Socioeconomics and the Ecosystem Approach to Management of Marine Resources

A Report to NOAA

By

Jon G Sutinen
University of Rhode Island
November 12, 2007

Introduction

Participating in the Workshop on the Economics of Ecosystem Based Fisheries Management Plans in the Chesapeake Bay afforded me the opportunity to present my views on the social science research that is needed to support the effective implementation of the ecosystem approach to management (EAM) of marine resources. The workshop also exposed me to some very interesting and promising lines of research being conducted by other participants in the workshop. I thank the organizers for inviting me to the event.

For 10-plus years I have been conducting research and writing on the human dimensions of marine ecosystems (cf. Hennessey and Sutinen 2005, and Olsen, et al. 2006). Currently, I am a member of the Advisory Board of BONUS, a Baltic Sea Research Consortium conducting social and natural science research on the Baltic Sea large marine ecosystem, and a co-author of the organization's science and implementation plan. I also served on the external Ecosystem Task Team (eETT) formed by the NOAA Science Advisory Board to provide advice on how to improve NOAA's ecosystem science enterprise over the next few decades. These experiences have strongly shaped the opinions expressed below.

This report is organized as follows. After summarizing next some of the evidence on the status of marine ecosystems, the report discusses how some countries are defining and implementing the ecosystem approach to management. Next, the report explains the decision support tool known as an integrated ecosystem assessment (IEA), which NOAA in the U.S. and scientific bodies in other countries are in the process of developing. To prescribe the social science information that, I believe, should be contained in an integrated ecosystem assessment, I briefly explain a basic framework for organizing information on the social and economic processes that operate in marine ecosystems. Following this, I summarize the socioeconomic research and information needed to support applications of EAM, and some of the challenges and opportunities that EAM and IEAs present to the social science research community. The report ends with a set of specific recommendations for incorporating economics into ecosystem based fisheries management, particularly in regard to applications in the Chesapeake Bay.

Threats to the sustainable development of marine ecosystems

Society reaps tremendous benefits from the world's oceans and coasts. In the United States, for example, the economies of coastal watersheds accounts for half of the gross domestic product and 60 million jobs. The human activities that generate this income and employment include oil and gas exploration and production; power generation; shipping and maritime transport;

dredging and dumping of wastes and litter; mining and mineral and aggregate extraction; fisheries and aquaculture; coastal engineering and land reclamation; human settlements and coastal industries (*e.g.* pulp and paper, iron and steel, chemicals and petrochemicals, and food processing operations); and recreation and tourism. These activities draw people to settle in and visit coastal areas. As a result, the coasts are becoming increasingly crowded. In 2003, 53 percent of the U.S. population lived in coastal counties, a zone that comprises only 17 percent of the total U.S. land area. Twenty-three of the 25 most densely populated counties are on the coast, and average 300 persons per square mile. In addition, there is growing demand to use living marine resources and to produce energy and minerals from offshore deposits.

The growth and settlement of populations in the coastal zone, in conjunction with the associated economic activities constitute a set of major stressors on coastal and ocean ecosystems. Humans' activities often lead to the degradation and loss of natural habitats, added waste disposal and pollution discharges to water bodies, overexploitation of living marine resources, invasive species, pathogens, toxic contaminants, and harmful algae blooms; and increased vulnerability to coastal hazards. In recent years in the U.S., for example, nearly a fourth of the estuarine areas were unsuitable for swimming or fishing; and there were 18,000 days of beach closings and advisories issued in 2003 due to high bacterial counts. Nonpoint source pollution has increased as human activities have grown in coastal areas, causing nutrient enrichment, hypoxia, harmful algal blooms, toxic contamination, and other problems that plague coastal waters. Problematic point sources of pollution include sewer system overflows, septic systems, wastewater treatment plants, animal feeding operations and industrial facilities – all of which are the products of major economic activities. In addition, the overexploitation of fishery and other living marine resources continues for many of the world's stocks. For the U.S., 20 percent of assessed fished stocks were subject to overfishing, and 25 overfished in 2005 (NOAA 2006c).

The ecosystem approach to management of marine resources

Management of marine resources traditionally has been organized around particular uses such as fisheries or mineral exploitation, resulting in separate regimes governing each use. Over time it has become ever apparent that such a sectoral approach is inadequate for sustaining the goods and services that flow from healthy ecosystems, and often aggravates conflicts among users. As a result, the ecosystem approach has emerged as the dominant approach to managing natural resources and the environment.

As NOAA defines it, the ecosystem approach to management (EAM) is geographically specified, adaptive, takes account of ecosystem knowledge and uncertainties, considers multiple external influences, and strives to balance diverse societal objectives. Implementation will need to be incremental and collaborative. In addition, NOAA defines an ecosystem as a geographically specified system of organisms (including humans), the environment (which includes biological, chemical, physical, and social conditions that surround the organisms), and the processes that control the ecosystem's dynamics.

There are various definitions of the EAM of natural resources and the environment. As an example, the Europe Union defines the EAM as 'the *comprehensive integrated management of human activities* based on the best available scientific knowledge about the ecosystem and its dynamics, in order to identify and take action on influences which are critical to the health of marine ecosystems, thereby achieving sustainable use of ecosystem goods and services and maintenance of ecosystem integrity' (emphasis added). This definition is useful for present

purposes, since it highlights the integrated management of human activities, which has implications for social science research.

The ecosystem approach also is reflected in the actions of a variety of states and in the work of international organizations ranging from the International Oceanographic Commission, to the Food and Agriculture Organization, to the United Nations Environment Program, and to the Global Environment Facility. For example, there are currently 18 Large Marine Ecosystem Projects funded by the Global Environment Facility and its partners that involve 121 countries and over US $1.0 billion devoted to assessment and management of the respective LMEs.

In the U.S., the ecosystem approach has emerged as the dominant approach to managing natural resources. The move towards applying the ecosystem approach is reflected in, for example, the Magnuson-Stevens Fishery Conservation and Management Act, NOAA's Marine Sanctuaries Program, the National Estuary Program, the National Estuarine Research Reserves System, the 1990 Amendments to the Coastal Zone Management Act and also in the actions of federal agencies with resource management responsibilities. [1] NOAA's Strategic Plan (1997) is based, in large part, on the ecosystem approach to living marine resource management; and the recent Ocean Action Plan (2005) prescribes applying the ecosystem approach to management of ocean resources.

Integrated Ecosystem Assessments

As part of its efforts to apply EAM, NOAA has embraced the development of the decision support tool known as Integrated Ecosystem Assessment (IEA) (NOAA 2006a, 2006b). In my judgment, the IEA is an excellent vehicle for assembling the information on human activities and interactions within marine ecosystems. In addition, the process of IEA development will help to identify important social science research needed to support the application of the EAM of marine resources.

As explained in last year's pronouncement by NOAA (2006a), 'An integrated ecosystem assessment (IEA) is a comprehensive account of an ecosystem's condition, stressors and drivers, and the potential for change in response to management options. It provides a "big picture" understanding of an ecosystem, its many components and functions (including humans and human activities), how they interact with each other and change over time, as well as how these changes affect lives, livelihoods and quality of life.' IEAs are valued for their potential in assessing the status of marine ecosystems and for providing information needed for managing human uses of ecosystem resources (NOAA 2006b).

The report by the external Ecosystem Task Team (2006), a study commissioned by NOAA's Science Advisory Board, strongly recommended developing IEAs as a principal vehicle for implementing the EAM in NOAA. As described by the eETT (2006), 'IEAs bring information sources together – organized geographically and supporting a diverse set of stakeholder needs. Ecosystem assessments are intended to accomplish the following (emphasis added):

[1] Since 1992 all four of the primary land management agencies (the National Park Service, the Bureau of Land Management, the Fish and Wildlife Service and the Forest Service) have independently announced that they are implementing or will implement an ecosystem approach to managing their natural resources, and each has been working to develop it own strategy (GAO, 1994). Several other agencies, including the Soil Conservation Service, the Department of Defense, Department of Energy, Bureau of Indian Affairs, Bureau of Mines, Bureau of Reclamation, Minerals Management Service, USGS, EPS, and NASA, have engaged in significant ecosystem management activities (CRS, 1994).

- Compile and archive all relevant data sets for a defined ecosystem, including physical oceanography, atmospheric, climatological and weather observations, *human use patterns* and statistics, abundance and distribution of biological resources.
- Report on current conditions and trends in relevant data time series of physical, biological and *human use* information
- Synthesize time series information to link important ecological outcomes to changes in relevant climate and *human use* drivers, as a basis for forecasting
- Evaluate data time series to provide suites of key indicators of ecosystem state (status), and utilize time series data and modeling results to propose reference levels for the desired state of marine ecosystems
- Forecast the relationship between state indicators and pressure indicators (e.g., pollution, climate change, fishing-related removals, coastal development, etc.) in order to inform the development of management options for marine ecosystems.
- Provide periodic ecosystem assessment updates to inform the managers, stakeholders and the public on the state of marine ecosystems and management options to achieve societal goals and targets, including *social science* aspects relevant to decision making.'

Examples of IEAs include the *Millennium Ecosystem Assessment* (2005) at a global scale, *Marine Ecosystems of the North Pacific* (PICES 2004), *State of Eastern Scotian Shelf Ecosystem* (DFO 2003), and several other similar examples. These and most of the other IEAs are weak on documenting and analyzing human activities and interactions in their respective marine ecosystems. By far, the best evidence in these IEAs on human activities is on marine fisheries.

On the other hand, there are two notable examples of IEAs. The first is *Alive and Inseparable* (BC Ministry of Environment 2006), an IEA of British Columbia's coastal environment. The BC report documents population trends and impacts, economic activities (including forestry, fisheries, tourism and mining), land use changes, waste water treatment, and nutrient loadings from marine traffic and shore-based economic activities. The report presents the results of the projections made for future changes in population, land use, economic activities, shoreline development, nutrient loadings and sewage discharges. The last section describes efforts by government, industries, and non-governmental organizations to address threats to the coastal marine ecosystem. This is a fine report and should serve as a model of IEAs for other marine ecosystems.

The other notable exception is the Fishery Ecosystem Plan (AI Ecosystem Team 2007) developed for the Aleutian Islands. In its section on 'Understanding the Aleutian Island ecosystem' the report recounts the regions history, socioeconomic relationships, and management processes. The ecosystem assessment in the report is very comprehensive, accounting for human and natural interactions, and reporting the findings of a risk assessment analysis. Both the contents and methods contained in the report provide valuable information on human activities and interactions within marine ecosystems that IEAs should contain.

Understanding human activities & interactions within marine ecosystems

It is clear from the available evidence that the failure to properly manage the human activities that affect oceans and coasts is compromising their ecological integrity, diminishing our ability to fully realize their potential, costing jobs and revenue, threatening human health, and putting

our future well-being at risk. Management of human activities that affect a marine ecosystem will, by necessity, depend on the information on the status and trends of the marine ecosystem. The United States Commission on Ocean Policy (2004) concluded that policy must be based on a scientific 'understanding of the natural, *social, and economic* processes that affect oceans and coastal environments' (emphasis added). In other words, it is essential to understand the social and economic processes that affect oceans and coastal environments. Policy makers and stakeholders need to understand and have the ability to explain variations in those human activities that impact habitat, pollute and over exploit the natural resources in a marine ecosystem.

The amount of information needed for describing and understanding the social and economic processes that affect marine ecosystem is enormous and complex. How best to organize this information? How can we produce the understanding that the Commission sees as necessary? And, perhaps most importantly, how can we convey that understanding in ways that are readily accessible?

To account for the many socioeconomic aspects of a marine ecosystem, I use Juda's (1999) governance framework for categorizing the forces that influence humans' interactions with the natural components of an ecosystem (see Olsen, et al. 2006 for more details). The framework consists of three basic mechanisms that drive and shape humans' use of and encroachment upon ecosystem resources: markets, government, and the institutions and arrangements of civil society (Figure 1). Individually and collectively the three mechanisms affect how humans use and otherwise interact with a marine ecosystem.

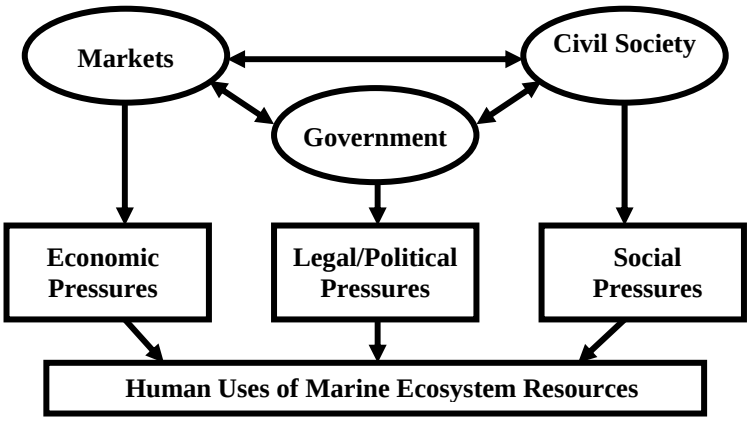

Figure 1. Three basic governance mechanisms

Markets, where goods and services are exchanged by profit-seeking producers, traders, and consumers, affect how the environment is utilized, what resources are extracted, and the manner in which these resources are exploited. In many cases, market prices do not reflect the ecological costs of the economic activities that use and encroach upon ecosystem resources. This market failure is the principal threat to the sustainable development of marine ecosystems. Manifestations of market failure come in the forms of overexploited and collapsed fish stocks, harmful algae blooms, dying coral reefs, coastal dead zones, deforestation, endangered species, global warming and the rise in sea level, and many other cases of environmental degradation. As a consequence, market-driven economic activities are one of the direct causes of overexploited fishery resources, and of the marine ecosystem's altered productivity and biodiversity, and poor overall health.

Government policies and regulations, whether at a local, regional, or national level, are well recognized mechanisms that can affect human behavior. Fiscal policies can provide incentives for particular types of conduct and, through government spending patterns, direct society's

resources to promote specific objectives. Regulatory efforts, such as zoning and permitting, can channel efforts along desired paths and, with their potential for unpleasant consequences in the form of fines or even imprisonment, can discourage undesired behavior. Governmental institutions are not always perfect, however, and can sometimes implement policies that are counter-productive and ultimately harm the condition of an ecosystem (for example, subsidies that aggravate fishing overcapacity, or that increase nutrient loadings to the ecosystem).

The institutions and arrangements of civil society play a central role in influencing behavior. Social norms and networks (social capital) shape individual and collective behavior, and also facilitate cooperation among individuals and between groups of individuals. The social norms and networks can encourage trust, civic engagement, and enhance effective governance while reducing management costs. These have considerable potential for advancing the ecosystem approach to management in informal governance systems. As with markets and government, the institutions and arrangements of civil society are not always supportive of sustainable development, since social norms are not always consistent with conserving marine ecosystem resources, protecting habitats and the quality of the aquatic environment.

Applying the ecosystem approach to management of marine resources requires an understanding of these fundamental, underlying mechanisms that drive human behavior, and more specific knowledge of how humans use and encroach upon marine ecosystems directly and indirectly for social, cultural, and economic benefits. Failure to understand these mechanisms and to heed their signals may doom efforts to manage human uses of marine ecosystem resources and achieve societal goals and objectives.

Socioeconomic research and information needs

What socioeconomic research and information are needed to support the application of the ecosystem approach to management of marine resources? To answer this question, I turn to the report by the eETT (2006), which recommended that NOAA needs to develop and/or strengthen core capabilities in monitoring, analysis, and integrated modeling and forecasting.

Monitoring

In its report (p. 33), the eETT argues that '[t]ime series observations of the status of ecosystem properties, environmental conditions, and human activities will remain essential because of the complexity of ecosystems and the unprecedented perturbations from climate variability and change, habitat change, resource extraction, invasive species, and pollution that they face.'

To improve the understanding of and ability to explain variations in those human activities that impact habitats, pollute, cause eutrophication, and over-exploit the ecosystem's natural resources the social science research community needs readily accessible time series data that will support investigations of these human activities. Data on market and non-market values are critical for supporting broad-based ecological decision making, and for understanding the social and economic processes that affect marine ecosystems. These data need to be available in a common format and easily accessed by the broad research community.

The first step in this set of tasks is to identify the data that are needed. To do this comprehensively, an inventory of the key actors (individuals and organizations) and their activities in the market, government, and civil society sectors must be conducted. The second step is to determine what data currently exist in the private and public sectors on the

aforementioned activities. Once this is done, NOAA and its partners will be in a good position to 'Acquire, assemble, and archive time series data (i) on all human uses and other interactions with ecosystem resources; (ii) on perceptions, attitudes and values of the ecosystem; and (iii) on local laws and regulations that govern the use of land, water, fishery and other ecosystem resources,' as recommended by the eETT.

Analysis

To produce information based on the time series observations, the eETT concluded that 'the analyses must include the variations of different species, habitat parameters, environmental and *human factors*.' (Emphasis added.) What social science research does this imply? The eETT recommended social science research capacity to

- Analyze and explain the spatial and temporal variations in the uses of the principal ecosystem resources (e.g., land use, extraction of living marine resources, recreation and tourism) in each region;
- Assess the market and non-market value of human uses of, and the natural services of ecosystems in each region;
- Assess the benefits and costs of protecting and/or restoring ecosystem resources (e.g., habitat, marine mammals) in each region; and
- Assess the sociocultural values of the uses of ecosystem resources and services in each region.

Integrated modeling and forecasting

The eETT concluded that there is a need to develop the ability to forecast the trajectory of marine ecosystems under various management scenarios, environmental variability, and human actions, in order to provide appropriate scientific support to management. In particular, as the EAM is applied to marine ecosystems, managers will demand spatially- and temporally-dynamic models of the salient human activities that are *explicitly linked to the natural components* of the ecosystems. In the view of the eETT (p. 38), 'bio-economic and demographic models will need to be nested within larger and more complex ecosystem models, and linked dynamically to key ecosystem components.

For example, bioeconomic models of fishing activity can be linked to models of climate variability to demonstrate how climate-driven changes in fish resources may affect fisheries and fishing community. Since the feedback does not necessarily stop with the fishing community, the bioeconomic model could be linked to models of land use and other human activities in coastal watersheds – which, when varied, will affect the coastal environment in different ways.'

Such integrated models can then be used to forecast the trajectory of marine ecosystems under various scenarios for management policies, environmental variability, and human actions

Beyond monitoring, analysis, integration and forecasting, the eETT identified the following additional areas of social science research needed to support the application of EAM:[2]

[2] The following indented paragraphs are excerpts from the eETT (2006) report.

Social Science Methods for Linking Ecosystem Science to Governance

> Governance processes produce government policies, regulations, and incentives: the principal mechanisms for managing human behavior. By encouraging certain behavioral patterns and discouraging others, governance is a matter of central importance to managing human behavior in an ecosystem context. To implement an ecosystem approach to management, experts must apply the tools of governance and socio-economic analysis to analyze how government policies, regulations, and management services are produced, and to ask what conditions lead to government successes and failures. With such analysis and understanding, it is possible to prescribe ways to correct the obstacles in the public sector that lead to failures of government processes and policies. These obstacles are expected to be common when governments are faced with the complex trade-offs inherent in ecosystem approaches to integrated management.
>
> It will also be necessary … to obtain useful information on public priorities and preferences that can be used in EAM decision making, both through greater use of opinion polls and general attitude surveys on ecosystem resource issues, and more labor-intensive ethnographic fieldwork to provide in-depth assessment of values and the degree to which they are strongly or weakly held.

Understanding Society and its Response to Changing Ecosystem Components

> Human populations both affect the status of marine ecosystems and respond to changes in the status of marine ecosystem components. Changes in the natural components of coastal and Great Lakes ecosystems will likely induce human responses that have significant consequences for population size and composition, types of economic activities, and distribution of incomes in coastal areas. Other responses, such as in perceptions, values, laws and other institutions, also shape the overall well-being of society and humans attitudes towards the environment. These human responses tend to occur over large spatial and long temporal scales and, therefore, are best examined by a large, diverse community of scholars.

Challenges and opportunities of EAM and IEAs

Providing the social science information that I believe will be needed for implementing the EAM and producing IEAs constitutes a set of substantial challenges and opportunities for the social science research community. The general task before us is to provide the scientific understanding, explanations, and forecasts or projections of human activities and interactions in marine ecosystems.

Documentation and analysis of the spatial and temporal variations in the uses of and encroachment upon the principal ecosystem resources (*e.g.* land use, waste disposal, extraction of living marine resources, recreation and tourism) will require research (in the social science areas of geography, demography, sociology and anthropology, social psychology, political science, and economics) that focuses on developing scientific explanations of the spatial and temporal variations in human activities that affect, and that are affected by ecosystem resources.

Documentation and explanation of the human responses to changes in marine ecosystems that tend to occur over large spatial and long temporal scales. These issues are best examined by a large, diverse body of research that includes demography (population size and structure),

sociology (perceptions, attitudes, values, social institutions), economics (market and non-market outcomes), and political science and law (laws, regulations, processes).

Assembling and producing information on public priorities and preferences that can be used in EAM decision-making will require development of improved social science (anthropology, economics, sociology, social psychology) methods for producing information on public priorities and preferences that can be used in EAM decision-making. This work will require assessment of the market and non-market value of human uses of, and the natural services of ecosystems in each region, and assessment of the benefits and costs of conserving, protecting, and/or restoring ecosystem resources (*e.g.* habitats, marine mammals) in each region; and assessment of the sociocultural values of the uses of ecosystem resources and services in each region.

Documentation and analysis of government policies and regulations requires social science (political science, public administration, economics, and legal) research to assess how government (through its laws, regulations, processes) influences the uses of ecosystem resources and services, diagnose sources of governance failure, and identify the necessary and sufficient conditions for producing successful EAM-related polices and innovations.

Estimating the ecological costs of the human activities that are harming the marine ecosystem and otherwise altering the environment will require integrating the socioeconomics research with natural science research on fisheries, pollution and ecosystem health, and productivity. Once the ecological costs of resource extraction, pollution, and reduced productivity are calculated, scientists and policy makers can examine ways for factoring the ecological costs into market forces.

The following table links social science disciplines to the areas of research needed to support the implementation of the EAM to marine ecosystems.

Table 1. Social science research and related disciplines

Monitoring	Resource users & ecosystem-related activities	Demography, economics, sociologists, geography
	Governance mechanisms influencing resource use	Political science, economics
Analysis	Human interactions with natural ecosystem components	Economics, sociology/anthropology
Integration	Forecasts of human activities (patterns & trends)	Demography, economics, sociology, geography
	Design & evaluation of management policy alternatives	Natural & social science collaboration

Specific Recommendations

In this brief section I provide a couple of recommendations for the social science research that I think deserved attention for implementing ecosystem based fisheries management in Chesapeake Bay.

Specific recommendation #1

Of the several excellent presentations made at the workshop, I view the Tschirhart, et al. integrated regional economic-ecological model of Alaska fisheries as coming closest to my vision of the kind of social and natural science collaborative research that is needed to implement the EAM of fisheries.[3] The model is a dynamic general equilibrium ecosystem model (GEEM) that Tschirhart and colleagues have developed and applied to a variety of ecosystem contexts. I believe that his GEEM has great potential for the study of Chesapeake Bay fisheries. Much of the biological data and some of the economic data for implementing the model may be available in the fishery ecosystem plan for the Chesapeake (Chesapeake Bay Fisheries Ecosystem Advisory Panel 2006).

An exercise that could be done with the information currently available would be to construct a flowchart for the fishery economy of the Chesapeake. The economy flowchart would constitute part of the human ecology that parallels the ecosystem food web interactions and modeling contained in the Chesapeake FEP (see element 2, p 103 ff.). I have attached the flowchart that Tschirhart used in his presentation to the workshop.

Once the flowchart is constructed, a simple next step would be to inventory the economic data that currently exist for the economic parameters for implementing the model. This step will reveal critical data gaps and reveal critical economic research to be done.

Once the parameters are estimated and the model calibrated to the Chesapeake Bay fisheries, it can implemented in ways similar to what was done by Eichner and Tschirhart (2007) and Finnoff and Tschirhart (in press) to make projections of different management and other scenarios. The model also has the potential to be further extended and linked to activities in the government and civil society sectors.

Specific recommendation #2

Implementing EAM involves the integrated management of human activities; and thus applying EAM to fisheries requires the integration of fishery management to the management of other human activities, such as land use, transportation, and other human activities in the drainage basin. Therefore, it is necessary to document the key linkages and interactions between the fisheries in the Chesapeake and the other human activities. Implementing EAM will require an understanding of the role of fishing in the local economies and communities of Chesapeake Bay.

This exercise could be organized to answer a series of questions, such as the following:

1. What are the principal human uses of the resources in the Chesapeake Bay (CB) marine ecosystem?
2. What are the principal environmental and natural resources that humans are using in the CB marine ecosystem?
3. What human activities and organizations are the principal users of the resources in the CB marine ecosystem? What is the extent of these activities?
4. Identify the principal governmental organizations that have policies and regulations affecting human uses of the resources in the CB marine ecosystem.

[3] Details of the model are presented in Eichner and Tschirhart (2007), Finnoff and Tschirhart (2005, in press), and Finnoff, Gong, and Tschirhart (2007).

5. Identify the nongovernmental organizations that are concerned with the condition of the CB marine ecosystem.
6. Who are the people and groups that constitute the stakeholders who have an interest in the outcomes of applying the ecosystem approach?
7. Identify the markets associated with the human uses of resources in the CB marine ecosystem. What goods and services are being exchanged in these markets?
8. What marine ecosystem goods and/or services are involved in the production of the goods and services are being exchanged in these markets?
9. What is the extent of these human uses and activities? Identify and assess the interactions, if any, between these activities.
10. What benefits – market and non-market – do these uses generate?
11. How have these uses impacted the conditions of the CB marine ecosystem? In terms of Pollution? Habitat? Fisheries? Other?
12. To what extent do these markets reflect the ecological costs of the uses of the CB marine ecosystem resources?
13. What human activities and uses of resources are regulated in the CB marine ecosystem?
14. What levels of government are involved in regulating those human activities and uses?
15. What are some of the principal government agencies that regulate the use of marine ecosystem resources?
16. What are these policies and regulations, and how are they intended to affect these human uses?
17. How, in practice, are these policies and regulations working to affect the uses, and how have the policies and regulations affected the condition of the CB marine ecosystem?
18. Are there any policies and/or programs that are counter-productive and harming the condition of the CB marine ecosystem? If so, what are they?
19. What social norms are affecting individual and collective attitudes and behavior towards the CB marine ecosystem? How are the norms affecting attitudes and behavior?
20. To what extent are users of the resources of the CB marine ecosystem complying with the laws and regulations that restrict use of those resources?
21. To what extent is there legitimacy of the laws, regulations and programs for conservation and management of the CB marine ecosystem? What are the key drivers of this legitimacy in the context of the CB marine ecosystem?
22. What organizations of civil society (NGOs) are active in shaping individual and collective attitudes and behavior towards the CB marine ecosystem?
23. What contributions to conservation and management of the CB marine ecosystem have been made by civil society organizations?
24. What positions are the NGOs advocating? What segments of society do they represent?
25. How have NGOs affected policies related to the CB marine ecosystem?

26. Are NGOs' positions consistent with sustainable development of the CB marine ecosystem?
27. What are the ecological costs caused by human activities in the CB marine ecosystem?
28. What, if any, measures are in place in the CB marine ecosystem to get markets to tell the ecological truth?
29. What opportunities exist in the CB marine ecosystem to shift taxes and subsidies to work in ecologically benign ways?
30. To what extent has government failed to support sustainable development of the CB marine ecosystem? What are the underlying causes of these failures?
31. What measures are in place in the CB marine ecosystem that affect the performance (success or failure) of government institutions?
32. To what extent do resource management programs in the CB marine ecosystem have public support? What is the basis for the support or lack of support? What can/could be done to improve the level of support?

These are but a few of the questions that policy makers will confront when implementing EAM.

References

AI Ecosystem Team. 2007. Aleutian Islands Fishery Ecosystem Plan. North Pacific Fishery Management Council.

BC Ministry of Environment. 2006. *British Columbia's Coastal Environment: 2006.* Ministry of Environment, British Columbia, Canada. www.env.gov.bc.ca/soe/bcce/

Chesapeake Bay Fisheries Ecosystem Advisory Panel (National Oceanic and Atmospheric Administration Chesapeake Bay Office). 2006. *Fisheries ecosystem planning for Chesapeake Bay*. American Fisheries Society, Trends in Fisheries Science and Management 3, Bethesda, Maryland.

DFO. 2003. State of the Eastern Scotian Shelf Ecosystem. Fisheries and Oceans Canada, Maritimes Region. Ecosystem Status Report 2003/004.

Eichner, T. and J. Tschirhart. 2007. Efficient ecosystem services and naturalness in an ecological/economic model, *Environ. Resource Econ.* 37:733-755.

External Ecosystem Task Team. 2006. *Evolving an Ecosystem Approach to Science and Management throughout NOAA and its Partners.* The External Review of NOAA's Ecosystem Research and Science Enterprise - A Report to the NOAA Science Advisory Board.

Finnoff, D. and J. Tschirhart. 2005. Inserting Ecological Detail into Economic Analysis: Agricultural Nutrient Loading of an Estuary Fishery. Unpublished manuscript, Department of Economics and Finance, University of Wyoming.

Finnoff, D. and J. Tschirhart. In press. Linking dynamic economic and ecological general equilibrium models, *Resource and Energy Economics.*

Finnoff, D., M. Gong, and J. Tschirhart. 2007. Final Report to Alaska Fisheries Science Center, Pacific States Marine Fisheries Commission.

Hennessey, T. and J. Sutinen (eds). 2005. *Sustaining Large Marine Ecosystems: The Human Dimension*. Large Marine Ecosystem Series 13. Elsevier B.V., Amsterdam.

Juda, L. 1999. 'Considerations in the Development of a Functional Approach to the Governance of Large Marine Ecosystems,' *Ocean Development and International Law* 30.

Millennium Ecosystem Assessment, 2005. *Ecosystems and Human Well-being: Synthesis*. Island Press, Washington, DC.

NOAA. 2006a. *Advancing NOAA Priorities through Regional Collaboration*, NOAA Office of Program Planning & Integration (November).

NOAA. 2006b. *NOAA Annual Guidance Memo FY 2009-13,* NOAA Office of Program Planning & Integration (November).

NOAA. 2006c. Status of U.S. Fisheries, a Report to Congress. Available online at http://www.nmfs.noaa.gov/sfa/statusoffisheries/SOSmain.htm#congress05

Olsen, S.B., J.G. Sutinen, L. Juda, T. Hennessey, and T.A. Grigalunas. 2006. *A Handbook on Governance and Socioeconomics of Large Marine Ecosystems*. Coastal Resources Center, University of Rhode Island. Available online at www.iwlearn.net/abt_iwlearn/pns/learning/b2-2lme/riworkshop

PICES. 2004. *Marine ecosystems of the North Pacific Ocean*. PICES Spec. Publ. 1, 280 p

Sutinen, J. G. 2000. *A Framework for Monitoring and Assessing Socioeconomics and Governance of Large Marine Ecosystems*. NOAA Technical Memorandum NMFS-NE-158. Northeast Fisheries Science Center, Woods Hole, MA.