The Human Dimension of Coral Reef Marine Protected Areas: Recent Social Science Research and Its Policy Implications

MICHAEL B. MASCIA

American Association for the Advancement of Science Environmental Fellow, 223 Constitution Avenue, NE Washington, D.C. 20002, U.S.A., email michael.mascia@duke.edu

Introduction

Coral reefs provide ecosystem goods and services to millions of people around the world (Cesar et al. 1997; Costanza et al. 1997). The long-term sustainability of these ecosystem benefits is threatened, however, by direct overexploitation of coral reef resources, destructive fishing practices, air and water pollution, and climate change (Wilkinson 2000). Traditional efforts to manage coral reefs—species by species, sector by sector—have proven insufficient to ensure resource sustainability or to protect biodiversity against these threats, spurring calls for an ecosystem-oriented approach (Botsford et al. 1997; Cicin-Sain & Knecht 1998; National Research Council 1999, 2001). Central to this ecosystem approach to coral reef management are marine protected areas (MPAs), a family of spatially explicit marine management systems that includes underwater parks, fishery reserves, and wildlife sanctuaries (National Research Council 1999, 2001).

Coral reef MPAs have yet to realize their full potential. Although the number of coral reef MPAs has grown rapidly in recent years, their performance remains highly variable (Kelleher et al. 1995; Halpern in press; M. G. Pajaro, C. M. Nozawa, M. N. Lavides, and S. Gutierrez. 2000. Status of marine protected areas in the Philippines: better management of coral reefs and coastal areas in the tropics. Paper presented at the 9th ICRS [hereafter referred to as Pajaro et al. 2000].). Research suggests that social factors, not biological or physical variables, are the primary determinants of MPA success or failure (Kelleher & Recchia 1998; McClanahan 1999). Efforts to design more effective coral reef MPAs are hindered, however, by the dearth of social scientific research into the human dimensions of MPA development and management.

Social science research presented during the ninth International Coral Reef Symposium (ICRS; in Bali, Indonesia, 2000) provides valuable insights into the human dimensions of coral reef MPAs. Here I synthesize findings from social science MPA research delivered at the ICRS and suggest several implications of these findings for coral reef MPA policy.

Findings from the International Coral Reef Symposium

The role of decision-making arrangements in the emergence, evolution, and performance of MPAs was discussed extensively at the ICRS (Mascia 2001). Pajaro et al. (2000) and White et al. (2002) demonstrated that devolution of authority for MPA development and management—from national government to local governments, nongovernmental organizations (NGOs), and resource users—can spur MPA establishment and enhance site performance. Dobrzynski and Nicholson (2003) and B. Haskell and J. Delaney (2000. The Tortugas Ecological Reserve: protecting critical coral reef habitat in the Florida Keys National Marine Sanctuary. Paper presented at the 9th ICRS [hereafter referred to as Haskell & Delaney 2000].) reported that adaptive and participatory decision-making arrangements fostered effectiveness of the Florida Keys National Marine Sanctuary (U.S.A.) by facilitating social learning, building trust, and enhancing the legitimacy of rules and regulations. Research by Kile et al. (N. Kile, J. E. Parks, A. M. Wilson, and M. Lam. 2000. Solomon Islands community participation in marine conservation areas: integrating science and custom. Paper presented at the 9th ICRS [hereafter referred to as Kile et al. 2000].) and M. B. Mascia (2000. Designing effec-

tive coral reef marine protected areas: insights from political science theory. Paper presented at the 9th ICRS [hereafter referred to as Mascia 2000].) suggests that collaborative MPA management structures are the most likely to link national resources with local interests and knowledge, and, thus, leading to more effective MPAs.

Exactly how and when participation should occur in MPA development and management was debated at the ICRS (e.g., Kile et al. 2000; V. Garrison, J. Bohnsack, R. Boulon, G. E. Davis, and J. Tilmant. 2000. Sex, food, and shelter: the story behind a proposed marine protected area in the U.S. Virgin Islands. Paper presented at the 9th ICRS.). Haskell and Delaney (2000) identified MPA advisory committees as one appropriate mechanism for ongoing stakeholder participation in MPA development and management, but Dobrzynski and Nicholson (2003) cautioned that mechanisms must be established to ensure that stakeholder representatives are accountable and responsive to constituents. Presenters also noted that differences among stakeholders with respect to beliefs (i.e., perceptions of how the world works), values (i.e., perceptions of what is good, desirable, or just), and interests (i.e., desired outcomes) often hinder MPA development and management, reflecting the need for decision-makers to agree on a process before trying to decide outcomes (Haskell & Delaney 2000; R. Grober-Dunsmore and M. Ridgely. 2000. A highly adaptable method for dealing with the messy business of designing marine protected areas. Paper presented at the 9th ICRS.).

Several presenters also addressed MPA compliance issues at the ICRS (Mascia 2001). Researchers demonstrated that clear, easily understood, and easily enforceable rules are positively correlated with MPA performance (Kile et al. 2000; Mascia 2000; Pajaro et al. 2000). Similarly, Kile et al. (2000) and M. B. Mascia (2000) demonstrated that clear internal and external MPA boundaries—those easily recognized by resource users and by enforcement personnel—are also positively correlated with MPA performance. M. B. Mascia (2000) and Woodley and Scary (2003) demonstrated that devolution of authority can enhance enforcement capacity. Their results also illustrate the need to design enforcement systems that promote accountability among enforcers and appropriate (not draconian) penalties for noncompliance with MPA rules and regulations (Mascia 2000; Woodley & Scary 2003).

Finally, presenters stressed the importance of both biological and social research and monitoring (Dobrzynski & Nicholson 2003; B. Haskell & J. Delaney 2000). Lincoln-Smith et al. (2003) emphasized that baseline data and sampling at multiple spatial and temporal scales are necessary to inform MPA development, measure change over time, and shape adaptive management. H. van Lavieren (2000. An assessment of coastal resources in the Northern Sierra Madre Natural Park and an approach to management. Paper presented at the 9th ICRS.) noted that enlisting stakeholders in the collection and analysis of research and monitoring data educates participants and builds capacity and trust.

Policy Implications

These social science findings have significant implications for public policies regarding coral reef MPA decision-making, enforcement, research, and monitoring. The findings presented at the ICRS suggest the following guidelines for practitioners and scientists involved in MPA policy-making:

(1) Share authority for MPA establishment. National governments can stimulate MPA development and establishment by sharing the authority to designate MPAs with local governments, NGOs, and resource users.

(2) Share authority for MPA management. Management authorities can enhance MPA effectiveness by delegating full or partial responsibility for management to local communities, NGOs, or resource users.

(3) Foster participatory decision-making. Bringing diverse stakeholders into MPA decision-making processes can improve the substance and legitimacy of these decisions.

(4) Foster adaptive decision-making. Adaptive decision-making can enhance MPA effectiveness through goal-oriented reform of resource use rules and decision-making arrangements.

(5) Decide on process before deciding on substance. Identifying basic rules and criteria for decision-making (i.e., process guidelines) before attempting to make substantive choices about MPA rules and regulations may reduce conflict and facilitate informed policy choices.

(6) Promote decision-maker accountability. To ensure that decision-makers further the interests of constituents rather than personal interests, mechanisms should be established that foster accountability, such as elections, consultative sessions, or open meetings.

(7) Establish advisory committees. Broadly representative advisory groups can enhance MPA effectiveness through improved decision-making and increased legitimacy.

(8) Make MPA rules and boundaries clear. Clear rules governing resource use and clear MPA boundaries will foster compliance and simplify enforcement.

(9) Share authority for enforcement. Enlisting resource users and others in MPA enforcement efforts will enhance enforcement capacity and likely will increase compliance with MPA rules and regulations.

(10) Build accountability into enforcement. Establishing mechanisms to ensure that enforcement personnel

are accountable for their actions will foster fair and active enforcement of MPA rules and regulations.

(11) Make the punishment fit the crime. Draconian penalties for noncompliance undermine the legitimacy of enforcement systems and encourage further noncompliance.

(12) Collect baseline data. Baseline data can enhance MPA effectiveness by informing the design of management systems. Baseline data also permit more accurate measurement of MPA performance and thus provide the basis for adaptive management.

(13) Measure both biological and social performance. Marine protected areas usually have both biological objectives, such as maintaining ecological integrity, and social objectives, such as enhancing the livelihoods of fishermen, so both biological and social performance indicators must be measured in assessment of MPA effectiveness.

(14) Sample wisely. To inform adaptive MPA management, data must be gathered at relevant temporal and spatial scales.

(15) Make research and monitoring participatory. Enlisting stakeholders in data collection and analysis will educate participants, build capacity, and foster trust.

Research presented at the ICRS substantially advanced social scientists' understanding of the human dimension of coral reef MPAs. The challenge now before scientists and policymakers is to translate these social science findings into policies that enhance MPA performance. The policy implications outlined above represent an initial step toward this goal, providing guidelines for the reform of existing MPAs and the establishment of new sites. Scientists can further aid policymakers by conducting policy-relevant MPA research and by promoting MPA policies consistent with the best available natural and social science. In doing so, scientists can help ensure that coral reef MPAs fulfill their promise in conserving reef biodiversity and providing socioeconomic benefits to millions of people throughout the tropics.

Acknowledgments

Literature Cited

Botsford, L. W., J. C. Castilla, and C. H. Peterson. 1997. The management of fisheries and marine ecosystems. Science **277:**509–515.

Cesar, H., C. G. Lundin, S. Bettancourt, and J. Dixon. 1997. Indonesian coral reefs: an economic analysis of a precious but threatened resource. Ambio **26:**345–350.

Cicin-Sain, B., and R. Knecht. 1998. Integrated coastal and ocean management: concepts and practices. Island Press, Washington, D.C.

Costanza, R., R. d'Arge, R. de Groots, S. Farber, M. Grasso, B. Hannon, K. Limburg, S. Naeem, R. V. O'Neill, J. Paruelo, R. G. Raskin, P. Sutton, and M. van den Belt. 1997. The value of the world's ecosystem services and natural capital. Nature **387:**253–260.

Dobrzynski, T. J., and E. E. Nicholson. 2003. User group perceptions of the short-term impacts of marine reserves in Key West. Pages 759–764 in M. K. Kasim Moosa, S. Soemodihardjo, A. Nontji, A. Soegiarto, K. Romimohtarto, Sukarno, and Suharsono, editors. Proceedings of the Ninth International Coral Reef Symposium. Indonesian Institute of Sciences and State Ministry for Environment, Republic of Indonesia, Jakarta, Indonesia.

Halpern, B. In press. The impact of marine reserves: do reserves work and does reserve size matter? Ecological Applications.

Kelleher, G., and C. Recchia. 1998. Lessons from marine protected areas around the world. Parks **8(2):**1–4.

Kelleher, G., C. Bleakley, and S. Wells, editors. 1995. A global representative system of marine protected areas. The World Bank, Washington, D.C.

Lincoln-Smith, M. P., J. D. Bell, K. A. Pitt, P. Thomas, and P. Ramohia. 2003. The Arnavon Islands Marine Conservation Area: lessons in monitoring and management. Pages 621–626 in M. K. Kasim Moosa, S. Soemodihardjo, A. Nontji, A. Soegiarto, K. Rominohtarto, Sukarno, and Suharsono, editors. Proceedings of the Ninth International Coral Reef Symposium. Indonesian Institute of Sciences and State Ministry for Environment, Republic of Indonesia, Jakarta, Indonesia.

Mascia, M. B. 2001. Designing effective coral reef marine protected areas: a synthesis report based on presentations at the 9th International Coral Reef Symposium. World Commission on Protected Areas—Marine, World Conservation Union, Washington, D.C.

McClanahan, T. R. 1999. Is there a future for coral reef parks in poor tropical countries? Coral Reefs **18:**321–325.

National Research Council. 1999. Sustaining marine fisheries. National Academy Press, Washington, D.C.

National Research Council. 2001. Marine protected areas: tools for sustaining ocean ecosystems. National Academy Press, Washington, D.C.

White, A. T., A. Salamanca, and C. A. Courtney. 2002. Experience with marine protected area planning and management in the Philippines. Coastal Management **30:**1–26.

Wilkinson, C., editor. 2000. Status of the coral reefs of the world: 2000. Australian Institute of Marine Science, Townsville, Queensland.

Woodley, J. D., and Z. Scary. 2003. Development of a locally-managed fisheries reserve at Discovery Bay, Jamaica. Pages 627–634 in M. K. Kasim Moosa, S. Soemodihardjo, A. Nontji, A. Soegiarto, K. Rominohtarto, Sukarno, and Suharsono, editors. Proceedings of the Ninth International Coral Reef Symposium. Indonesian Institute of Sciences and State Ministry for Environment, Republic of Indonesia, Jakarta, Indonesia.