



Contents lists available at ScienceDirect

Ocean & Coastal Management

journal homepage: www.elsevier.com/locate/ocecoaman

Opinion paper

The rise of large-scale marine protected areas: Conservation or geopolitics?

Pierre Leenhardt*, Bertrand Cazalet, Bernard Salvat, Joachim Claudet, François Feral

USR 3278 CNRS EPHE CRIOBE, Laboratoire d'Excellence CORAIL, University of Perpignan, 66860 Perpignan Cedex, France

ARTICLE INFO

Article history:
Available online xxx

ABSTRACT

In the last two decades, increasing number of international agreements have challenged traditional MPA design and management by calling for the implementation of large-scale marine protected areas (LSMPAs) within national jurisdictions and into the high seas. Since 2004, ten LSMPAs were established representing more than 80% of the worldwide MPA coverage, most of them in the Pacific. Here we analysed the drivers behind the establishment of LSMPA. This recent phenomenon is mainly driven by political reasons due to international conservation targets and intense domestic and international advocacy. Although we still lack scientific studies showing the benefit or the effectiveness of large-scale conservation, scientists advocate protecting marine biodiversity in remote places as a precautionary approach. 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. The rise of LSMPAs boosted the awakening of indigenous communities at the international, national, cultural and political level. In some cases the conservation initiatives catalysed indigenous claims to preserve their traditional and future rights forcing States to make sovereignty compromises on traditional rights. Ultimately, LSMPAs raise many issues of enforcement, management costs and governance structure that may challenge their effectiveness.

© 2013 Elsevier Ltd. All rights reserved.

1. Introduction

Marine protected areas (MPAs) have historically been established as relatively small areas in coastal waters (Mora et al., 2011). Lately increasing international agreements have challenged this traditional MPA conception by calling for large-scale conservation policies (Nelson and Bradner, 2010). Since 2004 and the re-zoning of the Great Barrier Reef Marine Park (GBRMP), many large-scale marine protected areas (LSMPAs) were established around the world (Gaines et al., 2010b). Although there is no official definition of LSMPA, some NGOs such as “Pew Environment Group” or the managers of the “Big Ocean” network define LSMPA as a marine conservation area larger than 100 000 km² (Jones, 2011). According to this definition, there are ten LSMPAs around the world (Table 1). Most of them were established in the Pacific and in the Indian oceans within national jurisdictions and two third of them were declared as marine reserves or “no-take areas” (i.e. where all harvesting and destructive activities are prohibited).

Recent scientific efforts to review different features of marine reserves suggest that there are potential benefits of LSMPAs implementation (Fenberg et al., 2012; Gaines et al., 2010a). Thus the review of biological effects within no-take areas (Lester et al., 2009) and inside LSMPAs (Alemany et al., 2012; Punt et al., 2012), the effect of MPA's size on ecological traits (Claudet et al., 2010, 2008), the benefit of large-scale reserve networks within and beyond national jurisdictions (McCook et al., 2010; O'Leary et al., 2012), the discussion in establishing pelagic MPAs (Game et al., 2009), the analysis of the legal implications of high-sea MPAs and marine spatial planning (Ardrion et al., 2008; Norse et al., 2005; Sumaila et al., 2007), the conservation costs of MPAs (Adams et al., 2010; Balmford et al., 2004; Ban et al., 2011; Ban and Klein, 2009; McCrea-Strub et al., 2011), and the governance analysis of large-scale marine areas (Day and Dobbs, 2013; Fidelman et al., 2011) highlight the possible potential of LSMPAs.

Other than a few cases, the implementation and the management of LSMPAs has not been well explored in practice or theory. Scientific investigations for LSMPAs are still limited and patchy (Caveen et al., 2012). For instance there is a crucial need for ecological and socio-economical modelling to explore the potential of LSMPAs in protecting highly mobile exploited species (Grüss et al., 2011), limiting access to protect stocks and ecosystems in

* Corresponding author. Tel.: +33 6 63065928; fax: +33 4 68503686.
E-mail address: pierre.leenhardt@gmail.com (P. Leenhardt).

Table 1

Implementation of large-scale marine protected areas during the last decade. This table presents the year of official designation, the global surface as well as the no-take area surface of the 9 largest large-scale marine protected areas over the world until 2010 (over 100 000 km²).

Year	Area (km ²)	No-take area (%)	Country	Site
2012	989 842	51	Australia	Coral Sea Commonwealth Marine Reserve
2010	636 600	100	UK	Chagos Islands (BIOT)
2010	286 200	?	International	North Atlantic MPA (OSPAR)
2010	150 000	100	Chile	Motu Motiro Hiva Marine Park
2009	246 608	100	USA	Mariana Trench Marine National Monument
2009	210 000	100	USA	Pacific Remote Islands marine National Monument
2009	180 633	13	South Africa	Prince Edward Islands Marine Protected Area
2008	408 250	100	Kiribati	Phoenix Islands Protected Area (PIPA)
2006	362 074	100	USA	Papahānaumokuākea Marine National Monument (PMNH)
2004	344 000	33	Australia	Great Barrier Reef Marine Park (GBRMP)

remote international waters, resolving territorial conflicts, and promoting more sustainable harvests of trans-boundary stocks (Gaines et al., 2010a). Furthermore most scientists would acknowledge that this research area suffers from a data poor context, forcing stakeholders and decision makers to implement and manage LSMPAs under great uncertainties and without the benefit of past experiences to draw upon.

Despite any consensus on the scientific effectiveness of LSMPAs, there is no choice but to accept that LSMPAs have been implemented. This fact suggests that these establishments were decided more for political than scientific reasons. In this article we provide an analysis of key context elements that in our opinion trigger the recent massive LSMPA establishments and we point out the different issues and challenges questioning LSMPA effectiveness. We start the analysis by focussing on the role of the international political context as well as the multiples advocates that enhance LSMPA implementations in remote and pristine places. From a geopolitical perspective we explore how coastal states use LSMPA implementation as an environmental duty/responsibility to enhance their sovereignties over sea spaces through several legal mechanisms. Then, as a consequence of these increasing sovereignties, indigenous claims question LSMPAs implementation in order to preserve their traditional rights and to be part of management processes. Finally we highlight the next challenges of LSMPA management that raise multiple doubts and concerns about their effectiveness.

2. The crucial importance of context in large-scale marine protected area implementations

2.1. International political context does matter

Since the United Nations Convention on the Law of the Sea (UNCLOS), calls and challenges for marine protection have increased, and are reflected within international agreements and declarations. The successive United Nations conferences of Rio, Johannesburg and Durban made States responsible for adopting measures protecting marine biodiversity and promoting the use of MPAs as a tool to maintain and/or restore marine biodiversity (Wood et al., 2008). Thus, in 1992, the Convention for Biological Diversity (CBD) set a target for 10% of the global marine area to be

designated as MPAs by 2010, recently extended to 2020 because the target wasn't met in time. Progress with designating MPAs is still slow since only 1.3% of marine areas and 3.2% the exclusive economic zones (EEZ) are covered (McCay et al., 2011). In 2008, only a few countries have come close to meeting targets (Marinesque et al., 2012) and, according to projections based on current progress, global MPA coverage targets will only be met in 2048 (Chape et al., 2005; Spalding et al., 2008; Wood et al., 2008).

Knowing the international political context of percentage-based targets for marine conservation and the difficulties to reach them, the recent rise of LSMPA implementations appears as a solution for states to meet their international objectives rapidly. The ten LSMPAs already established have had a great impact on conservation targets since they represent 80% of the worldwide MPA coverage. Today, bigger MPA projects are announced, such as the Cook Islands Marine Park (1 million km²), the Ross sea MPA (1.8 millions km²) or the New Caledonian Coral Sea MPA (1.4 million km²). If these massive LSMPA implementations can be seen as the direct effect of the percentage-based conservation targets it might be also compared to a race for marine conservation stewardship within the international political arena. Indeed, this infatuation for large-scale conservation is a political phenomenon. The most compelling evidence is that some implementations are decided despite any means of enforcement and sometimes in a context of legal controversy (De Santo et al., 2011; Guidetti et al., 2008; Pearce, 2005). If large-scale conservation targets are often perceived as over-ambitious and unattainable, they are frequently discredited or ignored (Roberts et al., 2003).

Emerging concerns are raised. Warnings have been raised on the potential danger of those conservation targets to prevent any LSMPAs from becoming paper parks (De Santo et al., 2011; Sheppard et al., 2012).

However, in spite of those considerations, international conservation targets provide political motivation for large-scale conservation. For instance, Caveen et al. (2012) reveal that the CBD had first considered a 5% target but then “settled on 10% as the 5% target was thought to be too small to encourage government action”. Moreover those conservation targets encouraged decision makers to scale-up marine conservation to expand the vision of MPAs from local to almost regional scales (Caveen et al., 2012). In this sense, France adopted the law on Natural Marine Parks in 2006 fostering conservation of larger areas than before [a]. Since 2006 and the creation of the French agency for MPAs, 8 Natural Marine Parks were established. Even if none of them is larger than 100 000 km², those new management tools have enabled France to implement marine management policies on a larger scale.

2.2. The advocates of large-scale marine protected areas

While international meetings provided percentage-based targets for marine conservation, advocacy for large-scale conservation plays an important role in implementing for large-scale no-take MPAs in remote places. Advocates are part of an “advocacy coalition” composed of academics, elected officials, civil servants, non-governmental organisations (NGOs), think tanks, journalists and member of civil society (Caveen et al., 2012). Indeed this coalition is found in networks occurring within the global environment movement (e.g. IUCN, WWF, PEW trusts). For example, part of the scientific community advocated for the establishment of LSMPAs, especially no-take MPAs (NTMPAs) (Jones, 2006). In 2011, according to the Centre of Excellence for Coral Reef Studies, “300 eminent scientists from 21 countries around the world urged the Australian Federal Government to create the world's largest no-take marine reserve in the Coral Sea” [b]. Similarly in 2010, according to the Global Ocean Legacy Project of the Pew Environment Group, 271

marine scientists from 40 countries were “calling for the establishment of a worldwide system of very large, highly protected marine reserves” [c]. Even if no-take MPAs (NTMPAs) or marine reserves have been promoted by some advocates as a win–win approach for marine biodiversity and fish stock conservation (Gell and Roberts, 2003; Gell, 2003), others argue that the primary goal of NTMPAs is to conserve and/or restore marine biodiversity (Jones, 2009, 2008). Large-scale NTMPAs are thus advocated as a precautionary restriction to protect large samples of marine biodiversity.

Despite poor scientific evidence on LSMPA effectiveness, Nelson and Bradner (2010) considered low human population sizes as a good criterion to select candidate sites for LSMPA. Indeed advocates focus their attentions on large-scale NTMPA establishments in remote and pristine places with low human pressure (except from tuna fisheries) (Nelson and Bradner, 2010). Many marine remote places are still relatively preserved from the anthropogenic disturbances due local coastal development and have then a great value in terms of biodiversity. Advocating protection of such places is considered as a precautionary approach. Until now LSMPAs have usually been established in remote places with low human density and relatively small socio-economical interests (except for the Great Barrier Reef Marine Park) (cf. Table 1). From an international perspective or from the viewpoint of residents from relatively populous large democracies who form a major advocacy base for LSMPAs, remote archipelagos with a limited human presence represent “low hanging fruits” to established LSMPA and then to meet conservation targets (Agardy et al., 2011; Norse et al., 2005). LSMPAs are politically easier to implement in those places than in more populated areas because of the reduction of potential conflict of uses (e.g. from professional and recreational fishermen and tourist operators).

3. Large-scale marine protected areas enhance State's sovereignty

With the recent development of LSMPAs, we are witnessing a shift in the political speech of coastal states to legitimize their sovereignties, from the original economic argument to the statement of environmental responsibilities across the oceans (Caillaud et al., 2012). The ocean now appeared as a space to deploy state sovereignties' for environmental reasons (Féral, 2011a). If this last argument is now put forward to legitimize the ownership of sea spaces the legal processes involved are not new and have been used by coastal states (for different reasons) since the United Nations Convention on the Law of the Sea (UNCLOS). Here we present several legal mechanisms enabling coastal states to enhance their sovereignties through large-scale conservation actions.

3.1. The principle of adjacency

The historical process of recognition of exclusive economic zones (EEZ)¹ under international law launched the beginning of an extension phase of coastal states' hold over sea spaces. The extension process of states' sovereignty started in the 50s and was based on the content of the rights granted to the States. States used the principle of adjacency or “coastal privilege” (Apollis, 1980). It was formalized by unilateral declarations registered with the

¹ Without having a full and complete sovereignty over its exclusive economic zones (EEZ), the Coastal State can exercise its jurisdiction, with specific rights and obligations. In accordance with Articles 55 and following of the UNCLOS signed in Montego Bay in 1982, the maximum width of the EEZ cannot exceed 200 nautical miles from territorial baseline.

Secretariat of the United Nations and was used mainly in fisheries and exploitation of the soil and subsoil. It enabled coastal states to enjoy a windfall effect, especially for fisheries and mining resources. Thus the ownership process for straddling stocks and high migratory species induced states to enlarge their borders and influences to monopolize natural resources. The geopolitical strategy for coastal states was to extend their influences on the high seas by controlling human presence and activities and (i.e. reducing area of freedom of access). More recently this principle has been used for environmental conservation purposes and sustainable use of marine resources. This is for example the case of the Mediterranean where no EEZ had existed until October 2012. France declared unilaterally an Ecological Protection Zone (EPZ) in 2004. This area was created to prevent degassing activities by shipping fleets. Even if this zone is not recognized as an LSMPA, France still exercises its jurisdiction for environmental reasons.

3.2. The “presential sea” theory

Many States have increased their sovereignties on international waters and this phenomenon is more and more justified by “The presential Sea theory”. It was originally initiated by Chile to extend its jurisdiction beyond its EEZ (Joyner and De Cola, 1993; Yturriaga, 1997). Chile extended its jurisdiction to a distance of 200 nautical (370 km) to cover its Humboldt Current fishing ground. More recently, in 2004, Brazil claimed for a 960 000 sq km expansion of its continental shelf to the Commission on the Limits of the Continental Shelf (CLCS) by referring to the article 76 of the UNCLOS. Indeed, articles 76 and following of the UNCLOS allow an extension of the outer edge margin of the continental shelf up-to 350 nautical miles.² This recognition also comes with exclusive rights for exploration and exploitation of natural resources of the soil and the subsoil (art.77.4). However, according to article 78, there is no similar competency granted above the continental shelf (e.g. regarding the water column). In 2009, Brazil legally obtained a 712 000 sq km expansion of its continental shelf (75% of the request gained) from the CLCS. Since then, and despite article 78 of UNCLOS, Brazil has exercised its surveillance and control over this area according to the “presential sea” theory. The 248 000 sq km missing (i.e. the 25% of the request not gained) became Brazilian ownership by unilateral declaration according to the Decree of Sept. 4 2011 (Ortoland and Pirat, 2010). These unilateral decisions by Chile and Brazil have no value in international law but this is a way to make a decision if there is no opposition to these declarations in the near future. One may remember that South American States were leaders on the recognition on the 200 nm EEZ in the law of sea.

3.3. The UNCLOS's reciprocal obligations

States have greatly benefited from high seas freedom as codified under the UNCLOS. However they have hardly implemented UNCLOS's reciprocal obligations to protect and preserve the marine environment in addition to the general obligation to cooperate to achieve these ends. By establishing LSMPAs and implementing large-scale conservation policies coastal states use an environmental alibi that allow them to benefit from UNCLOS's reciprocal obligations. Thus, environmental responsibilities of coastal states, codified by UNCLOS's reciprocal obligations, invite them to

² Neighbouring States could decide to organize a joint management of their continental shelf, such as the bilateral agreement just signed in March 2012 between Mauritius and Seychelles to a common area of 396 000 sq. km in the Indian Ocean.

implement LSMPAs, enhancing them their sovereignties over sea space. For now LSMPAs and large-scale conservation policies have mostly been implemented within national jurisdictions given the relative simplicity of negotiations inside EEZ. However marine conservation actions beyond national jurisdiction are beginning to appear such as the Oslo-Paris (OSPAR) Convention in the North-eastern Atlantic (O’Leary et al., 2012). Indeed in November 2003, a resolution of the UN General Assembly on Oceans and the Law of the Sea reiterated its call for a consideration of threats to marine biodiversity (e.g. deep sea corals) and to apply a precautionary principle “beyond national jurisdictions”. A movement for a moratorium on bottom trawling in deep water emerged 5 years after resulting in the OSPAR convention. This situation created a new legitimacy for coastal states to implement large-scale conservation actions beyond national jurisdiction.

4. The awakening and claiming of local indigenous community rights: A check on State sovereignties?

LSMPA establishments in remote places often had to deal with local indigenous communities directly affected by this large-scale conservation action. Since some decades, we have witnessed an awakening of indigenous communities at the international, national, cultural and political level in many countries especially in the Pacific (Nursey-Bray, 2011). In some cases the conservation initiatives catalysed indigenous claims to preserve their traditional and future rights forcing States to make sovereignty’s compromises.

4.1. Including indigenous people in natural resource management

Local indigenous communities might contest design, zoning and management plans of LSMPAs that are unilaterally decided and implemented by State administrations (e.g. through top-down processes). The legal bases of those claims are now part of the United Nations Declaration on the Rights of Indigenous Peoples (A/RES/61/295 on September 13th 2007).³ Article 26 recognizes that “indigenous peoples have the right to own, use, develop and control the lands, territories and resources that they possess by reason of traditional ownership or other traditional occupation or use, as well as those which they have otherwise acquired”. This very general formulation opens enough spaces for indigenous claims to be taken into account during LSMPA establishments. France adopted the declaration whereas other countries such as Australia didn’t ratify the declaration given the existence of the recognition of Indigenous Australians in the Federal Law (Féral, 2011b). Thus, the Australian government proclaimed the *Native Title Act* in 1993 providing Indigenous Australians (i.e. Aboriginal and Torres Strait Islander peoples) a legislative basis to lodge claims over areas of sea where Australia asserts sovereign rights (Nursey-Bray, 2011). Consequently Indigenous Australians could exploit marine resources without the need for government permits. Later in 1998, the *Native Title Amendment Act* allowed Aboriginal people to hunt fish and gather in selected areas (only for spiritual, non commercial and communal reasons), even in no-take zones inside the Great Barrier Reef Marine Park. Indigenous claims often deal with fishery resources but other subjects are also approached regarding natural resource management (Barbour and Schlesinger, 2012). For example, involvement of indigenous people in conservation efforts is increasingly being acknowledged and valued around the world

³ This declaration was signed by 144 states including the United Kingdom and the Republic of Kiribati. Four countries vote against (Australia, Canada, New Zealand and the United States).

and particularly in the Pacific (Aswani et al., 2007; Nurseybray and Rist, 2009). For example in New Zealand, all development projects require consultation and consent with local Iwi (Tribes). More over “New Zealand Maori have a quota of the EEZ fishery set aside for them as a part of a policy of compensating and empowering them for past grievances” (D’Arcy, 2009; Waitangi-Tribunal, 1985). Ultimately, the recognition by UNESCO of the importance of traditional knowledge and the recent launching of cultural practises as World Heritage is a strong sign.⁴ Finally, many success stories of co-management show the importance of mixing scientific knowledge with indigenous ecological knowledge and existing sea tenure governance. For example the management plan of the Papahānaumokuākea Marine National Monument (PMNM) includes a Native Hawaiian community involvement action plan providing active participation of the indigenous community in the management of this US LSMPA (Papahānaumokuākea Marine National Monument: Management Plan, 2008).

4.2. Context and scope of indigenous specific rights in LSMPAs

Indigenous claims for specific rights (i.e. especially fishing rights) exist especially in countries or territories that have been colonized during the last two centuries such as the Chagos Islands (i.e. the Chagossians) for the United Kingdom or New Caledonia for France. In this context preserving indigenous fishing rights in LSMPA is only possible if the local communities are not too numerous in order to prevent overexploitation. For example allowing Aboriginal fishing activities in the Great Barrier Reef Marine Park was possible given the relative small size of the indigenous community (“Aboriginal and Torres Strait Islanders” according to the Australian Bureau of Statistics, less than 2.5% of the Australian population) Whereas the same situation appear more complicated with the Kanaky fishing activities in New Caledonia lagoon (Kanakas represent 44% of the total population). Indigenous fishing rights concern generally the coastal zone and mainly territorial waters (12 nm from the shore line). However LSMPAs include large part of the EEZ (e.g. PIPA Kiribati, PNMN, the Chagos Islands (BIOT)). Natural resources within an LSMPA are numerous from shallow to very deep waters such as corals reefs, seamounts and mineral resources. As far as we know indigenous knowledge and traditional uses refer mainly on edible and common resources as well as cultural landscapes. They don’t refer to offshore resources such as tuna fisheries, poly metallic nodules, genetic resources or fossil resources. However another subject of claims from indigenous people about offshore resources stems from their role in guardianship these resources in their tradition. Whales, dolphins, tuna, turtle are often the “tauraa” (the totemic animal) of extended families and clans in eastern and central Polynesia. Up to the beginning of the XXth century, traditional experts (tahua, tohunga, tahuna) in Polynesia were in charge of the control of pelagic resources and spaces, before colonial laws interrupted this traditional management. Up to now actions for property right recognition of indigenous people concern only fisheries but their priorities might be enlarged in the future.

5. The challenges of large-scale marine protected areas

There are increasing concerns about the reality of conservation in LSMPAs. The implementation and management of LSMPAs raise

⁴ The joint natural and cultural World Heritage Site designation by UNESCO of the Papahānaumokuākea Marine National Monument is also an example of indigenous recognition in LSMPA management.

many issues of enforcement, management costs and governance structures that may challenge their effectiveness.

5.1. The enforcement issue

Enforcement is a crucial factor to consider in order to ensure MPA effectiveness (Claudet, 2012; Guidetti et al., 2008). The current international infatuation on LSMPAs may fall short of expectation if conservation goals are not achieved due to lacks of enforcement (De Santo et al., 2011). Indeed, when dealing with LSMPAs, enforcement of large remote areas raises many questions of feasibility and effectiveness especially for countries with large ocean areas relative to their capacity for management. For example, the state of Kiribati has not enough resources in term of specialists and budget to manage and above all control more than 400,000 km² of the Phoenix Islands Protected Area (PIPA). The Kiribati government is then helped by the New England Aquarium – Boston, Massachusetts – (who organized in the Phoenix Islands 3 research expeditions on biodiversity since 2000) and Conservation International (Global Conservation Fund and Pacific Islands Program) with a foundation to cover the core recurrent managements costs. Loss of revenue for the government due to tuna licence fishing restrictions in the MPA is also compensated by the foundation (“reverse fishing license”). Ultimately, the Government of Kiribati signed a “sister-site” agreement between PIPA and the US Papahānaumokuākea Marine National Monument. Thus, this agreement provide a framework for collaboration, allowing PIPA and PMNM to share common problems and challenges to enforce these LSMPAs. The PIPA case study is a great example of collaboration between NGOs, developed countries and developing country to protect its resources.

However, we still need to better monitor and communicate about the reality of conservation. New technical options exist to ensure the surveillance and enforcement of remote maritime areas (Brooke et al., 2010; Game et al., 2009). However, we still need more scientific data about the costs of surveillance and enforcement. Yet, LSMPAs make up the largest part of the worldwide MPA coverage but if they are not well enforced we do a great disservice by allowing perceptions of their success to keep us from really achieving effective ocean conservation.

5.2. The cost of large-scale marine protected areas

Recent studies have investigated the potential costs of establishing MPAs (McCrea-Strub et al., 2011) and the management costs regarding the type of regulation (i.e. 100% versus 30% of no-take marine reserves) (Ban et al., 2011). They show that LSMPAs are cheaper to implement per unit area than small MPA one and also cheaper to manage when regulation is always the same (i.e. 100% of no-take zones). As far as we know, in the scientific literature, LSMPA costs and revenue have only been investigated in the Great Barrier Reef Marine Park (GBRMP) in Australia since the rezoning plan of 2004 (McCook et al., 2010). In this case, the economic value of a healthy Great Barrier Reef to Australia was estimated to be about A\$5.5 billion annually⁵ while its management costs vary between A\$30 and A\$40 million annually. The major economic cost associated with the rezoning process was a compensation packages for commercial fishing of A\$211 million (this was significantly more costly than first anticipated). An other example from the Papahānaumokuākea Marine National Monument (PMNM) shows that 20% of the total establishment cost of the LSMPA was allocated towards a compensation program for the North-western Hawaiian

Islands commercial bottom-fish and lobster fishermen who were displaced by the creation of the PMNM (McCrea-Strub et al., 2011). More over, costs of management and enforcement may vary a lot regarding the size of the MPA or the diversity of users. For example, zoning enforcement represented 32% of the total expenditure in 2004 of the GBRMP (McCook et al., 2010). However, we still miss scientific studies investigating management costs with regard to the size of the MPA or its revenue in order to better forecasts implementation and management budgets. This type of investigations will be crucial to monitor the economic performances of LSMPAs and their effectiveness.

5.3. The governance of large-scale marine protected areas

Indeed LSMPA management faces legal and institutional challenges regarding governance structures (Fidelman et al., 2011; Kittinger et al., 2011). From a broader perspective, governance of LSMPAs required to take into account the complexity of the area under management (i.e. heterogeneous, multi-scaled and inter-linked) (Caillaud et al., 2012; Fidelman et al., 2011). For example, In the Great Barrier Reef Marine Park or in the Papahānaumokuākea Marine National Monument, institutional collaborations are required to enable different agencies with different cultures and mandates to manage together. Thus, the use of various governance forms such as formal government initiatives, market instrument, and community self-governance may be useful to cope with each contextual complexity (Christie and White, 2007; Hughes et al., 2007; Olsson et al., 2008).

6. Conclusion

There is an emerging trend for establishing and implementing LSMPA in remote places within and beyond national jurisdiction. This recent phenomenon is mainly driven by political reasons due to international conservation targets and intense advocacy. Although we still lack scientific studies showing the benefit or the effectiveness of large-scale conservation, scientists advocate protecting marine biodiversity in remote places as a precautionary approach. In our opinion, the environmental responsibility is put forward by coastal states to re-enforce their sovereignties over sea spaces by implementing LSMPAs. These massive investments in large-scale conservation are happening and are enabled by several legal mechanisms such as the principle of adjacency or the UNCLOS's reciprocal obligations. However increasing indigenous claims for traditional rights challenge states' sovereignties. In some LSMPAs (e.g. the GBRMP in Australia or in the PMNM in Hawai'i) indigenous communities now have unique traditional rights and are taking more and more part in the management processes. Finally, The logistical and economical challenges of implementing, managing and monitoring large-scale remote areas need to be raised to assure an effective protection and to prevent LSMPAs from becoming large-scale paper parks.

Acknowledgements

We would like to thank Paul D'Arcy and Tamatoa Bambridge, as well as three anonymous reviewers for commenting on an earlier version of the manuscript. We also thank all the participants of GRAMP seminars for their contributions. This work was supported by LITEAU - GRAMP, EU FP7 - COCONET and ERA Net biodiversa - BUFFER. Additional funding was provided by the French Marine Protected Areas Agency and the French Initiative for Coral Reef Study (IFRECOR).

⁵ Estimates only include use values and so underestimate total economic value.

References

- Adams, V.M., Pressey, R.L., Naidoo, R., 2010. Opportunity costs: who really pays for conservation? *Biol. Conserv.* 143, 439–448.
- Agardy, T., di Sciara, G.N., Christie, P., 2011. Mind the gap: addressing the short-comings of marine protected areas through large scale marine spatial planning. *Mar. Pol.* 35, 226–232.
- Alemany, D., Iribarne, O.O., Acha, E.M., 2012. Effects of a large-scale and offshore marine protected area on the demersal fish assemblage in the Southwest Atlantic. *ICES J. Mar. Sci.* 70, 123–134.
- Apollis, G., 1980. L'emprise maritime de l'Etat côtier.
- Ardron, J., Gjerde, K., Pullen, S., Tilot, V., 2008. Marine spatial planning in the high seas. *Mar. Pol.* 32, 832–839.
- Aswani, S., Albert, S., Sabetian, A., Furusawa, T., 2007. Customary management as precautionary and adaptive principles for protecting coral reefs in Oceania. *Cor. Reefs* 26, 1009–1021.
- Balmford, A., Gravestock, P., Hockley, N., McClean, C.J., Roberts, C.M., 2004. The worldwide costs of marine protected areas. *Proc. Natl. Acad. Sci. U S A* 101, 9694–9697.
- Ban, N., Adams, V., Pressey, R., Hicks, J., 2011. Promise and problems for estimating management costs of marine protected areas. *Conserv. Lett.* 4, 241–252.
- Ban, N.C., Klein, C.J., 2009. Spatial socioeconomic data as a cost in systematic marine conservation planning. *Conserv. Lett.* 2, 206–215.
- Barbour, W., Schlesinger, C., 2012. Who's the boss? Post-colonialism, ecological research and conservation management on Australian Indigenous lands. *Ecol. Manag. Restoration* 13, 36–41.
- Brooke, S., Lim, T., Ardron, J., 2010. Surveillance and Enforcement of Remote Maritime Areas (SERMA). In: *Surveillance Technical options*, Monographs of the Society for Research in Child Development.
- Caillaud, A., Damiens, F., Salvat, B., Wilkinson, C., 2012. Preventing coral grief: a comparison of Australian and French coral reef protection strategies in a changing climate. *Sustain. Develop. Law Pol.* XII, 26–31.
- Caveen, A.J., Gray, T.S., Stead, S.M., Polunin, N.V.C., 2012. MPA policy: what lies behind the science? *Mar. Pol.*, 1–8.
- Chape, S., Harrison, J., Spalding, M., Lysenko, I., 2005. Measuring the extent and effectiveness of protected areas as an indicator for meeting global biodiversity targets. *Philos. Tran. Royal Soc. London. Series B, Biol. Sci.* 360, 443–455.
- Christie, P., White, A.T., 2007. Best practices for improved governance of coral reef marine protected areas. *Coral Reefs* 26, 1047–1056.
- Claudet, J., 2012. Marine Protected Areas. *eLS*, pp. 1–8.
- Claudet, J., Osenberg, C.W., BENEDETTI-CECCHI, L., DOMENICI, P., García-Charton, J.-A., Pérez-Ruzafa, A., Badalamenti, F., BAYLE-SEMPERE, J., BRITO, A., BULLERI, F., CULIOLI, J.-M., Dimech, M., Falcón, J.M., Guala, I., Milazzo, M., Sánchez-Meca, J., Somerfield, P.J., STOBART, B., Vandepierre, F.F., Valle, C., Planes, S., GARCIA-CHARTON, J.-A., PEREZ-RUZAF, A., FALCON, J.M., SANCHEZ-MECA, J., 2008. Marine reserves: size and age do matter. *Ecol. Lett.* 11, 481–489.
- Claudet, J., Osenberg, C.W., Domenici, P., Badalamenti, F., Milazzo, M., Falcón, J.M., Bertocci, I., Benedetti-Cecchi, L., García-Charton, J.A., Goñi, R., Borg, J.A., Forcada, A., De Lucia, G.A., Perez-Ruzafa, A., Afonso, P., Brito, A., Guala, I., Le Diréach, L., Sanchez-Jerez, P., Somerfield, P.J., Planes, S., 2010. Marine reserves: fish life history and ecological traits matter. *Ecol. Appl.* 20, 830–839.
- D'Arcy, P., 2009. Variable rights and diminishing control. The evolution of indigenous maritime sovereignty in Oceania. In: *Water, Sovereignty and Borders in Asia and Oceania*. Routledge, p. 210.
- Day, J.C., Dobbs, K., 2013. Effective governance of a large and complex cross-jurisdictional marine protected area: Australia's Great Barrier Reef. *Mar. Pol. Null.*
- De Santo, E.M., Jones, P.J.S., Miller, A.M.M., 2011. Fortress conservation at sea: a commentary on the Chagos marine protected area. *Mar. Pol.* 35, 258–260.
- Fenberg, P.B., Caselle, J.E., Claudet, J., Clemence, M., Gaines, S.D., Antonio García-Charton, J., Gonçalves, E.J., Grorud-Colvert, K., Guidetti, P., Jenkins, S.R., Jones, P.J.S., Lester, S.E., McAllen, R., Moland, E., Planes, S., Sørensen, T.K., 2012. The science of European marine reserves: Status, efficacy, and future needs. *Mar. Pol.* 36, 1012–1021.
- Féral, F., 2011a. L'extension des aires marines protégées: une augmentation inversement proportionnelles à leur normativité. *Revue institutionnelle de l'UQAM* 3, 1–18.
- Féral, F., 2011b. Quelques éléments de doctrine autochtoniste sur les institutions de Nouvelle-Calédonie. *Revue juridique et économique de Nouvelle-Calédonie* 18, 1–14.
- Fidelman, P., Evans, L., Fabinyi, M., Foale, S., Cinner, J., Rosen, F., 2011. Governing large-scale marine commons: contextual challenges in the Coral Triangle. *Mar. Pol.* 36, 42–53.
- Gaines, S.D., Lester, S.E., Grorud-Colvert, K., Costello, C., Pollnac, R., 2010a. Evolving science of marine reserves: new developments and emerging research frontiers. *Proc. Natl. Acad. Sci. U S A* 107, 18251–18255.
- Gaines, S.D., White, C., Carr, M.H., Palumbi, S.R., 2010b. Designing marine reserve networks for both conservation and fisheries management. *Proc. Natl. Acad. Sci. U S A* 107, 18286–18293.
- Game, E.T., Grantham, H.S., Hobday, A.J., Pressey, R.L., Lombard, A.T., Beckley, L.E., Gjerde, K., Bustamante, R., Possingham, H.P., Richardson, A.J., 2009. Pelagic protected areas: the missing dimension in ocean conservation. *Trends Ecol. Evol. (Personal Ed.)* 24, 360–369.
- Gell, F., 2003. Benefits beyond boundaries: the fishery effects of marine reserves. *Trends Ecol. Evol.* 18, 448–455.
- Gell, F., Roberts, C., 2003. Marine reserves for fisheries management and conservation: a win-win strategy. *El Anzuelo: Eur. Newsletter Fisheries Environ.* 11, 4–6.
- Grüss, A., Kaplan, D.M., Hart, D.R., 2011. Relative impacts of adult movement, larval dispersal and harvester movement on the effectiveness of reserve networks. *PLoS One* 6, e19960.
- Guidetti, P., Milazzo, M., Bussotti, S., Molinari, a, Murenu, M., Pais, a, Spano, N., Balzano, R., Agardy, T., Boero, F., 2008. Italian marine reserve effectiveness: does enforcement matter? *Biol. Conserv.* 141, 699–709.
- Hughes, T.P., Gunderson, L.H., Folke, C., Baird, A.H., Bellwood, D., Berkes, F., Crona, B., Helfgott, A., Leslie, H., Norberg, J., Nyström, M., Olsson, P., Osterblom, H., Scheffer, M., Schuttenberg, H., Steneck, R.S., Tengö, M., Troell, M., Walker, B., Wilson, J., Worm, B., 2007. Adaptive management of the Great Barrier Reef and the Grand Canyon world heritage areas. *Ambio* 36, 586–592.
- Jones, N., 2011. Marine protection goes large. *Nature*.
- Jones, P.J.S., 2008. Fishing industry and related perspectives on the issues raised by no-take marine protected area proposals. *Mar. Pol.* 32, 749–758.
- Jones, P.J.S., 2009. Equity, justice and power issues raised by no-take marine protected area proposals. *Mar. Pol.* 33, 759–765.
- Jones, P.J.S., 2006. Point-of-view: arguments for conventional fisheries management and against no-take marine protected areas: only half of the story? *Rev. Fish Biol. Fish.* 17 (1), 31–43. <http://dx.doi.org/10.1007/s11160-006-9016-8>.
- Joyner, C., De Cola, P., 1993. Chile's Presidential sea proposal: implications for straddling stocks and the international law of fisheries. *Ocean Develop. Internat. Law* 24.
- Kittinger, J.N., Dowling, A., Purves, A.R., Milne, N., a., Olsson, P., 2011. Marine protected areas, multiple-agency management, and Monumental Surprise in the Northwestern Hawaiian islands. *J. Mar. Biol.* 2011, 1–17.
- Lester, S., Halpern, B., Grorud-Colvert, K., Lubchenco, J., Ruttenberg, B., Gaines, S., Airamé, S., Warner, R., 2009. Biological effects within no-take marine reserves: a global synthesis. *Mar. Ecol. Prog. Ser.* 384, 33–46.
- Marinesque, S., Kaplan, D.M., Rodwell, L.D., 2012. Global implementation of marine protected areas: Is the developing world being left behind? *Mar. Pol.* 36, 727–737.
- McCay, B.J., Jones, P.J.S., McCay, B.J., 2011. Marine protected areas and the governance of marine ecosystems and fisheries. *Conserv. Biol.* 25, 1130–1133.
- McCook, L.J., Ayling, T., Cappo, M., Choat, J.H., Evans, R.D., De Freitas, D.M., Heupel, M., Hughes, T.P., Jones, G.P., Mapstone, B., Marsh, H., Mills, M., Molloy, F.J., Pitcher, C.R., Pressey, R.L., Russ, G.R., Sutton, S., Sweatman, H., Tobin, R., Wachenfeld, D.R., Williamson, D.H., 2010. Marine reserves special feature: adaptive management of the Great Barrier Reef: a globally significant demonstration of the benefits of networks of marine reserves. *Proc. Natl. Acad. Sci. U S A*.
- McCrea-Strub, A., Zeller, D., Rashid Sumaila, U., Nelson, J., Balmford, A., Pauly, D., 2011. Understanding the cost of establishing marine protected areas. *Mar. Pol.* 35, 1–9.
- Mora, C., Aburto-Oropeza, O., Ayala Bocos, A., Ayotte, P.M., Banks, S., et al., 2011. Global human footprint on the linkage between biodiversity and ecosystem functioning in reef fishes. *PLoS Biol.* 9, e1000606.
- Nelson, J., Bradner, H., 2010. The case for establishing ecosystem-scale marine reserves. *Mar. Pollut. Bull.* 60, 635–637.
- Norse, E., Crowder, L., Gjerde, K.D., 2005. Place-based ecosystem management in the open ocean. *Biol. Sci.*, 302–327.
- Nursey-Bray, M., 2011. Social contexts and customary fisheries: marine protected areas and indigenous use, Australia. *Environ. Manag.* 47, 671–683.
- Nurseybray, M., Rist, P., 2009. Co-management and protected area management: achieving effective management of a contested site, lessons from the Great Barrier Reef World Heritage Area (GBRWHA). *Mar. Pol.* 33, 118–127.
- O'Leary, B.C., Brown, R.L., Johnson, D.E., von Nordheim, H., Ardron, J., Packeiser, T., Roberts, C.M., 2012. The first network of marine protected areas (MPAs) in the high seas: the process, the challenges and where next. *Mar. Pol.* 36, 598–605.
- Olsson, P., Folke, C., Hughes, T.P., 2008. Navigating the transition to ecosystem-based management of the Great Barrier Reef, Australia. *Proc. Natl. Acad. Sci. U S A* 105, 9489–9494.
- Ortoland, D., Pirat, J., 2010. In: *Atlas géopolitique des espaces maritimes Frontières, énergie, transports, piraterie, pêche et environnement*, Technip, Paris.
- Papahānaumokuākea Marine National Monument: Management Plan, 2008.
- Pearce, D.W., 2005. Paradoxes in biodiversity Conservation. *World Econ.* 6, 57–69.
- Punt, M.J., Weikard, H.-P., Ierland, E.C., Stel, J.H., 2012. Large scale marine protected areas for biodiversity conservation along a linear gradient: cooperation, strategic behavior or conservation Autarky? *Env. Res. Econ.* 53, 203–228.
- Roberts, C.M., Andelman, S., Branch, G., Bustamante, R.H., Carlos Castilla, J., Dugan, J., Halpern, B.S., Lafferty, K.D., Leslie, H., Lubchenco, J., McArdle, D., Possingham, H.P., Ruckelshaus, M., Warner, R.R., 2003. Ecological criteria for evaluating candidate sites for marine reserves. *Ecol. Appl.* 13, 199–214.
- Sheppard, C.R.C., Ateweberhan, M., Bowen, B.W., Carr, P., Chen, C.A., Clubbe, C., Craig, M.T., Ebinghaus, R., Eble, J., Fitzsimmons, N., Gaither, M.R., Gan, C.-H., Gollock, M., Guzman, N., Graham, N.A.J., Harris, A., Jones, R., Keshavmurthy, S., Koldewey, H., Lundin, C.G., Mortimer, J.A., Obura, D., Pfeiffer, M., Price, A.R.G., Purkis, S., Raines, P., Readman, J.W., Riegl, B., Rogers, A., Schleyer, M., Seaward, M.R.D., Sheppard, A.L.S., Tاملاندler, J., Turner, J.R., Visram, S., Vogler, C., Vogt, S., Wolschke, H., Yang, J.M.-C., Yang, S.-Y., Yesson, C., 2012. Reefs and islands of the Chagos Archipelago, Indian Ocean: why it is the world's largest no-take marine protected area. *Aq. Conser. Mar. Freshwat. Ecosys. n/a–n/a*.
- Spalding, M.D., Fish, L., Wood, L.J., 2008. Toward representative protection of the world's coasts and oceans-progress, gaps, and opportunities. *Conserv. Lett.* 1, 217–226.
- Sumaila, U., Zeller, D., Watson, R., Alder, J., Pauly, D., 2007. Potential costs and benefits of marine reserves in the high seas. *Ecol. Prog. Ser.* 345, 305–310.
- Waitangi-Tribunal, 1985. Report of the Waitangi Tribunal on the Muriwhenua Fishing Claim. Department of Justice, Wellington.
- Wood, L.J., Fish, L., Laughren, J., Pauly, D., 2008. Assessing progress towards global marine protection targets: shortfalls in information and action. *PLoS One* 3, 340–351.

Yturriaga, J., 1997. The International Regime of Fisheries: from UNCLOS 1982 to the Presential Sea. Publications on Ocean Development.

Web reference

- [a] Law on Natural Marine Parks http://www.legifrance.gouv.fr/affichTexte.do;jsessionid=CB55EA9863E401D146182FDCEC9DE018.tpdjo01v_2?cidTexte=JORFTEXT000000609487 (accessed 30.10.12.).
- [b] Statement from the ARC Centre of Excellence for Coral Reef Studies <http://www.coralcoe.org.au/news/scientists-call-for-no-take-coral-sea-park> (accessed 22.08.13.).
- [c] Statement from the Global Ocean Legacy Project of the Pew Environment Group <http://www.pewenvironment.org/news-room/press-releases/worlds-marine-scientists-call-for-large-scale-national-parks-at-sea-8589935354> (accessed 22.08.13.).