Rethinking the blue planet: Integrating social and ecological resilience attributes within a climate-response management framework for marine protected areas

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Abstract

Marine protected areas (MPAs) have traditionally been designed and managed to conserve and protect biodiversity resources and cultural values against the well-known, existing threats of pollution, habitat loss and resource exploitation, and to enhance livelihood outcomes, especially in developing countries. Marine and coastal ecosystems, however, now face new and growing threats: the direct effects of climate change, and interactions between existing threats and climate change impacts. Climatic drivers of marine ecosystem stress are in many cases global, rather than local, in scale, meaning that existing management approaches are unlikely to be responsive to the impacts of ocean acidification, warming, and sea level rise. Scholars are increasingly supportive of integrated spatial planning, local governance and adaptive management of MPAs, yet there remains a critical need for new thinking about MPAs in the context of a climate changing world. Strategic management of marine and coastal environments and resources should include consideration of both traditional and unconventional conservation and rehabilitation methods, and encompass the social dimensions of these social-ecological systems more explicitly.

Previously, researchers have proposed decision-making frameworks to evaluate potential responses to climate change impacts. These decision support tools have focused, inter alia, on the merits of species relocation within an ecological management framework, and strategic planning for organisations considering relocation as a response to climate impacts. At the same time, work on responses to climatic emergencies tends to exist as a separate literature stream; a form of resilience thinking is becoming institutionalised in disaster management but is not usually integrated with planning for ecosystem resilience, and is conceptually problematic in other ways. Human dimensions of these systems are not well conceptualised, or integrated into management approaches. For managers in marine SES, therefore, it is appropriate to consider strategies that incorporate cutting edge thinking and science, recognise the contingent aspects of local conditions and societies, and integrate long-term resilience planning with emergency response preparations. Ideally, management frameworks will foster local actions within a larger, regional network approach.

Here we build on previous work in the areas of social and ecological resilience to climate change and more broadly, marine protected area management. This paper offers an integrative synthesis of social and ecological resilience components, with key attributes across

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these areas drawn from previous research. We then describe a framework for management systems in marine and coastal reserves that promotes social-ecological resilience to climate change through a time-based approach. Specific management actions are prioritised in each of four phases: precautionary, current, responsive, and adaptive. This approach is novel in the MPA literature because it (1) integrates social and ecological resilience components in a practical, action-oriented framework; (2) facilitates strategic management of MPAs within the context of climate change; and (3) incorporates environmental, social, and regulatory considerations. The phase-based approach is responsive to the temporally disparate effects of climate change, and provides managers with a clear, practical path towards responding to climate change in marine protected areas at both near-term and long-term temporal scales.

**Keywords:** adaptive comanagement, adaptation to climate change, long term dynamics, marine, panarchy, protected areas, social ecological systems