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Special Section Essay

Marine Protected Areas and the Governance of Marine Ecosystems and Fisheries

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Marine protected areas (MPAs) are spatially defined marine units in which one or more human activities - particularly fishing - are restricted or prohibited. They represent a precautionary and ecosystem-based approach to ocean management (Mangel 2000; Pikitch et al. 2004; Jones 2006). The 1992 Convention for Biological Diversity set a target for 10% of the global marine area to be designated as MPAs by 2010. Progress with designating MPAs is, however, slow, MPAs covering just 1.3% of the marine area and 3.2% of marine areas under national jurisdiction. Consequently, the deadline was recently extended to 2020. Nonetheless, in the past two decades there has been a rapid increase in MPA research and implementation throughout the world. If the governance of MPAs is improved in ways we describe here, MPAs and other place-based approaches will continue to be important tools for the management of marine resources.

MPAs as Tools for Ecosystem-Based Fisheries Management

The proportion of the world's fish stocks that are considered to be unsustainably harvested has declined in some important fisheries in response to improved regulation (Worm et al. 2009) and has been estimated between 28 and 33%, a level that has been fairly stable in recent years (Branch et al. 2011). Can MPAs be used to further improve the status of fish stocks and the marine ecosystems in which they are found? MPAs have had stronger support in conservation biology than in fisheries science (Jones 2007), and integrating them into fisheries management remains a major challenge. The rapid increase in the size and number of MPAs has been accompanied by a similar increase in implementation of marine ecosystem-based management (EBM). Ecosystem-based approaches emphasize controlling bycatch, protecting critical habitats, and recognizing predator-prey and other ecological relations, albeit within the framework of traditional population-specific fisheries management (Rice 2011). Fisheries managers may close some areas to fishing, either permanently or temporarily but MPAs are still poorly integrated into ecosystem-based fisheries management (Halpern et al. 2010).

One reason for resistance to MPAs as a central component of ecosystem-based fishery management may be that they are a relatively new approach, whereas species-specific fisheries management has a long if not always successful history. Moreover, decisions about size, site selection, and disturbance levels within MPAs are technically difficult, particularly given the relatively high degree of variability and complexity in marine ecosystems (Jones 2001).

Decisions about MPAs are also politically difficult. Proposals to redefine traditional fishing grounds as MPAs affect communities already limited in resource use by intensified regulatory control, competition from highly capitalized industries, pollution, and decline in fish stocks. Planners have often been

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innatentive to social and political issues related to marine reserves (Christie et al. 2003; Mascia et al. 2010).

A second barrier to the integration of MPAs into fisheries management is an ideological dichotomy: humans as intruders in marine systems or seascape as essentially inhabited by humans (Agardy et al. 2003; Shackeroff et al. 2009). The former perspective, imbued with the notion of wilderness (Sloan 2002), often lies behind for large, permanent and completely protected (i.e. no-take) MPAs to restore ecological integrity. From the latter perspective of “peopled seascapes”, the ability to create no-take MPAs is constrained by the fact that human activities have long been fully integrated into many marine ecosystems (Fraschetti et al. 2008). This perspective underscores efforts to integrate of MPAs with complementary fisheries management tools (Little et al. 2011), and to collaborate with fishing interests to design zoned and mixed use areas, including rotational closures and other managed areas that fall short of complete and permanent closures.

Governance and Marine Protected Areas

Governance means more than government. It refers to the formal and informal laws and traditions of a society, and a working definition is “steering human behavior through combinations of civil society, state, and market incentives to achieve strategic objectives” (Jones et al. 2011; vii). Governance of MPAs may rely on government, but it can also depend on civil society – families, social networks, and voluntary organizations, and on market-related institutions – property rights, corporate businesses and trading.

Just as ecologists argue about the relative importance of top-down (e.g., fishing) versus bottom-up (e.g., planktonic productivity) drivers of ecosystem change (Micheli 1999), so policy experts argue about top-down versus bottom-up mechanisms of governance (McCay & Jentoft 1996). Top-down governance emphasizes the roles of governments and professional experts as sources of information, rules, and enforcement. It offers several advantages, such as the power and resources of the state and the potential for governance across larger areas. Bottom-up governance empowers members of civil society by involving them directly, either as autonomous decision-makers or as partners with government.

Experience with marine governance shows the need to find in each case an effective balance between top-down governance and distributed, localized bottom-up institutions (Wilson 2009). Considerable literature addresses expansion from local interventions, such as small MPAs (individual coral reefs or bays) to regional or international networks of MPAs (Mahon et al. 2010). Ecological, social, or political aspects of marine conservation or fisheries management often require scaling up because MPA governance is often linked with governance over larger areas affecting fisheries, aquarium trade, transportation, polluting activities, and mineral exploitation.

A shift in the other direction, from extensive, centralized interventions to interventions in smaller social, political, and ecological units can be critical to success (Christie et al. 2009). In some circumstances, scaling down may be warranted by ecological phenomena such as spawning aggregations or local populations of a species (Wilson 2002), and it may also be more appropriate to programs that engage local communities by granting territorial use rights in exchange for adopting conservation measures, as in the benthic coastal fisheries of Chile and Mexico (Defeo & Castilla 2005; Ponce-Díaz et al. 2009). Scaling-down, however, must avoid situations in which local priorities undermine more wider-scale, longer-term conservation objectives (Jones et al. 2011). The integration of central and local institutions through a nested hierarchy seems critical (Sievanen et al. 2011), particularly to address the challenges raised by increasing or decreasing the spatial and temporal extents of governance.

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Towards Improved Governance

A recent analysis of MPA governance undertaken through the United Nations Environment Programme (UNEP) (Jones et al. 2011) suggests that the effectiveness of governance depends on institutional diversity. This argument is based on a comparison of 20 MPAs worldwide that shows the effectiveness of combining top-down, bottom-up, and economic-incentive approaches to governance. For example, local-community participation can provide detailed knowledge, but top-down structures are often essential for taking account knowledge of ecological linkages across larger areas and more time (Cudney Bueno & Basurto 2009).

The UNEP study identified five categories of incentives for improving MPA governance: participative, legal, interpretative, knowledge, and economic. Participative incentives encourage a wide range of stakeholders to collaborate in planning and ensure broader cooperation with the program. Such collaboration or comanagement has proved effective in coordinating both top-down and bottom-up governance of MPAs. Comanagement refers to partnerships between local resource users and governments. It is accepted as a viable approach to ocean governance, particularly for less migratory fisheries on which local coastal communities depend (Wilson et al. 2003; Defeo & Castilla 2005; Gutiérrez et al. 2011). Comanagement brings experience-based and traditional knowledge, the legitimacy of rules developed democratically, and the strength of local institutions together with the powers and resources of centralized governments.

Legal incentives provide the legal framework for MPAs, the general and specific use restrictions, and the roles and responsibilities of different parties. These incentives operate from the top-down (e.g., national laws and authorities) and bottom-up (e.g., local laws supporting local rights of access to the MPA). For example, local-community participation provides detailed knowledge and increases the probability of compliance, but a strong legal framework for enforcement is also essential to the willingness of community members to participate.

Interpretative incentives address the need to communicate the rationale and expected results of an MPA. Knowledge incentives lead to improvements in scientific information relevant to the MPA, including local and traditional knowledge and independent advice or arbitration in the face of conflicting information.

Economic incentives can be particularly important for gaining the support of local stakeholders. No-take MPAs often provide direct benefits to local people through restored fish stocks (Mascia et al. 2010), but that outcome is uncertain and local people may lose subsistence, recreational, or commercial rights. Economic incentives may directly compensate lost opportunities or offer new jobs, including work with tourism, diving, or other activities allowed in the MPA. Direct monetary compensation is difficult because reliable information on the particular users of a given marine area is often limited. It is possible, however, to implement comprehensive compensation, as shown for the Great Barrier Reef of Australia (Olsson et al. 2008), but the amount of compensation claimed was 20 times greater than had been anticipated (Macintosh et al. 2010).

Market-based tools for governance could allow the rights of local people to be purchased or leased by outsiders who wish to create MPAs, and these may be economic incentives for local people if they hold exclusive property rights. Two examples would be individual transferable catch quotas or community concessions for fishing grounds or species. Another option is using eco-certification for the fisheries in an area that includes an MPA. This incentive provides higher prices from consumers willing to pay for sustainably caught seafood, as in the Marine Stewardship Council program.

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Is it possible to broaden the group of stakeholders desiring to pay for marine conservation? Is there an expanded role for local communities, local and regional nongovernmental organizations and ecotourism businesses, and local and national governments? These groups may value an MPA but lack the means to finance short-term costs. Marine protected areas may restore ecosystem services, but only over the long term. Consequently, widespread use of MPAs and networks of MPAs for marine conservation may depend on the resources of global actors, ranging from large international nongovernmental organizations to private investors. Efforts are underway to adapt for marine ecosystems terrestrial economic devices for conservation such as payment for watershed services, water quality trading, and biological diversity offsets (Ecosystem Marketplace 2010; Forest Trends and The Katoomba Group 2010).

Whether such payments benefit local stakeholders who may bear the costs of MPA restrictions is one of the equity issues evident in many MPA cases (Jones et al 2011). Marine protected areas typically function by a process involving multiple stakeholders from different sectors, a vital element that adds a challenging dimension to governance (Jones et al. 2011). The idea of stakeholder engagement is ubiquitous in planning processes but carries the risk of neglecting genuine differences in interest and power. For example, citizens of a coastal town in Costa Rica maintain rights to take turtle eggs in exchange for participating in a government-led program for turtle conservation. The program appears to have protected both turtles and human needs but is increasingly threatened by a noninterventionist approach promoted by national and global conservation groups that also claim the status and rights of stakeholders (Campbell 2007).

Marine Spatial Planning and the Great Barrier Reef

A central challenge for the future of MPAs is to move from discrete, small MPAs to marine spatial planning or ecosystem-based management for relatively large marine areas that incorporate MPA networks. An illustration is the rezoning of the Great Barrier Reef in Australia, composed of over 2900 individual reefs and 900 islands stretching for over 2600 kilometers. Zoned for multiple uses and degrees of protection (Day 2002), the system is now managed under a plan that has expanded the percentage of no-take areas and compensated commercial fishers and others adversely affected by the no-take areas. Additional measures have also helped safeguard connectivity and other ecological processes, thereby enhancing the resilience of the system in the face of stressors such as crown-of-thorns starfish (*Acanthaster planci*) outbreaks (McCook et al. 2010).

Research on planning for the Great Barrier Reef provides valuable lessons for other MPA and marine spatial planning efforts (Olsson et al. 2008; Day 2011). More such examples at this scale are needed. Among the specific lessons learned or reinforced are the importance of skilled leadership; seizing advantage of windows of opportunity for political support; strong legal frameworks, including the potential for cross-sectoral controls; changed interpretations of the reef as an MPA; and a high level of public consultation and participation.

Roles of MPAs in Resource Management

Marine Protected Areas are best seen as tools that complement other approaches to marine conservation and resource management. Like terrestrial parks and nature reserves, they can disrupt livelihoods, especially if MPAs provide few tangible benefits to local people. They also attract scientists, tourists, and others, creating a richer and more complex system for governance and some successes in marine conservation and restoration. Today, more effort is being devoted to creating networks of MPAs to enhance connectivity. A risk is that MPAs will become too large, losing the benefits of comanaged arrangements. Widespread threats such as climate change may require, however, even further increases in

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the size of protected areas—or significant shifts in where they are located. Remaining is the task of fully integrating MPAs into fisheries management, as would seem logical under the rubric of ecosystem-based management. The gap between MPAs and fisheries management may benefit from marine spatial planning (Agardy et al. 2011). Marine spatial planning can become the forum for compromises between those who seek the restoration to more pristine ecosystems and those who seek sustained seafood production. In relation to the latter, we believe future fisheries management should include efforts to develop more spatially explicit management approaches, consistent with ecosystem-based management and marine spatial planning. These approaches include temporary and rotating closures and use of the term *managed areas* or *fisheries sanctuaries* rather than *protected areas*. Regardless of the nomenclature, spatially defined or place-based management efforts in the oceans can benefit all parties.

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