Developing a framework for the efficient design and management of large scale marine protected areas

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Abstract

Following the designation of the Papahānaumokuākea Marine National Monument in 2000, globally there has been a growing trend in establishing large, remote, no-take marine reserves (> 150,000 sq km), generally known as Large-Scale Marine Protected Areas (LSMPAs). Yet such MPAs with vast geographical areas bring design and management challenges, as the islands and seas are spread over hundreds of nautical miles and are largely inaccessible and often uninhabited. In order to understand how management of LSMPAs can be successfully sustained, this study evaluates the Pitcairn Islands Marine Reserve (PIMR), designated in September 2016, against a framework based on 10 criteria, which were derived from the IUCN WCPA's Guidelines for Design and Management of Large-Scale MPAs. Initial findings show the PIMR was satisfactory in design focusing on sound management practices, taking into account uncertainties around financial sustainability and future administrations. This study identifies the importance of: acquiring robust baseline data, being fully protected (no-take), using ecosystem-based management, community inclusion, and of adopting an ecologically connected network approach. These features are needed for large marine reserves to maximize achieving both ecological and socioeconomic goals, with particular attention to engagement of local communities. This study opens the possibility of refining and adapting the criteria developed through the PIMR case study as starting point for other Large- Scale MPAs, as their global expansion could benefit from comparative analysis. It also acknowledges the importance of having comparative design and management guides, contributing towards globally recognized standards for large-scale MPAs.

1. Introduction

Marine protected areas, including marine sanctuaries, parks and no-take marine reserves (MRs) have been widely seen as socially, economically and ecologically viable mechanisms to provide both direct and indirect benefits for nature and humans, such as replenishing fisheries stocks, along with biodiversity, education, research, culture and economic values [1]. There are 15,604

estimated MPAs around the world with the largest five representing more than 50% of all the protected ocean (UNEP-WCMC, 2018). These were all designated between 2000 and 2012 and largely in the Pacific Ocean. Recently, immense deep-sea oceanic areas have been set aside, adding up to 80% of MPA coverage worldwide, with most being large-scale [30]. Yet, there is limited previous experience or knowledge in managing extremely large and remote ocean areas, therefore risking these becoming 'paper parks' and potential economic priorities outweighing the original conservation objectives [16,46] (Fig. 1 and Fig. 2).

Figure 1. Top 10 MPAs by coverage and MPAs in numbers (UNEP-WCMC, 2018).

The Aichi Targets of the Convention on Biodiversity (CBD) are calling for 10% of coastal and marine areas to be fully protected by 2020, especially 'areas of particular importance for biodiversity and ecosystem services' [8]. However, at present only about 6.97% of the global ocean is protected, accounting for 25 million square km (UNEP-WCMC, 2018). In the last five years, there has been a noticeable effort towards raising ocean protection, with sustained advocacy between international gatherings, e.g. the 'Our Ocean' conferences, to IMPAC4 in Chile, and the Economist's 'Global Ocean Summit', all of which praised MPAs for long-term ecological benefits. The UN's first Ocean Conference in New York will now be organized every three years, and the nomination of a UN Special Envoy for the Ocean (Ambassador Peter Thomson from Fiij), whose main role is to bring forward the implementation of Sustainable Development Goal 14 and positively support and represent the ocean community's interests as a whole. In parallel, progress from long-term efforts in drafting a high seas treaty,

[48] is accelerating and likely to result in more high seas MPAs, making the 10% target attainable, and as well as progress for 30% MPA coverage first accepted by IUCN members at the IUCN Congress in 2016 and then widely endorsed during the 4th International Marine Protected Area Congress in 2017.

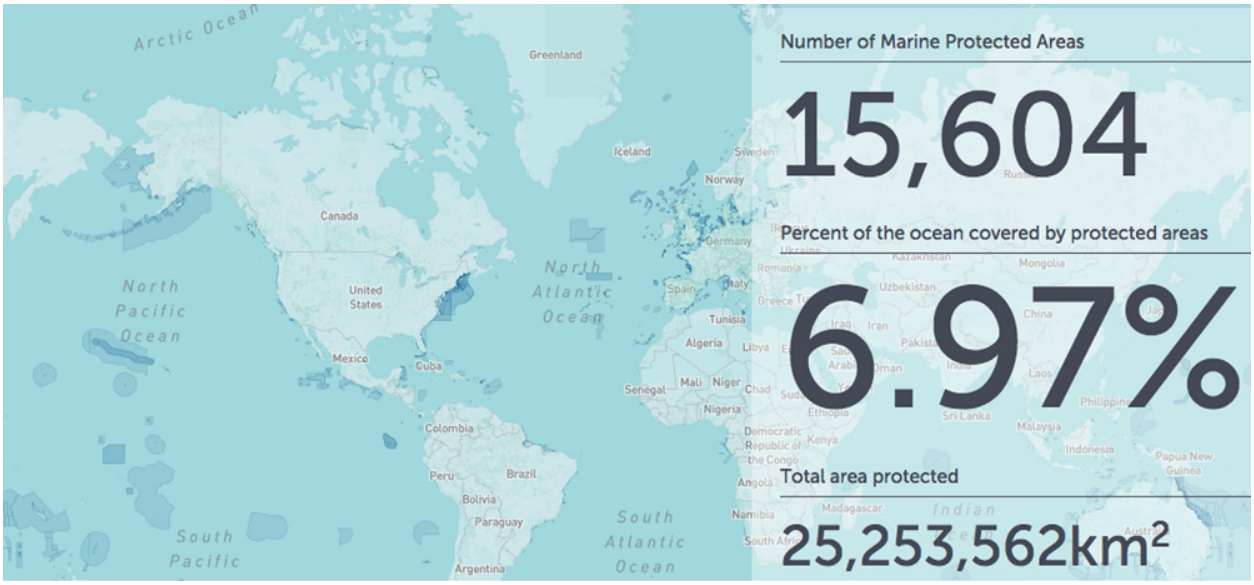

Figure 2. Top 10 MPAs by coverage and MPAs in numbers (UNEP-WCMC, 2018).

As a response to international conservation targets, the government of the United Kingdom (UK), with the 5th largest Economic Exclusive Zone (EEZ) in the world, put forward a plan to create a 'Blue Belt' of reserves (Conservative Manifesto, [9]). This included the Pitcairn Islands, a UK Overseas Territory in the central South Pacific Ocean with four islands, a land area less than 50 km2 and an EEZ of over 836,000 km2. In March 2015, the UK government announced their intention to designate 99% of the Pitcairn EEZ as a marine reserve, at that time the largest in the world. This process was achieved after 5 years of engagement with The Pew Charitable Trusts (hereafter, Pew) through Global Ocean Legacy (GOL) [10]. The GOL programme started in 2006 with a goal to protect the ocean for future generations by establishing 15 marine reserves of at least 200,000 km2 by 2022 [35]. In 2016, the Pew Bertarelli Ocean Legacy partnership was subsequently formed to help realize the GOL. The Pitcairn Marine Reserve (PIMR) announcement came after several years of scientific research, facilitation with the Pitcairn community, campaigning by NGOs, political lobbying and public engagement. Formally, the PIMR was announced, inscribed in the UK budget and legally declared following the release of a monitoring, enforcement and budget assessment in late 2016 [22] (Art. 2.259, UK Budget, 2015) (Fig. 3).

The term Pitcairn refers to a group of four islands located in the central South Pacific Ocean and associated sea area, lying between 23.9°S–24.7°S and 124.7°W–130.7°W, halfway between South America and New Zealand. Pitcairn Island is an extinct volcano, Oeno and Ducie islands are low coral atolls, and Henderson Island is a raised coralline island. The total land area of the Pitcairn group is 49 km2 and its EEZ has a total size of 836,108 km2, approximately 3 times the

size of the UK [26]. In 2011, Pew commissioned a report to compile all available evidence to build the case for increased marine environment protection, using scientific expedition data from as early as 1825 [26,7]. In 2012, an expedition led by the National Geographic Society's Pristine Seas in collaboration with the GOL team was conducted to survey the health of the marine ecosystems and to provide new and current evidence for a proposed designation as a marine reserve. Results showed that Pitcairn's waters are pristine and high in biodiversity [18,38]. The research campaign was the most significant ever executed in this region, and confirmed discovery of the undisturbed nature of Pitcairn's waters. A team of twelve scientists conducted 388 dives around the four islands at depths of 10 m and 20 m, while also surveying deeper parts of the EEZ with drop-down cameras at depths of 75 m to 1600 m. They filmed, conducted land surveys and assessed human impacts, such as plastic pollution [18,38]. This data, coupled with marketing campaigns aimed at raising Pitcairn's 'pristine' profile enabled GOL and its partners to build the case for the PIMR reserve (Fig. 4).

Figure 3. Location of the Pitcairn Islands (National Geographic, 2015).

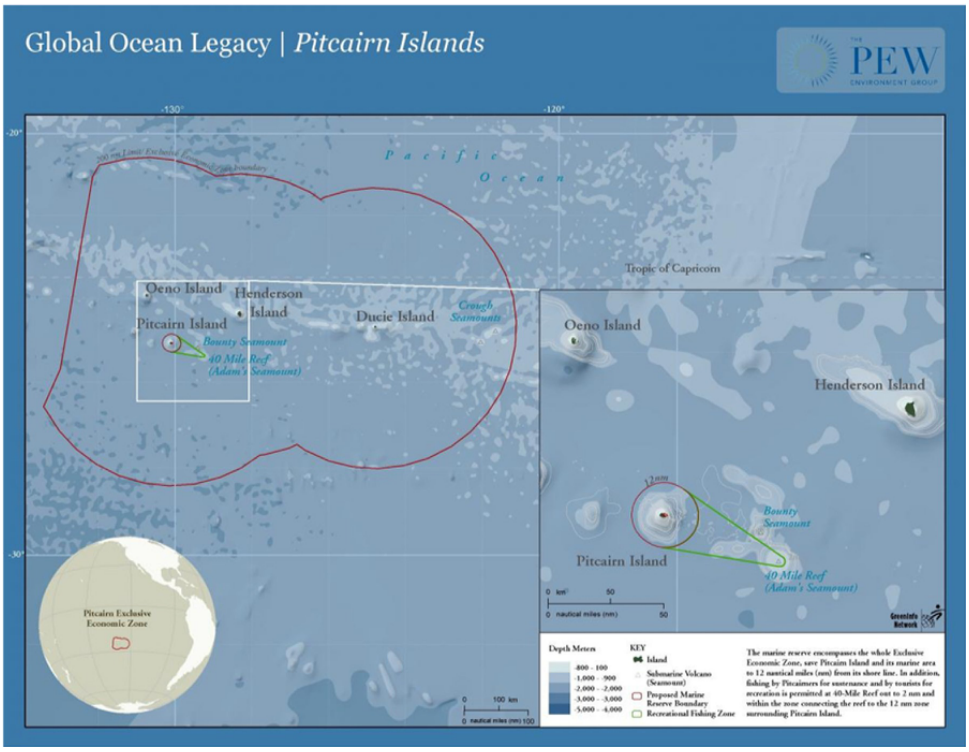

Figure 4. Global Ocean Legacy, Pitcairn Islands map (Pew, 2015).

2.Research approach

The main objective of any marine protected area is to protect existing resources or to increase resources [14]. To gauge its conservation efficiency, IUCN establishes a cycle of design, management, monitoring, evaluation and adaptation, made of inputs and outputs [33]. This paper used empirical evidence to evaluate the design and implementation phase, to inform the operational stage. While acknowledging there is no one-stop simple solution for design or management for any given MPA, this study applied a simplified yet adaptable framework to the Pitcairn Islands Marine Reserve (PIMR) (Fig. 5).

Figure 5. Big Ocean network map [3, 47]

The overall research approach used for this study was to evaluate the PIMR's design and implementation process against a set of guidelines developed by the International Union for the Conservation of Nature's World Commission on Protected Areas (IUCN-WCPA) and the Big Ocean think tank, made of MPA practitioners from around the globe. Through the use of 10 criteria adapted from these guidelines, grey literature and interviews, the PIMR was evaluated using a traffic light approach (TLA). Developed for fisheries management [5] this particular visualization tool was chosen in order to convey clear information to wide audiences. The use of a simple green, amber and red color scheme for each criterion does indeed make results legible to communicate widely. It is therefore also easier to identify weaknesses and take appropriate measures in the development towards the management and operational running phase. Each criterion was assessed according to performance and was awarded either a red (doesn't meet the criterion), amber (inadequately meets the criterion) or green (meets the criterion) (Table 1).

Informal interviews were conducted with some of the stakeholders directly involved in the PIMR design and implementation process. These included current and former Pew staff, Pitcairn Environment Group members, academics and professionals working in the field of MPA management effectiveness, Big Ocean network members and IUCN-WCPA members. Most of the data collected and used to evaluate the PIMR's adherence to the Big Ocean and WCPA-Marine Guidelines included grey literature, Pew briefs and reports as well as relevant journals and articles. It also included scientific reports from the expeditions and web content. This study was conducted from May 2016, was first completed through November 2016, and updated during 2017–2018 (Table 2).

Table 1. The Traffic Light Approach (TLA) used to evaluate the PIMR.

Traffic Light Approach	Color	Definition
Red		Does not meet the criterion requirement
Amber		Inadequately meets the criterion requirement
Green		Meets the criterion requirement

Table 2. The 10 criteria adapted from the IUCN WCPA guidelines.

Criterion	Definition
Good governance	Ethical effective approach to legislation with strong and transparent institutions
Good design	Scientifically assessed (data) in relation to size, biophysical characteristics, and ecology
Sustainable financing	Business plan, options for income generation, and partnerships (public – private)
Ecosystem-based management	Adaptive and strategic management based on ecosystemic dynamics and unpredictability
Planning	Timeline, goal setting, agreeing on standards, assessments, evaluating and reporting
Stakeholder engagement	Transparent process aimed at building trust with incorporation of strong representativeness
Compliance	Surveillance and enforcement supported by effective political and legal frameworks
Effective administration	Qualified and skilled professionals working towards operational effectiveness
Communication	Use of surveys, workshops, and public consultations, social outreach, photo and video
Vision and mission statement	Clear, sharp and concise view of the MPA for local and global ownership

The Large-Scale Marine Protected Area (LSMPA) Guidelines are the latest addition to the 'Best Practice' series developed by IUCN-WCPA. The success of a protected area can only be assessed by how effective it is in relation to its initial objective, whether ecological, socio-economic or educational ([23,28,40]). Although each site has its own characteristics and complexities, there has been an increase in scientific monitoring and reporting and evaluation of individual management practices, that can be associated to certain indicators to ensure both scientific and management criteria are being met [32]. For decades, IUCN-WCPA have worked to publish resources and make 'Best Practice' guidelines available for governments, policymakers and

managers to improve conservation practices and set recognizable standards starting with [28,27]. In 2010, the trend of MPAs 'going big' was acknowledged by marine park managers. This in part gave rise to "Big Ocean", an informal think-tank and network whose aim is to develop new methodologies and standards for the scale-specific design and management of large oceanic spaces [3,47]. After nearly a decade, in September 2017, at the 4th International Marine Protected Area Congress (IMPAC4), IUCN-WCPA and Big Ocean successfully launched the LSMPA Guidelines [31].

The following table presents the 10 criteria which were developed by taking key data from the Guidelines, refining them and using them as an 'LSMPA standard framework'.

3. Results - applying the IUCN-WCPA and Big Ocean framework to the PIMR

The section below gives an overview of how the PIMR performed against all 10 criteria adapted from the LSMPA Guidelines. It includes PIMR case specific details as to why each criterion was either fulfilled, inadequately met or was not met at all. (Table 3).

Table 3. Results for the PIMR using the TLA approach.

Criterion	Grade	Summary
Good governance		Top-down and bottom-up, strong institutions
Good design		Large, remote, mostly no-take, has support and engagement from the community
Sustainable financing		Uncertainty due to its isolation
Ecosystem-based Management		Strong baseline data, understanding of different ecosystems and scale to manage
Planning		Clear timeline and steady process forward
Stakeholder engagement		Input and transparency from government, NGOs and the local communities
Compliance		Innovative technology proving high compliance due to the PIMR's isolation
Effective administration		Uncertainty due to lack of financial stability and change in UK administration
Communication		Satisfactory campaign and strategy, use of visuals and engagement was a success
Vision and mission statement		Clear and effective message

3.1. Good governance

Governance of the PIMR is done by the UK government but it is also a community-led bottom-up process, using a collaborative approach based on transparency and shared objectives.

Institutionally, Pitcairn is the ‘smallest democracy in the world’, a UKOT and is subsequently governed through the Foreign and Commonwealth Office (FCO), the British High Commissioner to New Zealand, also Governor of Pitcairn based in Wellington. The MR is primarily managed by the Natural Resources Division [41]. The PIMR was proposed for designation following a public consultation period and instruction issued towards the Commissioner of the Overseas Territory by the British Foreign Secretary following approval by the UK parliament (Moscrop, Pers. Com.). It was officially announced by the FCO in September 2016, and a fisheries management plan [12] was drafted in partnership with the University of Dundee, SPC and the Pitcairn Government [13].

3.2. Good design

The LSMPA definition requires these to be at least 150,000 square km [31]. The PIMR is 834,000 square km so it falls in that category. The overall design benefited from a good balance of ecological and socioeconomic assessments undertaken from 2010 to 2017, achieved through a number of reports, two UK government-funded projects (under the UK Darwin Initiative programme), a scientific expedition and consultations with the local community. As a 99% fully protected no-take marine reserve, the only zoned areas allocated for non-commercial local subsistence fishing are designated Coastal Conservation Areas (CCAs) comprising the 12 nm territorial waters around all of Pitcairn's four islands, and the ‘40 Mile Reef’, a seamount located 75 km to the SE of Pitcairn Island [10,18]. This agreement was achieved through several consultations with the local community conducted by Pew, where other topics were covered such as entrance fees, cruise liner shipping, prohibition of fishing and all commercial extractive activities inside the reserve, as well as individual island policies around shell and coral collection, wildlife camping, signposting and visitors to the islands [37]. Ultimately, good design was largely achieved thanks to the support, engagement and enthusiasm of the Pitcairn Island Council and community, which was triggered by the 2012 expedition, making crucial scientific baseline data available. Combined with the many photographic records and videos, it reinforced the necessity for conservation.

3.3. Sustainable financing

Currently, there is no evidence of adequate sustainable finance for the PIMR's long-term management, monitoring, enforcement and evaluation, as an economic forecast predicts increased deficit [41]. Pitcairn is limited by its isolation, ruggedness and unsuitability for any significant agricultural or industrial production. Nutrient poor waters create a low-value fishery not tailored for commercial uses, even though climate change has been forecast to increase stocks, a speculative statement [2]. The small and ageing population makes financial sustainability ever more challenging as the number of physically able individuals declines [41–44]. Due to the collapse of the Pitcairn Island Investment Fund, the islands have been dependent on UK budgetary aid since 2004 at levels of up to £2.9 million per year. Historically, phiately used to be the only income, now supplemented by the sale of souvenir coins, landing fees, internet domain names and honey, accounts for up to NZ$ 200,000 per year. There are approximately 12 cruise ships that come to Pitcairn each year, and between 20 and 30 private yachts a year, but accessibility is still the biggest obstacle to substantial development of tourism

opportunities. In 2005, an economic report was ordered by Pew to establish a financial case for the MR and identified areas where financial sustainability could be reached. The reputation, high-value selling point and branding of having the 'world's largest marine reserve' could increase visitor numbers benefitting the local economy. National Geographic Expeditions and Lindblad Expeditions now offer 'upmarket' cruises to Pitcairn (Dickie, 2006; [42–44]).

3.4. Ecosystem-based management

In 2013, Pew, National Geographic and the PIC prepared a report entitled 'Pitcairn Marine Research Outline Plan' [29]. It identified the main steps to inform of scientific research and management priorities for the PIMR. It builds upon the baseline report of Irving and Dawson and the importance of the 2012 NG expedition in providing pre-marine reserve quantitative data on species diversity, including algae, coral, fish abundance and overall fish biomass [38]. Suggestions such as monitoring protocols for each island are proposed, standardized of methods of surveying, as well as an inclusion within international databases and studies (e.g. IUCN Red List, Living Planet Index). Understanding the PIMR's populations of endemic species, migratory paths of marine mammals, seabirds, turtles, reef fish, invertebrates, sharks is therefore key to manage effectively. While these are included individually as ways to improve understanding of the PIMR, they will require to be integrated strategically in a holistic regional ecosystem-based approach to inform decision making adequately. Fundamentally, biodiversity monitoring is crucial to practice an efficient EM management strategy. The leads on this are RSPB, the Darwin Initiative, Blue Ventures, ZSL, the Institute for Pacific Coral Reefs, the University of Western Australia and Pitcairn Islanders themselves. A second National Geographic expedition was proposed to take place in 2022. This should allow for a unique comparative study to assess the health of the PIMR before and after the PIMR was designated (Gammell, Pers. Com.).

3.5. Planning

The Pew GOL team used a cyclical approach to the implementing of the PIMR, leading to its designation. Everyone involved in the process engaged into what was a carefully strategized political campaign with some attention focused on developing relationships with series of planned meetings and discussions. Initially mandated by Pew, the marine environment report [26] and the scientific expedition report [38] created an incentive to present to the community what Pitcairn waters had to offer. The proposed designation of the PIMR is unique in its planning as it managed to combine an NGO and community-led bottom-up approach with a proactive top-down approach, converging interests both at community level and nationwide and meeting international conservation targets. Aside from Pew, planning was therefore delegated to various stakeholders and slowly instigated by PIC members, NGOs and politicians who drove the institutional PIMR process, mainly MPs Zac Goldsmith and Oliver Letwin, with the UK manifesto 'Blue Belt' declaration. In this sense, Pitcairn's remoteness and the time taken to get there gave it gradual and steady progress. Undoubtedly, the real key to the planning timeline was to get the early support from the Pitcairn Islanders themselves (Gammell, Pers. Com.)

3.6. Stakeholder engagement

Three visits in total were made to the islands by the GOL team and partners to get the final PIC green light for the reserve, a process started in March 2012 with the NG scientific expedition. It was during the 3rd trip in 2013 that the PIC voted unanimously in favor of the marine reserve (Whitebread, Pers. Com.). International communication, outreach and support for the PIMR was consolidated through the attendance at IMPAC3 where several Pitcairners made the trip with the 'Protect Pitcairn' campaign, receiving tremendous support [24]. Domestically, effective stakeholder engagement could not have been achieved without the active involvement of NGOs and particularly the Great British Oceans and its Marine Reserves Coalition, of which the Blue Marine Foundation, ZSL, the Marine Conservation Society, Greenpeace and NG are members. Through lobbying, it put pressure on the government, raised awareness and rallied support to make progress towards the proposal for designation (Moscrop, Pers. Com.) The Pitcairn Environment Group, of which the first meeting took place on 20th May 2013, and most recently on 5th May 2016 with the 8th meeting, equally played a key role in building trust between stakeholders. Further meetings are planned to pursue what is an essential forum for exchange, personal relationship building between the local community, the FCO, NGOs and various associations linked to Pitcairn and its environment. Whether the PIMR managed to fulfil the agendas of Pew, the Pitcairn community, UK NGOs and government and international targets, it has mainly been the fruit of concerted effort and hard work at the people level.

3.7. Compliance

Pew partnered with the UK government agency Satellite Applications Catapult to monitor the PIMR through 'Eyes on the Seas',a campaign to end IUU fishing, representing $23.5 billion worth of catches each year [49]. As remoteness is an obstacle leading to high cost of enforcement, compliance can be achieved at minimal cost using pioneering technology based on satellite imagery, fishing vessel databases and EEZ boundaries. This monitoring and surveillance technology uses optical satellite sensors providing high-resolution imagery. Combined with Vessel Monitoring Systems (VMS), Synthetic Aperture Radar (SYR) and Automatic Identification Systems (AIS) data, it can allow for a risk-profiling analysis of vessel movement, used to trace illegal activity, saving both time and effort [36,4]. Pew undertook a 13-month pilot monitoring phase, producing 10,000 h of monitoring during which up to 517 vessels were reported inside Pitcairn's EEZ, an average of 50/month and 90% identified by AIS, of which 180 were fishing vessels. Only 8 vessels were reported without their AIS switched on and could have potentially fished in the EEZ illegally. Pew is confident this technology is efficient to monitor large MRs, and with the first data coming from Pitcairn, compliance is already very high in the reserve.

3.8. Effective administration

Whilst Pew led the design and implementation process through the GOL campaign, whether they will be involved in the PIMR administration remains uncertain. The Pitcairn Environment Group forum was the main facilitation and administrative tool to ensure all PIMR information was centralized, informing activities to different parties (RSPB, the Pitcairn and Norfolk Islands Society, the UK Overseas Territories Conservation Forum). Legally, the PIMR will be formally

administered by the FCO, the PIC and its Division for Natural Resources, the Mayor's office (currently Shawn Christian) while NGOs are expected to ensure government actions are in line with the local community's objectives (Bradner, Pers. Com.) In New Zealand, British High Commissioner Jonathan Sinclair, also Governor of Pitcairn, is the main administrator for the islands, as well as recently appointed Deputy Governor Robin Shackell, sworn in on June 2nd, 2016 (Shackell, Pers. Com.). The MPA management plan was published in June 2016, involving stakeholders throughout the design phase. Activity over the last few months highlights is that a lot of effort has been made to avoid a top-down government led process that would have excluded the local community. Where the PIMR success lies is through its commitment to engage with its community and to administer collaboratively.

3.9. Communication

The PIMR designation proposal managed a positive communication strategy, both internally and externally. Pew, the FOC and all NGOs involved in the design and implementation process held numerous meetings, forming the 'Pitcairn Environment Group' whilst Pew ensured the message across published information and brochures was consistent. Through Zac Goldsmith's highly visual publication [19], MPs in the UK were able to work politically to include the 'Blue Belt' inside their Manifesto. This could not have been done without intense lobbying input from the NG expedition, its scientific report, and marine biologist Dr. Sala's TED talks, with subsequent documentaries on YouTube, that allowed the world to discover the pristine nature of Pitcairn's waters and agree on why it is important to preserve them. Undoubtedly, coming together at IMPAC3 and working to achieve a successful 'Protect Pitcairn' campaign was important. Communication was at the heart of this innovation, reinforced by technological improvements, digitalization of societies and strengthened by the participatory role of social media, and the rise of the 'ocean optimism' hashtag across Twitter. More websites (e.g. MPA News, Open Channels) are becoming access points to marine protection information and journals, calling for an alignment of objectives and collaboration through communication strategies [15].

3.10. Vision and mission statement

The simple but efficient 'Let's create the largest marine reserve in the world' title for the joint Pew, PIC and National Geographic Society publication for the PIMR is what the implementing team set out to do and thus succeeded. Eloquently, it matches the 2006 GOL objective to create the 'first generation of great marine parks' [34]. This is also consistent with the Pristine Seas mission vision, launched in 2008 by Dr. Sala, who sought out to save the 'last true wild places in the ocean', giving the world this sense of great responsibility and urgency, which so far has helped protect more than 3 million square km of ocean territory [39].

4. Discussion

As a summary, this evaluation finds an 80% level of positive criterion fulfilment using the 10 simplified criteria, so 8 out 10. Not only was the PIMR design and implementation process effective from its inception to its designation in late 2016, but it established how through collaboration and a mixed bottom-up and top-down approach how successful results can be

achieved, despite the scale of the ambition. Genuine trust was built across stakeholders, with the shared objective to tick all boxes at the ecological and socio-economic levels. However, there is a great deal of uncertainty in the ability for Pitcairn to effectively administer and finance the PIMR as the UK undergoes significant political change with Brexit. It will have to dedicate financial and human resources, technological and institutional input required to manage its assets, an issue that applies to all UKOT.

While Pitcairn is a good example of a large, no-take, remote, enforced and isolated MR, it is a newly established MPA and will need to be reviewed periodically over time with future surveys. A study surveying 87 MPAs looking at all fish biomass, large fish biomass, species richness of all fish and large fish numbers was conducted and established five key features an MPA should possess: no take, well-enforced, old (more than 10 years), large (bigger than 100 km^2), and isolated by deep water or sand, establishing the 'NEOLI' framework [17]. The pristine, or relatively low impact, nature of the PIMR is a fundamental rationale for preserving these large marine areas and islands. Hence attention needs to be focused on evaluating actual ecological benefits inside the reserve. This needs to be a priority for managers and given the scale, remoteness and high operating costs, an emphasis on collaboration across LSMPA is necessary, in all areas including scientific research expeditions [45] (Fig. 6).

Figure 6. The Pitcairn Marine Reserve team at IMPAC3 (Pew, 2013).

This study also highlights that without community participation at the start of an LSMPA design and implementation phase, yet the road to success remains challenging. While it is may be easier for a small close-knit community with somewhat shared values to achieve a consensus such as on Pitcairn, in the future, teams may need to address a wide variety of stakeholders, each with different agendas, cultural values and immediate priorities. Performance results from MPAs around the world suggest the social aspects of their management are the main elements for long-term success. However, they can also be undermined, if ecological interests are overly prioritized. Comparatively, the Marianas Trench National Monument, Papahānaumokuākea, the French Austral Islands or Marquesas cases aren't as straightforward, because of political and economic changes, e.g. Trump's Executive Order 13795 ordering for a review of all National

Marine Sanctuaries and Marine National Monuments or French Polynesia's industrial fishing expansion ambitions. An important new study looking at the human dimensions of LSMPA establishment in Palau, Marianas Trench, Kiribati, Easter Island and Bermuda found that stakeholder processes, governance, politics and socio-economic factors are equally important for efficient MPA design and implementation. They mainly highlight people's different interpretations of ocean space based on their identity, cultural and spiritual reasons to take a position in favor of the LSMPA or against it [21]. Another study identified ten considerations to focus on, ranging from attachment to place to participation, and highlighted is that it is very easy to dismiss the importance of the human in planning and to prioritize ecological objectives by drawing lines on a map [6].

This opens the door for increased research around the social science agenda for LSMPAs, if we want to understand socio-ecological processes better, to improve MPA efficiency [20]. Partnerships across LSMPAs can bring knowledge exchange, education and communication, and networks such as Big Ocean are important to bring people together in order to learn from each other [45]. Collective and participatory enforcement could be explored, as well as reinforcing close cooperation. Inherently, Big Ocean could help provide this much-needed platform for connectivity, to achieve a well-managed network of LSMPAs as per international conservation targets.

5. Conclusion

In terms of study limitations, this research did not separately weigh each criterion, nor did it use detailed attributes to define them. Whether the PIMR will fulfil its objective of marine protection, taking into account future climate change and uncertainties around its finance and administration, is impossible at this stage. It will require the rigorous implementation of the management plan and permanent, frequent evaluation. While the Big Ocean and WCPA-Marine LSMPA Design and Management Guidelines are useful to plan the implementation and help towards the drafting of a management plan, often broad generic instructions are not sufficient. Firstly, there is the obvious need to tailor solutions at the local level to make them work specifically for the context in which they are located, as each site is different. Secondly, design and management professionals need to take into account other MPA Standards (IUCN [25]) to avoid becoming paper parks. Fundamentally, any marine reserve success is first about the people who are involved.

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