Large Scale Marine Protected Areas
Current status and consideration of socio-economic dimensions

Discussion Paper Prepared by

Chris Smyth and Quentin Hanich
Australian National Centre for Ocean Resources and Security (ANCORS)
University of Wollongong, Australia

A Global Research Agenda for Large Scale Marine Protected Areas

Executive Summary

Global targets for Marine Protected Areas (MPAs) have evolved over the past two decades in response to rising global concerns about the health of the world's oceans and numerous scientific studies demonstrating the benefits of MPAs as a conservation tool. Throughout the past two decades, marine scientists and community advocates have called for MPAs, especially no-take ones, at the provincial, national and international scales. The benefits ascribed to MPAs include:

- conserving marine life at a time when oceans are under serious threat from various impacts
- increasing fish biomass
- protecting critical habitats used by threatened species such as sharks, marine mammals, turtles, seabirds and shorebirds
- returning ecosystems to stronger more complex structures
- insuring against risk from future threats
- building food and livelihood security for coastal communities
- building resilience to threats such as flooding, pest invasions and climate change
- boosting local economies through tourism, education and research
- supporting the ecological sustainability of fisheries e.g. spillover of fish and larvae
- catching up to the terrestrial ecosystems protection
- storing carbon as part of a blue economy
- protecting ocean areas before threats appear.

In all of the targets developed to-date, size is not mentioned. But through the 1990s to the present, there has been a large increase in the number of Large Scale Marine Protected Areas (LSMPAs). Five LSMPAs were created over a 24-year period, but in the past 18 years the number has risen to 33; several more are planned. Together, and in a relatively short time, LSMPAs will be the major contributor to achieving the 10% global target by 2020 because the 20 largest represent 70% of the world's MPA coverage. Marine scientists argue that the bigger the MPA, the better. Larger MPAs:

- enhance protection from the edge effects along boundaries
- are more cost-effective to manage
- protect and connect large (and sometimes entire) pelagic ecosystems, seamounts, canyons, ocean trenches and other ecosystems not possible in smaller coastal MPAs
- can include significant parts of the ranges of the larger migratory species including tuna, billfish, sharks, cetaceans, turtles and seabirds
- build greater resilience to climate change than smaller MPAs.

But simultaneously, there is rising concern at the proliferation of these LSMPAs, their effectiveness compared to other management responses, and their potential impact on developing States and their development priorities.

This paper discusses some of the many research needs, required to address stakeholder and government concerns from both developed and developing State viewpoints, and build a greater understanding of the benefits and impacts of Marine Protected Areas for the marine ecosystem and the stakeholders that depend on it.

LSMPAs, fish populations and spillover research needs
- For existing and proposed LSMPAs, identify key habitats and associated species along their boundaries to build a picture of fishing intensity that can be used to better understand potential spillover along with edge effects that may require management action in the future.
- Identify cost-effective and innovative monitoring and reporting techniques that can be applied to a better understanding of ocean ecology and biophysical processes in existing and candidate LSMPAs.
- Conduct social research to better understand how fishers are responding to existing LSMPAs and may respond to the establishment of candidate LSMPAs.
- Design and apply a research strategy to ground-truth models of spillover and fisher responses to LSMPAs.

LSMPAs and migratory species research needs
- Identify critical habitats for key species that existing and candidate LSMPAs are aiming to protect.
- Use tagging and other innovative monitoring technologies to build a better understanding of the biology and behaviour of key migratory species.
- Monitor the state of fisheries and the level of displaced fishing effort adjacent to existing LSMPAs and fishing intensities and impacts in candidate LSMPAs.
- Investigate MPA designs that maximise protection for migratory species and reduce displaced fishing effort.
- Map major habitats along LSMPA boundaries and analyse the potential edge effects of fishing the line.

LSMPAs and climate change research needs
- Establish baseline monitoring in existing and candidate LSMPAs to monitor trends in critical indicators of climate change and its effects on key species and habitats.
- Review the designs of LSMPAs to determine how effective they will be in building climate-change resilience and apply that understanding to the design of new LSMPAs.
- Investigate management measures that can make fisheries more resilient to climate change

Socio-economics of LSMPAs research needs
- Develop and implement a social science research agenda for LSMPAs that includes human dimensions, governance, politics, and social and economic outcomes.
- Investigate whether the Rising and Heal model can be ground-truthed in regions with candidate LSMPAs to assist the case for increasing protection in those regions.
- Conduct social research to identify practical adaptation measures that coastal fishing communities in or near existing and candidate LSMPAs can implement to minimise social and economic impacts.

- Develop and implement LSMPA planning and research strategies that are inclusive of the rights and aspirations of Indigenous communities and respectful of their culture.
- Investigate social, economic and cultural values in communities in or near existing and candidate LSMPAs and infuse this understanding into LSMPA identification, design and management.
- Investigate long-term and sustainable financing mechanisms for Indigenous communities when LSMPAs are created.
- Conduct social research to:
  - review the socio-economic impact of existing LSMPAs on island communities and investigate measures that can ameliorate negative impacts and enhance positive impacts
  - build a clearer picture of the needs and aspirations of island communities in regions where LSMPAs are proposed.
- Review the success or otherwise of financial and other incentives that have been used to build support for marine protection, and their benefits/impacts for communities.

Pelagic ecosystems and the blue economy research needs
- Develop and implement a research strategy to identify, map, quantify and value blue carbon storage in key areas of existing and candidate LSMPAs.
- Review the mechanisms that coastal communities can use to build and benefit from carbon storage.
- Develop a framework for ecosystem service payments and pilot it in several coastal communities.

Institutional arrangements for governance research needs
- Conduct social and institutional research to determine the most effective governance models to use in existing and candidate LSMPAs.
- Develop and implement a research strategy that establishes climate-change indicators to monitor trends in existing and candidate LSMPAs.
- Conduct social research to determine which mitigation and adaptation mechanisms are most likely to be adopted by coastal communities in and around LSMPAs.
- Investigate and quantify the level of contribution that non-MPA measures can contribute to achieving global protection targets.
- Continue to build knowledge of the high seas ecological and biophysical values.
- Establish an independent and reliable monitoring and reporting database on MPA coverage and levels of protection.
- Develop a marine conservation performance index to promote marine conservation efforts and help identify those nations that need support implementing LSMPAs.

Global science capacity to meet research needs
- Build global capacity and expertise in socio-economic methodologies and approaches to implement the research needs identified above, particularly in the Asia-Pacific region and developing State research institutions.
- Develop global networks and mentoring programs to share emerging methodologies and expertise, and build in-country expertise, particularly in the Asia-Pacific region and developing State institutions.

1. Background

1.1 Global targets for marine protected areas and their rationale

International agreement on protecting and conserving the world's marine environments is framed by the UN Law of the Sea Convention (LOSC)[1], which was adopted in 1982 and came into force in 1994. Parts V and VII refer to the conservation of living resources (although largely with regards to 'optimal utilisation' and the avoidance of overfishing) in Exclusive Economic Zones and on the High Seas. Part XII refers more generally to State obligations '…to protect and preserve the marine environment'. These provisions have given some legal underpinning to subsequent international collaboration and agreements on marine protected area (MPA) targets.

Global targets for MPAs have evolved over the past two decades from general to specific and in response to rising global concerns about the health of the world's oceans and numerous scientific studies demonstrating the benefits of MPAs as a conservation tool. Throughout the past two decades, marine scientists and community advocates have called for MPAs, especially no-take ones, at the provincial, national and international scales. The benefits ascribed to MPAs include:

- conserving marine life at a time when oceans are under serious threat from various impacts
- increasing fish biomass
- protecting critical habitats used by threatened species such as sharks, marine mammals, turtles, seabirds and shorebirds
- returning ecosystems to stronger more complex structures
- insuring against risk from future threats
- building food and livelihood security for coastal communities
- building resilience to threats such as flooding, pest invasions and climate change
- boosting local economies through tourism, education and research
- supporting the ecological sustainability of fisheries e.g. spillover of fish and larvae
- catching up to the terrestrial ecosystems protection
- storing carbon as part of a blue economy
- protecting ocean areas before threats appear.

The first international objective for MPAs appeared in 2002, when the Johannesburg World Summit on Sustainability Development (WSSD) agreed that nations should establish representative networks of MPAs by 2012. Two years later, the Convention on Biological Diversity (CBD) added a percentage target, 10% coverage by 2012. The Aichi Target 11[2] in the CBD Strategic Plan for Biodiversity 2011–2020, reaffirmed the 10% target:

> By 2020, at least 17 per cent of terrestrial and inland water areas and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well-connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscape and seascape.

---

[1] http://www.un.org/depts/los/convention_agreements/texts/unclos/unclos_e.pdf.
[2] https://www.cbd.int/doc/strategic-plan/targets/T11-quick-guide-en.pdf.

The rationale for the Aichi Target 11 was: 'Well governed and effectively managed protected areas are a proven method for safeguarding both habitats and populations of species and for delivering important ecosystem services'[3]. The lack of representation in protected areas of 'critical ecosystems such as tropical coral reefs, sea-grass beds, deepwater cold coral reefs, seamounts'[4], and the disparity between the protection levels of terrestrial, coastal and marine ecosystems, reinforced the need for the target.

Bookending the Aichi Target 11 were recommendations from the World Parks Congresses in Durban (2004) and in Sydney (2014) for targets of 20-30% and at least 30% respectively (the Bangkok, Seoul and Hawaii IUCN World Conservation Congresses have also recommended global MPA targets). Although the percentages vary from target to target, the key differences between those of the congresses, the WSSD and the CBD are in the level of protection and their legal status. The non-binding congress resolutions specify high-level (no-take) protection, while the WSSD and binding CBD targets include protected areas where extractive uses are allowed and managed under ecologically sustainable conditions.

Most recently, the UN Sustainable Development Goals (SDGs) reaffirmed the Aichi Target 11 in *SDG 14 Life below the water*: 'By 2020, conserve at least 10 per cent of coastal and marine areas, consistent with national and international law and based on the best available scientific information'[5]. The SDGs will guide future funding priorities of the United Nations Development Programme.

The value of setting a target is that it provides a goal for nation states and an indicator for measuring the success of their efforts. In its first iteration, the CBD's 10% target was to be achieved by 2012, but it soon became clear that many nations would struggle to meet that deadline; it was extended to 2020. Nevertheless, since 1993, global MPA coverage has become twenty times greater and doubled since 2010 to 5.7%[6]. New commitments[7] from parties to the CBD will soon add another 4.4% and expand coverage beyond the 10% threshold. The rapid increase in coverage is largely the result of national jurisdictions designating large-scale MPAs (LSMPAs). Although some researchers regard MPAs above 30,000 km^2 as LSMPAs, a broader consensus, and this paper, places the threshold at more than 100,000 km^2. Even so, the bulk of maritime states will fall well short of the 10% target for national jurisdictions[8].

According to the Protected Planet website (a joint project between UNEP and IUCN), there are now 15,609 MPAs covering 6.9% of the world's oceans or 25,245,207 km^2:

> 'National waters represent 39% of the global ocean and at present, 16.03% of these waters are designated as protected areas. In contrast, only 1.18% of ABNJ[Areas Beyond National

---

[3] ibid.

[4] ibid.

[5] https://sustainabledevelopment.un.org/sdg14.

[6] United Nations (2017) 'Global marine protected area target of 10% to be achieved by 2020', UN Environment Programme, media release, 5 June 2017, https://www.cbd.int/doc/press/2017/pr-2017-06-05-mpa-pub-en.pdf.

[7] ibid.

[8] Some caution needs to be applied to the data when measuring success against coverage. The variable quality of spatial data creates some uncertainty. For example, the MPAtlas indicates that the MPA coverage for Norway is 3.29% but the World Bank has it at 60.7%. The MPAtlas also lists Australia as having 1,064 MPAs (it is actually closer to 140) by including fisheries habitat areas and other marine management arrangements not recognised as MPAs in Australia.

Jurisdiction], which makes up the remaining 61% of the global ocean, has been established as protected areas…The USA, France and the United Kingdom and their overseas territories make up over 50% of the area covered by MPAs while Australia, the Cook Islands, New Zealand and Mexico cover an additional 30%'.

A major impetus for increasing the ambitions of nation states has been the annual Our Ocean conferences, the first of which was held in 2014, the most recent in October 2017. The conferences provide a venue for nations to announce MPA and other commitments to improve ocean health and to equitably share the benefits. At the 2017 conference, for example, Canada committed to an LSMPA off the coast of British Columbia.

In response to the expansion of MPAs, an increasing number of scientific papers have raised concerns about the focus on quantity rather than quality. Barr et (2011) found that '73% of countries have inequitably protected their biodiversity and that common measures of protected area coverage do not adequately reveal this bias…leaving many vulnerable species and habitats with little or no formal protection'[9]. This bias is borne out by research conducted by Spalding et al. (2013) and summarised in Figure 1. The map reveals that ecoregions in the Atlantic, southern Indian and Arctic oceans have no MPAs (mostly in High Seas), while there is also low to no ecoregion coverage along the coasts of Africa, South America, Asia and the Middle East.

'At the finest resolution there is considerable variation in MPA coverage in coastal waters – some 13 MEOW [Marine Ecoregions of the World] ecoregions have no MPA coverage, but five of these lie in international or disputed waters. A further 50 ecoregions have less than 1% MPA coverage. By contrast 73 ecoregions have over 10% MPA coverage, with 13 having over 75% coverage. The latter areas are typically far from population centres'[10].

A 2016 study[11] by the BIP Secretariat provides further evidence of the skewed coverage and is summarised in Table 1:

'…36% of the world's marine ecoregions have at least 10% of their area protected, an increase of 2% since 2014. Interestingly, 13% of the world's marine ecoregions have more than half of their area protected, and 22% of marine ecoregions have less than 1% of their area protected. The largest marine protected areas are concentrated in the Eastern Indo-Pacific (21% protected), Temperate Australasia (19% protected) and Temperate Northern Atlantic (17% protected) realms. Beyond 200 meters depth, only 8% of pelagic provinces have at least 10% of their area included in protected areas, and 49% have less than 1% of their total areas protected'.

Table 1 Protected area coverage (number of units and percentage) in the world's oceans

| Scheme	Less than 1%	At least 17%	At least 50%
Marine realms	0	3 (50%)	0
Marine provinces	4 (6%)	28 (45%)	7 (11%)
Marine ecoregions	51 (22%)	84 (36%	29 (13%)
Pelagic provinces	18 (49%)	3 (8%)	0

[9] Barr L, Pressey R, Fuller R, Segan D and McDonald-Madden E (2011) 'A new way to measure the world's protected area coverage. *PLoS ONE* 6(9): e24707. doi:10.1371/journal.pone.0024707.
[10] Spalding, M, Meliane, I, Milam, A, Fitzgerald, C and Hale, L (2013) 'Protecting marine spaces: Global targets and changing approaches', in A Chircop, S Coffen-Smout and M McConnell (eds), *Ocean Year Book 27*, Brill Nijhoff, The Netherlands.
[11] BIP Secretariat (2018) *Protected area coverage of ecoregions*, BIP Secretariat, Cambridge.

Figure 1 MPA coverage of ecoregions in the world's oceans[12]
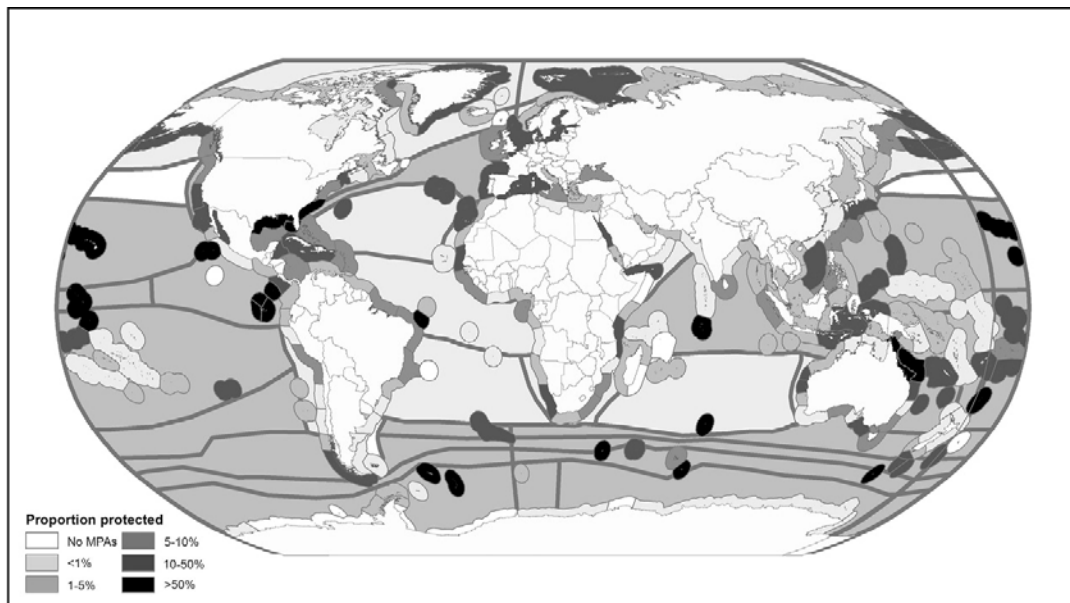
Klein et al. (2015) analysed the effectiveness of existing MPAs in capturing marine biodiversity. They assessed the overlap of global MPAs with the ranges of 17,348 marine species (fishes, mammals, invertebrates), and found 'that 97.4% of species have <10% of their ranges represented in stricter conservation classes. Almost all (99.8%) of the very poorly represented species (<2% coverage) are found within exclusive economic zones, suggesting an important role for particular nations to better protect biodiversity'[13].

Tropical corals and fishes are also poorly represented in global MPA coverage, according to research presented in Mouillot et al. (2015)[14]. They found that the greatest deficits were in the Eastern Pacific for corals and the western Indian Ocean and central Pacific Ocean for fishes.

Bias also occurs in the selection of areas for protection and the subsequent measure of their effectiveness as protectors of marine life. In the Galapagos Marine Reserve, Edgar et al. (2004)[15] determined that fished areas had higher densities of sea cucumbers and sharks than no-take areas, largely because the waters chosen for no-take were resource poor or possessed 'atypically-interesting' features favoured by dive-tour operators. Such bias has also been revealed by Devillers et al. (2014) both globally and in the new networks of marine parks in Australia's Commonwealth waters. The authors referred to these MPAs as located in residual areas, places that are remote or of little commercial interest.

---

[12] Spalding, M et al. (2013).

[13] Klein, C, et al. (2015) 'Shortfalls in the global protected area network at representing marine biodiversity', *Scientific Reports*, 5:17539, DOI: 10.1038/srep17539.

[14] Mouillot, D, et al (2015) 'Global marine protected areas do not secure the evolutionary history of tropical corals and fishes, *Nature Communications* 7:10359, DOI: 10.1038/ncomms10359

[15] Edgar, G, et al. (2004), 'Bias in evaluating the effects of marine protected areas: the importance of baseline data for the Galapagos Marine Reserve', *Environmental Conservation* 31 (3): 1–7.

Research by O'Leary et al. (2016)[16], which reviewed 144 MPAs studies, concluded that the 10% Aichi Target 11 is well below what is needed 'to protect biodiversity, preserve ecosystem services, and achieve socioeconomic priorities' and indicated 'protecting several tens-of-per cent of the sea is required to meet goals'.

The level of protection required is also a matter of great debate. In a study of 87 MPAs from around the world, Edgar et al.[17] found that to be successful, MPAs had to be no take (according to the MPAtlas, 2% of the world's oceans are in no-take), well enforced, old, large and isolated. The sobering message from the analysis was that in most of the MPAs studied there was no difference in the fish communities within and outside their boundaries, suggesting they were 'paper parks' failing to achieve their conservation objectives.

1.2 Development of LSMPAs

In all of the targets discussed thus far, size is not mentioned. But through the 1990s to the present, there has been a large increase in the number of LSMPAs. The world's first was the Great Barrier Reef Marine Park, created in 1975 in response to threats from mining. Next was the North-east Greenland National Park/UNESCO-MAB Biosphere Reserve in 1988, followed by Russia's Franz Josef Land Zakaznik Park in 1994 (a large marine area in this park was excluded from the more recent Russian Arctic National Park; it no longer meets the LSMPA threshold), Ecuador's Galapagos Marine Reserve in 1998, and Australia's Macquarie Island Commonwealth Marine Park in 1999.

Five LSMPAs were created over a 24-year period, but in the past 18 years the number has risen to 33; several more are planned. Together, and in a relatively short time, LSMPAs will be the major contributor to achieving the 10% global target by 2020 because the 20 largest represent 70% of the world's MPA coverage[18]. Table 2 lists each of the LSMPAs, their responsible jurisdiction and areas along with their Human Development Index (HDI) grouping.

The Human Development Index (HDI) is a summary measure of average achievement in key dimensions of human development: a long and healthy life, being knowledgeable and having a decent standard of living. Table 2 shows that 22 of the world's 33 LSMPAs have been established by nations with Very High HDIs, another five by nations with a High rating, and three by Medium-rated nations. The remaining three have been established groups of nations, most of which are in the Very High to High HDI ratings.

Marine scientists argue that the bigger the MPA, the better. LSMPAs:
- enhance protection from the edge effects along boundaries
- are more cost-effective to manage
- protect and connect large (and sometimes entire) pelagic ecosystems, seamounts, canyons, ocean trenches and other ecosystems not possible in smaller coastal MPAs
- can include significant parts of the ranges of the larger migratory species including tuna, billfish, sharks, cetaceans, turtles and seabirds
- can ensure connectivity of ecosystems

[16] O'Leary, B, et al. (2016), 'Effective coverage targets for ocean protection, *Conservation Letters*, November/December 2016, 9 (6), pp 398-404.
[17] Edgar, G et al. Nature 506: 216-220, (2014)
[18] www.protectedplanet.net/marine.

- build greater resilience to climate change than smaller MPAs
- can have economic benefits in terms of fisheries, tourism and maintenance of ecosystem services
- prevent future exploitation of remote and near-pristine ecosystems
- encourage international cooperation
- greatly enhance progress towards national and global conservation targets.

The purpose of LSMPAs is well summarised by the aims of the two Charlie Gibbs MPAs established by Protecting and Conserving the North-East Atlantic and its Resources (OSPAR):
- to protect, conserve and restore species, habitats and ecological processes which have been adversely affected by human activities
- to prevent degradation of, and damage to, species, habitats and ecological processes, following the precautionary principle
- to protect and conserve areas that best represent the range of species, habitats and ecological processes in the maritime area.

Only 99 of the world's 196 nations have Exclusive Economic Zones larger than 100,000 km^2 and thus the available waters for an LSMPA. As well as their large size, LSMPAs have a number of common features. One is remoteness. Most have been established by either well-developed nations (UK, US, Australia and France) in their external territories well removed from their mainlands and with few economic interests, or by small island developing states (Palau, Micronesia and Kiribati) concerned about the impacts of industrial fishing on high conservation values and their coastal communities.

The majority are in the Pacific Ocean, with just three in the High Seas, the outcome of negotiations between member states of the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) and OSPAR. Another common feature is that the science behind the creation of LSMPAs is severely limited, except for seabed topography and from fisheries records. Most available research has been about small, coastal MPAs.

For the well-developed nations, the remoteness of the LSMPAs and their level of use have generally made the politics of their establishment far easier. However, the Chagos reserve is caught up in a challenge in the International Court of Justice to the UK's claims over the region[19]. The Chagossian people, forcibly resettled decades ago by the UK, wish to return to the islands and believe the no-take MPA is a means by which the UK is working to prevent them. In New Zealand, the yet to be finalised Kermedec Ocean Sanctuary is being opposed by commercial fishers and the Iwi people[20], with its declaration stalled while being reviewed by the new Labor Government (elected December 2017). The boundaries of five new LSMPAs in Australia's EEZ were secured in 2012 but opposition to their draft management zones continues, especially against the Coral Sea Marine Park. The likely outcome will be significant reductions in the level of protection originally proposed in 2013.

---

[19] Bowcott, O (2017) 'Chagos Islanders take marine park case to supreme court', *The Guardian*, 28 June 2017.
[20] Kirk, S (2017) 'Kermedec sanctuary still on table, but Iwi consultation key—Labour', stuff.co.nz, 22 October 2017.

Table 2 LSMPAs by nation, HDI, total area and no-take area

Nation	Non-mainland Territories	Total Area	No-take area
HDI Very High			
Australia	Argo-Rowley Terrace Commonwealth Marine Park (29)	146,099	n/a
	Coral Sea Commonwealth Marine Park (6)	989,842	n/a
	Great Barrier Reef Marine Park (16)	345,000	
	Lord Howe Commonwealth Marine Park (33)	110,149	n/a
	Macquarie Island Marine Park (26)	162,000	
	Norfolk Commonwealth Marine Park (22)	188,433	n/a
	South-west Corner Commonwealth Marine Park (19)	271,898	n/a
Chile	Motu Motiro Hiva Marine Park (27)	150,000	?
	Nazca-Desventuradas Marine Park (18)	300,005	300,005
	Rapa Nui Rahui MPA* (10)	631,368	496,570
France	Natural Park of the Coral Sea (New Caledonia) (3)	1,368,806	3236
	Terres Australes Francaises (8)	673,000	120,000
New Zealand	Kermadec Ocean Sanctuary* (11)	620,000	n/a
	Niue Marine Protected Area* (32)	126,909	
United Kingdom	Ascension Ocean Sanctuary* (21)	234,291	50%?
	Chagos (British Indian Ocean Territory) MPA (9)	640,000	640,000
	Pitcairn Islands Marine Reserve (7)	834,334	834,334
	South Georgia and South Sandwich Islands MPA (5)	1,000,700	20,431
	St Helena Marine Protection Zone (14)	445,000	0
United States	Marianas Trench Marine National Monument (20)	246,608	0
	Pacific Remote Islands Marine National Monument (4)	1,270,000	1,270,000
	Papahānaumokuākea Marine National Monument (2)	1,508,870	1,508,870
HDI High			
Cook Islands	Marae Moana Marine Park (17)	324,000	?
Ecuador	Galapagos Marine Reserve (31)	133,000	?
Mexico	Pacífico Mexicano Profundo* (12)	577,800	187,871
	Revillagigedo National Park* (28)	147,629	147,629
Palau	Palau National Marine Sanctuary (13)	500,000	500,000
HDI Medium			
Kiribati	Phoenix Islands Protected Area (15)	408,250	408,250
Micronesia	Micronesia Marine Protected Area (23)	184,948	?
South Africa	Prince Edward Islands MPA (24)	180,000	?
HIGH SEAS			
CCAMLR	Ross Sea Protected Area (1)	1,549,000	1,120,000
OSPAR	Charlie Gibbs North High Seas MPA (25)	178,651	?
	Charlie Gibbs South High Seas MPA (30)	145,420	?
Total		16,592,010	
COMMITMENTS			
Seychelles	MPA over 30% of its EEZ	400,000	?
UK	Tristan da Cunha	750,000	?
	Bermuda Blue Halo (Sargasso Sea)	466,000	466,000
France	Expand Terres Australes Francaises by 1,000,000km^2 by 2022		?
Canada	New MPA of 140,000km^2 off British Columbia coast	140,000	?
Chile	Cabo de Hornos and Diego Ramirez Archipelagos MPAs	116,549	?
	Juan Fernandez Archipelago MPA	484,328	?

*Not yet established. Numbers in brackets locate the LSMPAs on the map in Figure 2.

Figure 2 Location of LSMPAs and their levels of protection[21]
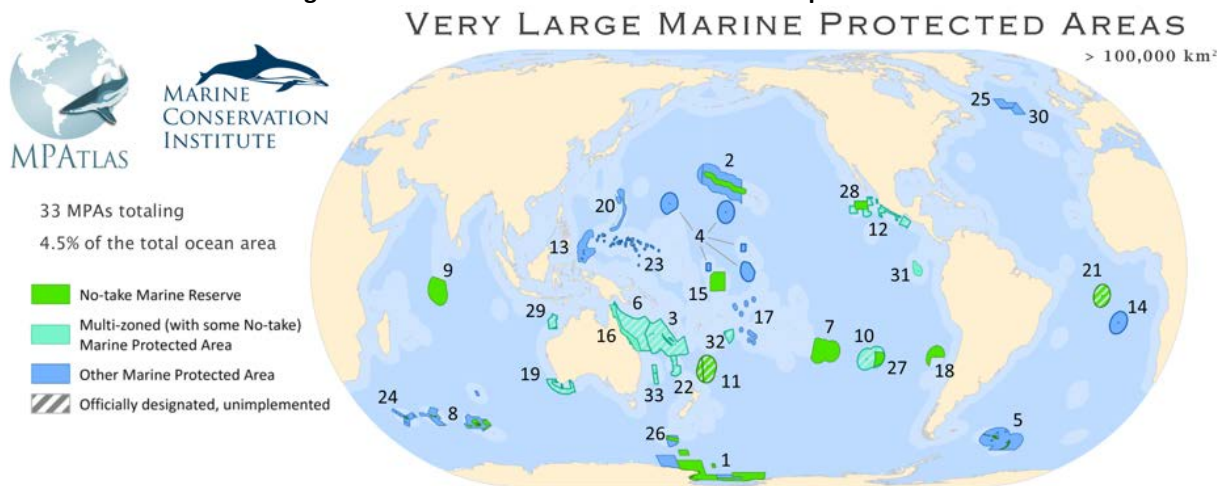
Gruby et al. (2017a) [22] challenge the presumption that by being remote LSMPAs have few stakeholders and negligible social outcomes, by presenting the results of research in five LSMPAs. They conclude:

'There is an assumption that remote spaces with few direct uses present easy political wins (Steinberg 2008). As our results demonstrate, however, resource users are not the only stakeholders to affect and be affected by LMPA negotiations and outcomes. Rather, the geographical and political features of LMPAs gives them the potential to intersect with broader and more diverse populations including but not limited to people with direct, material experiences or uses of the protected spaces'.

Richmond and Kotowicz (2015)[23] found that although visits by locals to the Mariana Trench Marine National Monument were rare due to distance, they were nevertheless culturally significant and provided connections to Indigenous roots. The authors believe that restrictions on fishing within the monument could 'directly and indirectly restrict local access to these culturally important waters' and urged that social and equity concerns be better considered in MPA siting and regulations.

Leenhardt et al. (2013)[24] argue that the drivers behind the rapid rise of LMPAs are:

'…political reasons due to international conservation targets and intense domestic and international advocacy…International conservation targets provided political motivation for LSMPA establishment enabling coastal states to benefit from several legal mechanisms to strengthen their sovereignties over sea spaces…[25]

[21] MPAtlas (2018) 'Very large marine protected areas', http://www.mpatlas.org/media/filer_public/53/09/53090daa-13cc-478f-a78a-0953eba885ed/vlmpa_dec2017.jpg.

[22] Gruby et al. (2017a) Conceptualising social outcomes of large marine protected areas', Coastal Management, 45:6, 416-435, DOI: 10.1080/08920753.2017.1373449

[23] Richmond, L and Kotowicz, D (2015), Equity and access in marine protected areas: The history and future of 'traditional indigenous fishing' in the Marianas Trench Marine National Monument, Applied Geography, 59, May 2015, 117-124

[24] Leenhardt, P, Cazalet, B, Salvat, B, Claudet, J and Fera, F (2013) 'The rise of large-scale marine protected areas: Conservation or geopolitics?, Ocean & Coastal Management 85 (2013) 112–118, http://dx.doi.org/10.1016/j.ocecoaman.2013.08.013, p. 1.

Bennett et al.[26] express concerns that with the rapid development of MPAs 'there is a real danger that the marine conservation community may promote actions that are socially unjust or inappropriate' and they recommend a code of conduct to 'promote fair conservation governance and decision-making, socially just conservation actions and outcomes, and accountable conservation practitioners and organizations'.

Other writers have echoed these concerns, stressing the need to consider the human dimensions of LSMPAs:

'social scientists have questioned whether protecting such large zones infringes on indigenous people's rights'…. and '…efforts to protect even remote sites can generate important outcomes for local residents that they may view as positive or negative. They can increase national pride and political leverage for indigenous populations, for example. They can also complicate international conservation negotiations or cause broad shifts in national economies'[27].

Peter Jones and Elizabeth de Santo[28] have been especially critical in various papers:

…relatively recent increases in the designation of remote, very large marine protected areas (VLMPAs) around the world threatens to undermine the very purpose and objectives of the Aichi biodiversity targets they are aiming to address. Questions are raised about the effectiveness, representativeness, and potential for connectivity of these remote VLMPAs as well as whether they are equitably managed. In addition, it is argued that the push for such designations in countries' overseas territories deflects attention and effort from the challenge of designating and effectively managing MPAs closer to home…

To better meet the MPA network criteria set out by the CBD, a range of types of MPAs must be implemented, including smaller MPAs in more intensely used 'metropolitan seas', and social justice considerations must be better integrated in conservation planning'.

Mark Spalding of The Nature Conservation says that size is important but not everything: 'Size is often a critical component of effectiveness. What is needed is for the conservation NGOs to wake up to the fact that size isn't everything, and to push equally hard for representative, equitable, effective, local, nearshore protected areas'.[29] Concerns have also been raised that the focus on MPAs more generally is ignoring the need for other marine management measures. Two decades ago, Allison, Lubchenco and Carr (1998)[30] argued that 'without adequate protection of species and ecosystems outside reserves, effectiveness of reserves will

[26] Bennett, N, The, L, Ota, Y, Christie, P and 21 others (2017) 'An appeal for a code of conduct for marine conservation', *Marine Policy* **81** (2017) 411–418.

[27] Gruby, R, Campbell, L, Fairbanks, L and Gray, N (2017b), 'To succeed, large ocean sanctuaries need to benefit both sea life and people', *The Conversation*, https://theconversation.com/to-succeed-large-ocean-sanctuaries-need-to-benefit-both-sea-life-and-people-86977, 22 November, 2017.

[28] Jones, P and de Santo, E (2016) 'Is the race for remote, very large marine protected areas (VLMPAs) taking us down the wrong track?', *Marine Policy* 73, 231-234 http://dx.doi.org/10.1016/j.marpol.2016.08.015.

[29] Vidal J (2016) 'The Papahānaumokuākea marine park created by Barack Obama could end up as just a 'paper park', argue US and UK marine experts', https://www.theguardian.com/environment/2016/sep/02/hawaii-and-other-big-marine-protected-areas-could-work-against-conservation.

[30] Allison, G, Lubchenco, J and Carr, M (1998) 'Marine reserves are necessary but not sufficient for marine conservation', *Ecological Applications*, 8 (1), Supplement, 1998, pp. S79-S92.

be severely compromised'. This is still true today. MPAs from large to small should be complemented by other measures to ensure they achieve their conservation objectives.

When reviewing the potential for an LSMPA in the Adriatic Sea, Bastari et al[31] summarised the key challenges for LSMPAs as:
- surveillance and enforcement (requiring new technologies)
- reaching agreements between multiple states
- limited empirical evidence to show that LSMPAs effectively protect exploited populations
- less likely spillover due to their sheer size
- directing resources away from where protection is most needed i.e. densely populated coastal areas
- the remote and unpopulated locations may contain ecosystems with the least need of protection

While acknowledging the disadvantages of LSMPAs, Wilhelm et al (2014)[32] believe that: 'Large MPAs complement and add to existing management and conservation measures. Decision makers should consider designating them as one of a suite of possible protection measures. Besides greatly enhancing the chance of reaching agreed biodiversity targets, large MPAs improve the quality of conservation'.

Singleton and Roberts (2014) agree:

VLMPAs may not be perfect, but neither are their coastal counterparts. Critically, we do not have to, and should not, choose between the two. Every time we create a VLMPA, we reinforce the message that there is something worth protecting. If there is a political mood to create them, let us seize that opportunity before it is taken away, as with the Coral Sea, or before resources degrade through intensified use. VLMPAs alone may not represent the perfect conservation strategy, but if they can help us embed the message of a need for marine protection in public and political psyches, we will be in a much stronger position to argue for more, including the many places where uses are intense.

1.3 Current status of LSMPAs and analysis of their location by region and developed and developing coastal nations

There is an uneven distribution of LSMPAs across the world's oceans. Table 3 reveals that of the current 33 LSMPAs, 21 are located in the Pacific Ocean, five in the Atlantic, four in the Indian and three in the Southern Ocean. There are none in the Arctic Ocean or the Mediterranean and Caribbean seas.

A comparison of figures 2 and 3, shows that LSMPAs are concentrated in the EEZs of nation states, with only three in the High Seas. The concentration in the Pacific Ocean is due to the large number of small island developing states found there, along with external territories of the UK, USA and France, and the EEZ of Australia. These four nations plus Russia, which has no LSMPAs, have the world's five largest EEZs.

---

[31] Bastari A, Micheli, F, Ferretti, F and Pusceddu, A (2015) Large marine protected areas (LMPAs) in the Mediterranean Sea: The opportunity of the Adriatic Sea, Marine Policy, **68** (2016) 165-177

[32] Wilhelm, A, et al. (2014), 'Large marine protected areas – advantages and challenges of going big', *Aquatic Conserv: Mar. Freshw. Ecosyst*. **24 (**Suppl. 2): 24–30 (2014)

The concentration of LSMPAs in the waters of developed nations is similar to the distribution of all MPAs; two-thirds of the global MPA network has been established by developing nations. Marinesque et al.[33] argue that 'MPA creation is opportunistic and primarily influenced by international agreements' and 'MPAs are increasingly used for meeting integrative and adaptive management goals'.

Table 3 Number of LSMPAs in each oceanic region

Ocean regions	No of LSMPAs	Nations
Arctic Ocean	0	Nil
Atlantic Ocean	3 South 2 North	UK, OSPAR (Belgium, Denmark, European Union, Finland, France, Germany, Iceland, Ireland, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom)
Caribbean	0	Nil
Indian Ocean	2 North 2 South	Australia, UK, South Africa, France
Mediterranean	0	Nil
Pacific Ocean	6 North 15 South	Australia, US, Mexico, Chile, Palau, France, Micronesia, Cook Islands, New Zealand, Ecuador, Kiribati
Southern Ocean	3	CCAMLR (Argentina, Australia, Belgium, Brazil, Chile, China, European Union, France, Germany, India, Italy, Japan, Republic of Korea, Namibia, New Zealand, Norway, Poland, Russian Federation, South Africa, Spain, Sweden, Ukraine, UK, USA, Uruguay), Australia

Figure 3 EEZs and the High Seas in the world's oceans[34]

The uneven distribution of LSMPAs may be set for a change. Agreement has now been reached in the UN General Assembly to develop a new treaty on marine biodiversity beyond national jurisdictions. Negotiations have been ongoing since 2006 and, once a treaty is in force, the High Seas may also be given greater LSMPA coverage.

---

[33] Sophie Marinesque, S, Kaplan, D, Rodwell, L (2016) Global implementation of marine protected areas: Is the developing world being left behind?, https://doi.org/10.1016/j.marpol.2011.10.010.
[34] Marine Conservation Atlas (2018) <mpatlas.org/data/map-gallery>.

1.4 Likely opportunities for future LSMPAs in the context of regional and developed and developing coastal nations

LSMPAs are currently concentrated in the EEZs of several nations with very high HDI ratings and the waters of small-island developing states in the Pacific Ocean. A number of nations have also signed up to three LSMPAs in the international waters covered by CCAMLR and OSPAR. But many developed and developing nations remain well below the Aichi Target 11 for 10% MPA coverage.

Tables 4 and 5 indicate where opportunities to establish LSMPAs may exist in the waters of developing and developed nations—nations that have already established LSMPAs are excluded. The HDI is used to differentiate between the two groups of nations. Table 4 lists the 20 nations with the lowest HDIs and with EEZs above 100,000 km^2 but which have not created LSMPAs, while Table 5 lists nations with the highest HDIs that also have EEZs above 100,000km^2 but have no LSMPAs. Each table also provides data on the current national coverage of MPAs in each jurisdiction. Not one of the listed nations has reached the 10% Aichi Target 11.

Without considering the socio-political issues associated with the regions, a superficial analysis of the data would suggest that opportunities may exist for LSMPAs in the EEZs of developing nations off the west coast of Africa in the Atlantic Ocean (shaded grey in Table 4). The MPAtlas website indicates that there is a proposal for an LSMPA to cover the West African marine ecoregions and one for Central Africa and the Gulf of Guinea (one of Mission Blue's campaign hope spots). In June 2017, Gabon, with an HDI of 0.69, announced the establishment of a network of 20 MPAs covering 26% of its national waters (53,000 km^2):

Table 4 20 nations with lowest UDIs and with EEZs large enough to include an LSMPA but don't[35]

State	EEZ	HDI	Location	MPA coverage (%)/no.[36]
Ghana	235,349	0.579	North Atlantic Ocean	0/0
Sao Tome and Principe	131, 397	0.574	North Atlantic Ocean	0/0
Myanmar	532,775	0.556	North Indian Ocean	0.08/8
Kenya	116,942	0.555	North Indian Ocean	0.66/11
Angola	501,770	0.533	South Atlantic Ocean	0/0
Tanzania	241,568	0.531	South Indian Ocean	2.34/28
Nigeria	181,654	0.527	North Atlantic Ocean	0/0
Papua New Guinea	2,392,610	0.516	South Pacific Ocean	0.18/51
Solomon Islands	1,595,838	0.515	South Pacific Ocean	0.1/89
Mauritania	155,352	0.513	North Atlantic Ocean	4.13/2
Madagascar	1,199,964	0.512	South Indian Ocean	0.58/49
Comoros	164,653	0.497	South Indian Ocean	?/5
Senegal	157,532	0.494	North Atlantic Ocean	1.09/12
Haiti	123,376544	0.493	Caribbean Sea	20.75/10
Yemen	544,760	0.482	North Indian Ocean	0.22/3
Côte d'Ivoire	173,684	0.474	North Atlantic Ocean	0/0
Liberia	246,122	0.427	North Atlantic Ocean	0/0
Guinea-Bissau	105,836	0.424	North Atlantic Ocean	8.71/6
Sierra Leone	159,410	0.420	North Atlantic Ocean	0/0

---

[35] Source of data from <www.mpatlas.org>; <http://hdr.undp.org/en/composite/HDI>.
[36] Marine Conservation Institute, MPAtlas, mpatlas.org, accessed 11 January 2018

Table 5 20 nations with highest UDIs and EEZs large enough to include an LSMPA but don't[37]

State	EEZ	HDI	Location	MPA coverage (%)/no.[38]
Norway	2,462,110	0.949	North Atlantic Ocean	3.29/827
Denmark	2,644,612	0.925	North Atlantic Ocean	4.54/258
Netherlands	143,022	0.924	North Atlantic Ocean	9.7/23
Sweden	155,675	0.913	North Atlantic Ocean	6.8/1277
Japan	4,026,572	0.903	North Pacific Ocean	0.52/276
Korea	324,406	0.901	North Pacific Ocean	0.96/195
Italy	538,209	0.887	Mediterranean Sea	8.58/398
Spain	1,003,525	0.884	North Atlantic Ocean/Mediterranean Sea	0.96/266
Greece	493,186	0.866	Mediterranean Sea	1.26/11
Saudi Arabia	219,298	0.847	Red Sea/Persian Gulf	2.14/61
Portugal	1,721,020	0.843	North Atlantic Ocean	0.71/94
Argentina	1,083,534	0.827	South Atlantic Ocean /Southern Ocean	0.26/46
Russian Federation	7,679,621	0.804	Arctic Ocean /North Pacific Ocean	2.96/50
Barbados	186,106	0.795	Caribbean Sea	0/7
Uruguay	129,806	0.795	South Atlantic Ocean	0.6/6
Bahamas	654,715	0.792	Caribbean Sea	0.02/49
Malaysia	334,671	0.789	North Indian Ocean	0.09/102
Panama	335,646	0.788	Caribbean Sea/North Pacific Ocean	1.8/25
Antigua and Barbuda	110,089	0.786	Caribbean Sea	0.07/43

'In creating the protected areas, the Gabon government also set up what scientists call the most sustainable fisheries management plan for West Africa—an area long known for rampant overfishing and abuses by foreign fleets. Separate zones have been established for commercial and artisanal fishing fleets, in an effort to restore sustainable fishing.'[39]

For the highly developed nations listed in Table 5, opportunities for LSMPAs may exist with nations bordering the north Atlantic Ocean (shaded grey) and the Caribbean Sea (stippled). The MPAtlas website indicates proposals for an LSMPA for the Azores/Mid-Atlantic Ridge (there is already a network of four separate areas that comprise the Azores Marine Park established by Portugal and together covering more than 120,000km^2) and the Caribbean Sea, where Mission Blue has identified multiple hope spots.

Politics and resistance by marine-based industries are the likely major barriers to new LSMPAs in the EEZs of developed nations listed in Table 5, although that will be influenced by whether the proposed areas contain resources of economic interest. The major barriers in developing countries will be their institutional capacity and funding costs, and high-priority struggles with poverty, food security and essential development, which may make marine conservation a low-order priority. They may also perceive that LSMPAs will place unfair restrictions on development opportunities and impact the livelihoods of coastal communities. The ecosystems proposed for protection may be of little interest to them as they are likely to be well offshore, while their coastal communities depend on coastal waters so protecting those remote habitats will not obviously benefit them.

---

[37] Source of data from <www.mpatlas.org>; <http://hdr.undp.org/en/composite/HDI>.

[38] Marine Conservation Institute, MPAtlas, mpatlas.org, accessed 11 January 2018

[39] Parker, L (2017) 'New Ocean Reserve, Largest in Africa, Protects Whales and Turtles', https://news.nationalgeographic.com/2017/06/gabon-marine-protected-area-ocean-conservation/.

1.5 Likely future opportunities for expansion of LSMPAs in the context of SDGs and IUCN targets and developed and developing coastal nations

In January 2016, the UN established Sustainable Development Goals (SDG) came into effect, aiming to tackle a variety of global issues. Goal 14: Conserve and sustainably use the oceans, seas and marine resources has as one of its targets, 'By 2020, conserve at least 10 per cent of coastal and marine areas, consistent with national and international law and based on the best available scientific information'. This target will be reached, largely due to LSMPAs, even though as discussed, the MPA distribution across ecoregions is uneven.

But there are several other goals of relevance to this discussion:
- Goal 1: End poverty
- Goal 2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture
- Goal 10: Reduce inequality within and among countries.

Could LSMPAs help achieve these goals? The Nereus Program believes that 'achieving SDG 14 contributes to the success of other SDGs. We also highlight the importance of climate change and social equity across the SDG targets'[40]. Analysis by Singh et al (2017) also points to co-benefits across SDGs:

'…oceans SDG targets are related to all other SDG goals, with two ocean targets (of seven in total) most related across all other SDG goals. Firstly, the ocean SDG target to increase economic benefits to Small Island Developing States (SIDS) and least developed countries for sustainable marine uses has positive relationships across all SDGs. Secondly, the ocean SDG target to eliminate overfishing, illegal and destructive fishing practices is a necessary pre-condition for achieving the largest number of other SDG targets. This study highlights the importance of the oceans in achieving sustainable development'[41].

Research by Leisher, van Beukering and Scherl (2007) [42] can also help with an answer. They analysed the link between biodiversity conservation and poverty reduction in four small no-take MPAs of varying sizes in Fiji (Navakuvu), the Solomon Islands (Arnarvon Islands), Indonesia (Bunaken) and the Philippines (Apo Island) and observe that 'marine protected areas can effectively contribute to poverty reduction' by 'improving fish catches, creating new jobs, mostly in tourism, improving local governance, and benefiting health and women'.

But these were small and coastal MPAs. Can the results be extrapolated to LSMPAs? With limited data available on existing LSMPAs, extrapolation of research results from small, coastal MPAs, along with modelling, has been the main technique used to predict the likely outcomes from larger protected areas. The discussion in the following pages will show that such a process is fraught, and that the implementation of a comprehensive research agenda is required to understand the benefits, and the costs, of LSMPAs.

---

[40] Nereus Program (2017) *Oceans and the Sustainable Development Goals: Co-benefits, climate change and social equity*, The Nippon Foundation, p.4.
[41] Singh, G (2017) *Marine Policy*, http://dx.doi.org/10.1016/j.marpol.2017.05.030.
[42] Leisher, C, van Beukering, P, Scherl, L, (2007) *Nature's Investment Bank: How marine protected areas contribute to poverty reduction*, a report for the Department of Environment and Water Resources, Canberra.

2. Research needs to address stakeholder and government concerns from both developed and developing nations

LSMPAs, fish populations and spillover

There is growing scientific evidence of the benefits that MPAs can generate for habitats and fish species within and beyond their boundaries. But one particular potential benefit, fish and larval spillover, has for some time been debated between marine scientists, who focus on the biodiversity benefits, and fisheries scientists focussed on potential changes in yield for displaced fishers and the role of MPAs as fisheries management tools (although this is not the primary purpose of MPAs).

Even so, research by Goni et al. [43] showed in the Mediterranean that 'coastal MPAs can be an effective management tool for artisanal fisheries in the region and can be extended to the rest of the western Mediterranean, as the fishing tactics studied are typical of the region'.
Six years after the establishment of a community-managed reserve, Da Silva et al (2015) [44] found 'fish assemblages have changed dramatically inside the reserve, and spillover is benefitting fish assemblages outside the reserve' and 'rapidly increasing catch rates after MPA implementation without measurable disadvantages for fishers'. Kerwath et al[45] (2013) concluded there was 'no indication that establishing the MPA caused a systematic drop in total catch or increased travel distances for the fleet' in the Goukamma MPA of South Africa.

After investigating data from 14 small MPAs, Halpern et al. (2010)[46] concluded that they 'can locally replenish fish stocks outside their boundaries' and benefit both conservation and local fisheries, although this was at relatively small scales within a kilometre from the reserve. In the Philippines, Russ and Alcala (2011)[47] found 'the spillover of species richness and community complexity is a direct consequence of the spillover of abundance of multiple species'.

Spillover is influenced by the design of the MPA and the location of habitats within their boundaries, as well as changes to fishing intensity. Forcada et al. (2009)[48] observed that in three small Mediterranean MPAs: 'Catches were significantly higher for some species near the borders of the MPAs when fishing on *P. oceanica* meadows, but not when fishing on sandy bottoms. The spillover effect appears to be limited by a lack of continuous suitable habitat through the boundaries of the MPA'.

Vandeperre et al. (2011)[49] used a meta-analysis of 28 data sets to review the impact on fisheries of seven MPAs in southern Europe and found that the Southern European MPAs

---

[43] Goñi, R, et al. (2008) 'Spillover from six western Mediterranean marine protected areas: evidence from artisanal fisheries', *Marine Ecology Progress Series* 366:159-174 (2008) doi.org/10.3354/meps07532.

[44] da Silva, I, Hill, N, Shimadzu, H, Soares, A and Dornelas, M (2015) 'Spillover effects of a community-managed marine reserve', *PLoS ONE* 10(4): e0111774. doi:10.1371/journal.pone.0111774.

45 Kerwath, S, Winker, H, Go ̈tz, A and Attwood, C (2013) 'Marine protected area improves yield without disadvantaging fishers', *Nature Communications*, DOI: 10.1038/ncomms3347, DOI: 10.1038/ncomms3347.

[46] Halpern, B, Lester, S, Kellner, J (2010) 'Spillover from marine reserves and the replenishment of fished stocks' *Environmental Conservation* 36 (4): 268–276.

[47] Russ, G, Alcala, A (2011) 'Enhanced biodiversity beyond marine reserve boundaries: The cup spillith over', *Ecological Applications*, 21(1), 2011, pp. 241–250.

[48] Forcada, A et al. (2009) 'Effects of habitat on spillover from marine protected areas to artisanal fisheries', *Marine Ecology Progress Series*, vol. 379: 197-211.

[49] Vandeperre F, et al. (2011), 'Effects of no-take area size and age of marine protected areas on fisheries yields: a meta-analytical approach', *Fish and Fisheries* **12** 412–426

showed clear effects on the surrounding fisheries, on the 'catch per unit effort' (CPUE) of target species, but especially on the CPUE of the marketable catch. These effects depended on the time of protection and on the size of the no-take area. CPUE of both target species and the marketable catch increased gradually by 2–4%pa over a long time period (at least 30 years).

Various factors influence the behavior of fishers after an MPA is established, with Costa et al [50] concluding: 'Besides the importance of assessing fishing effort within and around MPAs, this study shows that gear type, habitat features and MPA design influence individual fishers' behaviour and this must be taken into account when planning MPA design and evaluating the effects of marine conservation measures'.

Research needs
- For existing and proposed LSMPAs, identify key habitats and associated species along their boundaries to build a picture of fishing intensity that can be used to better understand potential spillover along with edge effects that may require management action in the future.
- Identify cost-effective and innovative monitoring and reporting techniques that can be applied to a better understanding of ocean ecology and biophysical processes in existing and candidate LSMPAs.
- Conduct social research to better understand how fishers are responding to existing LSMPAs and may respond to the establishment of candidate LSMPAs.
- Design and apply a research strategy to ground-truth models of spillover and fisher responses to LSMPAs.

LSMPAs and migratory species
MPAs are often criticised for failing to provide protection for large migratory pelagic species such as tuna and sharks, and for displacing and intensifying fishing effort to other areas. Doubts are also expressed about the potential for LSMPAs to benefit the more mobile and far-ranging species in what is a very dynamic environment with complex institutional arrangements and very little data.

But Game et al (2009)[51] argue that closed areas reduce threats and that fish movement patterns are often predictable, data levels are improving, and new technologies are making monitoring and management more feasible. Roberts (2002)[52] also believes MPAs can benefit migratory species by:
- reducing adult mortality in protected aggregation sites
- reducing juvenile mortality and increasing growth rates
- enhancing critical habitats
- reducing by-catch of juveniles
- increasing time spent by marine life in MPAs as habitat improves.

---

[50] Costa B, Batista M, Goncalves L, Erzini K and Caselle, J (2013) Fishers' Behaviour in Response to the Implementation of a Marine Protected Area. PLoS ONE 8(6): e65057. doi:10.1371/journal.pone.0065057.
51 Game, E, et al. (2009), 'Pelagic protected areas: the missing dimension in ocean conservation', Trends in Ecology & Evolution, 24(7), pp.360–9.
52 Roberts, C (2002) 'Fishery benefits of fully protected marine reserves: why habitat and behavior are important', Natural Resource Modeling, 15(4).

After reviewing the literature on highly mobile species and temperate MPAs, Breen et al. (2015)[53] recommended a network of smaller MPAs covering aggregation points such as feeding and breeding grounds rather than an LSMPA. Although aggregating fish are at their most vulnerable to exploitation, the setting of MPA boundaries may be difficult for protecting migratory fish that follow prey not always aggregating in the same area.

A simulation of fish migration between an MPA-based spawning ground and a fishery revealed to West et al. (2009)[54] that the benefits of protection lessened with increasing migration distances but concluded: 'an MPA provides greater protection and greater expected fisheries yield than a system without an MPA, irrespective of migration level. Combining MPAs with a harvest control rule may further increase protection and yield'. The authors concluded that the inclusion of a protected area as part of management made the fishery more resilient against collapse and yields were higher.

It is not only migratory fish species that can benefit from large pelagic MPAs. Young et al. (2015)[55] examined the link between the pelagic Pacific Remote Islands Marine National Monument and the Papahanaumokuakea Marine National Monument and the breeding and foraging habitats of three booby species. They found 'strong evidence that both PMPAs effectively contained the vast majority of foraging habitat utilized by three sympatric species during their incubation and early chick rearing periods', which to them demonstrated the 'potential of fixed PMPAs to protect relevant habitat for tropical pelagic species, during critical life history periods, even in the unpredictable and patchy nature of tropical foraging environment.

Grey reef sharks in the Palmytra Atoll National Wildlife Refuge, which covers 54,000 km^2, were tracked by White et al. (2017)[56], with two-thirds of the tracked sharks remaining in the reserve. The authors also regularly observed fishers fishing the line of the refuge's boundary, while tagged sharks were occasionally caught some distance outside; protection afforded by the refuge was incomplete.

LSMPAs may never be able to include the entire distribution range of shark, tuna and turtle species. But neither will such MPAs prove effective if fisheries management beyond their boundaries is not adjusted. Halpern, Gaines and Warner (2004)[57] refer to this as the 'squeeze factor' but also found that increases in biomass can offset the impact of displaced fishing effort.

To protect migratory species, MPAs could be very large or form an MPA network that protects the critical habitats for feeding and spawning, or key parts of their migratory corridors.

---

[53] Breen, P., Posen, P, Righton, D (2015) 'Temperate marine protected areas and highly mobile fish: A review'. *Oceans and Coastal Management*, 105: 75-83. doi:10.1016/j.ocecoaman.2014.12.021

[54] West, C. D., Dytham, C., Righton, D., Pitchford, J.W. (2009) 'Preventing overexploitation of migratory fish stocks: the efficacy of marine protected areas in a stochastic environment', *ICES Journal of Marine Science*, **66**: 1919–1930.

[55] Young, H, Maxwell, S, Conners, M, Shaffer, S (2015), Pelagic marine protected areas protect foraging habitat for multiple breeding seabirds in the central Pacific, *Biological Conservation* 181 (2015) 226–235 233

[56] White, T, et al. (2017) 'Assessing the effectiveness of a large marine protected area for reef shark conservation', *Biological Conservation*, 2017 (2017) pp 64-71.

[57] Halpern, B, Gaines, S, Warner, R (2004) 'Confounding effects of the export of production and the displacement of fishing effort from marine reserves, *Ecological Applicati*ons, 14: 1248–1256. doi:10.1890/03-5136.

Southern bluefin tuna, for example, spawn in the Timor Sea between the north-west coast of Australia and Indonesia.

Lauck et al. (1998)[58] argue that traditional forms of fisheries management will be unsuccessful due to scientific uncertainty, the uncontrollability of catches and incidental mortality. According to the authors, LSMPAs would insure against management limitations, enhance sustainability, avoid the need for more detailed stock assessments and assist the rehabilitation of depleted stocks.

Research needs
- Identify critical habitats for key species that existing and candidate LSMPAs are aiming to protect.
- Use tagging and other innovative monitoring technologies to build a better understanding of the biology and behaviour of key migratory species.
- Monitor the state of fisheries and the level of displaced fishing effort adjacent to existing LSMPAs, and fishing intensities and impacts in candidate LSMPAs.
- Investigate MPA designs that maximise protection for migratory species and reduce displaced fishing effort.
- Map major habitats along LSMPA boundaries and analyse the potential edge effects of 'fishing the line'.

LSMPAs and climate change
MPA networks play an important role in dealing with the impacts of climate change on marine life by reducing stressors, providing corridors for shifting species, reducing risk, increasing resiliency and providing points for monitoring ocean change. Simard, Laffoley and Baxter (2015)[59] indicate that there are 'adaptation and mitigation synergies for MPAs and climate change'. They note that although seagrass beds, saltmarshes and mangroves act as carbon sinks, they also face intense human pressure. A key point in their review is that: 'The development of the mitigation role of MPAs in the offshore area would require a significant increase in the number of large MPAs offshore, covering both the continental shelves and on the high seas'.

In a survey of MPA managers, Lam et al. (2017)[60] identified three key lessons to ensure MPAs built climate change resilience:
- strictly protected marine reserves are considered essential for climate change resilience and will be necessary as scientific reference sites to understand climate change effects
- adaptive management of MPA networks is important but hard to implement
- strictly protected reserves managed as ecosystems are the best option for an uncertain future.

[58] Lauck, T, Clark, C, Mangel, M, Munro, G (1998) 'Implementing the precautionary principle in fisheries management through marine reserves', *Ecological Applications,* 8(1) Supplement, 1998, pp. S72–S78

[59] Simard, F., Laffoley, D, Baxter, J (editors), (2016) *Marine Protected Areas and Climate Change: Adaptation and Mitigation Synergies, Opportunities and Challenges.* Gland, Switzerland: IUCN. 52 pp.

[60] Hopkins, C, Bailey, D, Potts, T (2016) 'Perceptions of practitioners: managing marine protected areas for climate change resilience', *Ocean & Coastal Management*, Vol 128, August 2016, pp18-28, doi.org/10.1016/j.ocecoaman.2016.04.014.

Research needs

- Establish baseline monitoring in existing and candidate LSMPAs to monitor trends in critical indicators of climate change and its effects on key species and habitats.
- Review the designs of LSMPAs to determine how effective they will be in building climate-change resilience and apply that understanding to the design of new LSMPAs.

LSMPAs and economics

Research on the link between MPAs and the economic returns to fisheries, released in 2014, suggests that the larger the MPA, the better the fisheries returns. By using MPA databases, stock assessments, catch-time series and sea surface temperatures, Rising and Heal (2014)[61] have developed a model that predicts the economic benefits of marine protection and indicates which countries are benefiting and those that could benefit from greater MPA coverage:

> We find that regions with significant MPA designations increased their yearly yield by 17e3 MT/yr while those without experienced a loss of 20e3 MT/yr…About 60% of country regions currently have insufficient protected areas to generate economic benefits, where the average break-even point for economic benefits of MPAs is at 8.5% of marine area.

Brander et al.[62] conducted a cost-benefit analysis on expanding MPA coverage to 10% and 30% of the total marine area. They found that for 10% coverage, each dollar invested yields $20 of benefits in return, with benefits increasing but at a slower rate up to 30% coverage. At 10% coverage, total ecosystem service benefits were in the range USD 622-923 billion from 2015-2050; and for 30% coverage, USD 719-1,145 billion.

Discussion about LSMPAs and fishing becomes moot if the high seas were closed to fishing, as argued by White and Costello (2014)[63], which for them would 'simultaneously give rise to large gains in fisheries profit (>100%), fisheries yields (>30%), and fish stock conservation (>150%)' and generate larger returns than if the high seas remained open to fishing.

Applying game theory to the concept of a high seas closure, Herrera et al. (2016)[64] concluded that 'the imposition of a closure of the high seas to fishing could be beneficial or at least not that costly to a collection of self-interested states exploiting a shared mobile stock' and 'for a large habitat, a closure might even emerge in the absence of any coordinated regulatory action (such as a treaty)'.

Sumaila et al. (2014) tested the impact on landed values of fish from the full closure of the high seas to fishing. The results of their analysis are summarised in Figure 5. The authors determined that less than 0.01% of the quantity and value of commercial fish species are taken exclusively in the high seas, presumed that there would be an 18% increase in straddling stocks due to spillover, and concluded that there would be no global loss of catch: 'closing the high seas could be catch-neutral while inequality in the distribution of fisheries benefits among the

[61] Rising, J, Heal, G (2014), Global benefits of marine protected areas, Working Paper 19982 http://www.nber.org/papers/w19982, National Bureau of Economic Research, Cambridge.
[62] Brander, L et al. (2015) The benefits to people of expanding Marine Protected Areas, Report R-15/05, IVM Institute for Environmental Studies, VU University Amsterdam, Amsterdam.
[63] White C, Costello C (2014) Close the High Seas to Fishing? PLoS Biol 12(3): e1001826. doi:10.1371/ journal.pbio.1001826
[64] Herrera, G, Moeller, H, Neubert, M (2016) 'High-seas fish wars generate marine reserves', pnas.org/cgi/doi/10.1073/pnas.1518509113

world's maritime countries could be reduced by 50%'. Based on Figure 5, most nations would experience gains in their landed values, the exceptions being in central and South America, parts of Asia, southern Africa and the Middle East, and Spain and France.

Research needs
- Investigate whether the Rising and Heal model can be ground-truthed in regions with candidate LSMPAs to assist the case for increasing protection in those regions.
- Investigate the data needs and limitations of the Brander et al. cost-benefit analysis and consider its application to LSMPAs more specifically.

Climate change and fisheries

Lam et (2016)[65] have modelled changes in projected revenues for global fisheries under climate change and suggest that:

'global fisheries revenues could drop by 35% more than the projected decrease in catches by the 2050s under high CO_2 emission scenarios. Regionally, the projected increases in fish catch in high latitudes may not translate into increases in revenues because of the increasing dominance of low value fish, and the decrease in catches by these countries' vessels operating in more severely impacted distant waters. Also, we find that developing countries with high fisheries dependency are negatively impacted.

Figure 5 Global map of the predicted distribution of gains and losses in total marine fisheries landed values
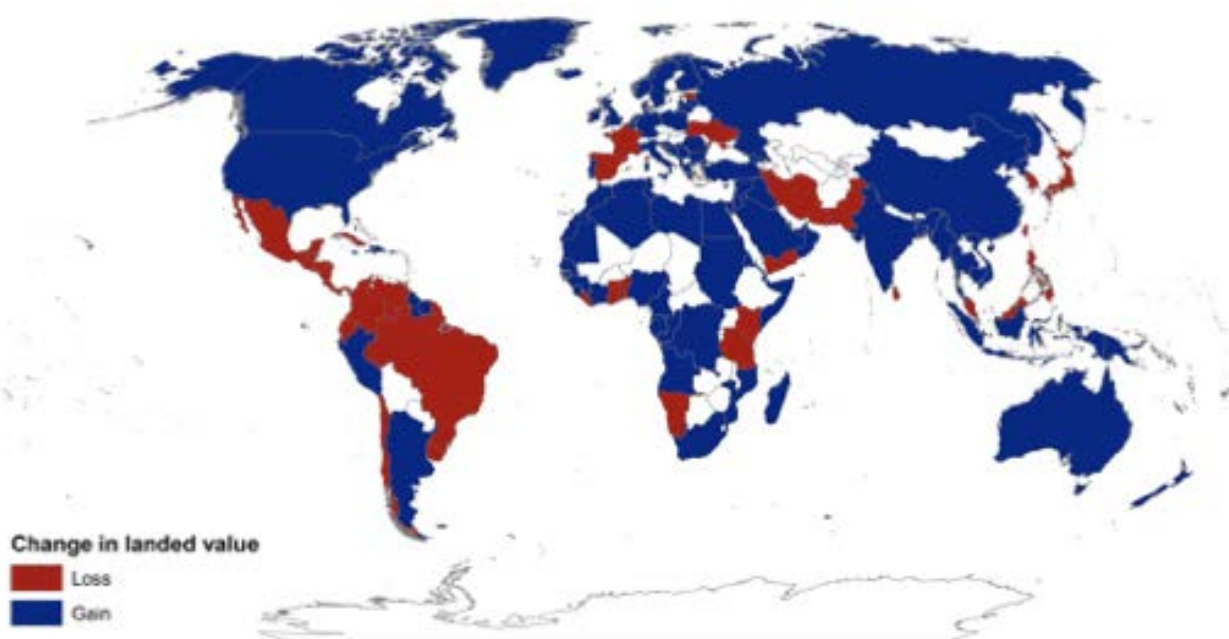
Research by Blasiak et al. (2017)[66] has shown that of 147 nations reviewed, the least developed nations will be the most vulnerable to the impact of climate change on fisheries

---

[65] Lam, V, Cheung, W, Reygondeau, G and Sumaila, U (2017), 'Projected change in global fisheries revenues under climate change', doi: 10.1038/srep32607

[66] Blasiak R et al. (2017) 'Climate change and marine fisheries: Least developed countries top global index of vulnerability', *PLoS ONE* 12(6): e0179632. https://doi.org/10.1371/ journal.pone.0179632

because they have little capacity to adapt. This will affect food security, livelihoods, public health and development and possibly create transboundary conflicts. Of the ten most vulnerable nations, seven were small-island developing nations, with the top 25% dominated by African, Asian and Oceania nations.

Reporting on the impacts of climate change, the FAO[67] says that: 'Fishers, fish farmers and coastal inhabitants will bear the full force of these impacts through less stable livelihoods, changes in the availability and quality of fish for food, and rising risks to their health, safety and homes. Many fisheries-dependent communities already live a precarious and vulnerable existence because of poverty, lack of social services and essential infrastructure. The fragility of these communities is further undermined by overexploited fishery resources and degraded ecosystems. The implications of climate change for food security and livelihoods in small island states and many developing countries are profound'.

More recently, Hanich et al. (2017)[68] reviewed the impacts of climate change on artisanal and subsistence fisheries in in the Pacific Islands region, along with the difficulties facing communities, governments and regional institutions in developing responses to 'rising temperatures, sea-level rise, saltwater intrusion of freshwater resources, coastal erosion, an increase in extreme weather events, altered rainfall patterns, coral reef bleaching, and ocean acidification'. The authors found that small-scale fishing communities had to be empowered, which required 'legitimacy, information and agreed decision-making processes that are accepted by the community and formal government', while 'coastal fisheries management requires substantial improvements in economic tools to strengthen coastal fisheries management measures'. They concluded: 'The increasing urgency around climate change impacts, looming food security challenges, and the declining state of many of the region's coastal fisheries will require a greater prioritisation of coastal communities and artisanal and subsistence fisheries to help ensure successful adaptation strategies, sustainable resource use and long-term economic returns'.

Research needs
- Investigate and the management measures that can make fisheries more resilient to climate change.
- Conduct social research to identify practical adaptation measures that coastal fishing communities in or near existing and candidate LSMPAs can implement to minimise social and economic impacts.

LSMPAs and traditional cultures and Indigenous communities
Leisher, van Beukering and Scherl (2007)[69] analysed the link between biodiversity conservation and poverty reduction in four small no-take MPAs of varying sizes in Fiji (Navakuvu), the Solomon Islands (Arnarvon Islands), Indonesia (Bunaken) and the Philippines (Apo Island):

'For the residents of Navakavu and Apo Island, their marine protected area contributed to poverty reduction in very substantial ways (though both sites have fewer than 700 people).

---

[67] FAO (2018) 'Fisheries and aquaculture and climate change', <http://www.fao.org/fishery/climatechange/en>.
[68] Hanich, Q, et al. (2017) 'Small-scale fisheries under climate change in the Pacific Islands region', *Marine Policy* (2017), https://doi.org/10.1016/j.marpol.2017.11.011.
[69] Leisher, C, van Beukering, P, Scherl, L, *Nature's Investment Bank: How marine protected areas contribute to poverty reduction*, a report for the Department of Environment and Water Resources, Canberra.

In the Arnavons and Bunaken, with populations of 2,200 and 30,000 respectively, the marine protected area has also clearly contributed to poverty reduction, though by no means eliminated it. Across all the study sites, over 95% of local people support the continuation of their marine protected area'.

In these four communities, MPAs contributed to poverty reduction by improving fish catches, creating new jobs, mostly in tourism, improving local governance, and benefiting health and women. The authors recommended that for MPAs like these to help poverty reduction, they need funding, they need to empower local communities, and they need to be integrated: 'a network of smaller marine protected areas each affiliated with a local community may contribute more to poverty reduction than a single larger marine protected area'[70].

In the commitments made at the past four Our Ocean conferences, there was a number involving funding to develop marine conservation initiatives in developing nations. For example, at the 2017 conference[71]:

'The European Union announced that it will commit EUR 20 million to support the management of marine protected areas in African, Caribbean and Pacific countries through the programme BIOPAMA II (Biodiversity and Protected Areas Management Programme). 'Germany announced the launch of the STRONG High Seas Project this year… it will develop and propose measures to support integrated and ecosystem-based ocean governance in the Southeast Pacific and Southeast Atlantic.

'The MAVA Foundation announced a EUR 70 million commitment over the next 5 years to the conservation of marine biodiversity mainly in the Mediterranean Basin and in West Africa for the benefit of people and nature.'

To progress LSMPAs in the developing nations and ensure traditional cultures are supported, will require ongoing funding initiatives like these.

Research needs
- Develop and implement LSMPA planning and research strategies that are inclusive of the rights and aspirations of Indigenous communities and respectful of their culture.
- Investigate social, economic and cultural values in communities in or near existing and candidate LSMPAs and infuse this understanding into LSMPA identification, design and management.
- Investigate long-term and sustainable financing mechanisms that will support Indigenous communities when LSMPAs are created.

MPAs, developing States and fishing access agreements
Over the past few decades there has been a significant expansion in the number of MPAs in developing nations and small island communities. Many are the result of top down establishment by central governments with insufficient institutional and resourcing arrangements. During the same period, developed nations looking for more fish to maintain

---

[70] ibid. p. v.
[71] Our Ocean (2017) *Our Ocean 2017 commitments*, www.ourocean2017.org.

their fishing fleets have been signing up developing nations to fishing access agreements. This follows the establishment of EEZs under UNCLOS.

The European Union's access agreements with 12 coastal States are one of the few publicly available examples. These include 'sustainable fishing partnership agreements' in the Pacific, Caribbean and West Africa including Cabo Verde, Côte d'Ivoire, Sao Tomé e Principe, Madagascar, Senegal, Liberia, Seychelles, Cook Islands, Mauritius, Mauritania, Morocco, Greenland and Guinea-Bissau.

In addition to licensing revenue, these agreements provide financial and technical support to the coastal nation for management, monitoring and surveillance. The financial support ranges from EUR 385,000 annually for the Cook Islands to EUR 30 million for Morocco.

According to Manach et al (2012)[72], the 'EU has subsidized these agreements at an average of 75% of their cost (financial contribution agreed upon in the agreements), while private European business interests paid the equivalent of 1.5% of the value of the fish that was eventually landed'. While seafood consumers in Europe might be paying twice for their fish, once for the subsidies and again at the market, the coastal nation can end up paying a much higher price. Olivier De Schutter, the UN's special rapporteur on the right to food said in 2012[73]:

> 'Ocean-grabbing, in the shape of shady access agreements that harm small-scale fishers, unreported catch, incursions into protected waters, and the diversion of resources away from local populations, can be as serious a threat as land-grabbing. Without rapid action to claw back waters from unsustainable practices, fisheries will no longer be able to play a critical role in securing the right to food of millions. Industrial fishing in far-flung waters may seem like the economic option, but only because fleets are able to pocket major subsidies while externalising the costs of over-fishing and resource degradation. Future generations will pay the price when the oceans run dry'.

Schutter would like to see 'artisanal fishing zones' established that would support cooperatives of small-scale fishers with small vessels. This would potentially secure and possibly increase the incomes of those fishers, which is a key element of developing any economic case for choosing marine protection over giving free rein to foreign fishing fleets.

In the context of access agreements, mounting an economic case for MPAs can be risky, having been used frequently in the past to gain community support for MPAs and then not delivering. Chaigneau and Brown [74] argue that the:

> 'win-win discourse surrounding many natural resource management and conservation strategies may improve their marketability and implementation. However, we argue that it can potentially backfire by having a negative effect on longer-term community support'.

---

[72] Le Manach F, et al. (2013) 'European Union's Public Fishing Access Agreements in Developing Countries', PLoS ONE 8(11): e79899. doi:10.1371/journal.pone.0079899.

[73] Harvey, F (2012) 'Developing nations' fishing grounds should be protected', UN says, *The Guardian*, 31 October 2012, https://www.theguardian.com/environment/2012/oct/31/developing-nations-fishing-protected-un.

[74] Chaigneau, T, Brown, K (2016) Challenging the win-win discourse on conservation and development: analyzing support for marine protected areas', *Ecology 'and Society* 21(1):36. http://dx.doi.org/10.5751/ES-08204-210136.

They conclude that 'with increasing fishing effort because of technological creep and increasing population size, it is clear that support for MPAs because of direct economic fishery benefits is not sustainable.

A case for marine protection needs to be far broader and understand the complexities of communities and their aspirations in developing nations. The surveys by Chaigneau and Brown indicate that economics is not necessarily the main reason for a community giving support to an MPA. It could be given because of concern for future generations, its aesthetic qualities or a sense of pride. Any case should be a part of a bigger package of incentives and capacity building, marine protected areas, ecologically sustainable fishing and minimising illegal fishing.

In the Coral Reef Rehabilitation and Management Project funded by the World Bank in Indonesia, 358 village communities have benefited from MPAs and reductions in destructive and illegal fishing. Incomes have increased by 21 per cent since 2008, with the project's third phase aiming for 15-per-cent income increases and a 70 per cent increase in coral reef health by 2019.

Other key elements of the case for marine protection would be strong governance, pollution reduction and developing knowledge and community capacity. But any argument for marine protection in coastal communities should not forget the need to reduce IUU fishing, rein in the subsidies and advance ecological sustainability in the fishing sector of developing nations.

Research needs
- Conduct social research to:
  - review the socio-economic impact of existing LSMPAs on island communities and investigate measures that can ameliorate negative impacts and enhance positive impacts
  - build a clearer picture of the needs and aspirations of island communities in regions where LSMPAs are proposed.
- Review the success or otherwise of financial and other incentives used to build support for marine protection as well as the capacity of communities to benefit.

Pelagic ecosystems and the blue economy
Coastal MPAs can help reduce blue carbon emissions and increase carbon sequestration, especially if mangrove, saltmarshes and seagrasses can be restored. The increasing international interest in blue carbon has seen the Dominican Republic, Costa Rica and Scotland quantifying blue carbon storage. In Scotland[75], blue carbon stored in the habitats and surface sediments of its inshore MPAs has been estimated at 9.4 Mt organic carbon and 47.8 Mt inorganic carbon, while its total sea area has 1,739 Mt inorganic carbon.

The protection of fish carbon in distant oceans can also help mitigate climate change, according to research[76] by GRID-Arendal and Blue Climate Solutions, which lists eight mechanisms for fish carbon including:

---

[75] Burrows, M et al. (2017) *Assessment of blue carbon resources in Scotland's inshore marine protected area network*, Scottish Natural Heritage Commissioned Report No. 957.
[76] Lutz S, Martin, A (2014) *Fish carbon: Exploring marine vertebrate carbon services*, GRID-Arendal, Arendal, Norway.

- carbon stored in the vertebrate biomass
- cycling of nutrients stimulating phytoplankton growth and uptake of dissolved CO_2
- animal carcasses sinking to the bottom where they are taken up by the benthos or buried in sediments
- excretion of calcium carbonate by bony fish, which increases alkalinity and tackles ocean acidification.

Daniela et al. (2015)[77] analysed the role of mangroves in Indonesia and found that MPAs 'reduced mangrove loss by about 14,000 ha and avoided blue carbon emission of approximately 13 million metric ton (CO_2 equivalent). Howard et al. (2017)[78] believe it is possible to integrate blue carbon into MPA design and management and protect and increase carbon sequestration. But Zaratate-Barrera and Maldonado (2014)[79] conclude that although the benefits from carbon capture and storage are substantial they are very much dependent on the success of international agreements and the dynamics of carbon credit markets.

Lau[80] outlines a framework for payments for ecosystem services in 'blue forests' based around carbon sequestration, shoreline protection, fish nursery, biodiversity and water quality. Implementation of the framework would 'begin with identifying the ecosystem service(s) and habitat of interest, the potential pool of voluntary providers and potential buyers, and performance indicators and management options for structuring the agreement'. Such a framework would incentivise conservation and help mitigate climate change.

Research needs
- Develop and implement a research strategy to identify, map, quantify and value blue carbon storage in key areas of existing and candidate LSMPAs.
- Review the mechanisms that coastal communities can use to build and benefit from carbon storage.
- Develop a framework and pilot community projects for ecosystem service payments.

Assessing socio-economic benefits from LSMPAs
In recent years, social scientists have taken a keen interest in reviewing the socio-economic benefits of MPAs in small coastal communities. Their research and its highlighting of inadequacies in the rollout of MPAs has ensured that socio-economic objectives are now critical elements in the MPA establishment process.

Voyer, Gladstone and Goodall (2012)[81] reviewed three Australian MPA planning processes and concluded that 'Social Impact Assessment (SIA) is under-developed in Australian MPA planning. Assessments rely heavily on public participation and economic modelling as

[77] Miteva, D, Murray, B, Pattanayak, S (2015) 'Do protected areas reduce blue carbon emissions? A quasi-experimental evaluation of mangroves in Indonesia', *Ecological Economics*, vol. 119, November 2015, pp 127-135 doi.org/10.1016/j.ecolecon.2015.08.005.

[78] Howard, J, et al. (2017) 'The potential to integrate blue carbon into MPA design and management', *Aquatic Conserv: Mar Freshw Ecosyst*. 2017; 27(S1):100-115.

[79] Zarate-Barrera T, Maldonado J (2015) 'Valuing blue carbon: Carbon sequestration benefits provided by the marine protected areas in Colombia', PLoS ONE 10(5): e0126627. doi:10.1371/journal. pone.0126627.

[80] Lau, W (2012) 'Beyond carbon: Conceptualising payments for ecosystem services in blue forests on carbon and other marine and coastal services', *Ocean & Coastal Management* (2012), doi:10.1016/j.ocecoaman.2012.03.011.

[81] Voyer, M, Gladstone, W, Goodall, H (2012) 'Methods of social assessment in Marine Protected Area planning: Is public participation enough?' *Marine Policy* Volume 36, Issue 2, March 2012, Pages 432-439

surrogates for dedicated SIA and are followed commonly by attitudinal surveys to gauge public opinion on the MPA after its establishment'. They recommended that the assessment of social factors would be improved if cross-disciplinary MPA planning processes were used.

The literature on the social impacts of MPAs is growing but it has largely focused on small, coastal MPAs. Ban et al. (2017)[82] conducted a meta-analysis of 12 MPAs (>10,000 km^2) that had been in existence for at least five years and with sufficient data to assess their social, ecological and governance characteristics. They found: 'Improved fisheries were associated with older marine protected areas, and higher levels of enforcement. Declining fisheries were associated with several ecological and economic factors, including low productivity, high mobility, and high market value. High levels of participation were correlated with improvements in wellbeing and ecosystem health trends'.

According to Gruby et al. (2015)[83], the consideration of human dimensions was not an early priority in the development of many LSMPAs. They suggest four key themes for a social science research agenda on and for LSMPAs: scoping of human dimensions, governance, politics, and social and economic outcomes.

More recently, Gruby et al. (2017b)[84] investigated the introduction of LSMPAs in Bermuda, Rapa Nui (Easter Island), Palau, Kiribati, Northern Mariana Islands and Guam. They found that 'efforts to protect even remote sites can generate important outcomes for local residents that they may view as positive or negative. They can increase national pride and political leverage for indigenous populations, for example. They can also complicate international conservation negotiations or cause broad shifts in national economies'. They also observed that the Palau LSMPA, a no-take area covering 80% of the nation's EEZ and designed to replace foreign fleets with a domestic fishing industry, is initiating positive social and economic change.

Research needs
- Develop and implement a social science research agenda for LSMPAs that includes scoping of human dimensions, governance, politics, and social and economic outcomes.

Institutional arrangements for governance
On September 29 2017, the Canadian Government announced a partnership with the Nunatsiavut Inuit Government to protect and manage the waters around northern Labrador, a long stretch of coast with the highest concentration of polar bears in the world. Co-management is one of a number of models that can be used for the governance of MPAs ranging from a small, community managed MPA up to LSMPAs that a governed by multilateral organisations such as CCAMLR.

In single EEZs, the institutional arrangements may already be in place for MPAs and could simply be extended to the LSMPAs, as in the case of those being established in Australia and to

---

[82] Ban, N, et al. (2017) Social and ecological effectiveness of large marine protected areas', *Global Environmental Change* 43 (2017) 82–91

[83] Gruby, R, Gray, N, Campbell, L, Acton, L (2015) 'Toward a Social Science Research Agenda for Large Marine Protected Areas', *Conservation Letters*, May/June 2016, 9(3), 153–163

[84] Gruby, R, Campbell, L, Fairbanks, L, Gray, N (2017b) 'To succeed, large ocean sanctuaries need to benefit both sea life and people', The Conversation, <http://theconversation.com/to-succeed-large-ocean-sanctuaries-need-to-benefit-both-sea-life-and-people-86977>.

be managed by Parks Australia, a federal government agency. However, in the case of the Great Barrier Reef Marine Park, which by itself is an LSMPA and straddles federal and state waters, a separate authority under its own legislation was established to plan for and manage the park – at that time there were no other federal MPAs.

The IUCN recognises four types of governance:
- centralized governance (government institutions managing the MPA, such as Great Barrier Reef and Channel Islands)
- shared governance or co-management (decision making by multiple stakeholders through collaboration, such as at La Caleta Marine Park, Dominican Republic)
- locally led governance (small scale and locally managed with high levels of community participation, such as Isla Natividad)
- private governance (NGOs, universities and research organisation or individual businesses, such as Great South Bay in the USA and Chumbe in Tanzania).

Weizel, Feral and Cazalet reviewed governance arrangements for MPAs in the developing countries in west Africa [85]. They found that over the past five decades, MPAs were established using a centralised and unilateral process, often after lobbying from the international community, whereas today there is 'often a difficult relationship between civil society and the State apparatus'. They also found that the 'MPAs may sometimes result in upheavals in the livelihoods, incomes and traditions of the poorest, most vulnerable and forgotten populations on the planet, while perverse effects such as poaching and seasonal migrations can destabilize societies'. But even decentralised governance was fraught due to a lack of resources and expertise coupled with remoteness.

With the establishment of the Papahanaumokuakea Marine National Monument off the Hawaiian Islands, two federal agencies were required to collaborate in its management which, according to Kittinger et al. (2010)[86] presented 'new challenges as agencies with differing mandates and cultures work together to implement ecosystem-based management'. But they also observed that 'institutional responses and increased maturity in the co-trusteeship have been successfully employed to reduce conflict and facilitate interagency interactions'.

Chricop et al. (2010)[87] examined MPAs in Mozambique, South Africa and Tanzania: 'Although on many issues there appears to be regional solidarity and convergence on principles, including participatory processes and decision making to guide MPA making, there are significant differences on lead roles, institutional structures, access to public information, and conflict management, among others, which would need to be factored in MPA cooperation'.

LSMPAs may include coastal ecosystems on which artisanal fishers and their communities are dependent but will also include vast areas where there is little human presence or activity. Compliance and enforcement will be tested, as will governance for institutions remote from

---

[85] Weigel, J, Féral, F, Cazalet, B, eds. *Governance of marine protected areas in least-developed countries. Case studies from West Africa.* FAO Fisheries and Aquaculture Technical Paper No. 548. Rome, FAO. 2011. 78 pp.

[86] Kittinger, J, Dowling, A, Purves, A, Milne, N and Olsson, P (2010) 'Marine Protected Areas, Multiple-Agency Management, and Monumental Surprise in the Northwestern Hawaiian Islands', *Journal of Marine Biology*, vol. 2011, Article ID 241374.

[87] Chircop, A, et al. (2010), 'Governance of Marine Protected Areas in East Africa: A Comparative Study of Mozambique, South Africa, and Tanzania', *Ocean Development & International Law*, 41:1–33, 2010, DOI: 10.1080/00908320903285398.

the protected area. LSMPAs become even more complicated when they are on the high seas or straddle multiple EEZs.

Freidlander et al. (2016)[88] believe that 'management, governance and research capacity limitations are magnified in LSMPAs, therefore highlighting the need to return to these prior forms of collaboration to achieve conservation objectives. Collaborations among LSMPAs in the Pacific include bilateral agreements, learning exchanges, as well as research, monitoring and enforcement activities. By working together, Pacific LSMPAs have been able to overcome some of the management and scientific challenges associated with conserving vast areas of the oceans'.

Christie et al. (2017)[89] identified a number of best-practice management processes to ensure that human dimensions were adequately considered in the design and location of LSMPAs: 'integration of culture and traditions, effective public and stakeholder engagement, maintenance of livelihoods and wellbeing, promotion of economic sustainability, conflict management and resolution, transparency and matching institutions, legitimate and appropriate governance, and social justice and empowerment'.

A key part of any LSMPA governance should be enforcement, and as the number of LSMPAs increase, Berger (2017)[90] reports that scientists are beginning to focus on the quality of LSMPAs, not just quantity. Illegal fishing, lax regulations and a failure to engage local communities has led to poor and inequitable management outcomes.

To promote the key criteria for successful MPAs, the Marine Conservation Institute has established its Global Ocean Refuge System to praise MPAs that have effective management, cover high-priority biodiversity hotspots, engage with local stakeholders and effectively limit human activities. To date there are only three that have satisfied the criteria: Hawaii's Papahanaumokuakea Marine National Monument (1.5 million km^2), Colombia's Malpelo Fauna and Flora Sanctuary (8570 km^2) and the Philippines' Tubbataha Reefs Natural Park (1300 km^2).

According to the MPA Governance[91], any MPA design and management requires a combination of top state control through laws and institutions, community-based approaches and market incentives for success.

The integration of top-down (centralised government) and bottom up (community-based) governance models was the focus of research by Gaynor et al (2014)[92], using five MPA case studies from Canada, Fiji, England, Chile and the Bahamas. They believe that resistance to centralised MPA proposals can be addressed through consistent engagement transparency

---

[88] Freidlander, A, et al. (2016) 'Co-operation between large-scale MPAs: successful experiences from the Pacific Ocean', *Aquatic Conserv: Mar. Freshw. Ecosyst.* **26** (Suppl. 2): 126–141 (2016).

[89] Christie, P et al. (2017), 'Why people matter in ocean governance: Incorporating human dimensions into large-scale marine protected areas', https://doi.org/10.1016/j.marpol.2017.08.002.

[90] Berger, M (2017) 'As Big Marine Reserves Proliferate, a New Focus on Enforcement', <https://www.newsdeeply.com/oceans/articles/2017/09/12/as-big-marine-reserves-proliferate-a-new-focus-on-enforcement>.

[91] MPA Governance 'Governing marine protected areas: social-ecological resilience through institutional diversity', <http://www.homepages.ucl.ac.uk/%7Eucfwpej/pdf/MPAGRome.pdf>.

[92] Gaynor, C et al. (2014) 'Merging top-down and bottom-up approaches in marine protected areas planning: experiences from around the globe, *Aquatic Conserv: Mar. Freshw. Ecosyst.* **24** (Suppl. 2): 128–144 (2014).

and community-derived benefits. Collaborative management between Indigenous communities and agencies must be based on the recognition of their rights, knowledge and deep marine connections, along with education and capacity building for their effective participation. The authors conclude that: 'How bottom-up and top-down approaches are used should consider the scale of the MPA (e.g. small vs. large), the geographic scenario (e.g. coastal vs. remote), the level of anthropogenic influence, the conservation objectives (e.g. species, habitats, ecosystems), the political and governance context, and specific cultural conditions, such as the presence of indigenous communities'.

Transboundary management options for marine biodiversity management between the 14 nations in the Western Indian Ocean (WIO) were the focus of research by Levin et al (2017)[93]. Although the WIO nations were found to share fish and coral species, there were few socio-economic and political connections and the extent of MPAs and the effectiveness of their management was highly variable, with many suffering from a lack of compliance and enforcement. According to the authors, any efforts to expand MPA coverage through transboundary cooperation in the WIO would 'need to be considered in the context of the challenges related to environmental change, subsistence economies, poor fisheries-dependent coastal populations and the international composition of the pelagic fisheries industry.

Research needs
- Conduct social research to determine the most effective governance models to use in existing and candidate LSMPAs

LSMPAs and the Paris Agreement
Climate change will have significant impacts on ocean processes and life inside LSMPAs, but their establishment can also support the implementation of the Paris Agreement[94]. The Agreement commits nations to among other things:
- holding the increase in global average temperature to below 2°C above pre-industrial levels and limiting it to 1.5 °C (Article 2)
- increasing adaptation to climate change and fostering climate resilience and low greenhouse gas emissions development (Article 2)
- setting mitigation targets from 2020 to be reviewed every five years, informed by a global stocktake (Article 9)
- transparency and accountability to provide confidence in a nation's progress towards targets (Article 13)
- financial, technological and capacity building support for developing countries (Article 9)
- conserving and enhancing sinks and reservoirs of greenhouse gases (Article 5).

Davies et al. (2017)[95] believe that climate change will impact on the distribution of various species and future research 'considering the present and also projected future distributions of species in identifying new LMPAs will be critical to ensure species' persistence'. According to

[93] Levin, N, Beger, M, Maina, J, McClanahan, T, Kark, S (2018) 'Evaluating the potential for transboundary management of marine biodiversity in the Western Indian Ocean', *Australasian Journal of Environmental Management*, 25:1, 62-85, DOI: 10.1080/14486563.2017.1417167.
[94] United Nations Framework Convention on Climate Change (2015) Paris Agreement, <http://unfccc.int/paris_agreement/items/9485.php>.
[95] Davies, T, Maxwell, S, Kaschner, K, Garilao, C, Ban, C (2017) 'Large marine protected areas represent biodiversity now and under climate change', *Nature* 7:9569, DOI: 10.1038/s41598-017-08758-5.

the authors, the retraction of species' ranges will lead to more of those ranges being represented inside LSMPAs. But sharks, skates, rays and birds will lose protection, with their ranges contracting the most. Ironically, these are the species that are often cited as beneficiaries of LSMPAs. Davies et al. identify some of the winners and losers in Figure 6.

Fisheries can benefit from implementation of the Paris target, according to Cheung et al (2016)[96]. They estimate that:

> 'potential catches will decrease by more than 3 million metric tons per degree Celsius of warming. Species turnover is more than halved when warming is lowered from 3.5° to 1.5°C above the preindustrial level. Regionally, changes in maximum catch potential and species turnover vary across ecosystems, with the biggest risk reduction in the Indo-Pacific and Arctic regions when the Paris Agreement target is achieved.

Figure 6 Winners and losers from climate change[97]
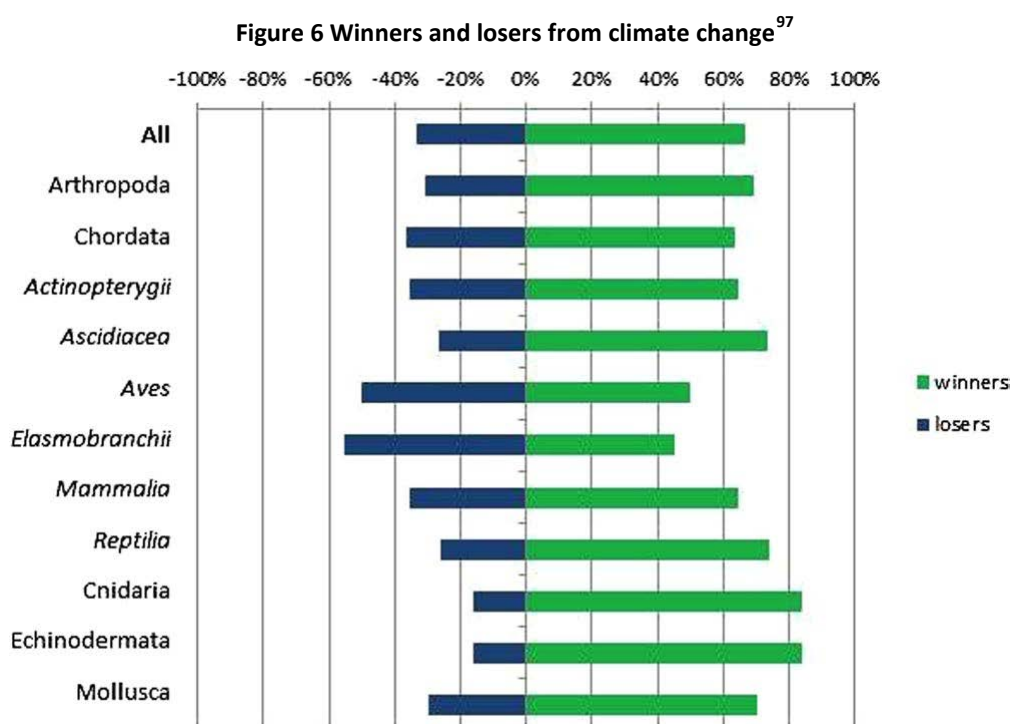
Ferrar (2016)[98] believes that LSMPAs can have greater resilience to climate change because they include more habitats and species than smaller ones and 'allows for the protection of more ecosystem services and functions that are necessary for the ocean as a whole to survive'. They can also be used to create corridors for species moving northwards to cooler waters where they can find refuge. This was also a finding of Roberts et al. (2017)[99], who conducted a global review of MPAs in relation to mitigation and adaptation. They also found that MPAs can help adaptation to ocean acidification, sea-level rise, increased storm intensity, species'

---

[96] Cheung, W, Reygondeau, G, Frölicher, T (2016) 'Large benefits to marine fisheries of meeting the 1.5°C global warming target', *Science* vol. 354 Issue 6319, December 2016.
[97] Davies, T, Maxwell, S, Kaschner, K, Garilao, C, Ban, C (2017) 'Large marine protected areas represent biodiversity now and under climate change', *Nature* 7:9569, DOI: 10.1038/s41598-017-08758-5.
[98] Ferrar, G (2016) 'How can marine protected areas save our oceans from climate change?', <https://blog.marine-conservation.org/wp-content/uploads/2016/01/Grace-blog.png?x41451>.
[99] Roberts, C et al. (2017) 'Marine reserves can mitigate and promote adaptation to climate change', *pnas* doi/10.1073/pnas.1701262114.

distribution shifts, and decreased productivity and availability of oxygen, and that larger highly protected and well-managed MPAs and relatively isolated ones were better. Barriers to mitigation were disturbance of the seabed from bottom trawling and seabed mining, which releases carbon, and the removal of predators by fishing leading to increased grazing of plants and reduced carbon storage.

Research needs
- Develop and implement a research strategy that establishes climate-change indicators to monitor trends in existing and candidate LSMPAs.
- Conduct social research to determine which mitigation and adaptation mechanisms are most likely to be adopted by coastal communities in and around LSMPAs.

LSMPAs and a high seas agreement
There is currently no legal mechanism to establish MPAs or uniform environmental impact assessment in the high seas, which cover two-thirds of the world's oceans. The existing global ocean regime is fragmented, a variety of institutions having responsibility for fisheries, specific fish species, mining, pollution, whaling and shipping. These have evolved in an ad-hoc way in response to the evolving impacts of human use.

The UN General Assembly has given its support to the preparation of a high seas agreement. Such an agreement, once in force (negotiations on its preparation will continue until mid-2020 but its operation is several years away), can provide the legal regime for establishing MPAs in the high seas, along with environmental and cumulative impact assessment systems, the regulation of genetic resource exploitation and the transfer of technology and capacity building, especially to developing nations.

There are regional mechanisms available—18 regional seas programmes (RSPs) and 14 regional fisheries management organisations (RFMOs)—that could be used to develop high seas MPA networks, but they have to date largely failed to do so. The three exceptions are CCAMLR, OSPAR and BARCON (in the Mediterranean). The remaining RSPs are focused on the EEZs of member nations, while RFMOs have other priorities.

Both the 'on-paper' and 'in-practice' performance of RFMOs were reviewed by Cullis-Suzuki and Pauley (2010)[100], who found 'low performance of RFMOs for both assessments, i.e. average scores of 57% and 49%, respectively. The latter result is emphasized by findings that two-thirds of stocks fished on the high seas and under RFMO management are either depleted or overexploited'. Gilman, Passfield and Nakamura (2013)[101] found 'large governance deficits' in RFMOs and 'nominal progress in gradually transitioning to ecosystem-based fisheries management: controls largely do not account for broad or multispecies effects of fishing, and cross-sectoral marine spatial planning is limited'.

The independent Global Ocean Commission in 2014 proposed a comprehensive reform of how the oceans are governed and managed because: 'Effective rules and agreed mechanisms to ensure the sustainable use and conservation of high seas biodiversity are missing. There is also

---

[100] Cullis-Suzuki, S, Pauley, D (2010) 'Failing the high seas: A global evaluation of regional fisheries management organizations', *Marine Policy*, 34 (2010) pp1036-1042.
[101] Gilman, E, Passfield, K, Nakamura, K (2014) 'Performance of regional fisheries management organisations: ecosystem-based governance of bycatch and discards', *Fish and Fisheries*, vol. 15, Issue 2, June 2014, pp 327-351

inadequate implementation of already agreed instruments and commitments and coordination across sectors'. The commission recommended a high seas regeneration zone with a ban on industrial fishing if 'insufficient action is taken and oceans decline continues in 5 years'. It also proposed the transformation of RFMOs into Regional Ocean Management Organisations with an integrated, ecosystem-based approach. Figure 7 maps the coverage of RFMOs.

Figure 7 RFMO coverage[102]
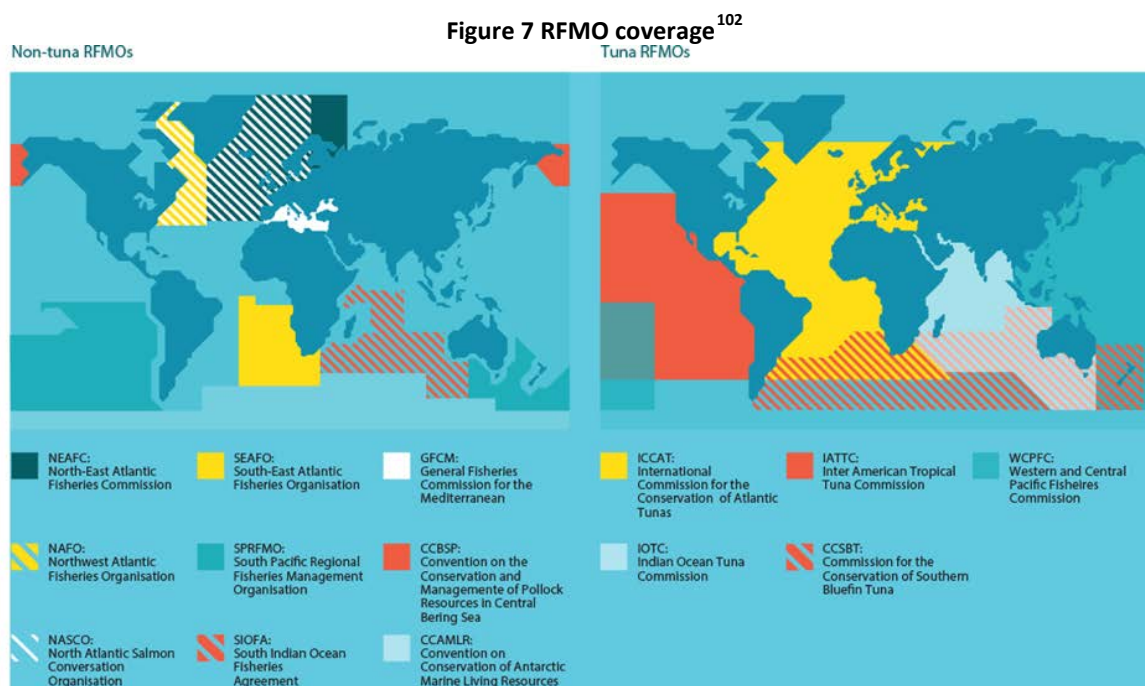
In support of efforts to develop a high seas agreement, The Pew Charitable Trusts published a report on 'Mapping governance gaps in the High Sea's[103], which revealed how little of the high seas were covered by agreements with a focus on marine conservation. The report concluded that: For governance organizations to effectively manage and conserve life on the high seas, three key elements are necessary: regulatory authority, a mandate to conserve the ecosystem as a whole, and the ability to manage across multiple sectors. Although some organizations have two of these three elements, they all lack comprehensive mandates to effectively manage and conserve ecosystems on the high seas. Figure 8 reveals the high-seas coverage of organisations with primary and partial mandates for marine conservation.

According to Rochette et al. (2014)[104], cooperation will be essential in the future for high seas biodiversity conservation, but 'there are very few actual examples for cooperation or coordination activities between institutions governing ABNJ at the regional level'. The authors also explain that regional agreements are poorly implemented because of 'the lack of political will, funding issues, political instability in some States, lack of capacity or weak enforcement mechanisms', along with 'limited technical and legal assistance'.

---

[102] WhoFishesFar (2018) <http://www.whofishesfar.org>. Accessed February 2018.

[103] Pew Charitable Trusts (2016) *Mapping governance gaps on the high seas*, Pew Charitable Trusts, Washington DC.

[104] Rochette, J et al. (2014) 'The regional approach to the conservation and sustainable use of marine biodiversity in areas beyond national jurisdiction', *Marine Policy* 49 (2104) pp109-117.

Establishing LSMPAs in the high seas without an agreement would be very difficult, but even with an agreement, and in the period between now and it coming into force, collaboration and cooperation between various regional organisations will be very important, according to Rochette et al.: 'The Implementing Agreement is therefore "not an "either/or" with the use of existing regional organisations": global discussions and regional actions are two interconnected processes which feed each other and both need to be strengthened'.

Figure 8 Organisations with partial and primary mandates to protect the high seas[105]

Map 3A
High Seas Organizations With Partial Conservation Mandate

Map 3B
High Seas Organizations With Primary Conservation Mandate

Organizations included

CCAMLR   GFCM   IATTC   MAP   NEAFC   NPAFC
OSPAR   SEAFO   SIOFA   SPREP   SPRFMO   WCPFC

© 2016 The Pew Charitable Trusts

There are also gaps in our high-seas scientific knowledge (why precautionary protection is important) but that knowledge is expanding. The CBD initiated a scientific exercise conducted by Bax et al. (2015)[106] that resulted in the identification of 203 ecologically or biologically significant areas in the oceans, with 66 of them partly or entirely in the high seas.

---

[105] ibid.

[106] Bax, N et al. (2015) 'Results of efforts by the Convention on Biological Diversity to describe ecologically or biologically significant marine areas', *Conservation Biology*, vol. 30, No. 3 pp571-581, DOI: 10.1111/cobi.12649.

The focus of advocacy groups in the period between now and when the agreement comes into force may be best directed at the RSPs, focusing on MPA gains in the EEZs of their member countries while building the scientific base for the identification and location of LSMPAs in the high seas. Building support within those RSPs for MPA networks in their EEZs may provide the foundation for their support of high-seas LSMPAs.

An alternative to an LSMPA is a marine managed area, which has multiple objectives and multiple zones that may include no-take, allocations for a specific extractive use or use for tourism and fishing. There are thousands around the world, many at the local community level and with co-management arrangements between governments, the community and corporates. They may also include marine parks, sanctuaries, refuges and national parks, and are a form of marine spatial planning. Their definition is so broad that they could include LSMPAs.

Rocliffe et al. (2014)[107] reviewed locally marine managed areas in the west Indian Ocean, which covered in total 11,000 km^2 and were 'hampered by underdeveloped local and national legal structures and enforcement mechanisms'. But they were also critical of MPAs which 'often fall short of their original goals and sometimes fail entirely, though published negative evaluations are rare. Inadequate long-term funding and widespread management failure have resulted in unenforceable and ineffectual ''paper parks''…In a recent review of marine conservation successes in the WIO, for example, Samoilys & Obura only mention one example of successful government-established MPAs: those of Kenya'.

Could other effective area-based conservation measures (OEABCMs) also be used to achieve conservation outcomes and help achieve global targets? Azmi and Dunstan (2018)[108] suggest giving a conservation objective to areas managed for submarine cables, particularly sensitive sea areas, traditional use areas, wreck sites, war graves, military zones and offshore wind farms:

'Critical to their success will be to ensure that conservation outcomes are supported by strong evidence, and to allow greater flexibility to design context-specific measures that address more than one objective rather than rely on prescriptive input requirements'. They would also only contribute to achieving global targets to a small degree.

Research needs
- Investigate and quantify the level of contribution that non-MPA measures can contribute to achieving global protection targets.
- Continue to build knowledge of the ecological and biophysical values of the high seas.

What drives marine conservation?
Of the 150 nations of the world with EEZs, some are regarded as leaders and others as laggards when it comes to the establishment of MPAs. But is it fair to categorise them in that way? And how do you measure it?

---

[107] Rocliffe S, Peabody S, Samoilys M, Hawkins J (2014) 'Towards a network of locally managed marine areas (LMMAs) in the Western Indian Ocean', *PLoS ONE* 9(7): e103000. doi:10.1371/journal.pone.0103000.
[108] Azmi, K, Dunstan, P (2018) 'Other effective area-based (marine) conservation measures: is an outcomes-based definition possible?' Discussion paper for the Expert Workshop on Marine Protected Areas and Other Effective Area-based Conservation Measures for Achieving Aichi Biodiversity Target 11 in Marine and Coastal Areas, 6-9 February 2018.

Some websites have attempted to do just that with various top 5 and top 10 lists. McCarthy (2015)[109] highlighted four countries that took big steps to protect the ocean in 2015: Palau, Chile, New Zealand and the UK, based on the size of MPAs they created from 500,000 to one million km^2. The world atlas website listed the top 12 countries for coastline and marine conservation in the following order: Monaco, Slovenia, Ecuador, Germany, France, Norway, Netherlands, New Caledonia, Belgium, Poland, Australia and Guinea-Bissau. The rating was based solely on the percentage of their EEZs covered by MPAs, which ranged from 45.9-100%. Except for Guinea-Bissau, each of these nations ranks 'High' to 'Very High' on the Human Development Index.

Does a country have to be wealthy to be a leader in marine conservation? Shugart-Smith (2014)[110] considers that the wealthy are not pulling their weight after an analysis of the efforts of G20 nations. She found that 'only five have protected more than 1% of the ocean area in their jurisdiction in no-take reserves'. She noted that 'collectively their economies account for approximately 85% of the gross world product. Yet their commitment to protecting their coastal waters is lacking, and capacity is clearly not the issue. One trend that stands out is that strong protection of large, remote areas makes up the vast majority of the no-take protection for many leading G20 countries'.

This raises the question of how to measure leadership. In the above examples, the world atlas website used percentage cover of all MPAs, whereas Shugart-Smith used the percentage of no-take MPA coverage and arrived at a different conclusion. A more sophisticated analysis would use both quantitative and qualitative measures to determine national performance and then leadership.

Yale's Environmental Performance Index[111] ranks how well countries perform on 19 different indicators in two broad policy areas: protection of human health from environmental harm, and protection of ecosystems. A similar index could be developed to measure the performance of nations against a set of marine conservation and management indicators. This may provide a more accurate measure of performance and identify those national characteristics that help a country become a leader. In any such index, there should be a weighting to ensure that developing nations are not always at the bottom of the list. Those in the Yale index were Afghanistan, Niger, Madagascar, Eritrea and Somalia (three of those are war-torn, so context can be everything), the Top 5 were Finland, Iceland, Sweden, Denmark and Slovenia.

Every nation can't be Sweden or Denmark. But they could be making relatively significant progress. A developing country that establishes a small network of no-take areas in coastal waters may be a stronger performer than one creating a large MPA in distant waters away from the difficulties of domestic politics. In those terms, who is the leader? But there are clearly national attributes that can allow leaders to rise to the top. They include:
- political will and a desire to influence others

[109] McCarthy, O (2015) 'These 4 countries took huge steps to protect the ocean in 2015', <https://howtoconserve.org/2015/11/20/marine-protected-areas/>.

[110] Shugart-Smith, K (2014) 'Are wealthy countries failing to protect the oceans', https://blog.marine-conservation.org/2014/11/are-wealthy-countries<<-failing.html.

[111] Yale University, Environmental Performance Index, <http://archive.epi.yale.edu/our-methods>, Yale University, New Haven.

- stable political circumstances
- a history of conservation measures and recognition of the need for conservation
- legislative and regulatory support for conservation
- strong community advocacy
- scientific expertise and knowledge, and faith in science
- a desire to be collaborative and cooperative (a leader of a group of one is not a leader).

Simultaneously, there are questions around categorisation. Although IUCN adjusted its categories to better reflect the nature of marine conservation, there exists some flexible interpretation by nations seeking to meet marine protection targets goals. Fitzsimons (2011)[112] observed that:

> The most recent guidance from the IUCN clearly states that commercial or recreational fishing is inappropriate in MPAs designated as category II (National Park). However, in at least two developed countries with long histories of protected area development (e.g., Canada and Australia), category II is being assigned to a number of MPAs that allow some form of commercial or recreational fishing.

Fitzsimons concluded that 'the application of IUCN categories is both transparent and consistent with international practice will be important, both for the sake of international conventions and to accurately track conservation progress.

Proposals for a regulation-based categorisation system have been hotly debated. Those proposing the system, such as Costa et al. (2017)[113] believe that: 'With an increasing number of MPA types being implemented, most of them multiple-use areas zoned for various purposes, assessing ecological and socio- economic benefits is key for advancing conservation targets and policy objectives. Although the IUCN categories can be used both in terrestrial and marine systems, they were not designed to follow a gradient of impacts and there is often a mismatch between stated objectives and implemented regulations'. They wish to see both the IUCN categories and the regulation-based classes applied to 'increase transparency when assessing marine conservation goals'.

Research needs
- Establish an independent and reliable monitoring and reporting database on MPA coverage and levels of protection.
- Develop a marine conservation performance index to promote marine conservation efforts and help identify those nations that need support implementing LSMPAs.

Conclusion: Global science capacity to meet research needs
In order to satisfy these research needs, and achieve global conservation targets, it is necessary to significantly increase science funding, engage institutional support from key governments, researchers and stakeholders, and build scientific capacity at the regional and domestic level.

---

[112] Fitzsimons, J (2011) 'Mislabeling marine protected areas and why it matters—a case study of Australia', *Conservation Letters* 4 (2011) 340–345.
[113] Costa, B et al. (2017) 'A regulation-based classification system for marine protected areas: A response to Dudley et al.', *Marine Policy* 77 (2017) 193–195.

While the conservation targets are global, their implementation is largely domestic. Governments must make decisions based on the best available science. This science has far more impact on governments and stakeholders if it is 'owned' by local and regional scientists and institutions, and presented in a manner that is socially and culturally appropriate. This science must answer local and regional priorities – not just address global conservation targets. In this context, it is important that capacity building and mentoring strategies are developed that connect globally recognized marine science leaders with local and regional emerging scientists. Consistent with the Sustainable Development Goals, we need to strengthen implementation of knowledge, technology and capacity transfers to enable the achievement of global marine conservation targets.

Research needs
- Build global capacity and expertise in socio-economic methodologies and approaches to implement the research needs identified above, particularly in the Asia-Pacific region and developing State research institutions.
- Develop global networks and mentoring programs to share emerging methodologies and expertise, and build in-country expertise, particularly in the Asia-Pacific region and developing State institutions.