

PISCO

Meeting for Oregon Scientists about the Science of Marine Reserves

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Anne Guerry, OSU Department of Zoology

## **Marine Ecological Research to Inform Public Processes**

Marine ecological research has the potential to inform public processes in numerous ways. I focus here on three themes in which the linkages between ecology and public processes are most clear: understanding the distributions and abundance of organisms, understanding connections within and between ecological systems, and understanding and communicating the importance of ecosystem functioning.

### *Understanding the distributions and abundance of organisms*

Understanding the distributions and abundance of organisms is an important part of safeguarding ecological systems. In any scientific endeavor, there is a trade-off between the spatial scale considered and the level of detail possible. At relatively large spatial scales, ecologists have documented that physical factors are important determinants of community structure. For example, work on Oregon's rocky shores has documented clear relationships between wave action, productivity, substrate type, and sand influence and community structure (Menge 1992, Menge et al. 1994). We can also use knowledge about the interactions between biotic and abiotic factors to classify habitat types. The creation of ecologically meaningful classification schemes is an important first step toward mapping ecological communities at relatively large spatial scales.

Regional surveys, such as the Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO) Biodiversity program, can yield information at both small and large spatial scales. At large scales, PISCO's surveys of biological diversity on rocky shores from Cape Flattery to San Diego can provide important insights into geographical patterns in biological diversity. At small scales, species lists for particular sites can be of great utility.

Surveys of special areas or taxa of concern can also generate information relevant to conservation planning. Examples of work aimed at understanding particular areas include the Oregon Department of Fish and Wildlife's surveys of nearshore rocky reefs and the habitat-based fisheries investigations of Heceta Bank by the National Oceanic and Atmospheric Administration (NOAA). Sometimes a focus not on habitats, but on particular species of interest is the goal of ecological work: the Oregon-Washington Marine Mammal and Seabird Surveys, conducted by the National Marine Fisheries Service, are an example work focused on one suite of species that could be useful in informing marine management decisions.

### *Understanding connections within and between ecological systems*

Understanding connections between trophic levels within ecological communities, between systems, and between discontinuous habitat patches of a particular type are

central to ecology's role in public processes. Connections between trophic levels are a key way in which we understand community structure. For example, the removal of top predators has dramatic, cascading effects throughout ecological communities (Paine 1966, Estes and Palmisano 1974, Jackson et al. 1997).

Salmon are emblematic of the connections between systems; they require both marine and freshwater systems. Less obvious, but equally important connections are exemplified by the functioning of estuaries as nursery habitats (Brown unpubl., Emmett and Durkin 1995). Finally, terrestrial inputs can affect coastal systems. Just as the removal of top predators has cascading effects throughout ecological systems, so too does the alteration of nutrient inputs. One example of work examining these linkages is that of Worm et al. (2002) who examined the ways in which changes in nutrient supply and top-level consumers affect species diversity and ecosystem functioning.

Connections between discontinuous patches of a single habitat type can also inform management decisions. For example, Sotka and Palumbi (unpubl, in Palumbi, Gaines, Leslie, and Warner in review) used genetic tools to examine barnacle dispersal along the Oregon coast. After they are released from their parents on rocky shores, barnacle larvae drift in the ocean for several weeks before returning to a rocky intertidal area, where they settle and mature. Most marine populations use different habitat types for different portions of their lifecycles. Hixon and Tissot (1992) used submersibles to examine the capacity of Stonewall Bank to serve as a nursery area for juvenile rockfish.

These ecological connections link to marine conservation planning in diverse ways. Connections between trophic levels teach us that intact systems matter in the safeguarding of ecological functioning. Connections between systems remind us that representation of different habitat types in conservation plans is essential. They also teach us that spatially explicit planning is important--for example, it might make sense to consider the juxtaposition of different habitat types in a reserve system. Placing terrestrial, marine, and estuarine reserves in proximity may warrant consideration. And finally, connections between discontinuous habitat patches remind us that redundancy matters; single patches of a habitat type in systems of protected areas may not best represent ecological knowledge in conservation planning.

### ***Understanding and communicating the importance of ecosystem functioning***

There has been a fundamental change in the science of ecology—our roots are in the study of small parcels of land or sea, but documentation of the human domination of ecosystems has inspired shifts in both the spatial and temporal scales of our endeavors. Vitousek et al. (1997) provide a global perspective on the impacts of humans on marine environments. Impacts on the marine environment include: 60% of the human population living within 100 km of the coast, 50% of mangroves transformed or destroyed, and 22% of marine fisheries overexploited or depleted (according to 1995 United Nations Food and Agriculture Organization (FAO) statistics).

I have highlighted the importance of understanding not only the content (the who is who and who lives where), but also the context (the who eats who, who travels where, and what connects to what) of ecological systems. Both of these are essential parts of understanding the functioning of the ecological systems on which we depend. Communicating that same understanding of both the content and context of functioning

ecological systems is an important role for ecologists as humans rethink the ways in which we use ecological systems. Communicating not only a concern for particular species or places, but also the ways in which systems are interconnected and the ways in which society depends on functioning ecological systems is an important role for ecologists.

With the communication of that understanding and concern for systems, ecologists can, and should, be involved in the crafting of ecologically sound management and the monitoring of the effectiveness of management strategies.

In conclusion, we know a lot about where organisms and habitats of interest are. We know that intact systems, representation of a diversity of habitat types, redundancy of habitat types, and spatially explicit planning are important. And finally, ecologists—and all scientists—have an important role to play throughout public processes.

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