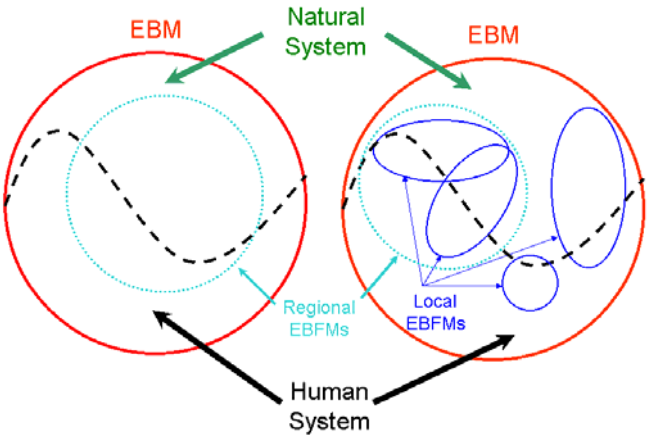
DEVELOPING A CONCEPTUAL FRAMEWORK FOR THE CONTRIBUTION OF THE SOCIAL SCIENCES TO ECOSYSTEM-BASED FISHERY MANAGEMENT



Workshop Report

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Report of the Workshop May 2-4, 2011 held at

Carriage House
Woods Hole Oceanographic Institution
Woods Hole, MA 02543

Background

This report summarizes the discussions of a workshop sponsored by the Cooperative Institute for the North Atlantic Region (CINAR) on developing a conceptual framework for the social sciences in ecosystem-based fishery management (EBFM). The workshop was held at the Woods Hole Oceanographic Institution during May 2-4, 2011. The participants included mostly social scientists from the five CINAR institutions and the NOAA Northeast Fisheries Science Center. An Appendix reprints the meeting agenda and lists the workshop participants and their affiliations. The workshop presentations and some related publications and documents are available on the CINAR file transfer protocol site in the "CINAR 2011 EBFM Workshop" folder.[1]

Introduction and Purpose

While much scientific attention has been directed at the ecological aspects of marine fisheries, arguably less effort has been devoted to research on the social science aspects of EBFM. The main purpose of the workshop was to begin to set right this imbalance by taking steps toward a conceptual framework for the contribution of the social sciences to EBFM and the identification of critical topics for social science research.

The workshop involved presentations by social scientists to describe the evolution of policy development in the United States with respect to EBFM; the importance of rights-based approaches to EBFM and to fisheries management in general; the state-of-the-art of integrated economic-ecological modeling; the current knowledge of fisheries governance, including co-management institutions, catch share programs, and community concerns; the geographic distribution of fishing effort, the distinction between near-shore and offshore fleets, and the social production of nature; and examples of ethically informed enactments by coastal communities of natural-human systems focused on marine fisheries. The workshop participants also benefitted from a presentation by Mike Fogarty, NEFSC Ecosystem Assessments Branch, on current natural scientific approaches to EBFM, including approaches from complex adaptive systems theory.

The social science presentations explored issues concerning the choices of alternative governance arrangements and policy instruments and their potential distributional impacts. The workshop participants posed questions concerning approaches to modeling, economic welfare evaluation, choices of governance institutions and policy instruments, and data requirements. The workshop discussions ranged from the potential for collaborations across the social sciences with an eye toward synthesizing approaches, including qualitative and quantitative modeling, to methods for enhancing fisheries management, making assessments of socio-economic impacts, and identifying information needs.

This report begins with a summary of the workshop discussions relating to the conceptual framework. A brief discussion of EBFM follows, including the reports of breakout groups on three distinctive dimensions of the social science approaches to EBFM: institutional, cultural, and ecosystem goods and services. The report concludes with some thoughts about future steps needed to move toward the realization of a conceptual framework for the contribution of the social sciences to EBFM, including its fuller characterization, wider acceptance, and effective implementation.

[1] These materials can be accessed with an ftp client [profile: WHOI ftp; host: ftp.whoi.edu; user: cinar; password: nar-ci].

A Conceptual Framework

The workshop participants were in general agreement that to date ecosystem-based fisheries management has been cast largely in natural science terms, adding to the management of fish stocks as natural resources in the context of ecological linkages among the stocks themselves and between those stocks and other ecosystem components (*e.g.*, Belgrano and Fowler 2011; Link 2010; McLeod and Leslie 2009; Pikitch *et al*. 2004). This is partly due to a greater engagement of natural scientists than social scientists. For example, fewer than four percent of the 221 signatories to the 2005 Scientific Consensus Statement on Marine Ecosystem-Based Management (McLeod *et al*. 2005) are identifiable as social scientists.

EBFM has not been completely ignored by social scientists, however (*e.g.*, Holland *et al*. 2010; Layzer 2008; Pitcher *et al*. 2009; Sanchirico *et al*. 2008; Edwards *et al*. 2004), and social scientists have been involved with natural scientists in many of the relevant National Academy panels (*viz*., NRC 2006, 1999), studies sponsored by NOAA Fisheries (NMFS 2009; EPAP 1999), and edited compilations of papers (McLeod and Leslie 2009; Browman and Stergiou 2005). It thus seems timely to identify and begin to address a wide range of important social science research questions that need much further attention or have been unexplored to date. We begin to specify and explore these questions below.

The different social science disciplines, including anthropology, economics, geography, and sociology, often approach the analysis of EBFM from contrasting viewpoints, and, in order to gain beneficial insights, there may be a need to clarify perspectives and to strengthen connections among the researchers in these fields as well as between them and researchers in the fisheries and oceanographic sciences.

In particular, the workshop participants agreed that managing the US Northeast fisheries[2] in ecosystem contexts necessitates collaborative work among social scientists on critical issues of ecosystem governance, including the selection of resource management goals, the choices of appropriate spatial and temporal scales, the choices of policy instruments, the assessment of welfare and distributional effects, the structuring of incentives for learning and adaptation, and the evaluation of the effectiveness of management approaches, among other issues.

Traditional conceptual frameworks for EBFM are based on the idea of the intersection or coupling of two distinct domains: an ecosystem comprised of non-human components and processes (*i.e.*, "nature") and a human-centered domain, which may be thought of simply as sources of stresses or inputs to the ecosystem or may be conceptualized as a socio-economic system. Efforts to fully encompass the human dimension have emerged in recent years, resulting in frameworks such as the three depicted in Figure 1. Depending upon their level of specificity, conceptual frameworks also may portray positive or negative feedbacks between nature and humans, external forcings or drivers, and governance institutions. Although such conceptual frameworks are recognized fundamentally as only simple heuristic devices, they may help to focus scientific questions—both natural and social—on system structures, processes, and complex adaptations occurring at a range of spatial and temporal scales.

More recent research efforts have been concerned with the dynamic interactions between natural and human systems within ecosystems. Notwithstanding recent emphases by the US National Science Foundation and other research sponsors on the social science aspects of coupled natural-

[2] The NMFS Northeast region comprises the geographic purview of both the New England and Mid-Atlantic fishery management councils.

human systems (*e.g.*, Liu *et al*. 2007), a defining feature of extant conceptual frameworks relating to EBFM is that nature tends to be distinguished from society; accordingly, the attention of the researcher, decision-maker, or stakeholder/participant tends to be focused on one or the other of two distinct sub-systems.

A consequence of this traditional coupled framework is that, when a sharp distinction is made between the natural system and the human system, the development of a full understanding of the inter-relationships may become compromised. The primary focus for natural scientists often is on the natural marine or terrestrial systems and their workings, and so what happens in the social system may be of second-order concern. Analogously, social scientists tend to focus on the human system, leaving the study of the natural system to natural scientists. As these two groups of scientists exploit their respective comparative advantages, the division between the two sub-systems is reinforced. The workshop participants felt that this distinction likely hinders progress on the realization of effective EBFM.

An example of alternative conceptual frameworks that helps to illustrate this separate treatment of natural and human systems may be found in a depiction of a shift in conceptual perspective now being implemented for the Chesapeake Bay (Paolisso 2010). Figure 2(a) depicts what might be characterized as a traditional conceptual framework for fisheries management, focusing on sustainable oyster populations as the central goal. In this framework, the central goal is to recover a collapsed fishery, using traditional fisheries science to inform the choice of management measures that are determined within a (typically) confrontational and competitive context of stakeholder negotiation.

Alternatively, a more contemporary concept depicted in Figure 2(b) focuses attention on human benefits as a dependent variable in a broader ecosystem context. In the latter conception, human benefits are hypothesized to be a function of the relevant human population, the social and ecological sciences, stakeholder information, and collaborative governance. In principle, specific hypothesis tests could be conducted to clarify the relationships between these elements: namely, incremental changes in the independent variables could be valued as incremental changes in human benefits.[3] Thus, the latter framework helps social scientists focus on research questions of import to a conjoined natural-human system. Also, in theory, this approach embodies an ideal of community-based management, in which community "participants" (as opposed to competitive "stakeholders") work to produce a jointly determined notion of and interaction with nature.

Thus, an alternative to the traditional practice of making an explicit distinction between natural and human systems is a unified (or coupled) "natural-human system" (sometimes also referred to as a "social-ecological system") comprising a framework in which the separation of the natural system from the human system is de-emphasized.[4] Although still practical only in a heuristic sense, in this case, conceptualizing EBFM as a manifestation of a natural-human system could

[3] Clearly, this is a theoretical conceptual framework. In practice, there could be many difficulties associated with the choice of measures and the compilation of data for each of the relevant variables. Further, some of the independent variables may be endogenous.

[4] Indeed, some of the workshop participants felt that the notion of an "ecosystem" is a human intellectual construct—not something that has an exclusively natural definition. In this sense, an ecosystem could be seen as "socially produced" (*cf.*, Olson 2011). Following this logic, humans might express preferences over and potentially choose among desirable ecosystem states—subject to biophysical limits on stocks and flows.

help to identify research questions that are more appropriate for management and for the relevant human community, thereby enhancing human capabilities for learning, adaptation, and the evolution of appropriate institutions. Further, within the framework of a natural-human system, issues of the characterization of compatible spatial and temporal perspectives are more likely to come to the fore.

A few of the general social science questions concerning EBFM that emerge from the concept of a natural-human system include:

- What are the central goals of EBFM?
- What are the most appropriate spatial and temporal scales for implementing EBFM?
- Which human communities should be involved in the natural resources to be managed through EBFM?
- What are the most appropriate forms of governance for implementing EBFM?
- How do different participant groups interact to develop governance approaches and design and implement specific management measures?
- Are information flows sufficient to permit cooperative behavior to arise with respect to use of marine natural resources?
- What are the most appropriate analytical approaches for decision-support and program evaluation?
- How is uncertainty about the natural system handled by different participant groups and under varying forms of governance?
- How does ecosystem-based fisheries management (EBFM) fit into a broader framework of ecosystem-based management (EBM) for all marine resources and uses?

Figure 3 depicts alternative realizations of natural-human systems. In each realization, EBFM is nested within a more encompassing EBM. Human and natural systems are fully intertwined. The left side represents a large-scale EBFM, perhaps one to which the current regional fishery management council might aspire. The figure shows that there are choices concerning the scale of EBFM within EBM and the relative importance of the human component vis-à-vis the natural component. The right side of the figure depicts a different scenario in which there are multiple sub-systems established for EBFM purposes. Each sub-system might occur at a different geographic scale, represent a different set of human interactions with nature, and be associated with an independent coastal community primarily responsible for its management. Some sub-systems might be deeply invested in the natural environment, while others might have only a marginal interest. The purview of some sub-systems might overlap, potentially necessitating the need for a more regional governance to help sort out conflicts.

By definition, the conceptual framework embodied in Figure 3 abstracts from the individual linkages between the human system and nature. Consequently, attention is directed toward the broader conjoined system. While the linkages surely are important for the participants of communities intimately involved in the details of managing their respective natural systems, this conception parallels frameworks of complex adaptive systems now being explored by marine ecologists. The defining feature of the approach to complex adaptive systems is that they

transcend mechanistic details, focusing instead on the emergent features of the broader system (Fogarty 2011).

In sum, the most novel aspect of treating EBFM as a natural-human system is that the human element is embedded throughout all of the (unseen, in Fig. 3) linkages,[5] thereby influencing EBFM social science research priorities. In other words, human interactions are incorporated from the start, and they drive the research rather than being tacked-on as an afterthought. A natural-human framework demonstrates the overarching concern that humans are integral to the natural system, and it fully integrates the human element throughout from the beginning stages to the end. On the basis of this approach, the human element is fully endogenous.

The Social Science Dimensions of EBFM

As found in the academic literature, the conclusions of research panels, and increasingly in public policy, EBFM comprises a distinct set of elements. Central to the concept is the notion that those marine species that are exploited by humans as economic goods are linked to other species and to the wider marine environment. An assumption is that the sustainability of the overall system potentially is threatened when these linkages are ignored.[6] The existence of ecological linkages has long been recognized, but traditional fisheries management may not have fully recognized their importance until recently.

The analytical methods of fisheries scientists have become increasingly sophisticated in modeling ecological linkages, but significant uncertainty in the dynamics of natural marine systems persists. Innovative approaches now are being taken to characterize the emergent properties of the integrated components of natural marine systems modeled as complex adaptive natural systems. Such approaches may involve modeling aggregates of species as guilds or trophic levels and the identification of appropriate ecological production units (potentially the 10-minute squares at which data currently is aggregated).

An overlapping and equally central issue concerns the choice of an appropriate spatial scale for managing a natural marine system. The issue of scale often is seen by natural scientists primarily as a positive question, namely, one to be determined by observing nature and the environment. From the social science perspective, however, the choice of spatial scale also may involve normative concerns because humans must decide on how to exploit the natural system for economic gain and also how to appreciate it for its non-market aspects (*e.g.*, aesthetics, eco-tourism, cultural significance, and assimilative capacity).[7]

Other elements of EBFM are thought to comprise stakeholder collaboration, learning and adaptation, application of a precautionary approach in the face of uncertainty, consideration of the cumulative impacts of exploitation, and the need to relate fisheries management to other uses

[5] For example, commercial and recreational fishing activities remove fish from the ecosystem, thereby affecting biomass in the upper trophic levels, and coastal development, pollution, and certain fishing practices can affect habitat and the environment for organisms at all trophic levels.

[6] Several of the workshop participants felt that "sustainability" in the sense of the management of marine fisheries is unachievable, either because of the difficulty of resolving distributional issues, the high levels of uncertainty about resource dynamics, or both.

[7] The workshop participants agreed that many non-market ecosystem services are undervalued—leading to a bias in decision-making that favors the provision of market-based ecosystem services. At least one participant questioned whether there were adequate resources for undertaking the necessary studies to be able to assign economic values to non-market ecosystem services with any degree of confidence.

(and non-uses) of the natural system (*i.e.*, within a more encompassing ecosystem-based management [EBM]). While these elements are assumed necessary for the realization of EBFM, they are not unique to it. For example, they may be necessary also for effective single-species fisheries management. Further, these elements, taken either independently or together may not be sufficient for EBFM. Many interesting social science questions arise when considering any one of these elements. Layzer (2008), for example, has questioned the effectiveness of stakeholder collaboration in large-scale EBM programs.

An important consideration in the design of EBFM is the choice of a management goal. Fisheries management at the federal level in the United States has long been characterized by multiple, often competing goals (the national standards of the Magnuson-Stevens Fishery Conservation and Management Act [P.L. 94-265, as amended by P.L. 109-479]). It is frequently the case that fishery resources are overexploited—biologically, economically, or both—in order to achieve certain outcomes, such as higher levels of employment or fairness in the distribution of access to the resource. For example, in order to avoid the short-term costs of limiting access to a fishery, the longer term costs of resource over-exploitation may be ignored.

Little progress on EBFM appears likely without a "common vision" for what people want from the marine environment (Leslie and McLeod 2007). Recent scientific advisory panels have chosen strikingly different goals for EBFM. For example, the Ecosystem Principles Advisory Panel established by the 1996 Sustainable Fisheries Act identified "marine ecosystem health and sustainability" as the central goal of EBFM (EPAP 1999). In contrast, an NRC panel on sustainability in marine fisheries identified the "sustainability of fisheries management" as the central goal (NRC 1999). An important focus of social science research concerns the extent to which some types of institutions, say, community-based cooperatives, are more likely than others, say, the current fishery management councils, to create and implement a vision or goal that could be deemed to be sustainable.

The workshop participants identified three broad dimensions of the human aspect of EBFM: institutional, cultural, and ecosystem goods and services. The broad outlines of these dimensions are sketched out here. The participants at the workshop recognized that significant overlaps occur among these dimensions. Particular attention was paid to characterizing the most important social science research questions that emerge from a consideration of these dimensions. Addressing many of these questions may require collaborations across the different social sciences as well as between the social and natural sciences.

The Institutional Dimension

Governance is a critical mechanism or linkage within coupled natural-human systems. By governance we refer to the institutions, actors, and organizations involved and how they channel behaviors in interaction with the biophysical components of the systems.

We follow the practice of seeing institutions as rules that shape the behavior of individuals and the organizations they create and participate in to help achieve collective goals. For example, the Magnuson-Stevens Act and the National Environmental Policy Act [P.L. 91-190] are important institutions that affect human interactions with natural marine systems, including what individuals can and cannot do as well as the workings of organizations such as government agencies, management councils, and non-governmental organizations.

Effective EBFM may depend critically upon the coordination of organizations working within emerging institutional frameworks. Figure 4 depicts an example of a current hypothesis

concerning the potential effectiveness of "polycentric, messy" institutions (Wilson 2010). The boxes connected by solid lines represent a traditional way of outlining and conceptualizing institutional structure and hierarchy. Organizations are linked by formal lines of communication and authority. In reality, lines of communication among organizations may be denser, as depicted by the addition of the dashed lines. Further, these dashed lines are suggestive of a dynamic, evolving interaction among the individuals within organizations that is overlooked by the traditional organizational model. Among other questions, research on such dynamic interactions may reveal the evolution of institutional forms that are more effective than traditional models in managing natural resources under different social-ecological conditions. Information flows and institutional arrangements among individuals may play a crucial role in determining the extent to which individuals are able to cooperate to achieve sustainable outcomes (Ostrom 2000).

A major task, analogous to descriptions of the food web and the community structure of the biological component of the natural-human system, is to characterize the current and likely or desirable future institutions, actors, and organizations relevant to EBFM. This can be thought of as a first step toward a Social-Ecological Assessment (SEA), which we tentatively propose as an alternative to Social Impact Assessment (SIA).

For EBFM, particular focus should be on the institutions, actors, and organizations engaged in: fisheries management (at multiple scales and levels) that are involved in the production and use of knowledge (both research-based and experience-based knowledge, at different sites); multi-stakeholder advocacy processes; and the support and production of stewardship and community. Further work is also needed on vehicles for translating data coming from the evaluation of ecosystem goods and services (see the discussion of the corresponding dimension below) into governance.

Several tools are available, including stakeholder analysis, network analysis, and empirical studies of multiple scales and cross-scale structures and relationships. Analyses of legislation and legislative records and the rosters and minutes of meetings; observation of meetings; and interviews with stakeholders are among the readily available sources of data. Another approach is coupled systems analysis, which focuses on points and processes of interaction between the human and natural components, with a view toward non-linear as well as linear relationships (for example, thresholds and transitions) and feedback. Feedback relationships can be negative or positive; they involve the potential of learning and adaptation, which are critical for the integrity and resilience of natural-human systems.

EBFM appears to warrant greater attention to governance through co-management. This in turn requires the engagement of more diverse institutions, actors, and organizations than classic fisheries management, and understanding this diversity is essential. The term "stakeholders" can be used in this context as well, meaning the interested, affected, and affecting individuals or groups relevant to the issue (but we urge some caution using this term, which suggests a "merely consultative" role).[8]

[8] One workshop participant felt that the term stakeholder was an "artifact of the rationalization of resource management." In this sense, stakeholders are competing for limited resources or for particular dispositions of resources. In a community-based management context, which might be an appropriate type of institution for EBFM, the members of the community would more appropriately be considered "participants" in management.

It is critical to develop social analyses early in the management process so that their results are available for use in management planning. The early timing of social analyses occurs rarely in present-day fishery management processes. Within the current federal fisheries management structure and processes, institutional analyses, social impact analyses (which are important and well-developed for fisheries through NEPA and Magnuson-Stevens Act requirements), and proposed natural-human analyses, which would be more explicit about human-environmental relationships, should be initiated concurrent with the scoping process, so that information is available to groups such as such as the regional fishery management councils' scientific and statistical committees (SSCs), plan development teams, monitoring committees, and other interested bodies prior to the development of specific management measures. (The conduct of social analysis concurrent with scoping occurs, to some extent today, on the US west coast but not on the US east coast.) This action is essential if we are to take seriously the notion that EBFM comprises a true natural-human system.

An initial outline of procedure begins with the synthesis of existing data, facilitated by the development of a socio-economic data clearinghouse and performance indicators by the Social Science Branch of the Northeast Fisheries Science Center. Next, the relevant institutions, actors, and organizations should be mapped out with assistance from stakeholders, who should be involved in the process from an early point. A natural-human assessment (SEA) that reviews the socio-economic and institutional conditions of the natural system and its fisheries would be drafted and made available to the relevant committees and teams mentioned above.

The process could be carried out by a subcommittee or team created by a fishery management council or another body.[9] One possibility could be a subcommittee of a council's SSC. This group should be multi-disciplinary, including social scientists, biologists, and industry and NGO participants, interacting with the Social Science Branch of the NEFSC. The results of their work would be available not only for management decision-making but also for the draft NEPA and SAFE documents or their equivalents.

There are several research priorities concerning the institutional dimension. These priorities include:

- Analyses of feedback processes and governance in coupled systems (*e.g.*, Liu *et al*. 2007), *i.e.*, how to appropriately assess and respond to events in natural-human systems that are characterized by multiple and shifting scales of system processes and by non-linear and 'surprising' events;
- Identification and characterization of conditions for effective "stakeholder" participation, co-management, and community-based management. A substantial literature now exists on these topics, and it should be reviewed and applied to cases at hand (*e.g.*, Layzer 2009; Chess and Johnson 2006; NRC reports);
- Identification of those types of institutions that might facilitate the development in the minds of stakeholders or the perspectives of communities of longer-term horizons (reductions in discount rates)?

[9] One suggestion was that CINAR could serve a role, at least initially, by constituting an ad hoc committee that would help to develop a process for developing and implementing SEA.

- Mapping of social networks and communication (*e.g*., Hartley and Robertson 2006); in regard to opportunities and barriers for stakeholder participation and knowledge production;
- Discovery of efficient and reliable ways of assessing social relationships, cultural values, dependency, and community resilience and vulnerability (*e.g*., Jacob and Jepson 2009).
- Development of improvements in social impact assessment (*e.g*., Pollnac *et al*. 2010). Basic research questions pertain to why this information is not put into the process in an earlier stage, which may relate to institutional constraints, rent-seeking, path-dependency, and historic reasons. Research is also needed on how an ecosystem-based approach to fisheries management can be incorporated into existing governance arrangements.
- Characterization of effective tools and other broad approaches to EBFM (market-based, community-based, others).

The Cultural Dimension

The cultural dimension can be divided usefully into two elements. The first considers the role of *cultural diversity* in the assessment of natural-human systems and the success of EBFM. The second develops an outline of a *process to implement a social science practice* that explores how cultural values, meanings, and ways of knowing environments influence behavior, decision-making, and EBFM possibilities. In assessing the cultural dimension, it is important to recognize that cultures and their institutions, norms, and practices are dynamic and adaptive. Similar to the ecological approach to the analysis of complex adaptive systems, there may be analogous "emergent" properties of cultures.

Identifying the diversity of cultural environmental understandings associated with a particular natural-human system is important in order to understand particular practices and natural-human outcomes. Such understandings are important where collaboration and collaborative learning are central to the success of EBFM. Advocates of EBFM highlight the need for collaborative processes in both the science and management domains. Such collaboration, however, can be hindered if, for example, conflicting understandings of nature remain unspecified and their implications unknown.

Diverse cultural environmental understandings also suggest sources of resilience and adaptation to change. Populations and communities with diverse values, meanings, and ways of knowing have greater capacity for adaptation or innovation in the face of environmental or socio-economic change. In addition, new research into bio-cultural diversity is drawing attention to the important feedback relations between biological and cultural diversity across a variety of natural-human systems. Social science research methodologies, including oral histories, ethnography, and public attitude and opinion surveys, may be useful in characterizing the diversity of cultural environmental understandings.

It is important to note that cultural analysis for EBFM is not limited to fishing subjects or sites associated with harvesting. Indeed, work aligned with science and technology studies reminds us that scientific and management institutions themselves might be investigated as sites of diverse cultural values, meanings, and knowledge. Such diversity may, for example, align with disciplinary training.

While maintaining cultural diversity is beyond the purview of EBFM, an ongoing assessment of it (*e.g.*, within resource user populations or peer groups of fishermen, coastal or port communities, scientist or management institutions) and a sensitivity to the limitations and potentials such diversity represents can usefully contribute to EBFM.

As a permanent element within EBFM, cultural analyses would be an ongoing practice that produces both continuous standardized data sets (*e.g.*, an annual survey) as well as more targeted investigations into particular matters of concern (which might be social, economic, or natural). Such analyses might be organized into three analytical processes and/or corresponding data productions.

- Ongoing data collections to provide standardized data on a number of variables important to cultural analyses. These include new and existing data designed for human cultural analyses as well as data which might be "re-read" for their insight into human cultural practices. Data needs include updating and maintaining time series; identifying and filling data gaps and repairing mismatches; and characterizing census limitations.
- Analyses of existing data to delimit and characterize populations or places and their various practices relative to the natural-human system. The result would be new derived data sets depicting social cultural diversity. These would not be so much for inventory as for research and analysis.
- Using data from the above processes (or not), ethnographic research targeting particular populations or communities would be conducted in response to matters of concern (to be prioritized as part of the annual round).

Throughout these analytical processes, as part of an EBFM process, every effort should be made to look for linkages and relationships between those cultural practices and processes being investigated and the natural system. How are cultural practices linked to natural system outcomes? And how do natural system outcomes affect cultural practices?

Finally, these analytical processes must recognize and incorporate multi-scale understandings of cultural processes and practices. Particular "local" practices are inevitably linked to and constituted by other practices in other locations near and far, processes at other social or economic scales, and institutions whose domains are well beyond the boundaries of the "local."

The Ecosystem Goods and Services Dimension

This dimension comprises human elements related to the provision of goods and services as a component of EBFM. Three general subtasks guided these efforts: to define goods and services provided by natural systems, to summarize research tools and frameworks relevant to assessing these services, and to identify research priorities. The definition of ecosystem goods and services follows the broad classification found in the Millennium Ecosystem Assessment (MEA 2000). Two classes of goods and services emerge: market and non-market. The treatment of research frameworks was expanded to include market and non-market valuation methods, nesting, and mapping. Research priorities are broadly characterized, representing a more complete array of assessments of services, gaps in assessments and quantification of ecosystem services, new influences such as emerging markets in fisheries, and assessments based on an array of regulations.

Ecosystem goods and services fall into the following general categories with relevant examples provided in parentheses:

- Provisioning (marine livelihoods, seafood production, ocean renewable energy, sand and gravel resources, waste disposal);
- Regulating (assimilative capacity, flood protection, climate regulation);
- Cultural (recreational fishing, eco-tourism, whale-watching, heritage and archaeology, sense of place);
- Supporting (primary production, nutrient cycling, carbon sequestration).

A number of analytical tools and methods can be utilized to characterize the economic value or social and economic impacts of ecosystem goods and services. Values or impacts may find use in characterizing tradeoffs among the choice of alternative natural system states or in understanding the distributional effects of particular resource allocations. In addition, such tools and methods could be used to assess progress in achieving stated social goals, such as through program evaluations. General categories of methods include:

- Market-based methods (input-output, computable general equilibrium, bio-economics, portfolio analysis);
- Non-market-based methods (contingent valuation, conjoint analysis, travel cost, hedonic pricing);
- Oral histories (norms, values, well-being);
- Mapping (characterizing local ecological knowledge);
- Livelihood approaches (factors affecting access to livelihood opportunities, such as social relations, institutions, power differentials);
- Network analysis (*e.g.*, characterizing densities of social networks).

Several areas stand out as priorities for research in the provisioning dimension. Importantly, research associated with this dimension can be useful in characterizing the "net national benefits" of management approaches and measures (a requirement under the Magnuson-Stevens Act); assessing human well-being or welfare in terms of tradeoffs; and capturing missing values, especially those associated with non-market goods and services. With respect to the latter, missing values—due to market or government failures—often lead to overexploited and unsustainable natural systems.

- Continue valuation of ecosystem goods and services (special attention to non-market goods and services);
- Redress gaps in assessing regulating, cultural, and supporting services;
- Track emerging markets and consumer preferences (*e.g.*, green products, branding);
- Match the spatial and temporal aspects of ecological and social models, including data[10] and reference points, need to be matched more closely;

[10] One workshop participant suggested that, in the future, EBFM could be enhanced through the more frequent compilation and analysis of data from commercial fishermen and other resource users, leading essentially to real-time monitoring of the system.

- Identify and seek to understand changes in fishermen's behavior and the resulting implications for interactions with biophysical dimensions (in particular, it will be important not to confuse motivations and rationales with observed changes);
- Continue development of metrics for gauging the performance of the fishing industry and the relevant economy (e.g., green accounting).

Summary and Future Direction

The workshop participants agreed that the development of a conceptual framework for social science research in EBFM was an appropriate and productive endeavor. A conceptual framework could help to correct an imbalance in scientific research relating to EBFM, which to date has emphasized the natural sciences, and it would be heuristically useful for articulating a wide range of relevant social scientific questions.

A defining feature of extant conceptual frameworks relating to EBFM is that nature tends to be distinguished from society. Conceptualizing EBFM as a manifestation of a natural-human system could help to identify research questions that are more appropriate for management and for the relevant human communities, thereby enhancing human capabilities for learning, adaptation, and potentially encouraging the evolution of appropriate institutions. A possible general framework comprising a natural-human system is suggested in Figure 3. The workshop participants agreed that a natural-human system can be characterized by its institutional, cultural, and ecosystem goods and services dimensions.

An important consideration in the design of EBFM is the choice of a management goal, and little progress in achieving sustainable management is possible without such a choice. The choice of goal may depend upon the biophysical characteristics of the resource, the relevant communities, the appropriate spatial and temporal scales, the available institutions, and other factors. Where more than one goal is chosen, care must be taken to assure they are compatible and not conflicting. Social science research can contribute to a deeper understanding of those factors that influence, first, the choice of goal(s) and, second, the likelihood of its (their) eventual achievement.

A central issue concerns the choice of an appropriate spatial scale for managing a natural marine system. From the social science perspective, the choice of spatial scale involves both positive and normative concerns relating to the description of the natural and human systems and their interactions and the development of an understanding of the effects of human actions taken to exploit or conserve natural resources.

A major research task will be to characterize both existing and desirable future institutions, actors, and organizations relevant to EBFM. In order to tackle this task, there may be a need to clarify perspectives and to strengthen connections among researchers in the different social science disciplines. Developing a characterization of institutions can be thought of as a first step toward a Social-Ecological Assessment (SEA). It would be critical to undertake analyses relevant to the development of an SEA at a very early stage in the fisheries management process so that results are available for use in management planning and implementation.

Analytical methods must recognize and incorporate multi-scale understandings of cultural practices, institutions, and diversity. It is important to recognize that local practices and institutions are linked to and constituted by those at other geographic, social, or economic scales. Ongoing assessments of cultural diversity and its potentials and limitations will be critical.

Tools and methods for evaluating the provision of ecosystem goods and services are important for assessing progress in achieving stated social goals and for evaluating changes in human welfare or well-being. The estimation of economic values or impacts is critical for characterizing tradeoffs among the choice of alternative natural system states and in understanding the distributional effects of particular resource allocations. Research on ecosystem goods and services can be useful in characterizing the "net national benefits" of alternative choices of governance approaches and management measures and in capturing missing values, especially those associated with non-market goods and services.

The workshop participants felt that the convening of a second workshop to further articulate a conceptual framework for EBFM would be useful. A second workshop could involve advance work by small teams integrating researchers from the different social science fields with marine ecologists, particularly those involved with NEFSC's Ecosystem Assessment Program.

The small teams could undertake pilot studies to think through integrated approaches to EBFM for genuine situations in both the Mid-Atlantic and New England. Some of the pilot studies could be based upon the notion of "ecological production units" that define the boundaries and significant elements of place-based natural systems including fisheries but also other activities. Other pilot studies could build upon existing species-specific fishery management units, addressing the question of how they might evolve into more ecological approaches to management, sensitive to trophic linkages and dynamics, and their relationships to human valuations, cultural diversity, and governance traditions.

References

Belgrano, A. and C.W. Fowler. 2011. *Ecosystem Based Management for Fisheries.* New York: Cambridge University Press.

Browman, H.I. and K.I. Stergiou, eds. 2005. Politics and socio-economics of ecosystem-based management of marine resources. *Marine Ecology Progress Series* 300:241–296.

Chess, C. and B.B. Johnson. 2006. Organizational learning about public participation. *Human Ecology Review* 13:182-192.

Ecosystem Principles Advisory Panel (EPAP). 1999. *Ecosystem-Based Fishery Management:A Report to Congress.* As mandated by the Sustainable Fisheries Act amendments to the Magnuson-Stevens Fishery Conservation and Management Act 1996. NMFS: Silver Spring, MD.

Edwards, S.F., J.S. Link and B.P. Rountree. 2004. Portfolio management of wild fish stocks. *Ecological Economics* 49:317-329.

Fogarty, M. 2011. Ecosystem-based fisheries management on the northeast U.S. continental shelf: options for implementation. Presentation at this workshop.

Hartley, T.W. and R.A. Robertson. 2006. Stakeholder engagement, cooperative fisheries research and democratic science: the case of the Northeast Consortium. *Human Ecology Review* 13:161-171.

Holland, D.S. *et al*. 2010. *Economic Analysis for Ecosystem-Based Management.* Washington: RFF Press.

Jacob, S. and M. Jepson. 2009. Creating a community context for the fishery stock sustainability index. *Fisheries* 34:228-231.

Layzer, J.E. 2008. *Natural Experiments: Ecosystem-Based Management and the Environment*. Cambridge, Mass.: MIT Press.

Leslie, H.M. and K.L. McLeod. 2007. Confronting the challenges of implementing marine ecosystem-based management. *Frontiers in Ecology and the Environment* 5:540-548.

Link, J. 2010. *Ecosystem-Based Fishery Management: Confronting Tradeoffs*. New York : Cambridge University Press.

Liu, J. *et al*. 2007. Complexity of coupled human and natural systems. *Science* 317:1513-1516.

McLeod, K.L. *et al*. 2005. Scientific Consensus Statement on Marine Ecosystem-Based Management. COMPASS <http://compassonline.org/?q=EBM>

McLeod, K.L. and H.M. Leslie, eds. 2009. *Ecosystem-Based management for the Oceans*. Washington: Island Press.

National Marine Fisheries Service (NMFS). 2009. *Report to Congress: The State of Science to Support an Ecosystem Approach to Regional Fishery Management*. NOAA Tech. Memo. NMFS-F/SPO-96. Silver Spring: US Department of Commerce.

National Research Council (NRC). 2006. *Dynamic Changes in Marine Ecosystems*. Washington: National Academy Press.

National Research Council (NRC). 1999. *Sustaining Marine Fisheries*. Washington: National Academy Press.

Olson, J. 2011. Producing nature and enacting difference in ecosystem-based fisheries management: an example from the Northeaster US. *Marine Policy* 35:528-535.

Ostrom, E. 2000. Crowding out citizenship. *Scandanavian Political Studies* 23:3-16.

Paolisso, M. 2010. Managing humans and oysters: challenges to an ecosystem-based management approach. Presentation at the Society for Applied Anthropology Annual Meeting. Merida, Mexico (March 26).

Pikitch, E. *et al*. 2004. Ecosystem-based fisheries management. *Science* 305:346-247.

Pitcher, T.J. *et al*. 2009. An evaluation of progress in implementing ecosystem-based management of fisheries in 33 countries. *Marine Policy* 33:223-232.

Pollnac, R. *et al*. 2010. Marine reserves as linked social–ecological systems. *Proc. Natl. Acad. Sci.* 107:18251-18255.

Sanchirico, J.E. *et al*. 2008. An empirical approach to ecosystem-based fishery management. *Ecological Economics* 64:586-596.

Wilson, J. 2010. A skeptical view of the NOP. Presentation at the *Symposium on National Ocean Policy*. Brunswick, ME: Bowdoin College (October 16).

Fig. 1: Traditional conceptual frameworks showing linkages and feedbacks between so-called "coupled" ecosystems and humans: (a) coupled systems linked by governance (Ostrom 20__); (b) CAMEO draft science plan (CAMEO 2011); and (c) coupled social and ecological Systems (McLeod and Leslie 2009).

(a)

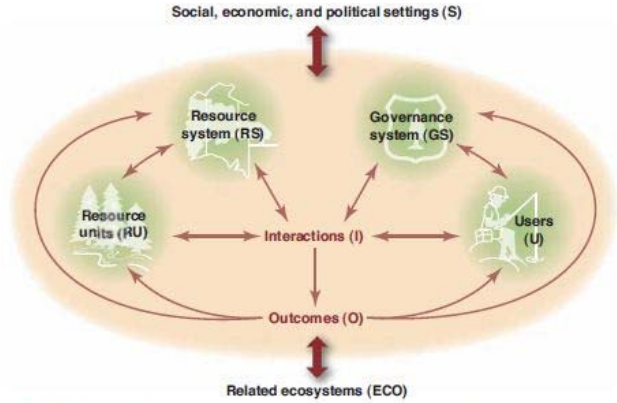
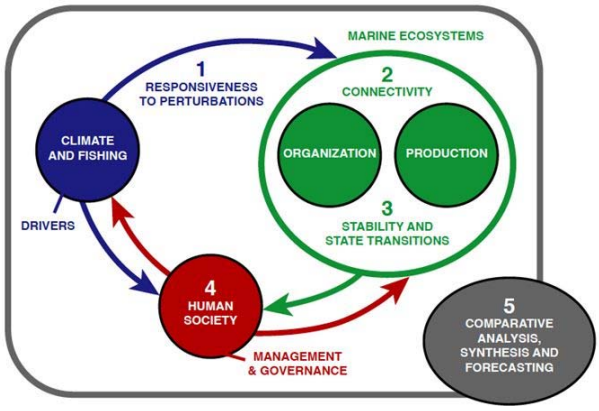


Fig. 1. The core subsystems in a framework for analyzing social-ecological systems.

(b)



(c)

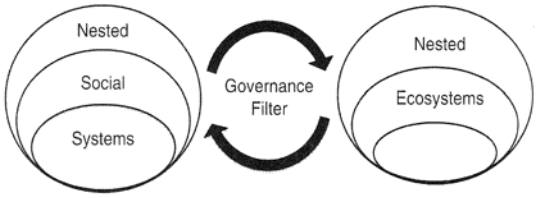
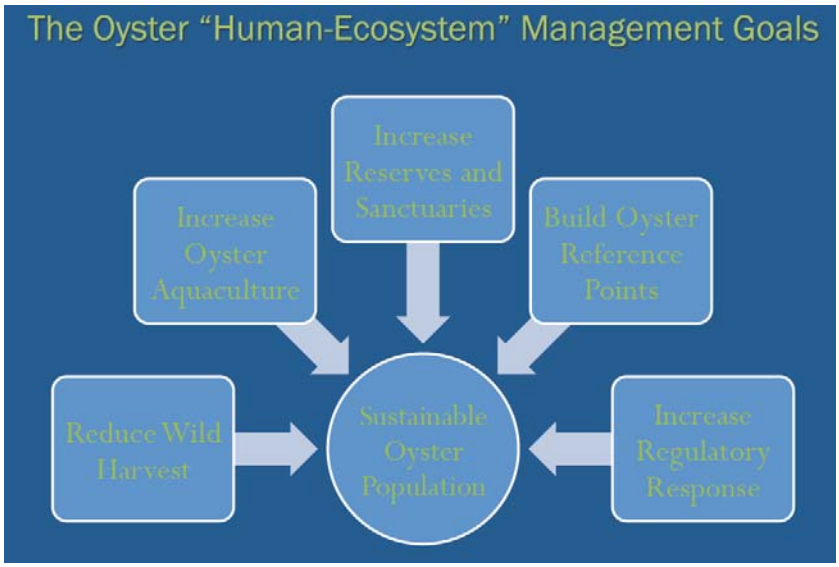


Fig. 2: Conceptual framework for the Chesapeake Bay showing management goals for: (a) the oyster "human-ecosystem" representing traditional fishery management and (b) the human "oyster-ecosystem" representing a more contemporary model of human benefits as a dependent variable (Paolisso 2010).

(a)



(b)

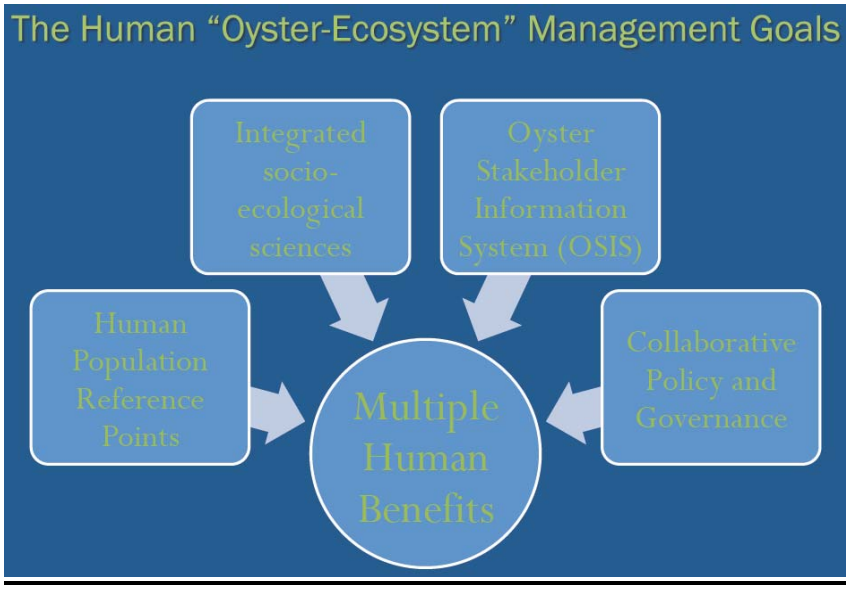


Fig. 3: Two conceptions of a natural-human system. See the text for a detailed description.

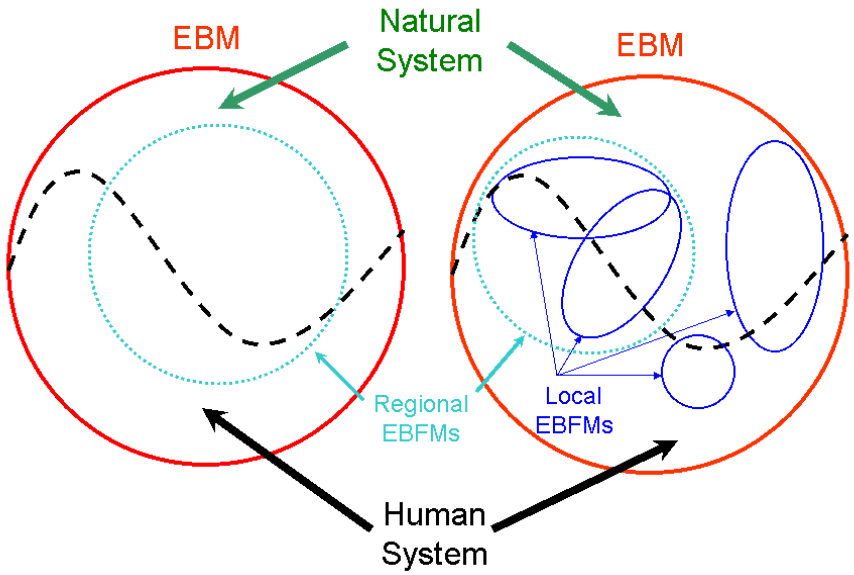
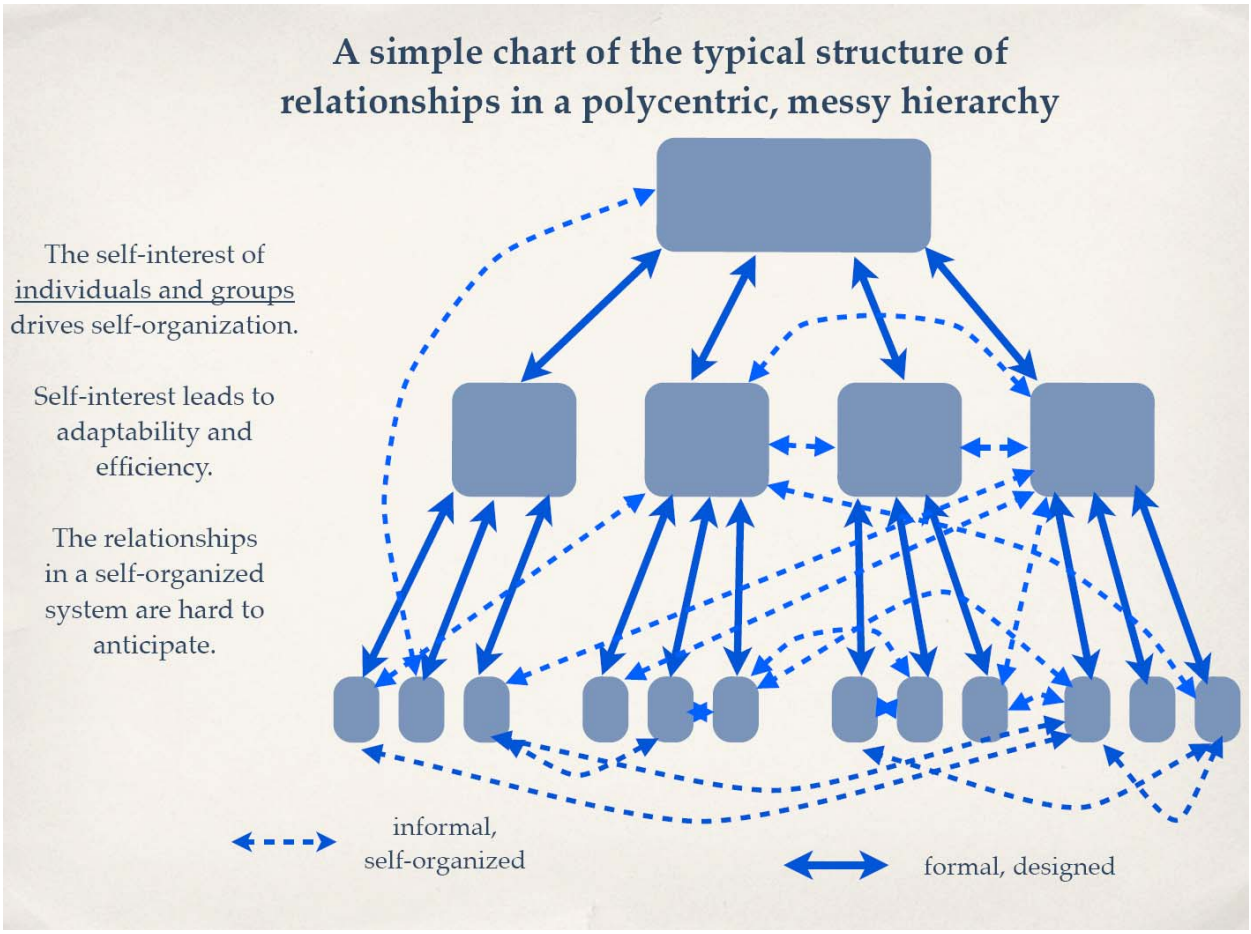


Fig. 4: The dynamics of self-organization embodied in a traditional hierarchical organization (Wilson 2010; Ostrom 2000).



APPENDIX

DEVELOPING A CONCEPTUAL FRAMEWORK FOR THE CONTRIBUTION OF THE SOCIAL SCIENCES TO ECOSYSTEM-BASED FISHERY MANAGEMENT (EBFM)

Sponsored by

NOAA Cooperative Institute for the North Atlantic Region (CINAR)

2-4 May 2011

Carriage House
Woods Hole Oceanographic Institution
Woods Hole, MA 02543

AGENDA

Monday, May 2:

8:30-9:00am	Coffee, Pastries
9:00-9:15am	Welcome: Porter Hoagland, Judy Kleindinst (CINAR), Mike Fogarty
9:15-10:45am	**Presentations** (Andy Solow, Chair): Porter Hoagland: Marine Policy and EBFM Phil Logan: Fisheries Management and EBFM: Economic Perspectives Di Jin: Food Web Models and EBFM
10:45-11:00am	Coffee
11:00am-12:15pm	**Panel Discussion:** Andy Solow, Eric Thunberg, Lisa Wainger, Jim Wilson
12:15-1:15pm	Lunch
1:15-2:45pm	**Presentations** (Matt McPherson, Chair): Bonnie McCay: The Human Dimensions of EBFM Julie Olson: Producing Nature and Enacting Difference in EBFM Kevin St. Martin: Mapping Human Communities onto Ecosystems
2:45-3:00pm	Coffee
3:00-4:15pm	**Panel Discussion:** Lisa Colburn, Anne Hayden, Matt McPherson, Michael Paolisso,
4:15-5:00pm	Directions for Days 2 and 3
5:30-6:30pm	Reception
Dinner:	On your own

Tuesday, May 3:

9:00-11:00am	**Presentation:** Mike Fogarty: Ecosystem-Based Fisheries Management on the Northeast US Continental Shelf: Options for Implementation
11:00-12:00	**Plenary Discussion:** Dimensions of a Conceptual Framework
12:00-1:00pm	Lunch
1:00-2:30pm	**Breakout Groups:** Dimensions of a Conceptual Framework 1. Provision of Good and Services 2. Social/institutional Dimension 3. Cultural Elements
2:30-4:30	**Plenary Discussion:** Identification of the Elements of a Conceptual Framework for the Contribution of the Social Sciences to EBFM
Dinner:	On your own

Wednesday, May 4:

9:00-9:30am	**Plenary:** Review of breakout group writing assignments
9:30-12:00am	**Plenary Discussion:** Summary of workshop efforts and future tasks
12:00pm	Adjourn

CINAR EBFM Workshop Participants

Participant	Organization	E-mail
Clay, Trish	NEFSC	patricia.m.clay@noaa.gov
Colburn, Lisa	NEFSC	lisa.l.colburn@noaa.gov
Creed, Carolyn	Rutgers	creed@aesop.rutgers.edu
Fogarty, Mike	NEFSC	michael.fogarty@noaa.gov
Hayden, Anne	UMaine	acjhayden@comcast.net
Hoagland, Porter	WHOI	phoagland@whoi.edu
Jin, Di	WHOI	djin@whoi.edu
Johnson, Teresa	UMaine	teresa.johnson@maine.edu
Joyce, Jessica	GMRI	jjoyce@gmri.org
Kite-Powell, Hauke	WHOI	hauke@whoi.edu
Logan, Phil	NEFSC	plowoho@comcast.net
McCay, Bonnie	Rutgers	mccay@aesop.rutgers.edu
McPherson, Matt	NEFSC	matthew.mcpherson@noaa.gov
Ofiara, Doug	Rutgers	dofiara@maine.rr.com
Olson, Julie	NEFSC	julia.olson@noaa.gov
Paolisso, Michael	UMd	mpaolisso@anth.umd.edu
Solow, Andy	WHOI	asolow@whoi.edu
St. Martin, Kevin	Rutgers	kstmarti@rci.rutgers.edu
Steele, John	WHOI	jsteele@whoi.edu
Thunberg, Eric	NEFSC	eric.thunberg@noaa.gov
Wainger, Lisa	UMd/CES	wainger@umces.edu