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MARINE CONSERVATION

How to heal an ocean

Marine protected areas are being implemented at an accelerating pace, and hold promise for restoring damaged ecosystems. But glaring shortfalls in staffing and funding often lead to suboptimal outcomes.

BORIS WORM

Humans have arrived at an interesting juncture in their relationship with the ocean. After using (and overusing) it for centuries as a free food source, highway and dumping ground[1], there is a growing political resolve to reverse some of the damage that has been inflicted[2]. Marine protected areas (MPAs; Fig. 1) represent a cornerstone of our global strategy to heal compromised ecosystems[2,3], but their success has been varied and uneven in practice[4–6]. In a paper online in *Nature*, Gill *et al.*[7] expose some of the reasons behind this variation, identifying global capacity gaps — shortfalls in staffing, funding and scientific monitoring — that have been opened by the rapid, but woefully underfunded, expansion of protected areas worldwide.

On the surface, the extraordinary growth of MPAs looks like an environmental success story. Since the 1960s, global coverage of these areas has been growing exponentially at a rate of more than 8% per year (Fig. 2). The past decade, in particular, has seen a dramatic expansion of extremely large MPAs in some of the remotest corners of our planet, and especially of strongly protected areas that ban commercial extraction of natural resources such as fish, minerals or oil, and where recreational or subsistence fishing is light.

Later this year, the world's largest conservation area of any kind will come into force, protecting 1.55 million square kilometres of the Ross Sea in Antarctica. This means that nine of the ten largest protected areas on Earth will be marine. Still, the combined coverage of designated and implemented MPAs currently accounts for just 4% of total ocean area (Fig. 2), compared with 15% on land. Several international agreements have committed coastal nations to reach higher to correct this imbalance, aiming at 10% MPA coverage by 2020, as ratified under the Convention on Biological Diversity and reaffirmed by the United Nations Sustainable Development Goals.

Despite such commitments, further MPA expansion can be controversial, and the utility and effectiveness of protected areas are sometimes questioned. Like parks on land, MPAs can flourish or fail. Previous analyses[4–6] that sought to disentangle some of the complex reasons for this have focused largely on biophysical aspects, such as the size, age, connectivity or remoteness of a particular area, all of which proved influential. Social factors influencing the effectiveness of management or governance have been more difficult to quantify. Gill *et al.* provide a new perspective by focusing squarely on the role of people in MPA effectiveness[7].

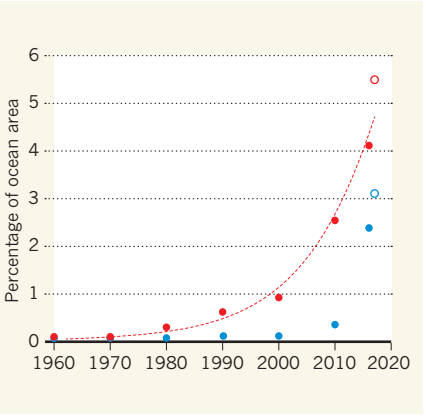

Figure 2 | Rapid growth of marine protected areas (MPAs). The percentage of the global ocean that has been designated and implemented as MPAs has grown exponentially since the 1960s (red symbols and line). Blue symbols indicate the subset of MPAs that are strongly protected — where commercial extraction of natural resources such as fish, minerals or oil is banned, and recreational or subsistence fishing is light. Open circles indicate coverage if current MPA proposals or announcements were implemented in 2017. (Adapted from ref. 2; data from J. Lubchenco, K. Grorud-Colvert and MPAtlas.org)

JIANGANG LUO/MARINE PHOTOBANK

Figure 1 | A diver monitors marine life at the Dry Tortugas Ecological Reserve in Florida. Gill *et al.*[7] report that the biggest factors in the success of marine protected areas are adequate staffing and funding.

The authors compiled an impressive database of management features in 433 MPAs around the world, and matched it with fish population data in 218 MPAs, thus providing a 'deep dive' into the relationship between socioeconomic factors and biological outcomes. The management data included a variety of indicators, ranging from budget constraints to the inclusion of stakeholders in decision-making processes.

The aggregate results were sobering, with 79% of MPAs in the global sample not meeting even half of the thresholds for adequate management. For example, just 35% of MPAs were appropriately funded, only 13% were informed by scientific monitoring, and 9% reported adequate staffing. Staffing and funding gaps were the strongest predictors of conservation outcomes, quantified as increases in fish biomass in an MPA relative to that in unprotected areas nearby. Despite their shortcomings, 71% of MPAs still secured substantial positive outcomes. But the degree to which they succeeded was mainly a function of human and financial resources.

To some extent, these results might not

surprise. To use an analogy, we cannot just build hospitals and hope that they will somehow ensure public health — the number of staff, the quality of their training and the level of funding clearly are crucial. The same goes for ocean conservation efforts, but it takes careful analysis to quantify capacity gaps and to show empirically where new investment is most likely to pay off. For example, Gill and colleagues' analysis suggests that raising staff capacity to adequate levels might increase fish biomass almost threefold. This investment would translate into downstream benefits for both tourism operators inside the MPA and fishermen outside it, who would benefit from fish spilling over reserve boundaries[8].

Gill and colleagues' work raises a broader point about the value of integrating social sciences into the study of human-dominated ecosystems. Another study[9] reported that the effectiveness of management schemes for small-scale fisheries depended mainly on factors such as leadership and social cohesion in the fishing community, and less strongly on biophysical aspects of the system under study. Other work has shown that enforcement of fishing rules is one of five key features that predict conservation outcomes on reefs worldwide[6]. Clearly, meaningful conservation measures need to be embedded in a social fabric that enables appropriate measures both inside and outside protected zones.

Later this year, policymakers will gather at the United Nations to discuss global development goals related to the conservation and sustainable use of the ocean. They should take note of Gill and colleagues' study, because it provides a timely warning that rapid expansion of protected areas by itself will not provide desired outcomes if there are large shortfalls in our capacity to manage, monitor and finance those areas. If the billions of dollars of subsidies that are currently spent on unsustainable fisheries were channelled into marine conservation, then the cited capacity gaps could be erased in one broad stroke[10].

Of course, money is only part of the solution. Public engagement, staff training and the capacity for scientific assessment should all be enhanced to build a truly robust, global MPA network. There is certainly no easy recipe for success, but global meta-analyses such as that of Gill *et al.* and others[6,9] will help us to further constrain what is needed to heal the ocean, and to provide long-term benefits to people. ■

Boris Worm *is in the Biology Department, Dalhousie University, Halifax, Nova Scotia, Canada B3H4R2.*
e-mail: bworm@dal.ca

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