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Viewpoint

One size does not fit all: The emerging frontier in large-scale marine conservation

Robert J. Toonen [a,*,1], T. 'Aulani Wilhelm [b,*,1], Sara M. Maxwell [c,d], Daniel Wagner [b], Brian W. Bowen [a], Charles R.C. Sheppard [e], Sue M. Taei [f], Tukabu Teroroko [g], Russell Moffitt [c], Carlos F. Gaymer [h], Lance Morgan [c], Nai'a Lewis [b], Anne L.S. Sheppard [e], John Parks [i], Alan M. Friedlander [j], The Big Ocean Think Tank [2]

[a] Hawai'i Institute of Marine Biology, University of Hawai'i, P.O. Box 1346, Kāne'ohe, HI 96744, USA
[b] Papahānaumokuākea Marine National Monument, 6600 Kalanianaole Hwy. #300, Honolulu, HI 96825, USA
[c] Marine Conservation Institute, 14301 Arnold Dr., Glen Ellen, CA 95442, USA
[d] Hopkins Marine Station, Stanford University, 120 Oceanview Blvd., Pacific Grove, CA 93050, USA
[e] School of Life Sciences, University of Warwick, Coventry CV4 7AL, UK
[f] Conservation International, Pacific Islands Program, Apia, Samoa
[g] Phoenix Islands Protected Area, Ministry of Environment, Lands, and Agricultural Development, Tarawa, Kiribati
[h] Departamento de Biología Marina, Universidad Católica del Norte, Centro de Estudios Avanzados en Zonas Áridas (CEAZA) and Institute of Ecology and Biodiversity (IEB), Casilla 117, Coquimbo, Chile
[i] Marine Management Solutions, Honolulu, HI, USA
[j] Fisheries Ecology Research Laboratory, Department of Biology, University of Hawaii at Mānoa, 2538 McCarthy Hall, Honolulu, HI 96822, USA

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ABSTRACT

On the 20th anniversary of the Convention on Biological Diversity, a network of very large marine protected areas (the Big Ocean network) has emerged as a key strategy in the move to arrest marine decline and conserve some of the last remaining relatively undisturbed marine areas on the globe. Here we outline the ecological, economic and policy benefits of very large-scale MPAs and show their disproportionate value to global marine conservation targets. In particular we point out that very large-scale MPAs are a critical component of reaching the Aichi targets of protecting 10% of global marine habitats by 2020, because in addition to encompassing entire ecosystems, they will bring forward the expected date of achievement by nearly three decades (2025 as opposed to 2054). While the need for small MPAs remains critical, large MPAs will complement and enhance these conservation efforts. Big Ocean sites currently contain more than 80% of managed area in the sea, and provide our best hope for arresting the global decline in marine biodiversity.

In 1992 the Convention on Biological Diversity (CBD) was opened for signature at the United Nations Conference on Environment and Development (the Rio "Earth Summit"). Recognizing the global crisis of dwindling biodiversity and extinction, the convention was eventually signed by 193 nations and territories. In 2010, at the 10th Meeting of the Conference of the Parties to the Convention on Biological Diversity in Nagoya, Japan, the Parties ratified the Aichi Biodiversity Targets, a broad set of initiatives including the following goal as part of Target 11: by 2020 at least 10% of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, would be conserved through effectively and equitably managed, ecologically representative and well-connected systems of protected areas and other effective area-based conservation measures that are integrated into the wider seascapes.

Many believed that this target was ambitious, because marine protected areas at that time encompassed only about 1% of marine habitats and had a median size of 4.6 km^2 (Spalding et al., 2013; Bertzky et al., 2012; Marinesque et al., 2012; Toropova et al., 2010; Wood et al., 2008). Fortunately, a few more nations stepped forward to declare large-scale marine protected areas (MPAs); i.e.,

* Corresponding authors. Tel.: +1 808 236 7471; fax: +1 808 236 7443.
E-mail addresses: .

[1] Shared first authorship. The original concept for the Big Ocean Network was developed by T.A.W., NOAA Superintendent for PMNM. She and T.T., Executive Director for PIPA, led the founding of Big Ocean Network under a sister-site agreement between U.S.A. and the Republic of Kiribati. The inaugural planning team for the Big Ocean Network included T.A.W., T.T., S.T., J.P., N.L. and Regen Jamieson.

[2] The Big Ocean Think Tank at the 25th International Congress for Conservation Biology included the following additional participants and organizers: K. Aiona, S. Anderson, Z. Basher, J. Bosanquet, J. Brider, N. Brownie, T. Carruthers, R. Constantine, T. Durbin, R. Jamieson, R. Kosaki, K. Morishige, J. Philibotte, R. Rotjan, G. San Martin, T. Short, A. Skeat, T. Tenuata, W. Tooma, S. van Dijken, I. Wright, and L. Wright-Koteka.

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MPAs > 240,000 km^2 that are actively managed for protection (Table 1).

The first large MPA was the Great Barrier Reef Marine Park at 344,000 km^2, founded in 1975 by the Government of Australia and recognized as a U.N. World Heritage site in 1981. In 2000 a second large MPA was established in the Northwestern Hawaiian Islands (360,000 km^2), now recognized as the Papahānaumokuākea Marine National Monument since 2006 and a U.N. World Heritage site since 2010. This was the first truly remote and uninhabited large-scale MPA. The Republic of Kiribati established a third large MPA in 2008, the Phoenix Islands Protected Area, and three more large-scale MPAs were established in the next 6 years (Table 1), with several others being likely to be declared soon.

Momentum continues to build. On the 20th anniversary of the original CBD (June 4, 2012), the Australian Government unveiled plans for the world's largest network of marine parks to "turn a corner on protection of our oceans." In August 2012, the Cook Islands and New Caledonia both announced plans to create marine parks spanning over 1,000,000 km^2 which would represent the largest MPAs on the globe. While some question whether such large-scale MPAs are effective, needed, or even actively divert attention from policies that could actually make a difference (Pala, 2013; Anonymous, 2013; The Nature Conservancy, 2012; Starck, 2009), here we outline why neither the science nor the reality support these views.

The vast majority of the world's MPAs have focused on nearshore and shallow-water habitats, but recent developments have spurred a new momentum for the creation of MPAs in offshore and open ocean areas as well. After the establishment of the Papahānaumokuākea Marine National Monument and declaration of the intent to establish the Phoenix Islands Protected Area in 2006, discussions began among managers and conservation professional to address the unique challenges faced by such large MPAs, especially the governance and protection of vast tracks of open ocean (Islands, 2007). These led to a sister-site agreement between the U.S.A. and the Republic of Kiribati aimed at addressing the challenges of managing very large MPAs (Wilhelm et al., 2011). Managers, scientists and partners from other sites (Fig. 1) soon joined this discussion and formed an alliance to share experiences, identify scientific gaps and to collaborate on efforts to cope with major challenges facing such large and remote sites. This led to the founding of a unique conservation organization in 2010, "Big Ocean: A Network of the World's Large-Scale Marine Managed Areas", (http://www.bigoceanmanagers.org/), focused on professionalizing this new genre of marine conservation. Big Ocean was launched with the straightforward objective of providing a forum for communication among the rapidly expanding network of large MPAs. In addition to improving efficiency and effectiveness of management at existing sites, Big Ocean also provides a foundation of experience and resources for new MPAs (Wilhelm et al., 2011). The launch of Big Ocean included the first managers' communiqué, formulated by the inaugural Big Ocean partners, providing a shared forum for discussion while recognizing that each site is in different stages of evolution and development, and with different scientific knowledge bases (Wilhelm et al., 2011).

1 year after the inaugural meeting, Big Ocean managers and scientists working in these areas convened a workshop in conjunction with the 25th International Congress for Conservation Biology Marine Think Tank in Auckland, New Zealand titled, "Big Ocean: A Research Agenda and Science Dissemination Strategy for Large-Scale MPAs". This workshop addressed the role of large-scale MPAs in achieving the goal of protecting 10% of the world's oceans by 2020, and how to ensure that the right habitats, species and ecosystem functions are protected in the process. The workshop focused on the unique set of benefits and challenges for large-scale MPAs, including ecological, economic, and political considerations.

Foremost among the ecological benefits of large MPAs is the protection of both entire ecosystems (Sheppard et al., 2012) and the synergistic links to adjacent ecosystems (Toonen et al., 2011) which is the most direct and effective manner of maintaining intact ecosystem services. Until recently, MPAs have largely focused on nearshore and shallow-water habitats, but Big Ocean has spurred the momentum for protection of offshore and open ocean areas as well. A unique feature of oceanic ecosystems is that key habitats, such as eddies and upwelling zones, will change in location and intensity over time; only large-scale MPAs will incorporate such mobile habitats, and protect vulnerable marine ecosystems such as seamount chains. Further, these MPAs afford greater protection to the oceanic migrants or highly mobile species whose home ranges vastly exceed the confines of coastal MPAs (Fox et al., 2012; Lester et al., 2009). A few studies have now considered the effectiveness of pelagic MPAs (Game et al., 2009; Notarbartolo-di-Sciara et al., 2007), and only very large-scale MPAs are likely to reach the ~20% 'rule of thumb' proportion of habitat required for effective protection (Lester et al., 2009). Additionally, large MPAs buffer against the inevitable uncertainties in manage-

Table 1
Inaugural sites of the Big Ocean Network.

Name	Country	Founded	Size	Proportion of site that is no-take (%)	Comments
Great Barrier Reef Marine Park	Australia	1975	344,000 km^2	33	U.N. World Heritage site in 1981.
Papahānaumokuākea Marine National Monument (PMNM)	U.S.A.	2000	362,074 km^2	100	Created as Northwestern Hawaiian Islands Ecosystem Reserve in 2000 and became a Marine National Monument in 2006. U.N. World Heritage Site in 2010.
Phoenix Islands Protected Area (PIPA)	Republic of Kiribati	2008	408,250 km^2	4	PIPA declared in 2006 and established in 2008. U.N. World Heritage Site in 2010.
Mariana Trench Marine National Monument (MTMNM)	Common-wealth of Northern Mariana Islands U.S.A.	2009	246,609 km^2	100	Only protected deep-sea trench in the world.
British Indian Ocean Territory (BIOT) Marine Protected Area	U.K. Overseas Territory	2010	640,000 km^2	100	British Indian Ocean Territory consists entirely of the Chagos Archipelago and surrounding waters, with the exception of Diego Garcia Atoll out to 3 nm. Contains 32% of the world's fully protected marine reserves.
Motu Motiro Hiva Marine Park	Chile	2010	150,000 km^2 (with planned expansion to 411,000 km^2)	100	Isolated reefs northeast of Rapa Nui (Easter Island), explicitly created to protect one of the last pristine ecosystems in the Pacific Ocean and advance the 10% goal of the Aichi Biodiversity Targets.