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From measuring outcomes to providing inputs: Governance, management, and local development for more effective marine protected areas

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ABSTRACT

Marine protected areas (MPAs) have the potential to conserve marine resources as well as provide social and economic benefits to local communities. Yet the percentage of MPAs that might be considered "successful" or effective on ecological and/or socio-economic accounts is debatable. Measurement of biophysical and socio-economic outcome indicators has become de rigeur for examining MPA management effectiveness so that adaptive feedback loops can stimulate new management actions. Scholars and practitioners alike have suggested that more attention should be given to the inputs that are likely to lead to successful MPA outcomes. This paper briefly discusses the potential ecological and socio-economic outcomes of MPAs then reviews the literature on three categories of inputs – governance, management, and local development – that lead to effective MPAs. In conclusion, the paper presents a novel inputs framework that incorporates indicators for governance, management and development to be used in the design and analysis of MPAs.

1. Introduction

Marine protected areas (MPA) are set aside to protect the marine environment [1]. MPAs are promoted globally as a tool for managing fisheries, conserving species and habitats, maintaining ecosystem functioning and resilience, preserving biodiversity, and protecting the myriad of human values associated with the ocean [2–5]. Ecologically, MPAs have been shown to be effective at protecting or reducing degradation of habitats and ecosystems [4,6,7] and increasing biomass and species diversity, richness, and numbers [8,9]. While the principal mandate of MPAs is conservation of marine resources and biodiversity, beneficial local development outcomes are also a pre-cursor of local support for these initiatives [10,11].

A significant body of literature suggests that MPAs can have beneficial outcomes for the environment and for local communities. It has long been theorized that the creation of MPAs, particularly no-take-zones (NTZ), can lead to beneficial outcomes for local fisheries through the replenishment of commercially valuable and depleted stocks leading to the "spillover" of adult fish into surrounding waters [4,12,13]. Authors have also suggested that socio-economic and conservation outcomes might be balanced through the development of tourism [14–16] and also through the promotion of other alternative livelihood strategies [17,18].

The proposition that MPAs both *can* and *should* lead to win-win outcomes for conservation and development thus satisfying the needs of conservationists, governments, fishers, tourism operators, and local communities is becoming the dominant paradigm. However, the successful achievement of this dual mandate is more complex in reality than in theory. Indeed, many authors and reports have questioned how effective MPAs have been at achieving either social or ecological outcomes [19–21]. De Santo [22] suggests that with agreements to establish MPAs in 10% of the ocean [23], quality is being lost in the push towards quantity and more attention needs to be given to achieving successful outcomes for conservation and local communities [10,24,25]. As noted by Gjertsen [26] "Disentangling the factors that contribute to effective conservation and improved human welfare is difficult, but necessary for understanding when these win-win scenarios are likely to emerge". Yet the majority of research on management effectiveness

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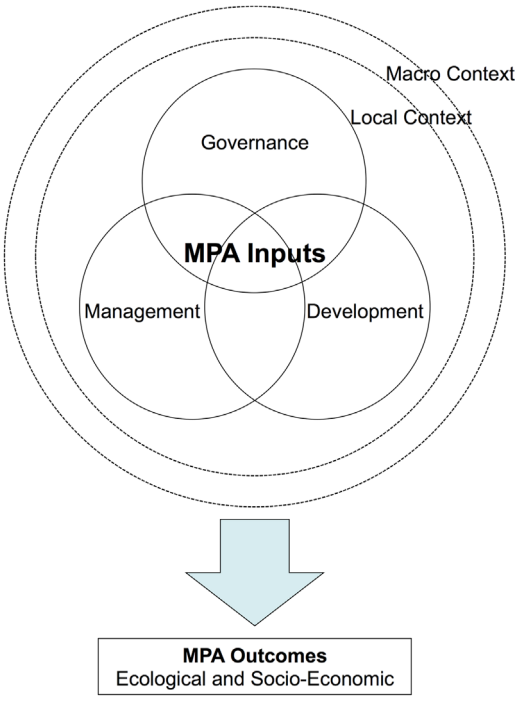

Fig. 1. Beneficial marine protected area outcomes depend on contextual factors and inputs.

has been on measuring impacts and outcomes rather than identifying input variables that produce effective MPAs and proposing solutions [27].

Previous research suggests that MPAs can contribute to positive outcomes in certain contexts and given the right inputs. The remainder of this paper will discuss contextual factors and inputs that contribute to beneficial socio-economic and ecological outcomes from MPAs through a review of the literature. Increased attention to the planning and provision of appropriate governance, management and development inputs in consideration of contextual factors is likely to lead to more beneficial MPA outcomes (Fig. 1). The authors propose a novel inputs framework to be used in the design and analysis of MPAs. The following section briefly reviews the extensive literature on the ecological and socio-economic outcomes of MPAs.

2. The outcomes of MPAs

2.1. Ecological outcomes

The potential ecological benefits of MPAs to marine systems include process benefits, ecosystem benefits, population benefits, and species benefits [28]. No-take reserves, in particular, may result in beneficial environmental outcomes. A global review of no-take reserves affirms that no take MPAs have resulted in average increases in biomass of 446%, species density of 166%, in species richness of 21%, and in size of organisms of 28% [8]. Claudet et al. [29] found that larger reserve size leads to greater reserve fish density but that larger buffer zones result in decreases. Lester and Halpern [30] also showed that partially protected areas may result in some benefits but that there is a significant difference between no-take areas and partially protected areas in terms of overall benefit and density of organisms. Recently, Edgar et al. [9] demonstrated that MPAs produce significantly increases in biomass and species diversity when they have four or five of the following key features: older, larger, isolated, non-extractive, and effectively enforced. No-take MPAs also lead to spillover of adult species into surrounding areas [31]. MPAs can protect critical habitats, such as coral reefs, mangroves, and seagrass beds [4]. For example, individual MPAs and networks may lead to improvements in coral cover, reef ecology, and structural integrity through limiting the effects of destructive fishing practices on reefs [6,32,33] and through increasing resilience to climate change [34,35].

Though environmental benefits are possible the number of MPAs that are managed effectively may be in the minority [20,36,37]. For example, Burke et al. [19] estimate that 14% are effectively managed in SE Asia and Lowry et al. [21] estimate that less than 20% of 1100 MPAs in the Philippines are managed effectively. Globally, only 24% of all protected areas are managed 'soundly' [38]. These figures raise questions about the number of MPAs that are achieving their ecological objectives or potential. Furthermore, many of the potential ecological benefits of MPAs are threatened by broader environmental conditions and extreme events [34,39], levels of management in the broader seascape [11,40,41], and impacts of current and future development within MPAs [42].

2.2. Livelihood and community outcomes

MPA creation reallocates rights or bundles of rights, which can lead to a combination of benefits and negative consequences for the various stakeholders involved [43]. Fishing and harvesting of other marine resources is the primary livelihood of many coastal people [44]. MPAs should benefit local fishers through the spillover of fish and other harvestable species [4]. Research shows that well managed MPAs can lead to fisheries benefits for local communities through increased catch and increased catch per unit effort [31,45–51]. Larger scale commercial fisheries, too, may benefit from the creation of no take zones; however, since spillover tends to occur at smaller spatial scales (on average up to 800 m from MPA boundaries) the provision of benefits to larger commercial fisheries would most likely require creation of larger MPAs or extensive networks [31,45]. However, fisheries benefits may be unequally shared among groups within and between communities [52,53]. Though MPAs may benefit local fisheries in the long term, in the short term compensation or alternative livelihood options need to be considered since displacement of rights to access the resource can lead to short-term hardships [50,54,55]. Diversification into alternative livelihoods may also reduce overall pressure on fisheries and the resource base [56]. However, care must be taken in assessing the vulnerability of proposed alternative livelihoods to future stressors such as climate change [57,58].

The development of alternative livelihood programs that benefit local people is an often-advertised benefit of MPA creation that is challenging to achieve in practice. The most often suggested alternative livelihood strategy is tourism, in the form of SCUBA diving, snorkeling, boating, wildlife viewing, historical and cultural tourism, eco-voluntourism, and even recreational fishing [14,59–63]. Tourism has significant potential as an MPA financing mechanism [15,64–66] and may lead to economic benefits at a broader scale; however, the level of *local* community benefit from and involvement in tourism can be minimal. Some MPAs, such as the Great Barrier Reef MPA in Australia [67], Mendes Island MPA in the Mediterranean [68], and Tsitskamma National Park in South Africa [69], have resulted in significant increases in tourism visitation and revenue [51,70]. A global study of 78 coral reef MPAs found that 75% of tourism jobs were retained locally [71]. However, a lack of testing for additionality – i.e., measuring the impact of an activity or intervention through comparison with a status quo metric or reference case – does not ensure that these