sectors and individual industries (identified by industrial classification number). In addition, the relevant ocean-related industries are identified for the secondary ocean sectors. Table 1c provides a concordance between the older US Standard Industrial Classification (SIC) system used for the 1995 model and the newer North American Industry Classification System (NAICS) used for the 2006 model. [9]

Coastal county economic activity represents an upper bound on economic impacts because of the inclusion of some industries that are unrelated to the coastal and ocean environment (in the secondary ocean sector) and because human activities may be distributed landward, away from the coast. Note, however, that most economic activity in coastal counties occurs within watersheds that drain to the coast, so that even if some industry sectors (*e.g*., components of the real estate market) are not located directly on the coast, they still depend on the ecosystem services of the ocean (*e.g*., proximity to beaches and estuaries; as a sink for nutrients).

[9] As shown in Table 1c, there has been some rearranging of the IMPLAN industry sectors as a consequence of a switch from the SIC system to the NAICS system. One noticeable difference between the old and new data occurs in the secondary fisheries sector, where "Agriculture, Fishery, and Forestry Services" have not been included in the 2006 data (fish hatcheries, which had been included in that sector in 1995, are now included with aquaculture in the "Animal Production" industry sector). More detail for comparing the two classification systems can be found at: http://www.census.gov/epcd/naics02/ N02TOS87.HTM (last accessed on August 12, 2008).

There are several well-known limitations to the use of the IO approach in characterizing socio-economic aspects. These limitations relate to the use of economic data to make decisions about the efficient or optimal allocation of resources (*e.g.*, Probst and Gavrilis 1987). From the perspective of welfare economics, for example, the traditional IO model does not yield estimates of net economic value, as represented by consumer and producer surpluses. This shortcoming can be remedied, in part, through the implementation of a non-linear "computable general equilibrium" (CGE) model (*viz.*, Finnoff and Tschirhart 2008). The CGE approach typically utilizes fewer industry sectors due to the increased complexity resulting from nonlinear mathematical relationships.

A second limitation to the IO approach is that it does not capture non-market benefits. Non-market benefits comprise consumer surpluses for environmental amenities that are not traded in established markets, and, therefore, are not produced by an industry. In the coastal and ocean context, such environmental amenities include resources that are used for recreation and ecotourism, water and habitat quality, and healthy ecosystems. Although recreational industries are represented in the IO model structure, these industries rely upon unpriced ecosystem services (*e.g.*, striped bass, bluefish, and summer flounder stocks). It is possible to make general statements about the reliance of industry sectors in an IO model on these amenities, and it is possible to extend the IO model, in some circumstances, to link the ecosystem to the economy (*viz.*, Jin *et al*. 2003).

Finally, the IO model is not a normative framework for "optimizing" the use of economic resources, such as capital, labor, and nature, in the economy. Instead, the IO model presents a empirical description of the economy, including the pattern and scale of transactions that take place among industry sectors. As such, the IO model provides a useful descriptive first step in understanding the importance of ocean sectors to the economy. Further, it helps to initiate the

process of identifying special circumstances and elucidating geographic areas that warrant closer attention by means of more specialized economic models and data.

3. Results

We use the North Atlantic coastal county model to generate estimates of industrial output, employment, and IO multipliers in 2006. (We estimate a specific kind of multiplier, the "Type II multiplier," which we define below.) Estimates for 2006 and 1995 are presented in Tables 2a and 2b. Industry output is the value of an industry's total production, which includes purchases by all other industries, purchases by consumers and government agencies for final demand, and exports. Annual coastal- and ocean-related output in the NAM-ERA region now stands at $362 billion. Corrected for inflation, there has been a 17% increase from 1995 to 2006 in direct output in the region's broadly defined (primary and secondary) ocean sectors.

Employment is equal to the total number of jobs for each industry. Annual ocean-related employment in the NAM-ERA region now stands at almost 3 million persons. There has been a 25% increase from 1995 to 2006 in employment in the region's broadly defined ocean sectors.

Type II multipliers are a measure of the strength of the linkages between each sector and the rest of the economy. These multipliers account for direct, indirect, and induced impacts. Using a fisheries example, if a fishing vessel is taken out of service, the resulting lost fishing jobs and income are measured as "direct" effects in the economy. Changes in related industries, such as lost jobs and income in boat repairing, are "indirect" effects. Finally, lower household incomes for employees in the affected industry and in the industries to which it is connected lead to "induced" effects, which include reduced spending on food, housing, automobiles, services, etc.

Most of the output multipliers show small increases over time (within 10 percent of the 1995 value). Three sectors show marked increases in multiplier values, however: "commercial fishing" (+28%), "seafood product preparation and packing" (+33%), and "search, detection, and navigation instruments" (+21%). Growth or decline in these ocean sectors is likely to have more significant impacts on the coastal economy than changes in other coastal- or ocean-related sectors.[10]

The employment multipliers reveal a different pattern of changes. Parallel to increases in the output multipliers, significant increases are observed in the "seafood product preparation and packing" (+81%) and "search, detection, and navigation instruments" (+27%) sectors. Of note, there is also a large increase in the employment multiplier for the "water transportation" (+55%) sector. And there is a decline in the "commercial fishing" (-7%) sector, which is contrary to the change in the output multiplier for that sector. The latter might be explained by a shift in the product mix coming out of the fisheries sector—for example, as a consequence of stock depletion in the groundfishery. Following this premise, increases in the commercial value of the lobster and sea scallop fisheries may have led to increased output impacts in the commercial fisheries sector, but, on average, these fisheries tend to involve fishing vessels with smaller crews than those utilized on groundfishing vessels.

Tables 3a and 3b show the monetary values of direct, indirect, induced, and total output and employment effects, compiled by industry sector type (primary and secondary) and by ocean industry sector. Table 3c shows the percentage change in each sector from 1995 to 2006. Increases in output and employment during this period have been driven by the coastal county "water quality, tourism, and real estate" sector. It is important to note that growth in this sector

[10] These increases in multiplier values may be an artifact of the implementation of the updated IO model using a revised industry structure to accommodate the new NAICS data. Nevertheless, each model represents the best description of industry structure at the time it was developed.

is critically dependent upon environmental quality. Continued growth of this sector may lead to excessive nutrient releases, thereby limiting future growth.

In Tables 3a and 3b, both the fisheries and the shipping/shipbuilding sectors exhibit declines. Indirect impacts in the fisheries sector (primary and secondary ocean sectors together) show a marked increase, however. This change suggests an enhanced link between the fisheries sector and other industry sectors in the region (*e.g.*, more inputs to the fisheries sector are supplied by industries within the region, rather than by imports). Again, this change may be driven by changes in the product mix supplied by the commercial fisheries sector.

Tables 4a and 4b compile the monetary values of direct, indirect, induced, and total "value-added" effects, compiled by industry tier and by broad industry sector. Value-added is defined as the value of industry sectoral output less the sum of the values of inter-industry sectoral sales and imports; *direct* value-added is equivalent to the measure used to estimate GDP. The combined primary and secondary ocean sectors' direct value-added impacts represent about 7.8% of the $2.9 trillion annual gross state product for the coastal states in the NAM-ERA region (an increase from 6.6% in 1995). The value-added data confirm the importance of the coastal county "water quality, tourism, and real estate" sector as a driver of the economy. Policies that enhance the quality of the *nearshore* ocean environment are likely to be important to continued growth of both this sector and the NAM-ERA coastal economy more broadly.

4. Discussion

A strength of the IO model for the NAM-ERA region is that it links the coastal counties together into a regional economy. Within this economy, we are able to estimate the economic scale of the ocean-related sectors and to measure their linkages to the rest of the coastal county economy.

Except for differentiating the coastal counties as an economy to be distinguished from the rest of the region or the nation, the IO model does not provide information on *gradients* of economic values across coastal and ocean environments. Notwithstanding this observation, we suggest the following ideas for enhancing the geographic representation of some or all of the IO data or results.

The underlying data on output by industry sector could be used to differentiate economic activity in each coastal county. For example, differences in shipping outputs or real estate or other industry sectors would be represented in a GIS context with different colors in each county. Further, value-added in the ocean sectors could be represented to discern variations in coastal county contributions to county or state GDP.

In general, unless there are data describing the geographic distribution of human activities in the ocean, it is not possible to distribute data on outputs, employment, or value-added over the ocean. The US National Marine Fisheries Service (NMFS) compiles data on the approximate location (at the level of 10-minute squares) and composition of fish catches. One could use the composition of catch to assign values (direct outputs) to catches at specific locations in the ocean. Using the multipliers, one could represent a geographic distribution of indirect or induced effects for output, employment, and value-added. A similar presentation might be constructed for known shipping lanes.

Although there are other activities ongoing or proposed in the NAM-ERA ocean region (e.g., deepwater ports, wind farms, pipelines, undersea cables), because these activities occupy only small ocean or seabed areas at present, GIS presentations of economic impacts of these are unlikely to be useful at the full NAM-ERA scale. If specific locations are identified as case studies in the future, geographic representations of economic activities associated with these uses may be developed.

One activity, recreational fishing, is a significant use. Except for NMFS data on the spatial distribution of federally permitted charter and party boat fishing, there are no other data currently being compiled on a consistent basis to describe recreational fishing. Much of this particular activity is located fairly close to shore, however.

Another recommended use of the coastal county IO model involves the study of changes in industry sectoral output (these studies are known as model "simulations"). For example, if a fishery management plan projects increases in landings from specific regions in the future, values in the IO model can be replaced with the projected increased value of landings, and the resulting impacts can be linked to the relevant area. Analogously, establishing a fishery reserve in a specific area would remove landings from that area and from the economy. The model could be used to assess the impacts of such a change.[11]

Most ocean habitats (sea grasses, seafloors, wetlands, cold-water corals, *etc*.) are unpriced natural resources. These habitats provide ecosystem services, and some studies have attempted to combine the results of independent estimates of value into a "meta-analysis" for use in developing estimates in unstudied areas (see Brander *et al*. 2006 for a meta-analysis of unpriced wetland values). For ocean and coastal resources, existing studies of their value apply to only a limited number of sites, and they tend to be outdated (Pendleton *et al*. 2007). Moreover, the application of meta-analyses for transferring benefits from these sites to unstudied areas currently involves high levels of error (Allen and Loomis 2008). The values estimated in these studies are net economic surpluses, analogous to the price of habitat *per se*.[12] The IO model cannot encompass ocean

[11] In a further elaboration, a fishery reserve could also be linked with a biological model to show "stock" effects (migrations of fish out of the reserve) and resulting yields, and the results used to run an IO simulation.

[12] Royalties and taxes are one component of the value-added measure in the IO model. These financial instruments are rough measures of the economic value of privately owned or managed land and natural resources, but they pertain exclusively to land-based habitats and resources and not to the ocean.

habitats, resources, or amenities explicitly as factors of production, precisely because such resources are unpriced, although attempts at linking ecological models to IO models to develop such estimates are currently under active development (Finnoff and Tschirhart 2008; Jin *et al*. 2003).

If information exists on the geographic distribution of ocean habitats, one approach is to apply Costanza-type annual flow values to these resources (Costanza *et al*. 2002). This type of "benefits transfer" is fraught with problems relating to the relevance of estimates developed in one location for use in another, but it could be viewed as a crude first-cut. Use of this type of benefits transfer would not provide much information beyond the coastal or nearshore environments, however, because, in the study by Costanza and his colleagues, there exist uniform annual flow values for such geographic descriptors as "open ocean," "estuary," and "coastal shelf," which encompass very large geographic areas in the NAM-ERA region. Such values would not represent the within-region variability that is the strength of the GIS presentation.

In theory, the link between these habitats and commercial markets (*e.g*., fish yields) could be used to provide an estimate of value (Barbier *et al*. 2008; Barbier 2002). Some studies have begun valuing the productivity of wetlands in North America this way (*viz*., Bell 1998). An important problem is that many commercial fisheries are regulated as open-access, implying that resource rents are small or non-existent and, therefore, the imputed value of habitat would be small as well. An exception is the mid-Atlantic surf clam/ocean quahog fishery, where rents exist because of an individual transferable quota (ITQ) system, which assigns rights to individual fishermen to harvest a proportion of a total allowable catch (or "quota") of these clam species. It would be useful to depict the mid-Atlantic grounds using the rents in this fishery as one of the only "valuable" offshore habitats.

An alternative is to identify studies of consumer surplus in the markets for the different fisheries (groundfish, pelagics, sea scallops, lobster, surf clams, *etc.*) and to map consumer surpluses with the geographic distribution of catches. These surpluses are a measure of economic value and therefore of the economic services provided by the ocean habitat.

5. Conclusion

The economy of the coastal states in the NAM-ERA region depends significantly upon those industries that utilize the ocean ecosystem. Our analysis of the ocean industry sectors in the coastal counties of this region suggests that they have been growing over the last decade at a rate that exceeds the growth of the broader region's economy. Some of the fastest growing ocean sectors, including real estate and commercial fishing and processing, rely upon good water quality, productive habitats, and healthy fish stocks. The continued degradation of coastal water quality, through the releases of nitrogen and phosphorous, and the overexploitation of fish stocks, owing to inefficient or inadequate regulations, will slow or reverse ocean-related economic growth in the NAM-ERA region. Critical extensions of the results reported here include distributing economic measures spatially over the NAM-ERA region and linking ecological or other models to the IO model to value ecosystem services more explicitly. Progress is most likely to occur in small steps, such as through the identification of localized case study areas and the implementation of more detailed models that can be tailored to address specific conservation goals.

References

Allen, B.P. and J.B. Loomis. 2008. The decision to use benefit transfer or conduct original valuation research for benefit cost and policy analysis. *Contemporary Economic Policy* 26:1-12.

Barbier, E.B. *et al*. 2008. Coastal ecosystem-based management with nonlinear ecological functions and values. *Science* 319:321-323.

Barbier, E.D. 2002. Do open access conditions affect the valuation of an externality? Estimating the welfare effects of mangrove-fishery linkages in Thailand. *Environmental and Resource Economics* 21:343–367, 2002.

Bell, F.W. 1998. The state of nature as an input into the production function. *Journal of Economic Research* 3:1-20.

Brander, L.M., R.J.G.M. Florax and J.E. Vermaat. 2006. The empirics of wetland valuation: a comprehensive summary and a meta-analysis of the literature. *Environmental & Resource Economics* 33:223–250.

Costanza *et al*. 2002. The value of the world's ecosystem services and natural capital. *Nature* 387:253-260.

Finnoff, D. and J. Tschirhart. 2008. Linking dynamic economic and ecological general equilibrium models. *Resource and Energy Economics* 30:91-114.

Hoagland, P., D. Jin, E. Thunberg and S. Steinback. 2005. Economic activity associated with the northeast shelf large marine ecosystem: application of an input-output approach. *In* T.M. Hennessey and J.G. Sutinen, eds., *Sustaining Large Marine Ecosystems: The Human Dimension*. Large Marine Ecosystem Series Vol. 13. Oxford, U.K.: Elsevier Science B.V., pp. 157-179.

Minnesota IMPLAN Group. (MIG). 2008. IMPLAN Professsional 2.0. Stillwater, Minn. Webpage at: http://implan.com/.

Jin, D., P. Hoagland and T.M. Dalton. 2003. Linking economic and ecological models for a marine ecosystem. *Ecol. Econ.* 46(3):367-385.

Pendleton, L., P. Atiyah and A. Moorthy. 2007. Is the non-market literature adequate to support coastal and marine management? *Ocean & Coastal Management* 50:363–378.

Probst, D.B. and D.G. Gavrilis. 1987. Role of Economic Impact Assessment Procedures in Recreational Fisheries Management. *Transactions of the American Fisheries Society* 116:450-460.

Input-Output Model Glossary

Term	Definition
Direct impacts	A measure of sales in an industry sector. Sometimes referred to as "direct output impacts" or "output impacts."
Employment	A measure of the number of jobs in an industry sector.
Indirect impacts	A measure of the effect of changes in other linked industry sectors due to a change in the output of a specific industry sector.
Induced impacts	A measure of changes in spending by employees due to a change in the output of a specific industry sector.
Industry	A set of firms that produce the same goods or services for a single market.
Industry Sector	A set of related industries grouped together.
Multiplier	An estimate of the degree of connectedness of an industry sector to the rest of the economy. "Type II" multipliers are a measure of direct, indirect, and induced economic impacts. Multipliers measure the broader economic impacts of small changes in output in an industry sector. They can be multiplied times direct impacts to obtain a monetary measure. Employment impacts can also be estimated with an IO model.
Ocean Sector	A set of related industries that depend upon the ocean as an unpriced input in the production of goods or services.
Output	The production of goods or services by an industry sector. Output is expressed in monetary units (2006 US dollars).
Primary Ocean Sector	An industry sector for which all of its industries depend directly upon the ocean.
Secondary Ocean Sector	An industry sector for which only a subset of its industries depend directly upon the ocean.
Value-added	The increase in value of a good when it is utilized as an input in the production of another good. For example, the seafood processing sector adds value to raw (unprocessed) fish landed at the dock by firms in the commercial fishing sector. Value-added includes employee compensation, industry profits, royalties, and taxes paid. It is identical to the measure used to calculate gross domestic product (GDP). Multipliers may be calculated for value-added as well.

Table 1a: Ocean Industry Sectors and IMPLAN Sectors (2006)

OCEAN INDUSTRY SECTOR	TYPE	IMPLAN INDUSTRY SECTOR	IMPLAN CODE	NAICS CODES	RELEVANT OCEAN INDUSTRY (2° only)
Fisheries	1°	Fishing	16	1141	
		Seafood product preparation and packing	71	3117	
	2°	Animal production, except cattle and poultry and eggs	13	1122, 1124, 1125, 1129	Aquaculture, fish hatcheries
Shipbuilding	1°	Ship building and repairing	357	336611	
		Boat building	358	336612	
	2°	Search, detection, and navigation instruments	314	334511	Search and navigation equipment
Shipping	1°	Water transportation	393	483	
Water Quality	2°	Water, sewerage and other systems	32	2213	
Tourism	2°	Food services and drinking places	481	722	
		Hotels and motels, including casino hotels	479	72111, 72112	
		Other accommodations	480	72119, 7212, 7213	Bed-and-breakfast inns, recreational vehicle parks and recreational camps
		Other amusement, gambling, and recreation industries	478	7131, 7132, 71391, 71392, 71393, 71399	Amusement parks and arcades, golf courses and country clubs, marinas, beaches
Real Estate	2°	Real Estate	431	531	

Table 1b: Ocean Industry Sectors and IMPLAN Sectors (1995)

OCEAN INDUSTRY SECTOR	TYPE	IMPLAN INDUSTRY SECTOR	IMPLAN CODE	SIC CODES	RELEVANT OCEAN INDUSTRY (2° only)
Fisheries	1°	Commercial Fishing	25	0912, 0913, 0919	
		Canned and Cured Seafoods	97	2091	
		Prepared Fresh or Frozen Fish and Seafoods	98	2092	
	2°	Miscellaneous Livestock	9	0273, others	Aquaculture
		Agricultural, Forestry, Fishery Services	26	0921, others	Fish Hatcheries
Shipbuilding	1°	Ship Building and Repairing	392	3731	
		Boat Building and Repairing	393	3732	
	2°	Search and Navigation Equipment	400	3812	
Shipping	1°	Water Transportation	436	4400	
Water Quality	2°	Water Supply and Sewerage Systems	445	4941, 4952	
Tourism	2°	Eating and Drinking	454	5800	
		Hotels and Lodging Places	463	7000	
		Amusement and Recreation Services	488	7999, others	Beaches, Headboats, Scuba
Real Estate	2°	Real Estate	462	6500	

Table 1c: Concordance between SIC and NAICS Codes

SIC Code	Industry	NAICS Code	Industry
0912	Finfish	1141	Fishing
0913	Shellfish		
0919	Miscellaneous Marine Products		
2091	Canned and Cured Fish and Seafoods	3117	Seafood Product Preparation and Packaging
2092	Prepared Fresh or Frozen Fish and Seafoods		
0273	Animal Aquaculture	1125	Animal Aquaculture
0921	Fish Hatcheries and Preserves		
3731	Ship Building and Repairing	336611	Ship Building and Repairing
3732	Boat Building and Repairing	336612	Boat Building
3812	Search, Detection, Navigation, Guidance, Aeronautical, and Nautical Systems and Instruments	334511	Search, Detection, Navigation, Guidance, Aeronautical, and Nautical System and Instrument Manufacturing
4400	Water Transportation	483	Water Transportation
4941	Water Supply	2213	Water, Sewage, and Other Systems
4952	Sewerage Systems		
5800	Eating and Drinking	722	Food Service and Drinking Places
7000	Hotels and Lodging Places	72111 72112	Hotels and Motels (including Casino Hotels)
		72119 7213 7217	Other Accommodations
7999	Amusement and Recreation Services	7131 7132 71391 71392 71393 71399	Other Amusement, Gambling, and Recreation Industries
6500	Real Estate	531	Real Estate

Table 2a: NAM-ERA (2006): Coastal County Level Sectoral Output, Employment, and Type II Multipliers

OCEAN INDUSTRY SECTOR	TYPE	IMPLAN SECTOR	OUTPUT†	TYPE II MULT	EMPLOYMENT‡	TYPE II MULT
Fisheries	1°	Fishing	1,082	2.35	29	1.32
		Seafood product preparation and packing	2,483	2.19	9	3.95
	2°	Animal production, except cattle and poultry and eggs	571	1.60	15	1.14
Shipbuilding	1°	Ship building and repairing	7,532	1.92	39	2.11
		Boat building	2,444	1.84	11	2.04
	2°	Search, detection, and navigation instruments	11,036	2.24	32	3.43
Shipping	1°	Water transportation	6,018	1.98	10	4.85
Water Quality	2°	Water, sewerage and other systems	1,534	1.70	6	2.24
Tourism	2°	Food services and drinking places	76,776	1.89	1,354	1.34
		Hotels and motels, including casino hotels	27,434	1.86	258	1.62
		Other accommodations	1,424	1.97	13	1.70
		Other amusement, gambling, and recreation industries	9,137	1.87	114	1.50
Real Estate	2°	Real Estate	214,403	1.58	1,014	1.89
TOTALS			361,874		2,904	
% of Coastal County Total			8.9%		10.8%	

† $U.S. millions (2006)
‡Thousands of employees

Table 2b: NAM-ERA (1995): Coastal County Sectoral Output, Employment, and Type II Multipliers

OCEAN INDUSTRY SECTOR	TYPE	IMPLAN SECTOR	OUTPUT†	TYPE II MULT	EMPLOYMENT ‡	TYPE II MULT
Fisheries	1°	Commercial Fishing	1,131	1.83	18	1.42
		Canned and Cured Seafoods	310	1.65	2	1.73
		Prepared Fresh or Frozen Fish and Seafoods	1,570	1.61	8	2.18
	2°	Miscellaneous Livestock	331	1.53	11	1.14
		Agricultural, Forestry, Fishery Services	1,927	1.68	45	1.27
Shipbuilding	1°	Ship Building and Repairing	6,444	1.77	50	1.86
		Boat Building and Repairing	972	1.71	7	1.79
	2°	Search and Navigation Equipment	8,669	1.85	35	2.71
Shipping	1°	Water Transportation	10,177	1.96	37	3.12
Water Quality	2°	Water Supply and Sewerage Systems	1,161	1.78	4	3.23
Tourism	2°	Eating and Drinking	51,578	1.80	1,042	1.33
		Hotels and Lodging Places	24,554	1.83	265	1.71
		Amusement and Recreation Services	7,160	1.84	171	1.31
Real Estate	2°	Real Estate	193,452	1.48	619	2.30
TOTALS			309,438		2,314	
% of Coastal County Total			10.65%		9.81%	

† $U.S. millions (2006)
‡ Thousands of employees

Table 3a: NAM-ERA (2006): Coastal County Level Output and Employment Impacts

	OUTPUT IMPACT†				EMPLOYMENT IMPACT‡			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Primary and Secondary Ocean Sectors	361,874	125,807	134,886	622,566	2,904	823	983	4,710
Primary Ocean Sectors	19,559	9,918	9,389	38,865	98	61	68	227
Fisheries*	4,136	2,732	2,031	8,898	52	23	15	90
Shipbuilding* & Shipping	27,030	14,641	13,930	55,602	92	71	102	265
Water Quality, Tourism & Real Estate	330,708	108,434	118,924	558,066	2,759	729	867	4,355

† $U.S. millions (2006)
‡Thousands of employees
*Includes Primary and Secondary Ocean Sectors

Table 3b: NAM-ERA (1995): Coastal County Level Output and Employment Impacts

	OUTPUT IMPACT†				EMPLOYMENT IMPACT‡			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Primary and Secondary Ocean Sectors	309,438	106,307	81,451	497,194	2,313	844	769	3,926
Primary Ocean Sector	20,604	9,052	8,501	38,157	123	65	80	268
Fisheries*	5,269	1,429	2,146	8,843	84	12	20	117
Shipbuilding* & Shipping	26,263	11,427	11,373	49,063	129	78	107	314
Water Quality, Tourism & Real Estate	277,905	93,451	67,933	439,288	2,100	753	641	3,495

† $U.S. millions (2006)
‡Thousands of employees
*Includes Primary and Secondary Ocean Sectors

Table 3c: NAM-ERA: % Changes in Coastal County Level Output and Employment Impacts: 1995 to 2006

	OUTPUT IMPACT†				EMPLOYMENT IMPACT‡			
	Direct	Indirect	Induced	Total	Direct	Indirect	Induced	Total
Primary and Secondary Ocean Sectors	17%	18%	66%	25%	26%	-2%	28%	20%
Primary Ocean Sector	-5%	10%	10%	2%	-20%	-6%	-15%	-15%
Fisheries*	-21%	91%	-5%	1%	-38%	92%	-25%	-23%
Shipbuilding* & Shipping	3%	28%	22%	13%	-29%	-9%	-5%	-16%
Water Quality, Tourism & Real Estate	19%	16%	75%	27%	31%	-3%	35%	25%

‡Thousands of employees
*Includes Primary and Secondary Ocean Sectors

Table 4a: NAM-ERA (2006): Coastal County Value-Added Impacts

	VALUE-ADDED IMPACT†			
	Direct	Indirect	Induced	Total
Primary and Secondary Ocean Sectors	226,115	72,152	82,733	381,000
Primary Ocean Sector	6,603	5,242	5,759	17,604
Fisheries*	857	1,363	1,246	3,465
Shipbuilding* & Shipping	9,769	7,411	8,544	25,725
Water Quality, Tourism & Real Estate	215,489	63,378	72,943	351,810

† $U.S. millions (2006)
*Includes Primary and Secondary Ocean Sectors

Table 4b: NAM-ERA (1995): Coastal County Value-Added Impacts

	VALUE-ADDED IMPACT†			
	Direct	Indirect	Induced	Total
Primary and Secondary Ocean Sectors	191,185	63,496	51,761	306,442
Primary Ocean Sector	7,892	4,802	5,402	18,095
Fisheries*	2,798	779	1,364	4,940
Shipbuilding* & Shipping	10,093	6,149	7,228	23,470
Water Quality, Tourism & Real Estate	178,295	56,566	43,171	278,032

† $U.S. millions (2006)
*Includes Primary and Secondary Ocean Sectors

Table 4c: NAM-ERA: % Changes in Coastal County Value-Added Impacts 1995 to 2006

	VALUE-ADDED IMPACT†			
	Direct	Indirect	Induced	Total
Primary and Secondary Ocean Sectors	18%	14%	60%	24%
Primary Ocean Sector	-16%	9%	7%	-3%
Fisheries*	-69%	75%	-9%	-30%
Shipbuilding* & Shipping	-3%	21%	18%	10%
Water Quality, Tourism & Real Estate	21%	12%	69%	27%

*Includes Primary and Secondary Ocean Sectors

Appendix: IMPLAN Codes, NAICS Codes, and Ocean Industries

IMPLAN	2002 NAICS	NAICS Title
13	112930	Fox production
13	112920	Burro production
13	112920	Donkey production
13	112920	Horse (including thoroughbreds) production
13	112920	Horses and Other Equine Production
13	112920	Mule production
13	112930	Fur bearing animal production
13	112930	Chinchilla production
13	112910	Royal jelly production, bees
13	112910	Apiculture
13	112920	Pony production
13	112910	Queen bee production
13	112910	Propolis production, bees
13	112910	Honey bee production
13	112930	Fur-Bearing Animal and Rabbit Production
13	112910	Bee production (i.e., apiculture)
13	112990	Buffalo production
13	1129	Other Animal Production
13	112519	Turtle production, farm raising
13	112519	Other Animal Aquaculture
13	112519	Frog production, farm raising
13	112910	Beeswax production
13	112990	Deer production
13	112990	Worm production
13	112990	Rattlesnake production
13	112990	Raising swans, peacocks, flamingos, or other adornment birds
13	112990	Llama production
13	112990	Laboratory animal production (e.g., guinea pigs, mice, rats)
13	112990	Kennels, breeding and raising stock for sale
13	112990	General combination animal farming
13	112990	Elk production
13	112990	Bird production (e.g., canaries, love birds, parakeets, parrots)
13	112990	Dog production
13	112930	Mink production
13	112990	Cricket production
13	112990	Companion animals production (e.g., cats, dogs, parakeets, parrots)
13	112990	Combination livestock farming (except dairy, poultry)
13	112990	Cat production
13	112990	Aviaries (i.e., raising birds for sale)
13	112990	Breeding of pets (e.g., birds, cats, dogs)
13	112519	Animal aquaculture (except finfish, shellfish)
13	112990	Alpaca production
13	112930	Rabbit production

IMPLAN	2002 NAICS	NAICS Title
13	112990	Earthworm hatcheries
13	1124	Sheep and Goat Farming
13	1125	Animal Aquaculture
13	112420	Mohair farming
13	112420	Milking dairy goat
13	112420	Goat farming (e.g., meat, milk, mohair production)
13	112420	Dairy goat farming
13	112420	Angora goat farming
13	112410	Sheep farming (e.g., meat, milk, wool production)
13	112410	Milking dairy sheep
13	112410	Lamb feedlots (except stockyards for transportation)
13	112511	Catfish production, farm raising
13	112410	Dairy sheep farming
13	112511	Baitfish production, farm raising
13	112210	Weaning pig operations
13	112210	Pig farming
13	112210	Hog feedlots (except stockyards for transportation)
13	112210	Hog and pig (including breeding, farrowing, nursery, and finishing activities) farming
13	112210	Feedlots (except stockyards for transportation), hog
13	112210	Feeder pig farming
13	112210	Farrow-to-finish operations
13	112990	Bison production
13	112519	Alligator production, farm raising
13	112410	Feedlots (except stockyards for transportation), lamb
13	112511	Trout production, farm raising
13	112512	Shrimp production, farm raising
13	112512	Shellfish hatcheries
13	112512	Oyster production, farm raising
13	112512	Mussel production, farm raising
13	112512	Mollusk production, farm raising
13	112512	Hatcheries, shellfish
13	112512	Fish farms, shellfish
13	112512	Cultured pearl production, farm raising
13	112512	Crustacean production, farm raising
13	112512	Clam production, farm raising
13	112511	Finfish production, farm raising
13	112511	Goldfish production, farm raising
13	112511	Finfish, hatcheries
13	112512	Crawfish production, farm raising
13	112511	Fish farms, finfish
13	112511	Tropical fish production, farm raising
13	112511	Hatcheries, finfish
13	112511	Hybrid striped bass production
13	112511	Minnow production, farm raising

IMPLAN	2002 NAICS	NAICS Title
13	112511	Ornamental fish production, farm raising
13	112511	Tilapia production
16	114111	Trout fishing
16	114111	Tuna fishing
16	114111	Tilefish fishing
16	114112	Clam digging
16	114111	Sea herring fishing
16	114112	Crabbing
16	114111	Whiting fishing
16	114111	Swordfish fishing
16	114111	Snapper fishing
16	114111	Sea trout fishing
16	114111	Sea bass fishing
16	114112	Crayfish fishing
16	114119	Other Marine Fishing
16	114111	Shark fishing
16	114112	Fisheries, shellfish
16	114112	Lobster fishing
16	114112	Mussel fishing
16	114112	Octopus fishing
16	114112	Oyster dredging
16	114112	Scallop fishing
16	114112	Sea urchin fishing
16	114112	Shellfish fishing (e.g., clam, crab, oyster, shrimp)
16	114112	Shrimp fishing
16	114119	Frog fishing
16	114119	Seaweed gathering
16	114119	Terrapin fishing
16	114111	Salmon fishing
16	114119	Sponge gathering
16	114112	Squid fishing
16	114111	Cod fishing
16	114119	Turtle fishing
16	114111	Sablefish fishing
16	1141	Fishing
16	114111	Anchovy fishing
16	114111	Cod catching
16	114111	Croaker fishing
16	114111	Dolphin fishing
16	114111	Eel fishing
16	114111	Finfish fishing (e.g., flounder, salmon, trout)
16	114111	Fisheries, finfish
16	114111	Flounder fishing
16	114111	Grouper fishing
16	114111	Haddock fishing

IMPLAN	2002 NAICS	NAICS Title
16	114111	Pollock fishing
16	114111	Bluefish fishing
16	114111	Hake fishing
16	114111	Rockfish fishing
16	114111	Ray fishing
16	114111	Porgy fishing
16	114111	Pilchard fishing
16	114111	Perch fishing
16	114111	Lingcod fishing
16	114111	Halibut fishing
16	114111	Herring fishing
16	114111	Mullet fishing
16	114111	Mackerel fishing
16	114111	Mahi-mahi fishing
16	114111	Menhaden fishing
32	221330	Steam heating systems (i.e., suppliers of heat)
32	221330	Air-conditioning supply
32	221330	Cooled air distribution
32	221330	Distribution of cooled air
32	221330	Distribution of heated air
32	221330	Distribution of steam heat
32	221330	Geothermal steam production
32	221330	Heat, steam, distribution
32	221330	Heated air distribution
32	221330	Steam supply systems, including geothermal
32	221330	Steam heat distribution
32	221330	Steam production and distribution
32	221320	Waste collection, treatment, and disposal through a sewer system
32	221310	Canal, irrigation
32	221330	Heating steam (suppliers of heat) providers
32	221310	Irrigation system operation
32	221320	Sewer systems
32	221310	Impounding reservoirs, irrigation
32	2213	Water, Sewage and Other Systems
32	221310	Water distribution (except irrigation)
32	221310	Water distribution for irrigation
32	221310	Water filtration plant operation
32	221320	Sewage treatment plants or facilities
32	221310	Water treatment and distribution
32	221310	Water treatment plants
32	221320	Collection, treatment, and disposal of waste through a sewer system
32	221320	Sewage disposal plants
32	221310	Water supply systems
32	221310	Filtration plant, water

IMPLAN	2002 NAICS	NAICS Title
71	311712	Fresh and Frozen Seafood Processing
71	311712	Chowders, frozen fish and seafood, manufacturing
71	311712	Cod liver oil extraction, crude, produced in a fresh and frozen seafood plant
71	311712	Freezing fish (e.g., blocks, fillets, ready-to-serve products)
71	311712	Dinners, frozen seafood, manufacturing
71	311712	Fish and marine animal oils produced in a fresh and frozen seafood plant
71	311712	Fish freezing (e.g., blocks, fillets, ready-to-serve products)
71	311712	Fish meal produced in a fresh and frozen seafood plant
71	311712	Fish, fresh prepared, manufacturing
71	311711	Shellfish curing
71	311712	Seafood products, fresh prepared, manufacturing
71	311712	Seafood products, frozen, manufacturing
71	311712	Seafood, fresh prepared, manufacturing
71	311712	Seafood, frozen, manufacturing
71	311712	Shellfish products, fresh prepared, manufacturing
71	311711	Canning, fish, crustacea, and molluscs
71	311712	Shellfish products, frozen, manufacturing
71	311712	Fish, fresh or frozen, manufacturing
71	311711	Fish meal produced in a cannery
71	311712	Picking crab meat
71	311712	Seafood dinners, frozen, manufacturing
71	311711	Chowders, fish and seafood, canning
71	311711	Cod liver oil extraction, crude, produced in a cannery
71	311711	Curing fish and seafood
71	311711	Drying fish and seafood
71	311711	Fish and marine animal oils produced in a cannery
71	311711	Surimi canning
71	311711	Fish egg bait canning
71	311711	Soups, fish and seafood, canning
71	311711	Fish, canned and cured, manufacturing
71	311711	Fish, curing, drying, pickling, salting, and smoking
71	311711	Floating factory ships seafood processing
71	311711	Seafood and seafood products canning
71	311711	Seafood and seafood products curing
71	311711	Seaweed processing (e.g., dulse)
71	311711	Shellfish and shellfish products canning
71	311712	Shucking and packing fresh shellfish
71	311711	Fish and seafood chowder canning
71	311712	Shellfish, fresh prepared, manufacturing
71	311712	Soups, frozen fish and shellfish, manufacturing
71	3117	Seafood Product Preparation and Packaging
71	311711	Cannery, fish
71	311712	Surimi, fresh and frozen, manufacturing

IMPLAN	2002 NAICS	NAICS Title
71	311712	Shellfish, frozen, manufacturing
71	311711	Cannery, shellfish
314	334511	Radar systems and equipment manufacturing
314	334511	Radar detectors manufacturing
314	334511	Proximity warning (i.e., collision avoidance) equipment manufacturing
314	334511	Position indicators (e.g., for landing gear, stabilizers), airframe equipment, manufacturing
314	334511	Pictorial situation instrumentation manufacturing
314	334511	Omnibearing instrumentation manufacturing
314	334511	Navigational instruments manufacturing
314	334511	Nautical systems and instruments manufacturing
314	334511	Machmeters manufacturing
314	334511	Light reconnaissance and surveillance systems and equipment manufacturing
314	334511	Radio magnetic instrumentation (RMI) manufacturing
314	334511	Instrument landing system instrumentation, airborne or airport, manufacturing
314	334511	Space vehicle guidance systems and equipment manufacturing
314	334511	Instruments, aeronautical, manufacturing
314	334511	Rate-of-climb instrumentation manufacturing
314	334511	Search and detection systems and instruments manufacturing
314	334511	Search, Detection, Navigation, Guidance, Aeronautical, and Nautical System and Instrument Manufacturing
314	334511	Sextants (except surveying) manufacturing
314	334511	Sonabuoys manufacturing
314	334511	Wheel position indicators and transmitters, aircraft, manufacturing
314	334511	Sonar systems and equipment manufacturing
314	334511	Speed, pitch, and roll navigational instruments and systems manufacturing
314	334511	Taffrail logs manufacturing
314	334511	Underwater navigational systems manufacturing
314	334511	Warfare countermeasures equipment manufacturing
314	334511	Inertial navigation systems, aeronautical, manufacturing
314	334511	Hydrophones manufacturing
314	334511	Sonar fish finders manufacturing
314	334511	Airspeed instruments (aeronautical) manufacturing
314	334511	Compasses, gyroscopic and magnetic (except portable), manufacturing
314	334511	Cabin environment indicators, transmitters, and sensors manufacturing
314	334511	Bank and turn indicators and components (aeronautical instruments) manufacturing
314	334511	Artificial horizon instrumentation manufacturing
314	334511	Angle-of-yaw instrumentation manufacturing

IMPLAN	2002 NAICS	NAICS Title
314	334511	Countermeasure sets (e.g., active countermeasures, jamming equipment) manufacturing
314	334511	Altimeters, aeronautical, manufacturing
314	334511	Air traffic control radar systems and equipment manufacturing
314	334511	Airframe equipment instruments manufacturing
314	334511	Aircraft flight instruments (except engine instruments) manufacturing
314	334511	Airborne navigational systems manufacturing
314	334511	HUD (heads-up display) systems, aeronautical, manufacturing
314	334511	Aeronautical systems and instruments manufacturing
314	334511	Infrared homing systems, aeronautical, manufacturing
314	334511	Angle-of-attack instrumentation manufacturing
314	334511	Gyrocompasses manufacturing
314	334511	Acceleration indicators and systems components, aerospace type, manufacturing
314	334511	Heads-up display (HUD) systems, aeronautical, manufacturing
314	334511	Distance measuring equipment (DME), aeronautical, manufacturing
314	334511	Gyrogimbals manufacturing
314	334511	Horizon situation instrumentation manufacturing
314	334511	Glide slope instrumentation manufacturing
314	334511	Flight recorders (i.e., black boxes) manufacturing
314	334511	Flight and navigation sensors, transmitters, and displays manufacturing
314	334511	Fish finders (i.e., sonar) manufacturing
314	334511	Fathometers manufacturing
314	334511	Electronic guidance systems and equipment manufacturing
314	334511	Driftmeters, aeronautical, manufacturing
314	334511	Gyroscopes manufacturing
357	336611	Patrol boat building
357	336611	Sailing ships, commercial, manufacturing
357	336611	Ship dismantling at shipyards
357	336611	Ship repair done in a shipyard
357	336611	Ship scaling services done at a shipyard
357	336611	Ships (i.e., not suitable or intended for personal use) manufacturing
357	336611	Shipyard (i.e., facility capable of building ships)
357	336611	Towboat building and repairing
357	336611	Submarine building
357	336611	Passenger ship building
357	336611	Yachts built in shipyards
357	336611	Dredge building
357	336611	Tugboat building
357	336611	Barge building
357	336611	Oil and gas offshore floating platforms manufacturing
357	336611	Container ship building

IMPLAN	2002 NAICS	NAICS Title
357	336611	Drilling and production platforms, floating, oil and gas, building
357	336611	Drydock, floating, building
357	336611	Ferryboat building
357	336611	Fireboat building
357	336611	Fishing boat, commercial, building
357	336611	Hydrofoil vessel building and repairing in shipyard
357	336611	Naval ship building
357	336611	Cargo ship building
358	336612	Cabin cruiser
358	336612	Yacht building, not done in shipyards
358	336612	Sailboat building, not done in shipyards
358	336612	Rowboats manufacturing
358	336612	Pleasure boats manufacturing
358	336612	Motorboat, inboard or outboard, building
358	336612	Hovercraft building
358	336612	Dinghy (except inflatable rubber) manufacturing
358	336612	Boats (i.e., suitable or intended for personal use) manufacturing
358	336612	Boat yards (i.e., boat manufacturing facilities)
358	336612	Air boat building
358	336612	Dories building
393	483114	Passenger transportation, coastal or Great Lakes (including St. Lawrence Seaway)
393	483211	Inland Water Freight Transportation
393	483211	Freight transportation, inland waters (except on Great Lakes system)
393	483211	Canal barge transportation (freight)
393	483211	Barge transportation, canal (freight)
393	4832	Inland Water Transportation
393	483211	Intracoastal transportation of freight
393	483114	Passenger transportation, deep sea, to and from domestic ports (including Puerto Rico)
393	483114	Lake passenger transportation, Great Lakes (including St. Lawrence Seaway)
393	483114	Intercoastal transportation of passengers to and from domestic ports
393	483114	Great Lakes passenger transportation (including St. Lawrence Seaway)
393	483114	Ship chartering with crew, coastal or Great Lakes passenger transportation (including St. Lawrence Seaway)
393	483211	Lake freight transportation (except on Great Lakes system)
393	483212	Lake passenger transportation (except on Great Lakes system)
393	483211	River freight transportation
393	483211	Ship chartering with crew, freight transportation, inland waters (except on Great Lakes system)
393	483211	Shipping freight, inland waters (except on Great Lakes system)

IMPLAN	2002 NAICS	NAICS Title
393	483211	Towing service, inland waters (except on Great Lakes system)
393	483212	Canal passenger transportation
393	483212	Car lighters (i.e., ferries), inland waters (except on Great Lakes system)
393	483212	Inland Water Passenger Transportation
393	483212	Intracoastal transportation of passengers
393	483114	Ferry passenger transportation, Great Lakes (including St. Lawrence Seaway)
393	483112	Deep sea passenger transportation to or from foreign ports
393	483211	Lighterage (i.e., freight transportation except vessel supply services)
393	483113	Coastal freight transportation to and from domestic ports
393	483212	Ship chartering with crew, passenger transportation, inland waters (except on Great Lakes system)
393	483	Water Transportation
393	4831	Deep Sea, Coastal, and Great Lakes Water Transportation
393	483111	Deep sea freight transportation to or from foreign ports
393	483111	Freight transportation, deep sea, to or from foreign ports
393	483111	Ship chartering with crew, deep sea freight transportation to or from foreign ports
393	483111	Shipping freight to or from foreign ports, deep sea
393	483111	Transporting freight to or from foreign ports, deep sea
393	483112	Cruise lines (i.e., deep sea passenger transportation to or from foreign ports)
393	483112	Passenger transportation, deep sea, to or from foreign ports
393	483112	Ship chartering with crew, deep sea passenger transportation to or from foreign ports
393	483113	Barge transportation, coastal or Great Lakes (including St. Lawrence Seaway)
393	483114	Deep sea passenger transportation to and from domestic ports (including Puerto Rico)
393	483113	Coastal shipping of freight to and from domestic ports
393	483113	Deep sea freight transportation to or from domestic ports (including Puerto Rico)
393	483113	Freight shipping on the Great Lakes system (including St. Lawrence Seaway)
393	483113	Freight transportation, deep sea, to and from domestic ports
393	483113	Great Lakes freight transportation (including St. Lawrence Seaway)
393	483113	Intercoastal freight transportation to and from domestic ports
393	483113	Lake freight transportation, Great Lakes (including St. Lawrence Seaway)
393	483113	Ship chartering with crew, coastal or Great Lakes freight transportation (including St. Lawrence Seaway)
393	483113	Shipping freight to and from domestic ports (i.e., coastal, deep sea

IMPLAN	2002 NAICS	NAICS Title
		(including Puerto Rico), Great Lakes system (including St. Lawrence Seaway))
393	483114	Coastal passenger transportation to and from domestic ports
393	483114	Cruise lines (i.e., deep sea passenger transportation to and from domestic ports, including Puerto Rico)
393	483112	Transporting passengers to or from foreign ports, deep sea
393	483212	Passenger transportation, inland waters (except on Great Lakes system)
393	483212	Water taxi services
393	483212	River passenger transportation
431	531210	Real estate agencies
431	531311	Cooperative apartment managers' offices
431	531210	Real estate brokerages
431	531210	Real estate brokers' offices
431	531210	Renting real estate for others (i.e., agents, brokers)
431	531210	Residential real estate agencies
431	531210	Residential real estate agents' offices
431	531210	Real estate agents' offices
431	531210	Residential real estate brokerages
431	531210	Residential real estate brokers' offices
431	531210	Selling real estate for others (i.e., agents, brokers)
431	53131	Real Estate Property Managers
431	531311	Condominium managers' offices, residential
431	531311	Managers' offices, residential condominium
431	531311	Managers' offices, residential real estate
431	531210	Offices of Real Estate Agents and Brokers
431	531311	Managing cooperative apartments
431	531311	Apartment managers' offices
431	531311	Managing residential condominiums
431	531190	Railroad right of way leasing
431	531190	Real estate (except building) rental or leasing
431	531190	Residential trailer parks
431	531190	Trailer park or court, residential
431	531190	Vacant lot rental or leasing
431	531190	Vacation and recreation land rental or leasing
431	531210	Agencies, real estate
431	531210	Brokerages, real estate
431	531210	Agents, real estate
431	531210	Exclusive buyers' agents, offices of
431	531210	Brokers' offices, real estate
431	531210	Buyers' agents, real estate, offices
431	531210	Buying agencies, real estate
431	531210	Buying real estate for others (i.e., agents, brokers)
431	531210	Commercial real estate agencies
431	531210	Commercial real estate agents' offices

IMPLAN	2002 NAICS	NAICS Title
431	531210	Exclusive buyers' agencies
431	531312	Managing commercial condominiums
431	531390	Listing services, real estate
431	531320	Appraisal services, real estate
431	531320	Appraisers' offices, real estate
431	531320	Offices of Real Estate Appraisers
431	531320	Real estate appraisal services
431	531320	Real estate appraisers' offices
431	531390	Agencies, real estate escrow
431	531312	Managers' offices, commercial real estate
431	531390	Escrow agencies, real estate
431	531312	Property managing, commercial real estate
431	531390	Other Activities Related to Real Estate
431	531390	Real estate asset management services (except property management)
431	531390	Real estate consultants' (except agents, appraisers) offices
431	531390	Real estate escrow agencies
431	531390	Real estate escrow agents' offices
431	531390	Real estate fiduciaries' offices
431	531390	Real estate listing services
431	531390	Agents' offices, real estate escrow
431	531190	Mobile (manufactured) home site rental or leasing
431	531311	Property managers' offices, residential real estate
431	531311	Property managing, residential real estate
431	531311	Real estate property managers' offices, residential
431	531311	Residential property managing
431	531311	Residential real estate property managers' offices
431	531312	Commercial property managing
431	531312	Commercial real estate property managers' offices
431	531312	Real estate property managers' offices, commercial
431	531312	Managers' offices, commercial condominium
431	531312	Property managing, nonresidential real estate
431	531312	Managers' offices, nonresidential real estate
431	531390	Consultants', real estate (except appraisers), offices
431	531312	Managing commercial real estate
431	531312	Nonresidential property managing
431	531312	Property managers' offices, commercial real estate
431	531312	Property managers' offices, nonresidential real estate
431	531311	Managing residential real estate
431	531312	Condominium managers' offices, commercial
431	531120	Conference center, no promotion of events, rental or leasing
431	531120	Hall, nonresidential, rental or leasing
431	531110	Single family house rental or leasing
431	531110	Town house rental or leasing
431	531120	Arena, no promotion of events, rental or leasing

IMPLAN	2002 NAICS	NAICS Title
431	531120	Auditorium rental or leasing
431	531120	Bank building rental or leasing
431	531120	Banquet hall rental or leasing
431	531110	Residential hotel rental or leasing
431	531120	Commercial building rental or leasing
431	531110	Residential building rental or leasing
431	531120	Dance hall rental or leasing
431	531120	Dock and associated building rental or leasing
431	531120	Executive suites (i.e., full service office space provision)
431	531120	Exhibition hall, no promotion of events, rental or leasing
431	531120	Flea market space, under roof, rental or leasing
431	531120	Full service office space provision
431	531120	Hall and banquet room, nonresidential, rental or leasing
431	531120	Building, nonresidential (except miniwarehouse), rental or leasing
431	531110	Cottage rental or leasing
431	531190	Mobile (manufactured) home parks
431	531390	Fiduciaries', real estate, offices
431	531	Real Estate
431	5311	Lessors of Real Estate
431	531110	Apartment building rental or leasing
431	531110	Apartment hotel rental or leasing
431	531110	Apartment rental or leasing
431	531110	Retirement hotel rental or leasing
431	531110	Building, residential, rental or leasing
431	531120	Convention center, no promotion of events, rental or leasing
431	531110	Duplex houses (i.e., single family) rental or leasing
431	531110	Dwelling rental or leasing
431	531110	Houses rental or leasing
431	531110	Housing authorities operating residential buildings
431	531110	Lessors of residential buildings and dwellings
431	531110	Mobile (manufactured) home, on site, rental or leasing
431	531110	Real estate rental or leasing of residential building
431	531110	Building, apartment, rental or leasing
431	531190	Farmland rental or leasing
431	531130	Lessors of self storage units
431	531130	Miniwarehouse rental or leasing
431	531130	Real estate rental or leasing of miniwarehouses and self-storage units
431	531130	Self-storage unit rental or leasing
431	531130	Self-storage warehousing
431	531130	U-lock storage
431	531120	Hotel building rental or leasing, not operating hotel
431	531130	Lessors of miniwarehouses
431	531120	Concert hall, no promotion of events, rental or leasing
431	531130	Warehousing, self storage

IMPLAN	2002 NAICS	NAICS Title
431	531190	Flea market space (except under roof) rental or leasing
431	531190	Forest land rental or leasing
431	531190	Grazing land rental or leasing
431	531190	Land rental or leasing
431	531190	Lessors of Other Real Estate Property
431	531190	Manufactured (mobile) home parks
431	531190	Manufactured (mobile) home sites rental or leasing
431	531190	Mining property leasing
431	531190	Agricultural property rental leasing
431	531120	Insurance building rental or leasing
431	531190	Airport leasing, not operating airport, rental or leasing
431	531120	Industrial building rental or leasing
431	531120	Theater, property operation, rental or leasing
431	531120	Lessors of nonresidential buildings (except miniwarehouses)
431	531120	Mall property operation (i.e., not operating contained businesses) rental or leasing
431	531120	Manufacturing building rental or leasing
431	531120	Medical building rental or leasing
431	531120	Meeting hall and room rental or leasing
431	531120	Motel building, not operating motel, rental or leasing
431	531120	Reception hall rental or leasing
431	531120	Shopping center (i.e., not operating contained businesses) rental or leasing
431	531120	Real estate rental or leasing of nonresidential building (except miniwarehouse)
431	531120	Professional office building rental or leasing
431	531120	Piers and associated building rental or leasing
431	531120	Office building rental or leasing
431	531120	Nonresidential building (except miniwarehouse) rental or leasing
431	531120	Stadium rental or leasing without promotion of events
478	713990	Nightclubs without alcoholic beverages
478	713990	Guide services, tourist
478	713990	Gun clubs, recreational
478	713990	Hockey clubs, recreational
478	713990	Hockey teams, recreational
478	713990	Horse rental services, recreational saddle
478	713990	Youth sports leagues or teams
478	713990	Horseback riding, recreational
478	713990	Curling facilities
478	713990	Hunting clubs, recreational
478	713990	Hunting guide services
478	713990	Ice hockey clubs, recreational
478	713990	Jukebox concession operators (i.e., supplying and servicing in others' facilities)
478	713990	Kayaking, recreational

IMPLAN	2002 NAICS	NAICS Title
478	713990	Lawn bowling clubs
478	713990	Miniature golf courses
478	713990	Mountain hiking, recreational
478	713990	Guide services, hunting
478	713990	Dance halls
478	713990	Nudist camps without accommodations
478	713990	Galleries, shooting
478	713990	Trampoline facilities, recreational
478	713990	Observation towers
478	713990	Discotheques (except those serving alcoholic beverages)
478	713990	Driving ranges, golf
478	713990	Fireworks display services
478	713990	Fishing clubs, recreational
478	713990	Fishing guide services
478	713990	Flying clubs, recreational
478	713990	Football clubs, recreational
478	713990	Guide services, fishing
478	713990	Girls' day camps (except instructional)
478	713990	Gocart raceways (i.e., amusement rides)
478	713990	Gocart tracks (i.e., amusement rides)
478	713990	Golf courses, miniature
478	713990	Golf courses, pitch-n-putt
478	713990	Golf driving ranges
478	713990	Golf practice ranges
478	713990	Guide services (i.e., fishing, hunting, tourist)
478	713990	Fishing piers
478	713990	Stables, riding
478	713990	Tourist guide services
478	713990	Shooting clubs, recreational
478	713990	Shooting galleries
478	713990	Shooting ranges
478	713990	Skeet shooting facilities
478	713990	Slot car racetracks (i.e., amusement devices)
478	713990	Snowmobiling, recreational
478	713990	Soccer clubs, recreational
478	713990	Sailing clubs without marinas
478	713990	Sports teams and leagues, recreational or youth
478	713990	Saddle horse rental services, recreational
478	713990	Summer day camps (except instructional)
478	713990	Trail riding, recreational
478	713990	Trapshooting facilities, recreational
478	713990	Waterslides (i.e., amusement rides)
478	713990	White water rafting, recreational
478	713990	Yacht clubs without marinas
478	713990	Concession operators, amusement device (except gambling) and

IMPLAN	2002 NAICS	NAICS Title
		ride
478	713930	Boating clubs with marinas
478	713990	Sports clubs (i.e., sports teams) not operating sports facilities, recreational
478	713990	Recreational camps without accommodations
478	713990	Pack trains (i.e., trail riding), recreational
478	713990	Para sailing, recreational
478	713990	Picnic grounds
478	713990	Pinball machine concession operators (i.e., supplying and servicing in others' facilities)
478	713990	Ping pong parlors
478	713990	Pool halls
478	713990	Pool parlors
478	713990	Pool rooms
478	713990	Sea kayaking, recreational
478	713990	Raceways, gocart (i.e., amusement rides)
478	713990	Outdoor adventure operations (e.g., white water rafting) without accommodations
478	713990	Recreational day camps (except instructional)
478	713990	Recreational sports clubs (i.e., sports teams) not operating sports facilities
478	713990	Recreational sports teams and leagues
478	713990	Riding clubs, recreational
478	713990	Riding stables
478	713990	Rifle clubs, recreational
478	713990	River rafting, recreational
478	713990	Rowing clubs, recreational
478	713990	Racetracks, slot car (i.e., amusement devices)
478	713290	Gambling device arcades or parlors, coin-operated
478	713290	Slot machine parlors
478	713210	Stand alone casinos (except slot machine parlors)
478	713290	Bingo halls
478	713290	Bingo parlors
478	713290	Bookies
478	713290	Bookmakers
478	713290	Card rooms (e.g., poker rooms)
478	713210	Gambling cruises
478	713290	Gambling control boards, operating gambling activities
478	713210	Cruises, gambling
478	713290	Gambling device concession operators (i.e., supplying and servicing in others' facilities), coin-operated
478	713290	Lottery control boards (i.e., operating lotteries)
478	713290	Lottery corporations
478	713290	Lottery ticket sales agents (except retail stores)
478	713290	Lottery ticket vendors (except retail stores)

IMPLAN	2002 NAICS	NAICS Title
478	713290	Off-track betting parlors
478	713290	Other Gambling Industries
478	713290	Slot machine concession operators (i.e., supplying and servicing in others' facilities)
478	713290	Coin-operated gambling device concession operators (i.e., supplying and servicing in others' facilities)
478	713120	Amusement device (except gambling) parlors, coin-operated
478	713930	Marine basins, operation of
478	713990	Coin-operated nongambling amusement device concession operators (i.e., supplying and servicing in others' facilities)
478	7131	Amusement Parks and Arcades
478	713110	Amusement parks (e.g., theme, water)
478	713110	Parks (e.g., theme, water), amusement
478	713110	Piers, amusement
478	713110	Theme parks, amusement
478	713210	Riverboat casinos
478	713120	Amusement arcades
478	713210	Floating casinos (i.e., gambling cruises, riverboat casinos)
478	713120	Amusement devices (except gambling) operated in own facilities
478	713120	Arcades, amusement
478	713120	Electronic game arcades
478	713120	Family fun centers
478	713120	Indoor play areas
478	713120	Pinball arcades
478	713120	Video game arcades (except gambling)
478	7132	Gambling Industries
478	713110	Water parks, amusement
478	713990	Boating clubs without marinas
478	713990	Athletic clubs (i.e., sports teams) not operating sports facilities, recreational
478	713990	Canoeing, recreational
478	713990	Aviation clubs, recreational
478	713990	Ballrooms
478	713990	Basketball clubs, recreational
478	713990	Beach clubs, recreational
478	713990	Beaches, bathing
478	713990	Carnival ride concession operators (i.e., supplying and servicing in others' facilities)
478	713990	Billiard rooms
478	713990	Baseball clubs, recreational
478	713990	Boccie ball courts
478	713990	Bowling leagues or teams, recreational
478	713990	Boxing clubs, recreational
478	713990	Boys' day camps (except instructional)
478	713990	Bridge clubs, recreational

IMPLAN	2002 NAICS	NAICS Title
478	713990	Camps (except instructional), day
478	713290	Video gambling device concession operators (i.e., supplying and servicing in others' facilities)
478	713210	Casinos (except casino hotels)
478	713990	Billiard parlors
478	713920	Cross country skiing facilities without accommodations
478	713290	Video gaming device concession operators (i.e., supplying and servicing in others' facilities)
478	713910	Country clubs
478	713910	Golf and country clubs
478	713990	Bathing beaches
478	713920	Alpine skiing facilities without accommodations
478	713990	Archery ranges
478	713920	Downhill skiing facilities without accommodations
478	713920	Four season ski resorts without accommodations
478	713920	Ski lift and tow operators
478	713920	Ski resorts without accommodations
478	713990	Amusement device (except gambling) concession operators (i.e., supplying and servicing in others' facilities)
478	713910	Golf courses (except miniature, pitch-n-putt)
478	713990	Amusement ride concession operators (i.e., supplying and servicing in others' facilities)
478	713920	Skiing facilities, cross country, without accommodations
478	713990	Amateur sports teams, recreational
478	713930	Yacht clubs with marinas
478	713930	Sailing clubs with marinas
478	713930	Marinas
478	713920	Skiing facilities, downhill, without accommodations
478	713930	Yacht basins
479	721120	Hotels, resort, with casinos
479	721110	Motor lodges
479	721110	Resort hotels without casinos
479	721110	Seasonal hotels without casinos
479	721110	Ski lodges and resorts with accommodations
479	721110	Summer resort hotels without casinos
479	721110	Tourist lodges
479	721120	Hotels, seasonal, with casinos
479	721120	Hotels, casino
479	721110	Motor inns
479	721120	Resort hotels with casinos
479	721110	Alpine skiing facilities with accommodations (i.e., ski resort)
479	721120	Casino hotels
479	721110	Hotel management services (i.e., providing management and operating staff to run hotel)
479	721110	Automobile courts, lodging

IMPLAN	2002 NAICS	NAICS Title
479	721110	Motor hotels without casinos
479	721110	Health spas (i.e., physical fitness facilities) with accommodations
479	721110	Hotels (except casino hotels)
479	721110	Hotels (except casino hotels) with golf courses, tennis courts, and/or other health spa facilities (i.e., resorts)
479	721110	Hotels, membership
479	721110	Hotels, resort, without casinos
479	721110	Hotels, seasonal, without casinos
479	721110	Membership hotels
479	721110	Motels
479	721110	Motor courts
479	721110	Auto courts, lodging
480	721214	Guest ranches with accommodation facilities
480	721310	Boarding houses
480	721214	Vacation camps (except campgrounds, day instructional)
480	721214	Trail riding camps with accommodation facilities
480	721214	Summer camps (except day, instructional)
480	721214	Recreational camps with accommodation facilities (except campgrounds)
480	721214	Outdoor adventure retreats with accommodation facilities
480	721214	Hunting camps with accommodation facilities
480	721310	Sorority houses
480	721214	Nudist camps with accommodation facilities
480	721310	Dormitories, off campus
480	721310	Fraternity houses
480	721310	Migrant workers' camps
480	721310	Off campus dormitories
480	721310	Residence clubs, organizational
480	721214	Girls' camps (except day, instructional)
480	721310	Rooming and boarding houses
480	721214	Wilderness camps
480	721310	Workers' camps
480	721310	Workers' dormitories
480	721310	Residential clubs
480	721191	Bed and breakfast inns
480	721310	Clubs, residential
480	721214	Fishing camps with accommodation facilities
480	72119	Other Traveler Accommodation
480	721191	Bed-and-Breakfast Inns
480	721191	Inns, bed and breakfast
480	721199	Cabins, housekeeping
480	721199	Cottages, housekeeping
480	721199	Guest houses
480	721199	Hostels
480	721199	Housekeeping cabins

IMPLAN	2002 NAICS	NAICS Title
480	721199	Housekeeping cottages
480	721214	Camps (except day, instructional)
480	721199	Youth hostels
480	7212	RV (Recreational Vehicle) Parks and Recreational Camps
480	721211	Campgrounds
480	721211	Recreational vehicle parks
480	721211	RV (recreational vehicle) parks
480	721211	Travel trailer campsites
480	721214	Boys' camps (except day, instructional)
480	721214	Children's camps (except day, instructional)
480	721214	Dude ranches
480	721199	Tourist homes
481	722212	Buffet eating places
481	722211	Take out eating places
481	722211	Steak houses, limited-service
481	722211	Sandwich shops, limited-service
481	722211	Restaurants, fast food
481	722211	Pizzerias, limited-service (e.g., take-out)
481	722213	Coffee shops, on premise brewing
481	722211	Pizza parlors, limited-service
481	722211	Restaurants, carryout
481	722212	Cafeterias
481	722213	Bagel shops, on premise baking and carryout service
481	722213	Ice cream parlors
481	722213	Canteens, fixed location
481	722213	Confectionery snack shops, made on premises with carryout services
481	722213	Cookie shops, on premise baking and carryout service
481	722213	Doughnut shops, on premise baking and carryout service
481	722211	Pizza delivery shops
481	722110	Full service restaurants
481	722213	Beverage (e.g., coffee, juice, soft drink) bars, nonalcoholic, fixed location
481	722110	Restaurants, full service
481	722213	Frozen custard stands, fixed location
481	722	Food Services and Drinking Places
481	722110	Bagel shops, full service
481	722110	Diners, full service
481	722110	Doughnut shops, full service
481	722110	Family restaurants, full service
481	722110	Fine dining restaurants, full service
481	722110	Pizza parlors, full service
481	722110	Pizzerias, full service
481	722211	Limited-Service Restaurants
481	722110	Steak houses, full service

IMPLAN	2002 NAICS	NAICS Title
481	7222	Limited-Service Eating Places
481	722211	Carryout restaurants
481	722211	Delicatessen restaurants
481	722211	Drive-in restaurants
481	722211	Family restaurants, limited-service
481	722211	Fast-food restaurants
481	722110	Full-Service Restaurants
481	722410	Bars (i.e., drinking places), alcoholic beverage
481	722330	Ice cream truck vendors
481	722330	Lunch wagons
481	722330	Mobile food stands
481	722330	Refreshment stands, mobile
481	722330	Snack stands, mobile
481	722330	Food carts, mobile
481	722410	Alcoholic beverage drinking places
481	722330	Coffee carts, mobile
481	722410	Cocktail lounges
481	722410	Drinking places (i.e., bars, lounges, taverns), alcoholic
481	722410	Lounges, cocktail
481	722410	Nightclubs, alcoholic beverage
481	722410	Taverns (i.e., drinking places)
481	722213	Fixed location refreshment stands
481	722330	Street vendors, food
481	722310	Food service contractors, cafeteria
481	722213	Pretzel shops, on premise baking and carryout service
481	722213	Snack bars (e.g., cookies, popcorn, pretzels), fixed location
481	722213	Soft drink beverage bars, nonalcoholic, fixed location
481	7223	Special Food Services
481	722310	Airline food services contractors
481	722310	Cafeteria food services contractors (e.g., government office cafeterias, hospital cafeterias, school cafeterias)
481	722330	Food concession stands, mobile
481	722310	Food service contractors, airline
481	722330	Canteens, mobile
481	722310	Food service contractors, concession operator (e.g., convention facilities, entertainment facilities, sporting facilities)
481	722310	Industrial caterers (i.e., providing food services on a contractural arrangement (except single-event basis))
481	722320	Banquet halls with catering staff
481	722320	Caterers
481	722320	Catering services, social
481	722330	Beverage stands, nonalcoholic, mobile
481	722310	Food concession contractors (e.g., convention facilities, entertainment facilities, sporting facilities)