California Current Ecosystem-Based Management (CCEBM) initiative:

Advancing the Science for Ecosystem-Based Management on the U.S. West Coast

January 30-31 2008, Santa Cruz CA

Meeting Overview

This two-day meeting, co-hosted by the University of California Santa Cruz (UCSC) and the Communication Partnership for Science and the Sea (COMPASS), aimed to explore and develop the science needed to move forward with more comprehensive ecosystem-based management (EBM) along the US West Coast. This meeting stemmed from recognition that despite general agreement on the need for EBM and its key elements, details on how to apply scientific knowledge to facilitate EBM implementation are lacking. The ninety participants included social and biogeophysical scientists from a variety of academic, government and private institutions, as well as participants with expertise in management and policy.

Prior to the meeting, a Science Advisory Committee met to direct and explore the content of the meeting, with guidance from a Steering Committee (see *For More Information*). The Science Advisory Committee discussed key research areas relevant to EBM, including cumulative impacts, ecosystem services, ecosystem variability and change, and ecological and social indicators. The committee focused on the information needed for EBM in the context of NOAA's Integrated Ecosystem Assessment (IEA) approach, which includes each of these key research areas. Through the course of their IEA discussions, they developed a framework, *Science to Inform Ecosystem Service Tradeoff Analysis (*SIESTA), to visualize and assess tradeoffs among ecosystem services. These frameworks, particularly SIESTA, were a focus of the meeting. Furthermore, while they were presented using West Coast examples, they are general approaches that can be applied to any geographic location or spatial scale.

The meeting was a mix of plenary presentations and discussions and smaller, breakout group discussions. Plenary sessions covered 1) the emerging science of marine ecosystems (in general and specifically for the California Current region), 2) the IEA and SIESTA approaches, and 3) case studies along the US West Coast (Puget Sound, WA; Klamath River, OR and CA; Elkhorn Slough, CA) that reflect high priority management issues across a range of sectors. Breakout sessions were devoted to discussions of 1) reactions to the IEA and SIESTA approaches, 2) application of IEA and SIESTA to the three case studies, 3) assessing the state of the science needed both to apply the frameworks and more generally for achieving EBM along the US West Coast, and 4) management and policy opportunities and challenges for implementing and applying science to EBM. The meeting concluded with a discussion of next steps forward, from the perspectives of science, management, and policy.

The following synthesis is intended to capture the main ideas that emerged from the meeting; it does not necessarily represent a consensus opinion of the attendees.

Key Topics Discussed

Tradeoffs among ecosystem services

Focusing on ecosystem services is a useful approach for advancing EBM.
The goal of EBM is to ensure the long-term provision of the ecosystem services that humans want and need. Furthermore, it is now widely recognized that the continued delivery of these services depends on healthy, productive and resilient ecosystems. As a result, a focus on ecosystem services rather than on EBM *per se* allows us to manage in a way that optimizes the delivery of multiple services, not just within a single sector, but across sectors. It also reveals a need to develop new approaches and improve existing methods for mapping and valuing services under different management scenarios, and for evaluating tradeoffs among different services. These tools provide a basis for communicating the value of ecosystem services so that management can initiate an EBM approach.

Approaches and tools to evaluate and manage ecosystem services are needed.
EBM requires an approach that allows scientists and managers to evaluate and analyze potential tradeoffs among different management strategies. This approach should provide an efficient, transparent summary of the status of ecosystem components, screen and prioritize potential risks, and evaluate alternative management strategies against a backdrop of environmental (e.g., climatic, oceanographic, seasonal) variability. To achieve this, scientists need to organize and assess what we know scientifically about how ecosystems function and how social and ecological factors affect the delivery of key ecosystem services. The coupling of the *Integrated Ecosystem Assessments* (IEA) and *Science to Inform Ecosystem Service Tradeoff Analysis* (SIESTA) approaches may be an effective way to fulfill these needs, and thus constituted a primary focus of the meeting.

An Integrated Ecosystem Assessment (IEA), under development by NOAA, is a formal synthesis and quantitative analysis of information about natural and socio-economic factors in relation to specified ecosystem management goals within a defined region. It involves and informs citizens, industry representatives, scientists, resource managers, and policy makers through formal processes and is defined by four key steps: scoping, indicator development, risk assessment, and management strategy evaluation.

A method under development by the CCEBM Science Advisory Committee, Science to Inform Ecosystem Service Trade-off Analysis (SIESTA), is an approach for achieving the management strategy evaluation step of the IEA. SIESTA is a means for defining and visualizing the relationship and potential trade-offs among the delivery of key ecosystem services. SIESTA is not a model, but rather a heuristic tool that reveals acceptable versus poor management options and opportunities for improving our ability to both protect and procure services from the ecosystem. SIESTA was presented at the meeting and illustrated by hypothetical examples: 1) the tradeoff between biodiversity

preservation and fisheries production in the Channel Islands, CA, 2) the tradeoffs among wave energy production, fisheries production, and shoreline protection in Oregon, and 3) managing for the sustained delivery of a diversity of services in Willapa Bay, WA.

These approaches appear to be promising for EBM applications, but require further scientific development (e.g., more sophisticated underlying dynamics for SIESTA) and case study tests. Creating the translational products where basic science supports specific applications, including how to communicate these tools to managers, also requires additional development.

Is focusing on ecosystem services too anthropocentric?
A focus on ecosystem services suggests an emphasis on the benefits that humans receive from a functioning ecosystem, rather than on the intrinsic importance of the ecosystem or its importance to other species. Some argue this perspective is too anthropocentric and ignores important ecosystem attributes that are difficult to quantify and value. Others assert that ecosystem services are an effective basis for EBM, as this focus acknowledges the connections between human and natural systems, is useful for conveying these ideas to the general public and that the intrinsic value of an ecosystem can be quantified and incorporated into analyses of ecosystem service tradeoffs. Taken together, these views suggest an inherent challenge of EBM: how to acknowledge and balance the social and ecological components of the ecosystem. This careful balance is not only possible, but essential, and requires that we do not limit our focus on ecosystem services to those with market value.

Scientific foundations of ecosystem-based management

We have moved beyond defining EBM.
Discussions focused on how to apply science to the implementation of EBM, rather than on what EBM means or why we need to apply this approach. Furthermore, there are an increasing number of scientists whose research is embedded in EBM projects or who are working to advance key science underlying EBM such as ecosystem service valuation, evaluating cumulative impacts of human activities, and working to understand factors affecting ecosystem resilience. Interdisciplinary scientific research along the West Coast with management implications is increasing in quality and quantity. Scientists are also thinking and working at a wider range of temporal and spatial scales, creating a need to draw connections and integrate data across these scales (e.g., ocean observing systems). Despite these important developments within the scientific community, there is still a demand for a new generation of scientists devoted to refining the science needed for improved and more comprehensive marine management.

Science is not the limiting factor.
In general, we have enough scientific information to move forward with an EBM approach now. The scientific community has made important strides forward in a variety of areas that will help EBM implementation including: 1) understanding and measuring cumulative impacts, 2) using ecosystem modeling to forecast the effects of different management decisions and select appropriate indicators of management success (e.g.,

Atlantis), and 3) mapping and evaluating ecosystem services (e.g., Natural Capital Project). However, despite a general consensus among the scientific community that we have the necessary science to improve on existing management practices, we lack an accurate and specific assessment of our scientific knowledge (see *Next Steps*). Lastly, given the wealth of information available we need improved data synthesis, integration, and accessibility.

There continue to be rich areas in which to further advance science in support of EBM. Despite recent scientific advances and agreement that we have the knowledge necessary to improve on current management practices, areas for scientific development remain. Specifically, research needs include:

1) understanding the connections and feedbacks between the human and biophysical components of the ecosystem,
2) assessing cumulative impacts of management decisions and ecosystem function on social components of the system,
3) developing indicators and metrics to assess the impact of management strategies on society,
4) building more capacity for advancing the social science underpinnings of EBM,
5) understanding the natural and social science implications of managing ecosystems at larger spatial scales and over longer time scales,
6) comprehensive seafloor and coastal habitat mapping,
7) understanding and predicting climate change impacts, including an improved ability to understand interactions between natural and anthropogenic driven variability, and
8) understanding land-sea connections.

The participants recognized that EBM should be implemented as an adaptive management approach, being modified as we learn from our actions and increase our scientific understanding of the system. Moving forward with EBM will reveal important areas of high uncertainty, allowing more targeted research and data collection.

From science to implementation

Science is not the only factor affecting our ability to achieve marine EBM. While there are important scientific advances enabling improved marine management, and important scientific limitations that must be addressed with new research agendas, we should not be discussing science in a “vacuum”. Moving forward with EBM also requires focusing on governance challenges, such as institutional structures, incentives, or changes to policy. Parallel efforts are underway to study the jurisdictional, institutional, political and legal challenges of EBM, and there is a need to connect these efforts to the scientific outcomes from this meeting. Similarly, there will be a need for a “procedural map” for how to apply science to EBM in the real world.

The precautionary principle can be applied when scientific uncertainty is high. EBM is ideally an adaptive management approach. Within this framework, the level of scientific uncertainty can be used to guide our level of management precaution. The less we know about the effect of a particular activity, the more the activity should be

regulated and/or restricted. This approach thus provides political incentive to promote data collection and research to reduce scientific uncertainty while identifying the issues where decision making can provide an adaptive management response.

Science must be communicated in a comprehensible way to a range of audiences. For science to be applied to marine EBM, it must be communicated clearly to managers, policy makers and the general public. Furthermore, there is need for scientific tools that can provide practitioners with more transparent means of making management decisions.

Next Steps

The following next steps were identified during plenary and breakout discussions at the meeting. These are not intended to represent a comprehensive list of all the action items needed to move forward with EBM on the US West Coast.

- Scientific development:
  - Synthesis and specific accounting of available scientific knowledge that can support moving forward with EBM. It is not sufficient to say we know enough to manage better; we need a more specific assessment of the state of the social and natural science relevant to EBM.
  - Continued development of interdisciplinary and cross disciplinary research relevant to EBM, potentially leveraging research conducted on ecosystem services, coupled social and natural systems, and resilience in terrestrial systems.
  - New connections between sectors that are sensitized to key issues where EBM tools can be especially effective (e.g., water supply and climate change).
  - Form an “EBM swat team” to advise EBM pilot projects.
  - Create a regional data repository or build from existing data integration efforts (e.g., ocean observing systems).
  - Address scientific challenges listed above, with particular attention to advancing the social sciences.

- Tool and model refinement:
  - Tools supporting EBM (including models and other approaches such as IEA and SIESTA) require additional scientific refinement and application to real world case studies.
  - Development of tactical models that demonstrate how to apply science to management.

- Management development:
  - Host a similar meeting for coastal and marine managers to promote more effective application of science to real-world management issues.
  - Promote hierarchical scaling of local scale pilot projects to increasingly larger and longer scales, including moving farther offshore.
  - Demonstrate near-term successes and opportunities for EBM.

- Train high-level managers in EBM and related principles (e.g., ecosystem services, cumulative impacts).
- Develop a synthetic guide on how to implement EBM for managers.

• Improved communication:
- EBM relevant science needs to be communicated clearly and effectively to managers and policy makers.

For More Information

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CCEBM website: http://ims.ucsc.edu/ccebm
- Background materials provided to meeting participants
- Meeting agenda and presentations

COMPASS website: http://www.compassonline.org

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