Assessment of Information Needs for Ecosystem-Based Management of Coastal Marine Systems

Report on a survey by the National Center for Ecological Analysis and Synthesis
October 2008

Introduction

The National Center for Ecological Analysis and Synthesis (NCEAS), a research center of the University of California, Santa Barbara, aims to develop scientific knowledge about ecological, social, and economic processes that affect management and legislative regulation of coastal–marine ecosystems. In particular, we seek to examine, both conceptually and via empirical evidence, how such knowledge can be transferred effectively to planning, decision making, and implementation at different scales and in different geographic locations worldwide.

During 2009 and 2010, we will convene two or three working groups that will conduct synthetic research on ecological, social, or economic topics; ways to communicate and transfer information; or analytic tools that bear on management of coastal–marine ecosystems. Working groups are multidisciplinary teams (typically 12–15 individuals) of researchers, managers, and policy makers with diverse affiliations. These groups meet in person several times over a period of approximately two years, with substantial work conducted between meetings at the participants' home institutions.

Before developing a request for proposals for working groups, which will be disseminated to and promoted among practitioners as well as natural and social scientists, we sought to identify synthetic research topics most relevant to implementation of ecosystem-based management. With input and guidance from professionals in the natural and social sciences, we conducted a survey of practitioners of ecosystem-based management. The survey was designed to address two primary questions:

1. What types of information might fill gaps or needs in the practice of ecosystem-based management?
2. What might be the most useful ways to share this information with practitioners?

For the purposes of this survey, we define ecosystem-based management as management that is multi-sectoral, considers humans as part of the ecosystem, and has an ecosystem-level rather than (or in addition to) a species-level focus. The process of ecosystem-based management also requires evaluation of ecological, social, and economic tradeoffs among objectives and potential actions for achieving those objectives. We asked practitioners to respond to our survey using this definition of ecosystem-based management regardless of whether they agreed with the definition.

We focused our survey efforts on seven geographic regions: western Caribbean, Galapagos / eastern tropical Pacific, Philippines, Gulf of California, Great Barrier Reef, Gulf of Maine, and six locations along the west coast of the United States (Elkhorn Slough, Ventura County, Morro Bay, Humboldt Bay, Port Orford, and San Juan Islands) that have formed a network led by the National Oceanographic and Atmospheric Administration's Coastal Services Center. For each region, we developed an initial list of potential respondents based on existing professional contacts. We contacted a number of individuals on each of those initial lists to request their suggestions for additional potential respondents. We also asked each recipient of the survey to recommend other suitable respondents. Each of these steps yielded new potential respondents.

Before distributing the survey to the entire sampling group, we asked a senior professional in each geographic region to complete a trial version of the survey and provide us with feedback. Three professionals responded, and their comments were used to revise the survey instrument. Bernardo Broitman, a postdoctoral associate at NCEAS who is a native speaker of Spanish, translated the final version of the survey into Spanish. We distributed both the English and Spanish versions of the survey to individuals in the Galapagos, western Caribbean, and Gulf of California. Two individuals responded to the Spanish version.

The number of distributed surveys and responses for each geographic region was as follows.

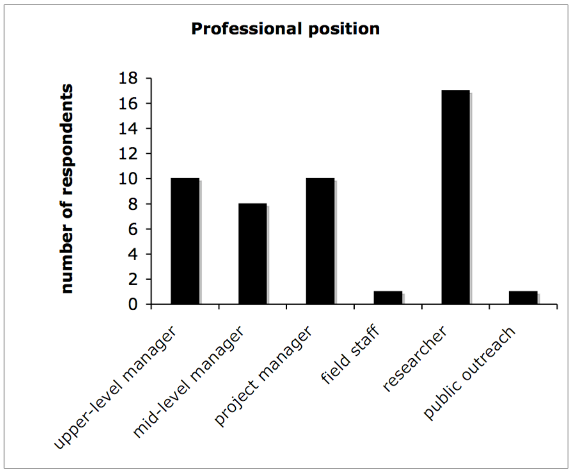
region	distributed	responses (percent)
western Caribbean	7	2 (29%)
Galapagos / eastern tropical Pacific	16	2 (13%)
Philippines	32	12 (38%)
Gulf of California	8	4 (50%)
Great Barrier Reef	24	6 (25%)
Gulf of Maine	92	11 (12%)
west coast USA	41	10 (24%)
total	220	47 (21%)

Each individual to whom we sent the survey received a maximum of three reminders requesting their input.

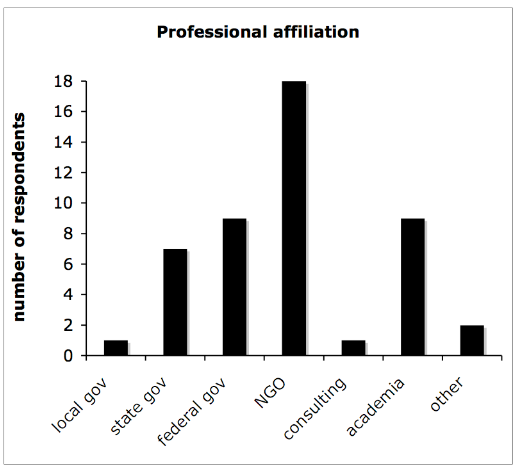
Demographic Data

We received responses from 30 men and 17 women. In general, the majority of respondents appeared to be mid-career. The average age of respondents was 45.5 ± 8.9 (SD). Respondents have been employed as conservation practitioners for an average of 15.5 ± 8.4 years.

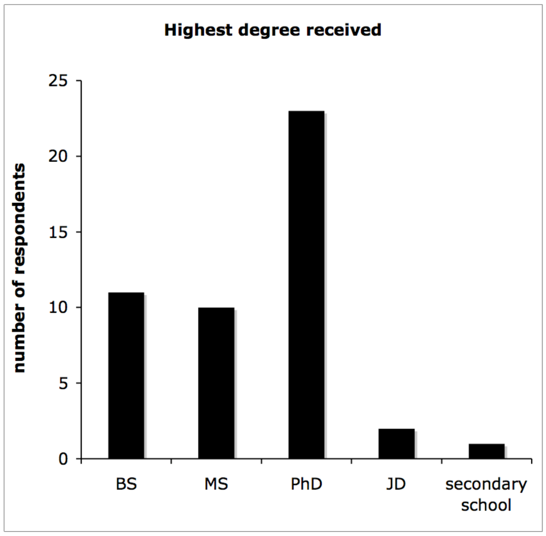
The diversity of positions and professional affiliations of respondents was high, and gave us insight into the perspectives of individuals who play different roles in non-academic organizations. Only 19% of respondents were affiliated with academia (see below), but approximately one-third (34%) characterized their position as natural or social scientist or researcher. Mid-level or upper-level managers comprised 38% of the respondents, and 21% of respondents considered themselves project managers.



The greatest number of respondents (38%) were affiliated with nongovernmental organizations. Respondents that were affiliated with federal government and academia (excluding extension) each accounted for 19% of respondents.



Nearly three-quarters of respondents had advanced degrees, and all but one had some post-secondary training.



We have not compared survey responses among the demographic groups described above, but doing so is feasible for categories that do not have extremely small sample sizes.

Presentation of Results

In general, results below are reported for the full group of respondents and are not presented in detail for the seven geographic regions. However, we have compiled results for each geographic region, which are available on request. For most survey questions, we found strong concordance in responses among geographic regions. As a result, we did not detect strong differences among regions on the basis of their economic status or major climatic category (e.g., temperate versus tropical). In the summary below, we note any regional patterns that appeared striking. Small sample sizes likely would prohibit a meaningful quantitative analysis of responses among geographic regions, but we may be able to pool responses from multiple regions for certain qualitative comparisons.

For open-ended questions, we have summarized the primary themes that emerged from the suite of answers. In some cases, we also included a number of responses, presented anonymously, that were illustrative of common or unusual perspectives. These quotations are indicated with italics.

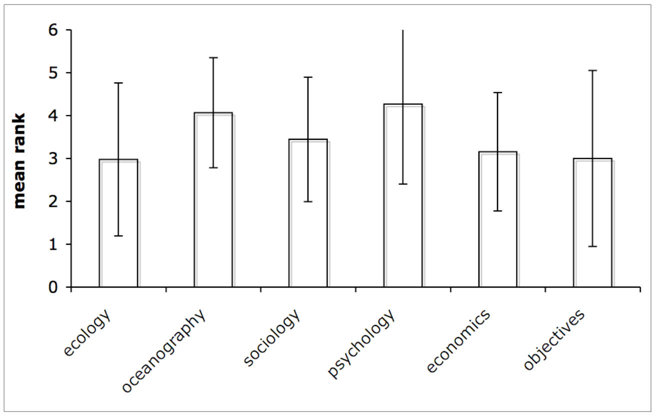
The original, complete survey is available on request.

Section 1. General needs for conducting ecosystem-based management

Question 1. We asked practitioners to rank obstacles that may be encountered by organizations that are trying to develop and implement an ecosystem-based approach to management. For each grouping below, we asked practitioners to rank the obstacles in terms of the challenges they pose to their organization, where "1" is most challenging and "6" is least challenging (thus, bar height in the figures is inversely proportional to the magnitude of the challenge).

Question 1a.
- ☐ Insufficient information about ecology
- ☐ Insufficient information about oceanography
- ☐ Insufficient information about sociology
- ☐ Insufficient information about psychology
- ☐ Insufficient information about economics
- ☐ Insufficient information for addressing specific management objectives

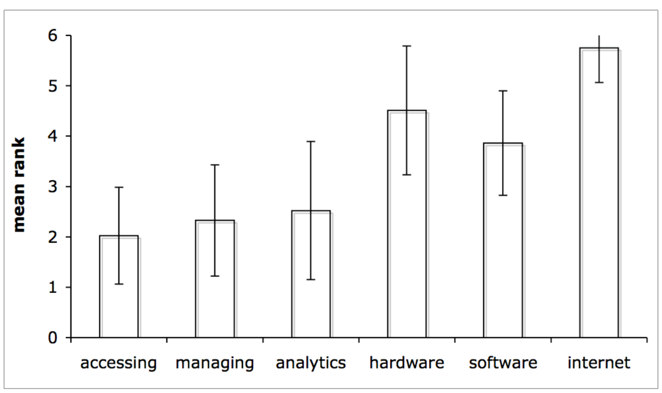
> None of these topic areas appeared unusually challenging relative to all others. For the entire pool of respondents, mean rankings ranged from 3.0 for ecology and addressing specific management objectives (± 1.8 and 2.1 [SD], respectively) to 4.3 ± 1.9 for psychology. Among geographic regions, relative rankings were somewhat more variable. Insufficient information about psychology, for example, was reported to be a much greater challenge in the Gulf of California (1.8 ± 1.5) than in the Great Barrier Reef (5.2 ± 1.3) or west coast of the United States (5.0 ± 1.8).



Question 1b.

- ☐ Difficulty in accessing data
- ☐ Difficulty in managing data
- ☐ Insufficient information about analytic methods
- ☐ Insufficient hardware
- ☐ Insufficient software
- ☐ Insufficient access to the internet

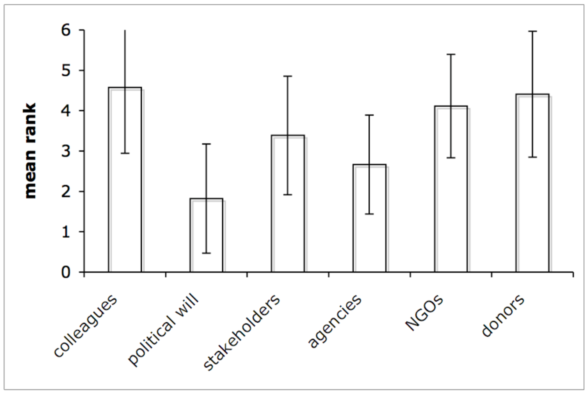
Most respondents appeared to have sufficient access to electronic means of communication and computing equipment. Respondents were relatively more constrained by data access and data management.



Question 1c.

- ☐ Lack of commitment from colleagues
- ☐ Lack of will from policy makers
- ☐ Difficulty in communicating with stakeholders
- ☐ Difficulty in coordinating among governmental agencies
- ☐ Difficulty in coordinating among nongovernmental organizations
- ☐ Difficulty in coordinating among donors

Lack of will from policy makers and difficulty in coordinating among governmental agencies appeared to be the greatest challenges to development and implementation of an ecosystem-based approach to management. Lack of will from policy makers received the lowest average rank in five of the seven geographic regions, and the second-lowest rank in the other two regions.



Questions 2–3. We asked practitioners whether they experience barriers to the use of natural science and social science in their work. If so, we asked them to describe the barrier and any suggestions they have for overcoming the barrier.

31 respondents (66%) reported that they experience barriers to using natural science. The most common theme among the open-ended responses was that stakeholders have limited understanding of how science can be applied to decision making. Responses also indicated a need to translate technical information into a format that can be understood easily by decision makers and the public.

34 respondents (72%) reported that they experience barriers to using social science in their work. Many respondents commented that they and their coworkers have limited knowledge of social science and few opportunities to interact with social scientists.

"Barriers exist mostly because of lack of social science information for our area and general lack of understanding of how to use it or what it is."

"Insufficient financial resources and technical information about analytic methods. I suggest that more resources should be specifically devoted in using social sciences in the same manner as natural science."

Section 2. Use of science and information in ecosystem-based management

Questions 4–5. We asked what, if any, ecological, social, or economic data would help practitioners improve the scientific basis of management in their region or the practical effectiveness of management in their region.

Answers to these questions were diverse. Among the data that might improve the scientific basis for management in one or more geographic regions were data on the ecology of commercially harvested species; information on connectivity, including but not limited to exploring connections among marine protected areas and adjacent waters;

measures of local effects of climate change; information on the location of marine ecosystem types, especially benthic types; and nutrient loading. Respondents also noted a need for stock assessments, estimates of market and non-market values of commercial fisheries, and mapping of social networks. Several respondents were interested in obtaining geographic data, such as satellite images or higher resolution digital elevation models.

"This is a big question that we were unable to properly address with US$700,000 and 18 months in [our region]. There are so many different resource types and systems each with different needs. For example, small scale fisheries need information on livelihoods and potential for organization. Commercial shrimp fisheries may need information on oceanography and fleet economics."

Data that respondents indicated would improve the practical effectiveness of management included maps of land use and ecosystem types, stock assessments, and especially economic valuation data (market and non-market).

Questions 6–7. We asked what, if any, hardware or software would help practitioners improve the scientific basis of management in their region or the practical effectiveness of management in their region.

Many respondents identified software for geospatial analyses and hardware with sufficient power to run those analyses as a means to improve the scientific basis of management. Respondents also indicated that they would benefit from software and hardware, including but not limited to data loggers and electronic log books, for collecting and analyzing time series data. Several respondents expressed a desire for software to support development and evaluation of alternative scenarios. One individual noted that software programs such as Marxan and ArcGIS are available, but typically are underutilized.

"Real time monitoring equipment, be they simply temperature, salinity and oxygen or underwater microphones or even cameras engage citizen-scientists . . . their observations may not be scientific, but their knowledge of what is normal and what is not goes far to alert scientists when systems are going awry."

To improve the effectiveness of management, many respondents again focused on geospatial hardware and software. Several individuals commented that they would be assisted by decision-making software.

Answers to these questions, and the following two questions, suggested that terms associated with data management and analysis are not clear to many members of the professional community. It did not occur to us to define hardware or software. However, we found that some respondents confounded analyses or data sources with software.

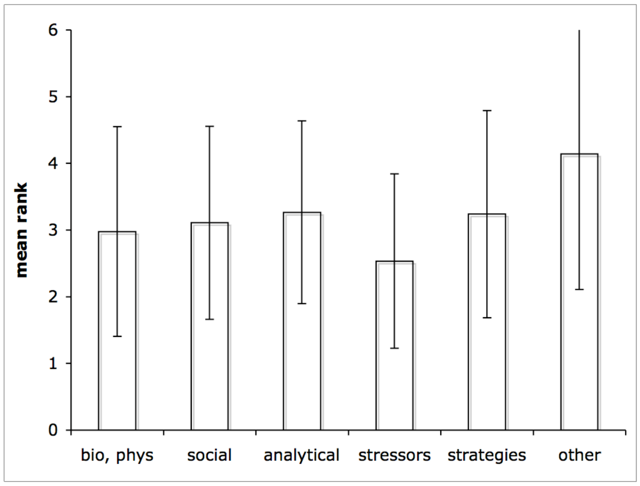
Questions 8–9. We asked what, if any, analytic methods would help practitioners improve the scientific basis and practical effectiveness of management in their region.

> Respondents noted that analyses such as basic stock assessment, simulation models, reserve selection algorithms, and hydrological models (e.g., water circulation and sediment transport) might improve the scientific basis of management. Several respondents also highlighted a need to analyze costs and benefits of alternative scenarios or decisions.
>
> To improve the practical effectiveness of management, respondents again suggested analyses that illustrate ecological and, especially, economic tradeoffs among decisions. Also mentioned were analyses to facilitate processing of remote sensing images. In addition, respondents indicated a need to improve access to and management of distributed and long-term sets of data.
>
> *"Simple data management tools that can assist to consistently collect, store and analyze data over extended periods will be useful to improve management effectiveness."*

Question 10. We asked practitioners to rank the following areas or aspects of science in terms of the amount of additional information that is needed to improve ecosystem-based management in their geographic region.

☐ Biological and physical sciences (e.g., population biology, ecology, oceanography, hydrology, climatology)
☐ Social sciences (e.g., anthropology, political science, sociology, psychology, economics)
☐ Analytical methods (e.g., reserve selection algorithms, processing of remote sensing images, predictive modeling approaches, social impact assessment, measures of management success)
☐ Effects of stressors on ecosystems (e.g., effects of climate change, storm patterns, fishing, pollutants)
☐ Effectiveness of alternative strategies and actions for minimizing or mitigating stressors to ecosystems (e.g., policies to improve conservation on private lands, establishment of marine protected areas, regulation of flood waters)
☐ Other (specify:)

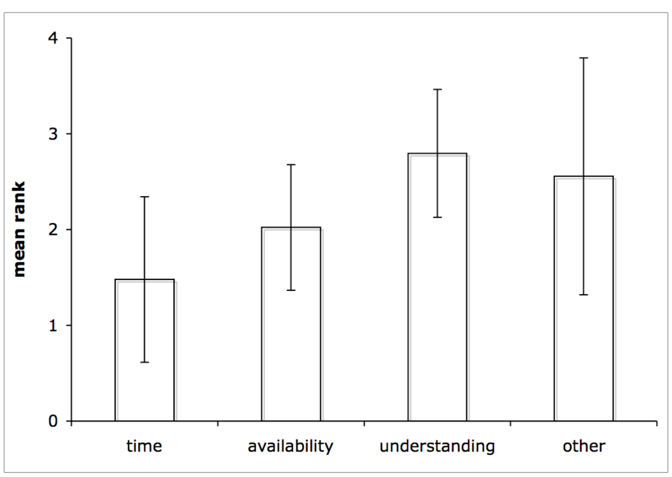
> Overall, different areas of science received similar mean ranks. When responses from all regions were pooled, it appeared that information on the effects of stressors on ecosystems might be especially useful. However, there was some variance among geographic regions. Respondents from the Great Barrier Reef and western United States indicated that information from the biological and physical sciences would be especially useful, whereas respondents from the Caribbean highlighted a need for more information on social science and respondents from the Galapagos prioritized information on alternative strategies. Other sources of information that respondents would find useful probably would fit within the categories listed, but ranged from cost of specific management actions to radar-based imagery that can provide information for areas with heavy cloud cover.



Question 11. We asked individuals to rank the following factors in terms of the challenges the factors present to their ability to stay informed about the latest advances in natural and social sciences relevant to ecosystem-based management, where "1" is the greatest challenge and "4" is the least challenge.

☐ Finding time in my schedule
☐ Obtaining suitable materials
☐ Understanding materials
☐ Other (specify:)

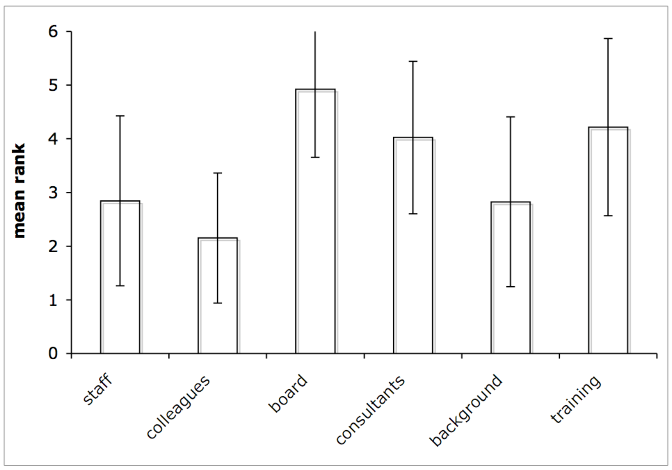
Limited time is perhaps the greatest challenge to practitioners' ability to stay informed about scientific advances. However, on average, practitioners in the Philippines and Gulf of California find it more difficult to obtain suitable materials than to allocate time to digesting those materials. Several respondents noted that they are constrained by the availability of materials in Spanish. Other challenges that respondents cited ranged from free access to online journals to meeting invitations to funding to attend meetings.



Question 12. We asked practitioners to rank various sources of scientific information in terms of their importance on a personal level, where "1" is most important and "6" is least important.

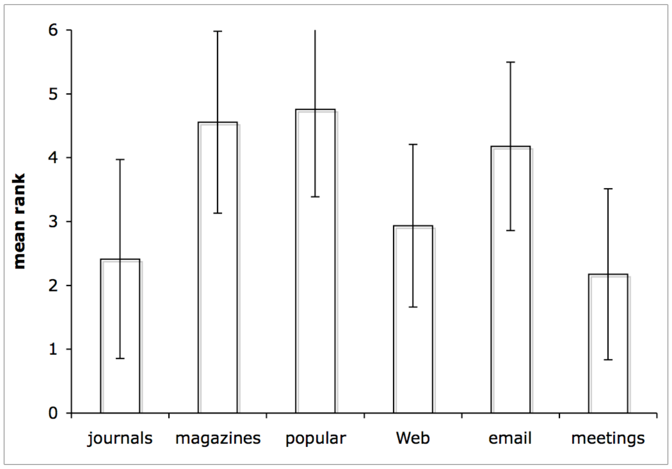
Question 12a.
☐ Natural or social scientists on your organization's staff
☐ Colleagues outside your organization
☐ Your organization's advisory board
☐ Paid consultants
☐ My academic training
☐ Professional training programs (e.g., sponsored by a government agency or private foundation)

Colleagues outside the practitioners' organization (lowest rank in six of seven geographic regions) and practitioners' own academic training generally were among their most important sources of scientific information.



Question 12b.
☐ Peer-reviewed journals (e.g., *Conservation Biology*, *Human Ecology*)
☐ Trade magazines (e.g., *Conservation* magazine*)*
☐ Popular media (e.g., *New York Times, National Public Radio, television news)*
☐ Web sites (other than sites for the sources listed above)
☐ Email listservs
☐ Scientific or professional meetings

Scientific or professional meetings, peer-reviewed journals, and Web sites also were important sources of scientific information. On average, meetings were ranked as most important by respondents from the Philippines, Great Barrier Reef, and west coast of the United States. Journals were ranked as most important by respondents from Gulf of California, Gulf of Maine, and Galapagos. Meetings and journals received equal mean rank among respondents from the Caribbean.



Question 13. We asked practitioners to list any journals that they read on a regular basis.

Respondents listed nearly 60 journals as important sources of scientific information. *Conservation Biology* was cited by 15 respondents, followed by *Science* (11) and *Ocean and Coastal Management* (9). *Marine Ecology Progress Series* and *Nature* each were cited by seven respondents.

Questions 14–15. We asked practitioners whether they were aware of any situations in which new information about natural or social science has challenged their organization's management strategies or goals. If yes, we asked them to describe the situation, and whether their organization adjusted its strategies or actions in response to that new knowledge.

Twenty-two respondents said that new information about natural or social science had challenged their organization's management strategies or goals. Several respondents noted that their management strategies and goals had been challenged by new science on marine protected areas. Three respondents indicated that peer-reviewed journal articles had directly challenged their management.

"The increasing use of social science in the design of MPA and fisheries management approaches has challenged my organization . . . not to rely totally on biophysical science in the determining the optimal solution for MPA design, location and implementation."

"Several ecosystem-based management or ecosystem-based fisheries management papers in various journals were useful in developing our vision, mission, and program goals. Our advisory team reads ecosystem-based management papers published these past few years extensively."

"State Parks conducts outdoor recreation surveys every few years that changes the policies and focus for management of parks."

"New science on disease in sea otters has changed the way we consider land to sea runoff and refocused our priorities on reducing stormwater runoff."

Whether organizations had adjusted in response to the new knowledge was more equivocal, and spanned a gradient from specific adjustments (e.g., "We have put specific language in stormwater permits addressing sea otter health issues") to fairly broad changes in mandate that may have little effect on daily practice.

"In particular, a) the importance of socio-economic information in effective MPA network planning and b) the acceptance of certain good practices in the use of Marxan have led us to revise our strategies. We have invested less in developing natural science products and more in influencing the direction of planning processes, establishing collaborative relationships, and working at the political level to create an impetus for EBM."

"This change is taking time but it comes from within and the employment of scientists and practitioners with a broader range of skills, knowledge and interest to pursue new approaches to marine conservation."

Section 4. Improving relationships between researchers, practitioners, and other communities

Questions 16–17. We asked practitioners to describe how researchers can make their work more useful or accessible to practitioners, and how practitioners can make their needs for scientific information clearer to researchers.

A clear message that emerged from the responses to the former question—how researchers can make their work more useful or accessible to practitioners—was that practitioners would like researchers to distill scientific information into reports with minimal jargon and into interactive seminars or other participatory mechanisms. Several respondents indicated a desire for researchers to become more actively involved in regional planning and decision making.

"'Involve' us in the research in some way. Don't just pass on the findings."

"They need to be more sensitive to understand conservation problems and not use the 'conservation issues' to continue their research"

"Collaborate on projects including identifying key questions and stakeholder input of design of research project."

Some answers to the question of how practitioners can make their needs for scientific information clearer to researchers, such as sustained mechanisms for interaction, were similar. A number of respondents also noted that practitioners could provide more information to researchers on current management priorities and the nature of the decisions they are facing.

"Clearer terms of reference for researchers. Terms of reference should be based on what scientific information is needed to arrive at decisions."

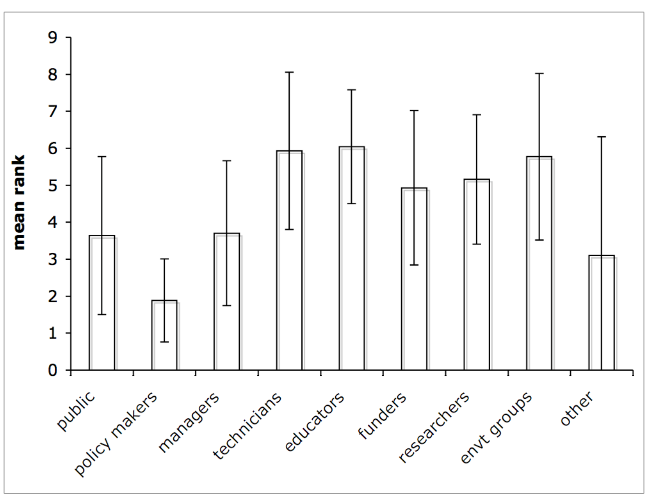
"We have to be perceived as an interesting area to do research. It has to be a place that attracts funding and other resources. There has to be some foundation of information to build on as well."

"We need a way to communicate with researchers who are looking for collaborative projects—we have many research questions that need answers but do not know the pool of candidates who might help us get the work done."

Question 18. We asked practitioners to rank the following audiences in terms of the audiences' importance in their efforts to communicate management objectives and outcomes, where "1" is most important and "9" is least important.

- ☐ General public
- ☐ Policy makers
- ☐ Other managers
- ☐ Field technicians
- ☐ Educators
- ☐ Funders
- ☐ Researchers
- ☐ Environmental organizations
- ☐ Other

Policy makers were a key audience for all geographic regions. Other managers and the general public also appear to be priorities for virtually all groups of practitioners we surveyed. Other important audiences included publishers and representatives of industry. Several respondents included stakeholders in the "other" category.



Question 19. We asked practitioners if there was anything else they would like us to know about how natural and social sciences are relevant to their practice of ecosystem-based management. Several responses that we found particularly interesting or useful are below.

"Being an anthropologist working on environmental projects, the natural sciences allow me to understand natural processes, which give insights how the human component of any conservation program can be introduced to have significant contribution both to ecosystems and human well-being."

"Recently have trained and encouraged tourist operators to collect basic scientific information at their site on a daily or more regular basis than most scientists currently are able to do; collectively the combined results of frequent basic measurements with comprehensive but less frequent measurements is giving us a much better overall and finer scale understanding"

"People love to learn. They are curious about their marine area. Participation in research (at all levels) is one of the best ways to get people interested and engaged in the management issues within an area—before they become a crisis."

"Our agency likes to use hard numbers such as the various long-held limits on certain pollutants. Most natural sciences don't generate hard numbers. For example, how many feet of undisturbed riparian habitat are necessary to buffer creeks, how much impervious surface can we allow in a watershed before it ceases to function correctly . . . If research ends with practical, well-defined endpoints like these, agencies are much more likely to understand and incorporate scientific outcomes into management. But scientists tend to shy away from black and white statements . . . to the point that managers (particularly engineers!) are less apt to act on them."