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Developing and delivering scientific information in response to emerging needs

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Ecological information that adequately informs society's decisions often differs in several ways from that which science routinely provides. This workshop examined changes that may be required if some of society's pressing goals (eg sustained provision of ecosystem services, establishment of policy that adequately reflects interacting economic, social, and environmental factors, and an engaged public making increasingly informed choices) are to be achieved. Using a common framework, representatives of the Long Term Ecological Research networks in Canada, the US, and Mexico described their concerns and initiatives related to the delivery and effectiveness of the data and information they generate. Workshop participants reached consensus on a number of recommendations: (1) that it is the responsibility of ecologists to effectively inform societal choices, policies, and decisions; (2) that improved outcomes need to be an additional performance measure at a science program level; and (3) that a variety of recommendations need to be acted upon to enhance the effectiveness of ecological science. A full symposium through the Ecological Society of America is suggested.

Muchas veces hay diferencias importantes entre la información ecológica que se requiere para adecuadamente informar a la sociedad y la que proporciona la investigación científica de manera continua. Este taller examinó cambios que podrán ser requeridos si se esperar alcanzar las demandas de una sociedad (eg la provisión sustentable de servicios ecosistémicos, el establecimiento de políticas que adecuadamente reflejen las interacciones económicas, sociales y factores ambientales, y un público incluido en la toma de decisiones). Usando una estructura común, representantes del Long Term Ecological Research en Canadá, Estados Unidos y México discutieron sus preocupaciones e iniciativas relacionadas con la forma de entrega y la vigencia de los datos e información producidos. Los participantes del taller formularon las siguientes recomendaciones: (1) que es la responsabilidad de los ecólogos de generar información científica que informe eficazmente a la sociedad en cuanto a opciones, políticas y la toma de decisiones; (2) que generando los mejores resultados deberá ser una medida adicional al nivel de la comunidad científica; (3) que una variedad de recomendaciones deben ser implementadas para mejorar la eficacia de la ciencia de la ecología. Se sugiere la organización de una sesión completa a través de la Ecological Society of America para dar seguimiento a este tema importante.

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At the Merida workshop reported here, representatives of the Long Term Ecological Research (LTER) networks in Canada, the US, and Mexico discussed their shared concerns about, and methods for, the effective delivery of data and information, with the aim of improving their networks' ability to constructively inform society's choices. Comments on the presentations and the issues they raised were provided by Exequiel Ezcurra, Director of the

Biodiversity Center at the San Diego Natural History Museum and former Director of the Mexican National Institute of Ecology. Subsequent discussion achieved a consensus among participants that was presented in a plenary session the following day.

■ Background

Public environmental concerns and issues are increasingly place-based and related to ecological sustainability. As a result, measures of scientific success for ecologists no longer simply involve developing new information and making it available, but should also incorporate the production and delivery of information that improves and informs decisions and policies. The word "delivery" is deliberately chosen to indicate that an ongoing dialogue with those who require or use ecological information in making choices or developing policies must be involved in order to ensure that tailored information fulfills users' needs. This additional focus

Workshop: Developing and delivering scientific information in response to emerging needs

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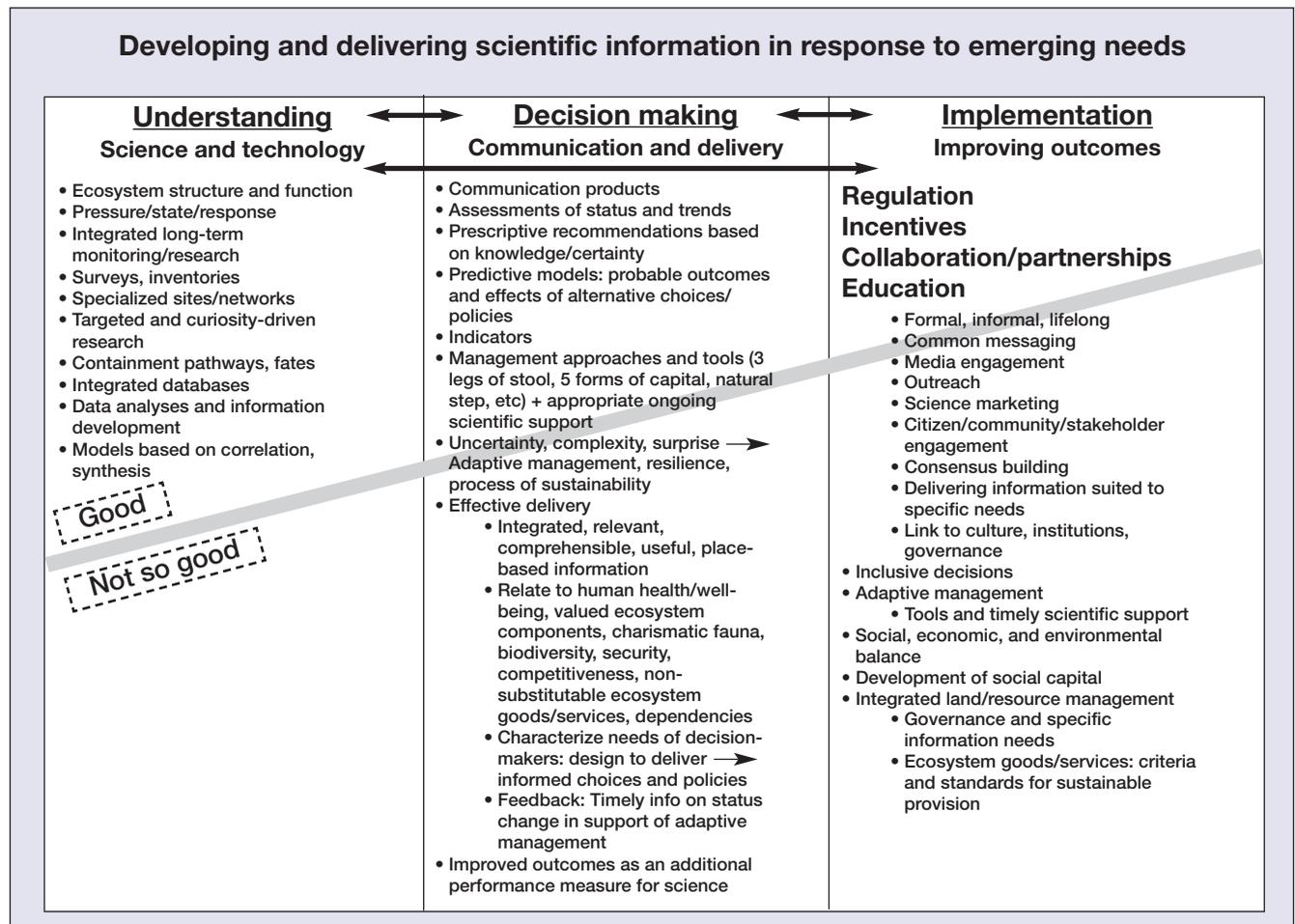


Figure 1. Needs framework used to guide discussions.

means that improvement in the way research and monitoring programs are planned and managed is required. This workshop aimed to identify gaps and to discuss ways to improve the generation of information and its delivery to decision makers, the public, stakeholders, research personnel, and managers, so that better-informed choices can be made (Vaughan *et al.* 2003).

In many cases, decision makers receive information well past the desirable point of intervention. This leads to a lag in policy decisions that may ultimately result in initiatives that are no longer timely or useful. Other factors that affect our ability to deliver information rapidly and effectively include our ability to communicate science usefully, our assumption of the responsibility to do so, our ability to deliver information that is specifically shaped, based on the known needs of the decision maker, and the development of public capacity to use that information (EMAN 2005).

The nature of information that can influence policy processes and public choices is not entirely consistent with that of the information routinely provided by ecologists (Figure 1). Information should (after EMAN and CNF 2003):

- Be relevant to problems and players
- Be useable in form and for a specific context
- Be targeted, accessible, and understandable to its audience

- Be integrated and suggest a course of action
- Be timely
- Allow decision makers to weigh choices, trade-offs, and consequences
- Ensure that those involved continue to be in control of the problem

The provision of information as feedback which is timely, integrated, and non-confrontational is particularly necessary in supporting adaptive management, where the tempo of decisions is closer to annual than to the decades often required to achieve statistical certainty of trends in observational data. Such information would comprise an additional product line for science, one that trades off certainty for timeliness in order to provide a basis for fine-tuning of management actions, including operations, development trends, interventions, or the implementation of policies. A useful analogy might be to a compass that ensures the desired heading is maintained from one moment to the next. Ecologists, particularly those associated with observational programs and monitoring, should consider that our fixation on certainty and peer review too often prevents us from supplying what is most needed and that there are no others to fill the gap.

Such feedback fuels adaptive management and sustain-

ability, processes of iterative decisions based on timely information, even if of limited certainty (MA 2005). This does not alter the fundamental importance of the solid, peer-reviewed science required for understanding, predictive modeling, and the management of critical issues (NRC 2005). Quite the opposite; such science is enhanced through an additional focus on its effective delivery, and both aspects are arguably required in order to achieve some of society's broader goals, such as sustained ecosystem services, resilient industrial development, policy decisions adequately reflecting interacting economic, social, and environmental factors, and an engaged public making increasingly informed choices (EMAN and CNF 2003; Vaughan 2003; EMAN 2005; MA 2005; NRC 2005).

A needs framework was developed to guide presenters and workshop participants in discussions to identify gaps and develop recommendations. Some questions for discussion were suggested:

- (1) **Why** is improved delivery of scientific information important? Is it a problem of science generally or is it specific to ecology?
- (2) **How** can we do a better job of informing choices, decisions, and policies?
 - Who should be responsible for delivery: the scientist, those involved with the project, the program, or the institution, the collaborative network, or others?
 - What additional rewards, incentives, and performance measures would be required for the scientist, those involved with the project, the program, the institution, or the collaborative network, and others?
 - What might be the cost to the scientist of being pushed to improve the outcomes of implementing his/her science?
 - How does the scientist benefit from the effort?
- (3) **Feedback based on needs**
 - To what extent should societal demand help define science priorities and performance?
 - How should the improvement of outcomes be measured?
- (4) **Next steps**
 - What specific enhancements to existing science would be effective in bridging the apparent gaps in delivery?
 - What is the path forward and what are the next steps in addressing the issues raised?

■ Presentation highlights

The framework and proposed questions were presented and discussed; this was followed by a description of the contrast-

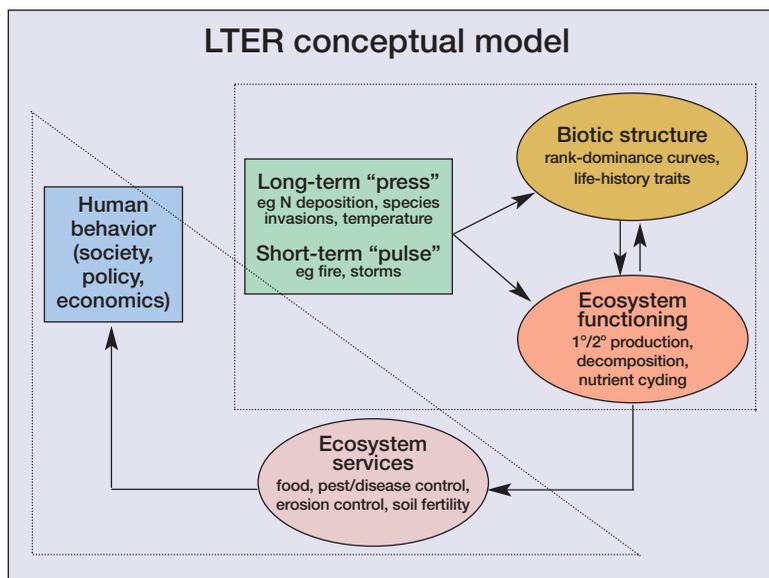


Figure 2. LTER model with a focus on ecosystem services as a bridging mechanism between science and society.

ing histories of the three national (Canada, US, Mexico) networks. The Ecological Monitoring and Assessment Network and Environment Canada focused on increasing the effectiveness of ecological monitoring and assessment through collaborative initiatives in standardization, increased engagement of broader sections of society, place-based assessments, and a heightened focus on the delivery of results and information tailored to the identified needs of decision makers at a variety of scales (see www.eman-rese.ca).

A description of the recent development of the MEX-LTER network was then presented, which included an ecosystem-management framework emphasizing social and economic goals linked to increased understanding of ecological processes (see www.mexlter.org.mx/). This approach has led to the inclusion of educators and planners from the network's inception.

The LTER network's growth from a group of individual sites focused primarily on site-based research to a functioning network with an increased emphasis on the application of research was described. A variety of examples from agriculture, forestry, and fisheries management were used to illustrate this trend (see www.lternet.edu), and a series of lessons on delivering information was summarized. An ongoing strategic planning exercise (Figure 2) showed how the US LTER network is seeking to link ecological models with human behavior and the provision of ecosystem services.

Descriptions of recent experiences in the Sea of Cortés were presented, in which unique species, communities, and ecosystems have attracted a great deal of research interest and awareness, in contrast to the degradation arising from seemingly unstoppable growth in population, per capita footprint, and overexploitation of land and freshwater. Recent social and economic trends in Finland were offered for comparison, along with a discussion of key factors, particularly the availability and public use of science

information, inclusive decision-making processes, and a shared appreciation of long-term values.

■ Consensus and recommendations

- (1) It is the responsibility of ecologists to effectively inform societal choices, policies, and decisions
 - The scientific community is in charge of initiating the process of consultation, engagement, education, and delivery. If not us, then who?
 - It is not enough to make science “available” or “accessible”; it needs to be actively delivered, which involves a dialogue with users, as well as changes to programs, outputs, and the design of installations.
 - Scientific investigation is usually instigated and driven by questions. A suitable question might be “how can we better develop and deliver science which effectively informs society’s choices, policies, and decisions from local to global scales, from the present time to the next generation?”
- (2) Improved outcomes need to be an additional performance measure at the science program level. For example, were results relevant to real needs and did they make a measurable difference outside the scientific community?
 - In their program designs, ecologists need to consider the appropriate pressure points for information delivery that achieves action, change, and improved outcomes, then design programs to accomplish this.
 - The role of the researcher is not altered through this additional performance measure, though delivery at a program or institutional level will come at a cost to research if there is no budget increase.
 - The term “decision maker” applies to everyone. It is perhaps better to start with desired outcomes in order to establish priorities for disseminating information.
 - Outstanding questions include: How should we market messages? How can we engage youth?

■ Increasing effectiveness

- Increase focus on ecosystem goods and services; these appear to serve as a bridging language or currency to engage decision makers.
- Increase focus on adaptive management and new product lines that deliver timely, useful feedback to support the process of sustainability (eg extension, community-based data collection).
- Characterize the information needed by a spectrum of decision makers: design to deliver.
- Altering outcomes is best done using a team approach:
 - engage a broader range of disciplines in teams (social scientists, educators, marketers)
 - use an ecosystem management framework, including consultation, engagement, education, and delivery
- Standardization (protocols, databases, ecosystem management framework, common messages) enables movement across scales.

- Greater emphasis should be placed on the synthesis of scientific information across research sites, between disciplines, and on the basis of place.

■ Other observations

- Factors in the long-term viability of a society:
 - include best available science in decisions
 - include long-term values, shared vision
 - citizen participation, access to information, and transparent decision-making
- Ecologists increasingly resemble people on the Titanic debating how to arrange the deck-chairs (after EO Wilson).
- Participants felt that there is a pressing need to address these issues and expressed regret that, despite competition from 16 concurrent workshops, more ESA members were not present.
- Walk the walk: ESA meetings should be carbon neutral and demonstrate the highest standard of recycling, energy efficiency, and local education and engagement.

■ Workshop outputs and products

- Oral report to ESA plenary session
- Report presented on the ESA website and the websites of the three national networks
- Seeking an early opportunity to develop a full symposium, ESA preferred

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