A Synthetic Approach to the Science Of Ecosystem Based Management

Working Group Meeting 1
Executive Summary

NCEAS, Santa Barbara, CA

January 30 – February 1, 2006

Overview

The goal of this group is to produce a modeling and decision support framework that can be used in the implementation of marine ecosystem based management (EBM) in a coastal setting. We are focused on modeling a set of ecosystem services within a decision support framework that allows one to consider the outcomes of different management scenarios and meaningfully evaluate ecological, social and economic tradeoffs associated with different courses of action. We aim to produce a transparent and general process that is easy to use and to transfer to other systems, but also to investigate specific examples for real case study systems.

The major products of our work will be (1) a system model(s) that captures key components, linkages and feedbacks of the biological, social and economic systems that drive the delivery of ecosystem goods and services of interest, (2) a valuation framework based on Total Economic Value that defines the values placed on different ecosystem states by stakeholders and decision makers in a utility function, and (3) a decision support framework that integrates the system model and utility functions described above and allows the exploration of different scenarios of management action.

Key cross-cutting issues

- Spatial scales of ecological processes and management, scale mismatches between them, and cross-scale linkages
- Integration of disparate datasets collected at varying spatiotemporal scales
- Coping with uncertainty in data, models, and valuation

The services

We will focus our modeling efforts on three sets of ecosystem services: seafood production, recreation and ecotourism, and watershed services (including land use for coastal development, water quality provisioning and regulation, etc.). These three main areas will be made more specific for individual models and case studies.

The case studies

We tentatively plan to use the Monterey Bay National Marine Sanctuary and Elkhorn Slough (and perhaps one other ecosystem) as case studies. A subgroup focused on the question of how to determine ecosystem boundaries will further refine the choice and definition of these working group case studies over the next couple months. These two case studies were deemed appropriate because of their nested spatial scales, the quality of data available, existing interest in EBM within these areas and the agencies with jurisdiction, and the potential for collaboration and cross-fertilization with the Packard-funded regional initiative at Elkhorn Slough. During the next six months, members of the working group will gather existing empirical data on these potential case studies and meet with managers from the areas to solicit their expertise and advice on key management objectives, target ecosystem services, and critical ecosystem linkages for their system.

Example questions:

- How should the boundaries of ecosystems be defined? What constitute coherent, natural units for management within Central California?
- How do the ecosystem components, key drivers, management objectives, and governance issues differ between an estuarine system and a more oceanic system?
- What are the best techniques for integrating datasets that derive from diverse disciplines and have been collected at varying resolutions and spatial scales? How can one account for the joint uncertainties associated with integrated data layers and incorporate them into models?

The system models

Two subgroups of the working group are working on developing approaches for modeling the key components of the case study ecosystems. One group has started with a multispecies bioeconomic model and will investigate various techniques for capturing the production of ecosystem services with these sorts of models as a starting point. The other group is focused on producing a system model that starts with the services, rather than with the ecosystem components, taking a more aggregated approach (e.g. mass balance, trophic transfer models). At the next working group meeting we will compare these different approaches and decide whether they converge or can be combined (e.g. using different models for different scale questions) or whether one approach is more promising than the other.

Example questions:

- What is the appropriate level of aggregation (or detail) for modeling ecosystem dynamics for EBM?
- How might the choice of model affect management decision-making?
- What kind of modeling framework is most appropriate for situations where data are sparse?

The valuation framework

Another subgroup is developing a process based on Total Economic Value for integrating empirical information on people's revealed and stated preferences for particular ecosystem properties and/or states of the ecosystem. This information will be used to create a valuation or utility function (or set of functions, reflecting heterogeneity in valuation) that can be used in the decision support framework outlined below. We will express all values for ecosystem goods and services and ecosystem states in terms of dollars. We are currently seeking support for a graduate intern to review the literature for existing information that can be used in this valuation.

Example questions:

- How does heterogeneity in the value that people place on ecosystem goods and services or the state of the ecosystem affect optimal decision making in marine EBM?
- When and how does the method of determination of valuation affect the decision making process?

The decision support framework

We have begun to develop a decision support framework that combines the valuation function and system model(s) described above in the form of a nonlinear constrained optimization model. This model allows one to solve for the optimal management action under various conditions and to ask how much worse the outcomes of actions that deviate from the optimal solution might be in terms of total economic value. We will use tools and techniques from standard decision theory for this work, and will focus in particular on how system and decision uncertainty may affect results.

Example questions:

- Operating under uncertainty – what is the minimum set of data needed to use this approach? Can it work when data are sparse?

Organizational Structure and Timeline

A flowchart of key tasks and subgroups is given on the next page and summarized in the table below. We identified four subgroups who will divide up the work between now and the 2nd working group meeting. Names in bold indicate subgroup leaders. Names in parentheses indicate working group members who would like to be kept in the loop with subgroup activities.

Group	Objective	Members	Tasks	Time
1	Definition of ecosystem boundaries for case studies and data mining for system modeling	**Bernardo, Carrie**, Geoff, Dave, Steve, Ben, (Mike), Fio	1. RM, CK, FM - Meet with Elkhorn Slough and MBNMS folks 2. CC, SG, DS, RM, BH, CK- Meet in SB with Group 3 3. Data mining 4. Decide on 2-3 spatial scales/case studies 5. Get more concrete about particular issues of interest for ea case study	Feb/Mar/ Apr Mar 8 Mar-Jun Apr Apr
2	Development of valuation framework and data mining for economic valuation data	**Susanne**, Kenny, Carrie, Dan, Andy, Marc, Jim, Ana Spalding? Andy's student? Marc's students?	1. SM & CK - Draft position description for grad intern 2. Review NAS report on valuation 3. Hire grad intern 4. Intern - Collect revealed & stated pref data 5. SM et al - Begin to develop methods for integrating data in utility fxn 6. CK - Contact Linwood Pendleton re: valuation data and methods for CA 7. DB & SM - Put together literature list 8. Group conference call	Feb Feb Mar 1 Mar-Jun Mar-Jun Feb Feb Late Mar
3	Development of finer scale system model and decision framework	**Chris**, Jim, Steve, Dave, Rebecca, Ben, Carrie, Marc, Fio, (Salvador), (Dan), Marc's students?	1. Develop generalized modeling approach 2. CC, SG, DS, RM, BH, CK - Meet in SB with Group 1 3. Start to write programs 4. First model runs	Feb Mar 8 Feb-Apr May-Jun
4	Development of aggregated system model and decision framework	Andy, **Mike**, Susanne, Carrie, Rebecca, (Salvador), (Dan), Marc's students?	1. RM & CK (and groups 1&2) - Compile data on biol, social and econ drivers 2. CK, AR, FM meet in California 3. AR, SM, MF - Try to write down system model in detail 4. CK & AR - Path analysis to identify key interactions and linkages	Mar-Jun June Feb-Mar Mar-Apr

Upcoming Meetings

Subgroups on system modeling and defining ecosystem boundaries

- March 8 Local members of groups 1&3 - Carrie, Ben, Bernardo, Dave, Steve, Chris, and Becca - to meet in SB. Additional small group-meetings (at UCSB and UNH) will be scheduled through spring-summer 2006

Next working group meeting

- September 2006

Meeting participants

Fiorenza Micheli	Stanford University	*Principal Investigator*
Andy Rosenberg	University of New Hampshire	*Principal Investigator*
Carrie Kappel	NCEAS	*Postdoctoral Fellow*
Kenneth Broad	University of Miami	
Bernardo Broitman	NCEAS	
Dan Brumbaugh	American Museum of Natural History/Natl. Marine Protected Areas Ctr.	
Christopher Costello	UC Santa Barbara	
Michael J. Fogarty	NOAA Fisheries	
Steven D. Gaines	UC Santa Barbara	
Ben Halpern	NCEAS	
Salvador Lluch Cota	CIBNOR	
Marc Mangel	UC Santa Cruz	
Rebecca Martone	Stanford University	
Susanne Menzel	University of York	
Chato Osio	University of New Hampshire	
James N. Sanchirico	Resources for the Future	
Geoffrey G. Shester	Stanford University	
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