

MPA NEWS



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The State of MPA Science: A Survey of Experts on What We Need to Know

Can marine reserves assist in improving the management of fisheries? This concept has received significant attention lately in the pages of scientific journals and on the agendas of fishery managers. Sometimes called "no-take zones," these protected areas have displayed some evidence of contributing to increased fish abundance outside their boundaries, namely through the outflow of larvae from the reserve. Fishery managers have generally welcomed what they see as a promising tool to help rescue declining fish stocks.

But what do we know about the science of marine reserves? How applicable are the scientific findings from one species and area to the next? The still-nascent science has focused primarily on reef species in tropical waters, while reserves with long-lived temperate species are less-understood. Some MPA experts suggest that it is too early to say that the value of marine reserves in fishery management has been proven.

This month, MPA News surveyed a dozen MPA experts around the world for their thoughts on the state of science on marine reserves. We asked them a single question:

If you could have the answer to any scientific question regarding MPAs, what would it be and why?

We hoped to receive a wide range of responses, and we did. Below are their direct quotes:

Dr. Jim Bohnsack, National Oceanic and Atmospheric Administration, Miami, Florida, USA

My question would be: "How much protection can no-take marine reserves provide for the preservation of genetic biodiversity of exploited species?" I consider this the most important question because the loss of genetic biodiversity is essentially permanent and cannot be recovered in ecological time.

Answering this question first requires some knowledge about what effects selective fishing has on population genetics of exploited species. There is almost no information available on this problem although fishing is known to be selective on certain individuals, behaviors, ages, and sizes. The problem is in some ways circular, because without no-take marine reserves there is little opportunity to have control areas to assess selective effects of fishing. As practiced, fishing operates in reverse of animal husbandry in that the most desirable individuals are selectively removed from the genetic pool and less desirable individuals are allowed to breed. This selection can potentially reduce maximum size, reduce growth rates, and modify behavior in ways undesirable from a human viewpoint. Considerable genetic theory exists that indicates that fishing could be a very big problem. Its importance depends on the selectivity of fishing gear, heritability of population traits, and the genetic variability of those traits.

The potential of no-take marine reserves to protect genetic quality is great considering the fact that fishing can remove most of the population; and that densities of individuals, ages and sizes can be much greater in no-take marine reserves than in fishing grounds. Exact benefits to individual species will depend on the species, the levels of fishing mortality, and the proportion of the populations eventually protected by no-take marine reserves.

Dr. Sian Pullen, World Wide Fund for Nature UK, Goldaming, UK

My question would be, "Is it possible to determine the percentage of marine habitats that require protection under MPA status in order to ensure the maintenance (and recovery, if necessary) of that habitat and the species associated with it?" For example, can we determine that providing MPA status and good management to 15% of the world's kelp forests or 30% of the world's coral reefs or 20% of the seamounts will ensure that these areas and their associated species are maintained at a favorable status worldwide?

Then we would know what our ultimate goal should be with respect to the international commitments given to establish networks of marine protected areas.

Dr. Perry Alino, Marine Science Institute, University of the Philippines, Quezon City, Philippines

I would like to know the answer as to the mechanisms and extent that natural catastrophic events (e.g., El Niño) affect or interact with human-induced impacts on the reefs. This might help me have fewer sleepless nights trying to rationalize or overcome frustrations in dealing with scientific questions to help MPA management in a developing country like the Philippines. Here, people have grave problems of poverty, and it becomes difficult to contextualize pursuing expensive scientific investigations that people feel do not contribute to getting their next fish on the table.

Dr. Colin Buxton, Tasmanian Aquaculture and Fisheries Institute, Taroon, Australia

I would like to find out more about the effects of effort displacement that arise out of the proclamation of MPAs. This issue is important from a fisheries perspective, particularly in quota management situations and especially if quota is not adjusted to take account of the loss of fishing ground. The relationships are not likely to be simple as loss of ground should in many instances be compensated for by improvements in yield, spawner biomass and enhanced egg and larval production from the MPA. Also of concern are ecosystem effects, such as the formation of urchin barrens in the presence of reduced predation, or loss of kelp canopy as a result of increased grazing, that are likely to be exacerbated at a local scale through effort displacement.

Dr. Martin Willison, School for Resource and Environmental Studies, Dalhousie University, Halifax, Nova Scotia, Canada

I should begin my answer by admitting that it is strongly influenced by a research project in which I am involved. In the Maritime region of Canada, I have helped organize a project in which we have asked a wide range of people, "What are the issues or questions about MPAs that require research in our region?" We have done this in order to steer research in a "participatory" direction, that is, toward the involvement of those who believe they will be affected by the outcome of the research. In this case, it is the involvement of those whose lives or livelihoods will be affected by MPAs.

The overwhelming majority of issues and questions raised by our participants did not concern natural science, and thus the "science" question that I want answered falls in the realm of the social and management sciences. It is impossible to reduce the roughly two hundred issues raised so far by participants to a single research question, but the following is my attempt to render one recurring theme:

"By what methods can we select and manage marine protected areas so as to ensure that they will have the support of those stakeholders and local communities that the marine protected areas will affect?"

This question has numerous sub-themes, including: political and legal process, social and economic assessments, inter-agency rivalry, community-based management, conflict resolution, philosophical foundation, regulation and enforcement, and so on. Several participants proposed that socio-economic and management experiments should be conducted. That is, that we should not assume that we can work out the best methods for marine protected area management on the basis of theory or existing experience, but that we should be open about the need for managerial experimentation. Experimentation and rational analysis of the results is the foundation of science. Successful comparative case study analysis requires that there be a wide variety of management experiments, including careful data collection and honest reporting. This is the science that I believe we need.

Graeme Kelleher, Former Director, Great Barrier Reef Marine Park Authority, Australia

What effects does bottom trawling have on the whole ecosystem and how big must the "no take" zones be to maintain essential life support systems? Bottom trawling changes habitat, not just stocks, and we need to know how to maintain ecosystems with MPAs.

Dr. Callum Roberts, Department of the Environment, University of York, UK

How do you change opposition to proposed reserves into acceptance? We know there is a need for reserves and we have good reasons for believing they will work, but the key sticking point in most cases is implementation.

Dr. Paul Dayton, Scripps Institution of Oceanography, La Jolla, California, USA

How can we evaluate the cost/benefit ratio as a reserve is scaled in size? There will be a threshold, but how do we identify it?

Dr. Rob Wilder, Director of Education, Pacific Whale Foundation, Hawaii

Perhaps the most vexing scientific question is, "Do no-take MPAs in fact increase total biomass, both within and outside their borders?" My gut reaction is that they do, but the data supporting this key conclusion are still being developed. However, even having an answer to that one question -- at first blush my favorite -- is still not the top issue I choose.

Instead I dearly want an answer on how the marine environment will look 100 years from now if no-take MPAs are adopted, as opposed to our continuing with business as usual. I believe that with current trends, we are losing marine biodiversity as well as crucial ecosystem structure and function. If serious changes are not implemented soon (and too few are seriously contemplated), then we will all be far worse-off.

Having an answer to this comparative question would provide politicians and ocean managers with the willpower needed to adopt robust no-take zones. To protect fishing as a way of life, now and long into the future, demands a wise, cautionary measure: the setting aside of (possibly networked) portions of the sea as "safe zones."

Dr. Alan Hastings, Department of Environmental Science and Policy, University of California, Davis, California, USA

My question is: "How do larvae of species with sessile adults move from areas where they are produced to where they settle?" This is absolutely key to designing systems of MPAs.

Dr. Tundi Agardy, Conservation International, Washington, DC, USA

I would say the most critical question is, "Over what size area and with what restrictions should MPAs be implemented in order to effectively conserve ecological processes that maintain biodiversity and productivity?" It is a huge question, of course! If anyone knows the answer, even with respect to a single locale, I would love to know it.

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MPA science bibliographies

For online lists of MPA science-related articles and books, visit the following websites:

Fisheries and Oceans Canada (updated as of 1996)
www.oceansconservation.com/mpa/related/mpabiblio.htm

Gulf of Maine Marine Protected Areas Project (updated as of 1998)
www.gulfofmaine.org/library/mpas/biblio.htm

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