THE VALUE OF OFFSHORE MARINE PROTECTED AREAS FOR OPEN OCEAN HABITATS AND SPECIES

TECHNICAL SUMMARY

MACBIO
Marine and Coastal Biodiversity Management in Pacific Island Countries
THE VALUE OF OFFSHORE MARINE PROTECTED AREAS FOR OPEN OCEAN HABITATS AND SPECIES

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The open ocean, beyond the 80 metre depth contour, is under pressure from overfishing, cargo and cruise shipping, impacts on by-catch, oil, gas and mineral extraction, destructive fishing, pollution and climate change. Until recently, no-take and other marine protected areas (MPAs) were an underused tool in the ocean management toolbox, but knowledge has shifted and has led to a number of large-scale MPAs (LSMPAs) being implemented that include deep oceanic waters\textsuperscript{1,2}.

MPAs are defined here as “a clearly defined geographical space, recognised, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values” \textsuperscript{3}. No-take MPAs are defined as areas in which all extraction of natural resources is prohibited, for the protection of populations and ecosystems\textsuperscript{4}; they have had clear benefits for exploited populations, food webs, and, in some cases, habitat condition\textsuperscript{5-7}.

Here, we highlight the positive effects of MPAs upon deep sea benthic and pelagic habitats and for pelagic, mobile and/or migratory species.

**HOW TO DEFINE OPEN OCEAN HABITATS?**

Open ocean habitats can be characterized in various ways. Firstly, there are topographic features on the sea floor such as seamounts, rises, shelf breaks, canyons, ridges and trenches. Secondly, there are oceanographic features such as currents, fronts, eddies and upwellings. Both can be mapped\textsuperscript{8}.

Thirdly, the deep open ocean varies dramatically with depth, in physical (especially light, temperature and pressure), biological and ecological characteristics with depth, across at least five major layers or zones, known as the epipelagic or photic, mesopelagic or mesophotic, bathypelagic, abyssopelagic and hadal zones\textsuperscript{9}. Fourthly, within each zone there are horizontal patterns in physical and biological characteristics with latitude and longitude, at various spatial scales, which may or may not overlap vertically\textsuperscript{10,11}.

Finally, species do not move randomly through open ocean habitats, but tend to follow certain pathways (vertically and horizontally) and aggregate at certain sites. And for species that can theoretically travel long distances, it may be only a few individuals who undertake extensive migrations, while the majority remains within a smaller home range\textsuperscript{12}.

**BENEFITS OF OFFSHORE MPAS**

**Offshore MPAs benefits offshore species.** Most of the open ocean’s inhabitants comprise small planktonic and nektonic fishes and invertebrates with relatively sedentary lifestyles; these species directly benefit from effective spatial protection and are often food sources for larger species\textsuperscript{13,14}. Some larger species are more mobile. A few individuals among these larger species can travel thousands of kilometers and cross ocean basins, however, this is always much further than the average movement distance of the species as a whole\textsuperscript{15}.

Aside from this, new science tells us that natural selection can operate rapidly to benefit the population as a whole, when the more “sedentary” individuals survive fishing mortality and pass on genes for lower mobility to the next generation\textsuperscript{16}.

In addition, many of the more mobile species use predictable movement pathways for breeding, feeding and resting areas in the ocean that can be tracked, mapped and protected\textsuperscript{17,18}.

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Many threats to open ocean organisms are either site specific or cumulative, and can be reduced through spatial protection at particular sites 19.

At least 30-50% of a species’ range needs to be included within MPAs to ensure both healthy populations and ecosystem integrity 20. Nations are showing that they recognise the need for, and benefits of large-scale offshore MPAs, or networks of offshore MPAs, by their willingness and capacity to establish large-scale MPAs; globally, there now 10 MPAs >200,000 km² in size 21.

In sum, these facts mean that open ocean MPAs can be highly effective in protecting offshore marine animals, including fish and their prey.

**Catch and gear regulations and MPAs are both important components of ocean management.** Catch and gear controls can limit incidental capture of threatened fauna 5. However, they have so far proved inadequate in protecting many target and by-catch species 22. Offshore MPAs complement traditional fisheries management tools to help: provide better protection for target, non-target and bycatch species, ensure fisheries sustainability as well as bringing broader ecosystem benefits 23.

**Static MPAs help protect physical processes that are often dynamic in space and time.** Many important pelagic features are spatially or temporally predictable 24, so that static or dynamic MPAs can be designed accordingly 25. Larger-scale MPAs (LSMPAs), even if static, would have a high likelihood of including entire dynamic features 21. For features with less predictability, mobile fisheries closures have already been effectively implemented in some locations and similarly would work for broader ecosystem objectives 25,26.

**Offshore data are adequate to design LSMPAs and offshore networks of MPAs.** Widespread datasets, especially time-series data on remotely sensed physical and biological features (e.g., chlorophyll), are useful for MPA design. For example, in the Pacific there are at least 70 such datasets that can inform MPA planning, and have already been used to map marine bioregions at scales useful for national planning 27. In contrast to the use of fisheries catch limits for management purposes, the placement of offshore MPAs does not have to rely on acquiring a full understanding of the life history of individual species in order to ensure their conservation and wise use. In fact, MPAs are one way to factor uncertainties into marine resource, including fisheries, management.

**Illegal use of the open ocean is becoming easier to observe, making regulations more enforceable.** Widespread adoption of vessel monitoring systems (VMSs) and satellite imagery, both within and beyond fisheries, and financial support for use of these data in developing nations, is improving remote surveillance to identify if vessels are illegally entering MPAs with electronic “fences” 12. Multi-jurisdictional surveillance and monitoring efforts (both within and beyond countries) are also increasing the efficiency and effectiveness of compliance efforts.

**CONCLUSIONS**

MPAs are essential in the management and protection of the open ocean. The bulk of the population of wide-ranging species have smaller ranges than the maximum migration distance, so that it is likely that 30-50% of the population will be contained within an appropriately designed network of no-take MPAs.

LSMPA and networks of offshore MPAs play a critical role in protecting both wide-ranging as well as the less mobile species. Understanding of the ocean’s three-dimensional complexity is increasing rapidly, and there is an ever-increasing willingness of nations to establish large-scale MPAs and national networks of MPAs which they know will protect the ocean ecosystem services upon which they rely.