

## Feedback on Subject of Marine Reserve Science: Readers Respond With Variety of Views

The December 2003/January 2004 issue of *MPA News* offered two essays by scientists on marine reserve research. One questioned the rigor with which reserve research has been conducted, while the other explained difficulties involved in studying reserves, including finding adequate control sites. The essays presented a dilemma: we all want the best science on reserves, but to get it will require significantly more time and money — resources that are already scarce for managers.

Readers responded to the essays with a range of views, from arguing that the state of reserve science is stronger than was depicted, to suggesting that scientists should focus more attention on other issues, like socioeconomic factors in reserve success or the effects of pollution on MPAs. Because of the amount of feedback, we have devoted a larger-than-usual portion of this month's issue to letters. Here, *MPA News* highlights four of the responses received.

### Response #1 Moving the Discussion About Marine Reserve Science Forward

By Benjamin Halpern, Robert R. Warner, and Steven D. Gaines

It was with great interest and concern that we read the piece by Willis *et al.* in the last issue of *MPA News* (*MPA News* 5:6). Although we fully support healthy scientific debate, we feel that this piece misrepresents the current state of knowledge about marine reserves. This is not an issue of differing opinions about what marine reserves can and cannot do; instead it is a question of what the science of marine reserves can and cannot tell us. We appreciate the call for more rigor in marine reserve monitoring. As Willis *et al.* note, some reserve monitoring schemes have been poorly conceived. Nonetheless, our current state of knowledge is not nearly as dire as they depict.

#### Methods for evaluating reserve effects

Willis *et al.* claim we know little about how reserves affect fish species, since few monitoring studies show density increases greater than 100%. However, posing an arbitrary one-tailed "minimum criterion" is misguided (i.e., we cannot presume only positive effects); species should vary in their response, including some declines. More importantly, the Willis *et al.* approach ignores the power of synthesis. Meta-analyses of reserve effects have shown that there is a strikingly consistent increase in density, size, and diversity of exploited stocks within reserves. This is what meta-analyses do: when single studies have limited statistical power, consistency in the direction of changes across multiple studies can uncover real and significant patterns.

Willis *et al.* also misrepresent the significance of variable outcomes from theoretical models. Variable outcomes

arise in theoretical studies because they include different assumptions or processes. Syntheses of modeling results gain power from variable outcomes. This variability focuses our attention on critical mechanisms, generates hypotheses to test empirically, and provides insight into problems that are experimentally intractable. Although we are unaware of any management decisions that have been based solely on reserve theory, the future development of these models should enhance management decisions, rather than obscure them.

#### Inadequate experimental design

How many studies of reserve effects have had perfect experimental designs? None, as Willis *et al.* point out. But enough have had designs that allowed a test for the presence and the potential effects of the five experimental shortcomings Willis *et al.* identify:

(1) Insufficient sample replication: Although it is theoretically possible to find a location where multiple reserves could be established to ensure proper replication, it is politically and logistically unlikely. Meta-analysis is a way to overcome this limitation.

(2) Spatial confounding (reserve sites are always in better areas than control sites): Syntheses of results from Before-After-Control-Impact (BACI) studies show that although initial conditions in reserve and control sites differ, there is no bias or trend in these differences.

(3) Lack of temporal replication: Reserve studies have monitored reserve impacts over years to decades, and

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these studies show a rapid response for some species and a slower response for others. On average, however, responses inside reserves typically exceed those from associated control sites.

(4) Lack of treatment (reserve) replication: Most reserves have been established in isolation rather than in networks or multiple reserves. Recent noteworthy exceptions (e.g., the Channel Islands of California) will provide such treatment replication for future studies. Until then, meta-analysis is a powerful way to overcome this limitation.

(5) Non-random placement of reserves: Again, BACI studies have shown that control sites are just as often placed in better than in worse locations. There is no *a priori* reason to expect a reserve effect to be positive.

Finally, while it is true that “with a sufficiently large sample size, a statistically significant difference between two sites can almost always be obtained due simply to true natural biological variability between the sites,” this expectation is two-tailed (the difference could be positive or negative) unless one assumes that reserve sites always start out better than control sites (existing studies suggest this is not true). Sadly, no study of marine reserves has had the luxury of detecting statistically significant yet trivial effects, since sample sizes are consistently too small.

### Lessons for reserve managers

Rather than simply instructing managers to be more rigorous in reserve design, we think it is more useful to point out the potential problems with reserve monitoring, and to suggest practical solutions.

First, because of the expected export function of reserves, there are no true controls even when habitats vary little among locations; sites outside of reserves may show increases (from export) or decreases (due to displaced fishing effort). While most existing reference areas have shown increases following the establishment of nearby reserves, many more studies are needed. Monitoring designs based upon analyses of gradients in responses as a function of distance from reserves may prove especially insightful.

Second, meta-analyses suggest the level of exploitation, life history, and trophic level of a species can strongly affect its response to protection, and monitoring schemes and expectations must take these expected differences into account. Arbitrary “minimum criteria for biological significance” ignore basic ecological principles.

Third, power analyses using known natural variation in recruitment and population size in marine species suggest that many effects of marine reserves will be difficult to detect even in the best of circumstances. This variation must be taken into account in both monitoring design and in setting time limits for marine reserve performance.

### Conclusion

If the requirement for an adequate and appropriate experimental design for testing reserve effectiveness is multiple (and identical) reserve and control sites, measured before and after reserve creation, across multiple times, that demonstrate at least a 100% increase in some measure of interest, for all species, as Willis *et al.* suggest, then we will never have a good empirical test of reserve effects. Furthermore, reserves are not established as perfectly designed ecological experiments; they arise from political processes with inherent compromises. Should we then ignore reserves as a conservation and management option? We argue that this is not only conservative beyond reason, but that it also ignores the power and lessons of syntheses of both data and models. We have learned much about the science of marine reserves in the past decade, and this guides us toward areas that require further research. Importantly, we currently know enough about marine reserves to justify their use and implementation as one of several conservation and resource management tools. 

[Editor’s note: Halpern, Warner, and Gaines are all from the Department of Ecology, Evolution and Marine Biology at the University of California at Santa Barbara (USA). For readers interested in the scientific literature on which they have based the above statements, a version of this piece containing literature citations is available online at <http://depts.washington.edu/mpanews/halpernlitcite.htm>.]

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## Response #2 The Science of Marine Protected Areas: How Much of It Is Useful?

By Nancy Dahl-Tacconi

Kelleher (1999) put it simply when he wrote, “The science done for an MPA has to be driven by management needs.” Since each MPA is managed in a unique context, the information needed by managers varies according to the objectives and challenges of each situation.

Despite the vast range of natural and social scientific information needed by managers, the bulk of science on MPAs in the past few decades has focused primarily on two areas: issues of design (including studies on

biological diversity, dispersal and migratory ranges, and minimum requirements for species viability); and patterns of abundance and distribution of economically important species (mainly studies on fisheries potential). Regrettably, studies on social dimensions of MPAs have been uncommon.

The quest to identify a “reserve effect” on fisheries resources has become increasingly trendy in recent scientific literature. The difficulties in designing and

executing “good science” toward this cause have stirred up debates in the scientific community (*MPA News* 5:6). I agree that science should strive to be rigorous, but in the cash-strapped, politically charged, and value-laden world of MPA management, how much sleep can we afford to lose over this when there are so many other issues that need to be investigated? Lee (1993) offered us some helpful advice: “In the case of large ecosystems, pragmatism is a prime virtue: to learn what we can, and to recognize its limits.”

Rigor alone does not ensure that scientific information is useful in a management context. Management is not conducted in a world that abides by the idealistic rules of appropriately replicated and controlled scientific experiments. For managers, investing valuable resources in achieving ideal experimental designs may be overkill, especially in areas where small investments in education campaigns or alternative livelihood programs can largely negate the need to conduct research on MPA effects for the purpose of convincing stakeholders of the value of protecting their marine environment.

To a manager, information is useful for changing or reinforcing someone’s attitudes or behavior, including everything that any stakeholder (that also includes management staff) thinks or does in or around an MPA. That is the ultimate purpose of the application of information in an MPA management context. The two biggest contributions that scientific information can make toward improving the use of MPAs as a management tool are, first, to assist in designing and establishing areas that will be well-suited to their intended management objectives, and second, to assist in adapting management strategies to improve the likelihood of achieving those objectives.

Managers need a vast range of critical information to do their jobs effectively. In order to develop, monitor, and adapt management strategies, they need information on: awareness levels, aspirations and compliance of stakeholders; nature and extent of threatening processes; abundance and distribution of focal species or habitats; costs and benefits of management initiatives such as alternative livelihood programs or capacity building; changes in stakeholders’ perceptions of social and environmental values; quality of life in adjacent communities; adequacy of various financing mechanisms; current and future political climates; trends in industrial technology; and a host of other important considerations that influence how managers make decisions and implement their programs. The vital roles of natural science, social science, and a pragmatic approach to investigating relevant issues are obvious.

**“For managers, investing valuable resources in achieving ideal experimental designs may be overkill....”**

### Citations

- Kelleher, G. 1999. *Guidelines for Marine Protected Areas*. IUCN, Gland (Switzerland).
- Lee, K.N. 1993. *Compass and Gyroscope: Integrating Science and Politics for the Environment*. Island Press, Washington, DC (USA).

Current studies on information requirements of MPA managers and how stakeholders define a “successful MPA” are exposing reasons why certain types and combinations of information are particularly useful for improving management in different contexts. Considering “context” is the key. Scientific articles on MPAs rarely mention specific management objectives or relevant contextual issues surrounding management actions at the research sites. This impedes the application of scientific information in a management setting for two reasons. Recommendations from research conducted oblivious to management realities may be irrelevant to managers. Alternatively, inappropriate presentation of potentially useful information can obscure its actual relevance.

Research that is designed, conducted and presented in a way that is relevant to the actual management goals and challenges of an MPA, and responsive to the information needs of managers, will go a long way toward improving the image and management practice of MPAs.

Message to scientists: Information on economically important species comprises just a few large drops in the bucket of information that practitioners must consider while designing areas and adapting management strategies. Scientific findings presented in the context of actual management issues will get used. The rest may not.

Message to managers: “Science-based” recommendations generated without regard to the actual management context should be applied with great caution. While working with scientists to design research, communicating explicit intentions for the results will help facilitate the best use of scientific information in practice. 

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## Response #3 No-Take Zones Are Not the Only Way to Achieve Benefits for Biodiversity and Fisheries

By Graeme Kelleher

The articles in the December/January edition of *MPA News* implied (by omission of mention) that benefits for both biodiversity and fisheries flow only from no-take MPAs. There is another consideration in relation to achieving biodiversity and fisheries objectives that I think deserves mention. I refer to the use of non-trawling zones in large MPAs.

I think that it would be fair to assume that many benefits to both categories of objective (biodiversity and fisheries) can flow from non-trawling zones where limited line-fishing may be permitted, especially when significant transmission of target larvae or fish occurs from the non-trawl zones into surrounding areas. The visual evidence from films and photographs showing the benthic effects of bottom trawling is very powerful. It is obvious that bottom trawling drastically changes benthic habitats and, consequently, could well have negative effects on biodiversity and may also reduce total catch of a target species.

Although demonstrating scientifically that repeated bottom trawling often reduces biodiversity is difficult and expensive, I think it is fair to assume that in many circumstances this will be the effect, just as plowing reduces

biodiversity on land. Meanwhile, research is proceeding here in Australia and elsewhere on this question.

In the interest of balance, I also should mention that it is evident from fishing data on, for instance, prawn (shrimp) catches, that repetitive trawling can increase catch of a target species over time and reduce by-catch — i.e., it can reduce benthic biodiversity, but improve the fishery.

I emphasize that the above comments represent only my personal opinion.

As another of your recent articles recognizes, the recent draft re-zoning of the Great Barrier Reef Marine Park aims to increase the no-take area of the MPA from a trivial 16,100 km<sup>2</sup> to about 113,000 km<sup>2</sup> (*MPA News* 5:6). What was not emphasized is that the non-trawling areas (which include the no-take areas) will hopefully be increased from a mere 169,000 km<sup>2</sup> to 229,000 km<sup>2</sup>. The MPA area in total is 344,400 km<sup>2</sup>. 

[Editor's note: Kelleher served as chairman and chief executive of the Great Barrier Reef Marine Park Authority from 1979 to 1994. He is now a senior advisor to the IUCN World Commission on Protected Areas.]

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## Response #4 Scientists Should Focus More on Threat of Pollution

By Floor Anthoni

The appearance in *MPA News* of two essays by marine scientists questioning the rigor of marine reserve research attests to courage since it is not easy to say that the Emperor has no clothes. There is indeed much wrong with the claims made for perceived fisheries benefits from marine reserves. Due to a variety of reasons, much of marine science has succumbed to the "snapshot" approach, where inexperienced junior scientists make dives for a year to collect data to prove a hypothesis. These scientists are not long-term observers, and so do not notice events happening around them that could influence the outcomes of their studies, such as climatic oscillations or habitat degradation.

Meanwhile, scientists have remained largely oblivious to the major damage caused to the world's coastal seas by land-based pollution, including mud, fertilizer runoff,

and sewage. (Mud, for example, has had a significant impact on the world-renowned Goat Island marine reserve here in New Zealand.) Too few scientific studies have been done on how pollution can impact marine life. Scientists must focus more of their research on this threat, and every marine protected area should have an action plan for rehabilitating the land in its catchment areas.

Marine reserves are but a small tool in the toolbox of marine conservation. To save the sea will require a fully integrated approach that looks at the causes of all the threats to the sea, not just those from fishing. I invite *MPA News* readers to visit the Seafriends website ([www.seafriends.org.nz](http://www.seafriends.org.nz)), which is devoted to this philosophy. 

[Editor's note: Anthoni is director of the Seafriends Marine Conservation and Education Centre, an NGO dedicated to the conservation of New Zealand seas.]

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### Proceedings available from World Congress on Aquatic Protected Areas

Proceedings of the World Congress on Aquatic Protected Areas, held August 2002 in Cairns, Australia, are available in limited supply from the Australian Society for Fish Biology (ASFB). The 689-page, hardcover book costs AU\$125 (US\$95) per copy, plus postage and handling. To order a copy, contact ASFB President Dan Gaughan, WA Fisheries, PO Box 20, North Beach, WA 6920, Australia. E-mail: dgaughan@fish.wa.gov.au

## Notes & News

### Australia to compensate fishers impacted by MPAs

Under a new policy announced in January, the Australian Government will compensate fishermen and communities that suffer “significant and demonstrable negative impacts” from new or re-zoned MPAs in Commonwealth waters. The policy, detailed in a statement released in January, requires decisions on providing adjustment payments to be made by the Government on a case-by-case basis, taking into account the nature of each MPA and its impacts. In the event of a decision favoring adjustment assistance, management agencies, industry, and the community will be involved in designing the assistance program.

While there is no constitutional or legal requirement for the Government to provide such compensation, the policy states the payment framework will ensure “fairness and equity” in offsetting foregone profit or other impacts. Some state governments in Australia, including Victoria (*MPA News* 4:7), have already instituted programs to help fishermen adjust financially to MPAs in state waters.

The process of drafting the federal policy took six months and involved all relevant federal agencies and ministers, according to Peter Taylor, director of marine protected areas for Parks Australia. The official statement announcing the policy is available online at <http://www.deh.gov.au/coasts/mpa/displaced-fishing.html>. Taylor notes that although the preamble to the statement suggests it is a “draft”, it is in fact a final policy statement approved by the prime minister.

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### Report available on technology needs of managers; inventory underway on decision-support tools

Based on input from coastal managers, scientists, and technology specialists in the US, a new report from the National MPA Center documents the technological tools needed by MPA managers to help them map, enforce, and monitor their sites more effectively. Intended as a guide for the National MPA Center and other government agencies to design MPA-support services, the report cites needs as simple as cellular phones and digital cameras to aid enforcement, and as sophisticated as benthic habitat maps for inventorying resources. The report recommends that addressing these needs should involve communicating the benefits and costs of various technologies and improving accessibility of data and training, among other efforts. It is available online at [http://www.csc.noaa.gov/mpa/mpa\\_needs.html](http://www.csc.noaa.gov/mpa/mpa_needs.html). (Hard copies may be requested by e-mailing Greg Moretti at [greg.moretti@noaa.gov](mailto:greg.moretti@noaa.gov).)

Managers interested in learning about GIS-based decision-support tools that are available at low or no cost may benefit from an upcoming inventory of such tools, underway at the National MPA Center’s Training and Technical Assistance Institute. Intended to educate managers on the range and applicability of these tools, the inventory will provide detailed analyses on five or so instruments, including how they have been used at particular MPAs. In addition there will be a comprehensive list of all other known decision-support tools that are GIS-based and MPA-relevant. “Our goal is to raise the visibility of tools that are out there and spark ideas for managers for how they could be applied,” says Kim Cohen, who is co-developing the inventory. The inventory is expected to be released by September 2004.

Readers worldwide who are interested in contributing a decision-support tool to the inventory — including tools that might still be under development — should send a brief e-mail to Cohen about the tool, any experience the writer has with it, and contact information. Her e-mail address is [kimberly.cohen@noaa.gov](mailto:kimberly.cohen@noaa.gov).

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### Citing budget and staff concerns, California halts program to create marine reserves

The state of California (US) has halted a program to create a system of marine reserves throughout its waters, citing shortages of funds and staff to carry out the effort. The program, required by a 1999 state law (*MPA News* 1:3) and involving seven regional working groups to develop reserve options, is now on “indefinite hold” until the state has the necessary resources to restart and complete it, according to government officials. The state is in discussions with private organizations, including foundations, to see if non-governmental funds could help pay the bill, estimated at up to US\$2.3 million to run the two-year working group process. “The state needs to be creative about alternative ways to design the process that are not so resource-intensive,” says Karen Garrison of the Natural Resources Defense Council, an environmental NGO.

The program has been handicapped by past delays. In 2002, state officials set aside two years of reserve-planning work by scientists in response to protests by fishermen that they had not had enough input in the planning process (*MPA News* 3:9). The state redesigned the planning process to feature working groups of stakeholders, but ran into funding shortages in early 2003, which have kept the working groups from meeting since then.

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### East Asian nations agree to designate more MPAs

Governments of 12 East Asian countries have agreed to designate new marine protected areas and coordinate their management of regionally important MPAs under an accord signed in December aimed at addressing a range of coastal and marine concerns in the region.

The agreement, called the Sustainable Development Strategy for the Seas of East Asia (SDS-SEA), provides a package of principles, action programs, and instruments for integrated management and sustainable use of the marine environment and resources. Calling for improvements in fisheries management and reductions in coastal pollution, among other objectives, the strategy represents the regional implementation of marine and coastal commitments made at the World Summit on Sustainable Development (*MPA News* 4:3). The SDS-SEA is available online in PDF format at <http://www.pemsea.org>.

By Adrian Phillips, IUCN

## Editor's note:

Adrian Phillips, author of this perspective piece, is a senior advisor to IUCN on World Heritage. He has authored, co-authored, and edited several books and reports on protected areas, including the IUCN Best Practice Protected Area Guidelines series. Phillips's essay here was adapted by *MPA News* from an article he authored for *The George Wright Forum* (Vol. 20, No. 2), the journal of the George Wright Society, a US-based conservation NGO. The original article can be found online in PDF format at <http://www.georgewright.org/202phillips.pdf>.

Over the past half-century, changes that have occurred in our thinking and practice toward protected areas amount to a revolution. Formerly, the climate in which protected areas were set up favored a top-down and rather exclusive view, fitting well with the prevailing approach that governments knew best. Moreover, the basis upon which areas were selected, and their boundaries drawn, often involved arbitrary judgment rather than local knowledge or scientific understanding of how natural systems worked. Parks were established mainly for scenic protection and spectacular wildlife.

In contrast, the new paradigm for protected areas turns those ideas on their heads. Spurred significantly by national and international recognition of the link between human rights and environmental protection, protected areas are now more often run with, for, and even by local people, who are increasingly seen as essential beneficiaries of protected area policy, both economically and culturally. Besides local groups, other institutions outside of central government — such as regional and local governments, NGOs, the private sector, and indigenous groups — are also playing an increasingly integral role. The processes of site selection, planning, and management are now viewed as political exercises, requiring sensitivity, consultation, and astute judgment. And unlike before, the rationales for establishing protected areas often include important economic, cultural, and scientific considerations.

The new approach is widely shared worldwide and accords well with prevailing political, economic, and scientific conditions in the 21<sup>st</sup> century. Nonetheless, it is not without challenges. Here are some:

### **Devolution of political power from the center has led to the break-up of some protected areas agencies with unfortunate results.**

An extreme case is Indonesia, where the parks system in a country of globally important biodiversity has, to a large extent, been undermined by the breakdown of central control and widespread corruption: several vital sites face wholesale destruction from a range of threats. When central government loses the ability to defend these areas, they are doubly vulnerable in a political climate that encourages the heavy extraction of natural resources.

### **Stakeholder participation and community involvement may be essential but they can make great demands of resources (staff, time, and money) from overstretched protected areas agencies.**

Also, they call for fine political judgments about who stakeholders are and how conflicting interests can be

determined and reconciled. Sometimes it becomes too difficult and managers complain of “analysis paralysis” and “stakeholder fatigue”.

### **We should not be naïve about the willingness or ability of all local communities to support conservation and sustainable use.**

Not every community has responsible traditions in its use of natural resources. Furthermore, modern hunting and fishing technologies can change the balance between humans and wildlife. Population growth can be a factor, too: a fast-growing community has a different impact on natural resources than one with a stable population. How to build partnerships with local people in the context of such challenges poses dilemmas for many protected area managers.

### **In our enthusiasm for people-based conservation, we may diminish the achievements of government-managed, strictly protected areas.**

Government-owned and -managed parks that are strictly protected against all kinds of exploitative use will remain the cornerstone of many countries' systems of protected areas. The new paradigm should not undermine the value of such places but instead point out new ways of managing them, as well as the contribution that other kinds of protected areas and actors can make.

### **We are making the manager's job more difficult.**

The demands of stakeholder analysis are only one part of the protected area manager's ever-expanding set of responsibilities. He or she is expected to master — or at least employ experts in — many new and complex areas of expertise (business skills and fundraising, economics, conflict resolution, public relations, and so on) on top of natural resource and visitor management. Increasingly the manager is being urged to think even beyond the protected area's boundaries to engage in bioregional planning activities, or to address wider social problems faced by surrounding communities.

Although there are no easy solutions to these challenges, the new paradigm should be welcomed. Strictly government-owned and -managed protected areas are not enough anymore. What has emerged is a broader, more culturally respectful way of looking at protected areas, with participatory resource management and the alignment of human needs with nature. In theory, at least, we know now what needs to be done to achieve successful protected areas. The overarching challenge is to apply the theory. 

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