REVIEWS

Toward a Social Science Research Agenda for Large Marine Protected Areas

Rebecca L. Gruby[1], Noella J. Gray[2], Lisa M. Campbell[3], & Leslie Acton[3]

[1] Department of Human Dimensions of Natural Resources, Colorado State University, CO, USA
[2] Department of Geography, University of Guelph, Ontario, Canada
[3] Nicholas School of the Environment, Duke University, Durham, NC, USA

Abstract

Large marine protected areas (LMPAs) are a high-profile trend in global marine conservation. Although the social sciences have become well integrated into marine protected area research and practice, human dimensions considerations have not been an early priority in the development of many LMPAs. This article argues that because LMPAs exhibit unique characteristics in form, function, and/or conceptualization, they warrant a distinct social science research agenda. We outline an agenda for social science research on and for LMPAs in four related themes: scoping of human dimensions, governance, politics, and social and economic outcomes. The article is informed by interviews, participant observation at the 2014 World Parks Congress, a literature review and the authors' research experiences. LMPAs are at an early stage in what promises to be a globally significant, long-term project of ocean conservation and governance. There is a timely opportunity to translate relevant insights from decades of social science research to LMPAs and generate new knowledge, where necessary, to give them their best chance at biological and social success.

Introduction

Large marine protected areas (LMPAs)[1] are a high-profile trend in global marine conservation, featuring prominently in the press, at international environmental meetings and, increasingly, within donor portfolios and academic debate. The first LMPA was the Great Barrier Reef Marine Park, established in 1971. The more recent expansion began in the early 2000s, with 16 LMPAs established between 2006 and 2014 and at least four additional sites currently under development[2] (Figure 1).

LMPAs account for the recent significant increase in global MPA coverage. As of 2013, the 20 largest MPAs in the world accounted for 60% of global MPA coverage and just three of these sites,[3] all established since 2010, accounted for 23% of global coverage (Spalding et al. 2013). LMPAs under development, such as the 1.065 million km² and 834,334 km² sites in the Cook Islands and Pitcairn Islands, respectively, will further boost these percentages. Recent projections claim that LMPAs place the CBD target of 10% marine coverage within reach by 2025, while it could take until 2054 without them (Toonen et al. 2013).

LMPAs are established to meet a variety of objectives (e.g., sustainable development, biodiversity conservation, species management, cultural preservation) and in a variety of forms (e.g., no-take, multiuse zones, etc.) (Wilhelm et al. 2014). Marine ecologists have long argued that MPAs and reserves "must be scaled up" to provide intended biodiversity and fisheries benefits (Gaines et al. 2010). Accordingly, LMPAs have been promoted for their capacity to encompass biologically connected ecosystems; intact, open ocean, or deep-sea habitats not often included in smaller MPAs closer to shore; and significant portions of large and highly migratory species ranges (Graham & McClanahan 2013; Wilhelm et al. 2014). From a social perspective, LMPAs have been championed by some as politically and administratively easier and less expensive to establish than smaller MPAs closer to shore (Balmford
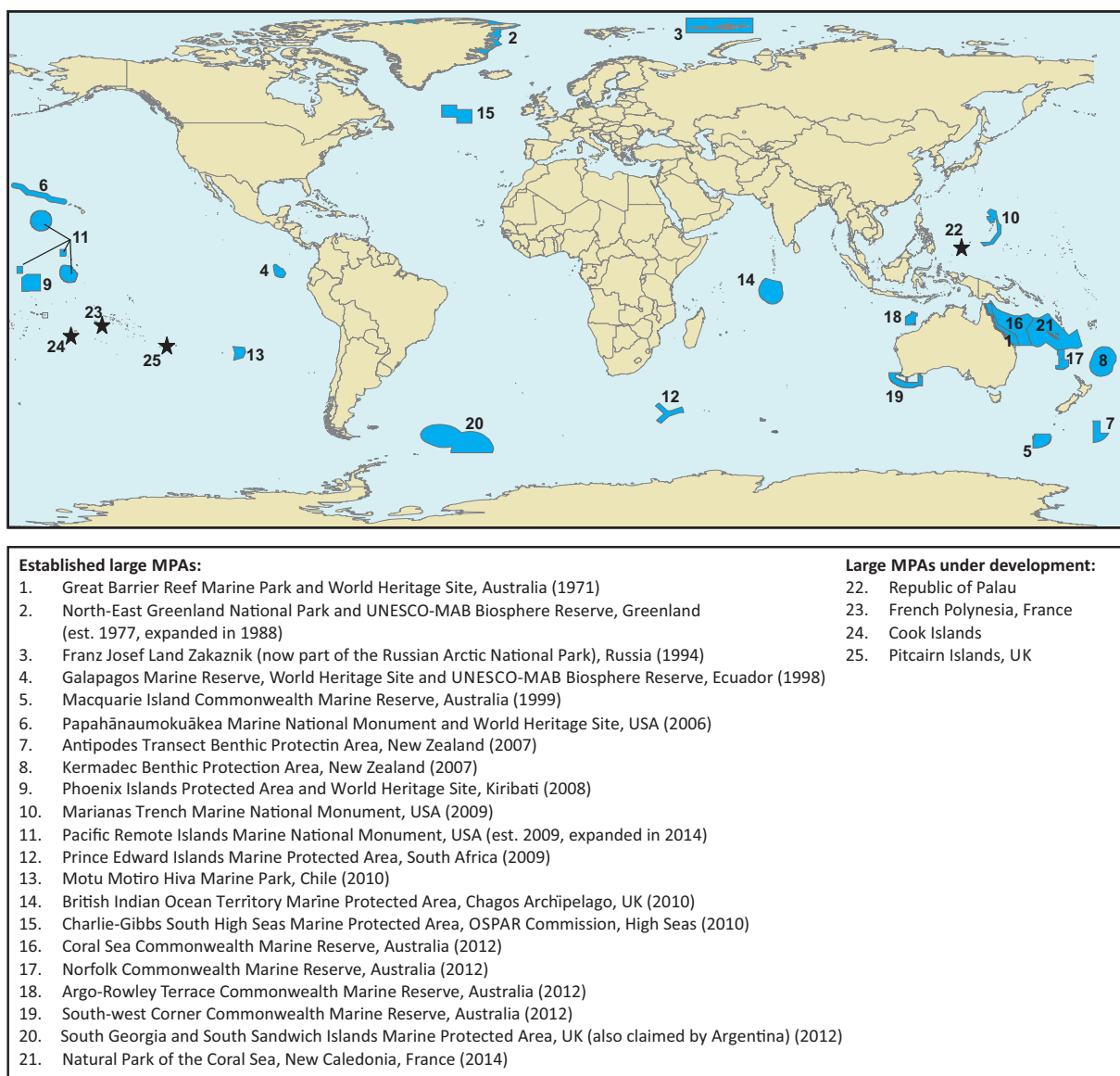
Established large MPAs:

1.   Great Barrier Reef Marine Park and World Heritage Site, Australia (1971)
2.   North-East Greenland National Park and UNESCO-MAB Biosphere Reserve, Greenland (est. 1977, expanded in 1988)
3.   Franz Josef Land Zakaznik (now part of the Russian Arctic National Park), Russia (1994)
4.   Galapagos Marine Reserve, World Heritage Site and UNESCO-MAB Biosphere Reserve, Ecuador (1998)
5.   Macquarie Island Commonwealth Marine Reserve, Australia (1999)
6.   Papahānaumokuākea Marine National Monument and World Heritage Site, USA (2006)
7.   Antipodes Transect Benthic Protectin Area, New Zealand (2007)
8.   Kermadec Benthic Protection Area, New Zealand (2007)
9.   Phoenix Islands Protected Area and World Heritage Site, Kiribati (2008)
10. Marianas Trench Marine National Monument, USA (2009)
11. Pacific Remote Islands Marine National Monument, USA (est. 2009, expanded in 2014)
12. Prince Edward Islands Marine Protected Area, South Africa (2009)
13. Motu Motiro Hiva Marine Park, Chile (2010)
14. British Indian Ocean Territory Marine Protected Area, Chagos Archipelago, UK (2010)
15. Charlie-Gibbs South High Seas Marine Protected Area, OSPAR Commission, High Seas (2010)
16. Coral Sea Commonwealth Marine Reserve, Australia (2012)
17. Norfolk Commonwealth Marine Reserve, Australia (2012)
18. Argo-Rowley Terrace Commonwealth Marine Reserve, Australia (2012)
19. South-west Corner Commonwealth Marine Reserve, Australia (2012)
20. South Georgia and South Sandwich Islands Marine Protected Area, UK (also claimed by Argentina) (2012)
21. Natural Park of the Coral Sea, New Caledonia, France (2014)

Large MPAs under development:

22. Republic of Palau
23. French Polynesia, France
24. Cook Islands
25. Pitcairn Islands, UK

Figure 1 Global map of established and developing LMPAs.[9,10]

et al. 2004; McCrea-Strub *et al.* 2011). Proponents of LMPAs suggest they are the "first generation of the world's great marine parks" (Pew Charitable Trusts Undated) and "our best hope for arresting the global decline in marine biodiversity" (Toonen *et al.* 2013), but these views are not universally shared.

Some marine scientists have criticized the proliferation of "super-sized" MPAs as a risky political "race" of questionable value for fisheries and biodiversity goals (Dulvy 2013). Others argue that remote no-take LMPAs do protect unique compositions and abundances of species (Graham & McClanahan 2013) or at least offer good publicity for the cause of marine conservation (Singleton & Roberts 2014). At the 2014 World Parks Congress, one thread of debate about LMPAs questioned whether they are "just lines on a map." A few social scientists who have written about LMPAs have raised concerns about management effectiveness and social justice (De Santo 2013; Leenhardt *et al.* 2013; Richmond & Kotowicz 2015).

We suggest that any conclusion on the value of LMPAs is premature given the newness of many LMPAs and the limited empirical social science research thereon. Although there is an extensive body of work on the

longer-standing Great Barrier Reef Marine Park (e.g., Day 2002; Fernandes *et al.* 2005), empirical analysis of LMPAs more generally is just beginning to emerge (*e.g.*, De Santo 2013), and there are thus far few field-based studies of other LMPAs (e.g., Richmond and Kotowicz 2015). Diversity in LMPA form and function is understudied, and desktop analyses and editorials (e.g., Dulvy 2013; Singleton & Roberts 2014) must be supplemented with additional empirical research examining associated biological and social processes and outcomes.

Although LMPA managers have published a research agenda for the biological, geochemical, and physical sciences (Wagner *et al.* 2013), a complementary agenda for the social sciences has not yet been developed. While existing research on the human dimensions of relatively smaller MPAs and networks closer to land (hereafter conventional MPAs[4]) will provide some relevant insights, the emergent large-scale model also exhibits unique characteristics that raise new questions for social science "on" and "for" conservation (Sandbrook *et al.* 2013). There is a need for a comprehensive social science research agenda on and for LMPAs that is reflective of their distinctive features and the needs of diverse actors and interests (e.g., governments, nongovernment organizations [NGOs], industry, scientists). Our contribution toward this end is twofold. First, we outline some unique human dimensions of LMPAs and call attention to their importance even in the most remote oceanic spaces. Second, based on the ways in which LMPAs differ from conventional MPAs, we argue that LMPAs warrant a distinct social science research agenda and propose key themes that should be included within it.

The research agenda presented here is informed by 24 semistructured and unstructured interviews with LMPA managers, advocates, scientists, and donors working in diverse LMPA sites and at the global level[5]; participant observation of LMPA-related events at the 2014 World Parks Congress[6]; a review of conventional MPA and LMPA literatures; and the authors' experiences studying conventional MPAs in diverse contexts. We collected and analyzed this data as part of a participatory research design process undertaken to inform our own field-based research on LMPAs. Data were uploaded to NVivo, a qualitative data analysis software tool, and coded for key themes and recurring questions or concerns. Based on the foregoing, we argue that LMPAs warrant a distinct research agenda centered on four related themes: scoping of human dimensions, governance, politics, and social and economic outcomes. We found that LMPAs exhibit unique characteristics within these themes in two ways. First, LMPAs often differ from conventional MPAs in form and/or function. Second, many people believe that LMPAs are unique and therefore imagine and treat them differently from conventional MPAs, sometimes despite their similarity. In scoping this agenda, we thus attend to existing insights from social science research on conventional MPAs that may scale up to LMPAs, and to areas in which new research is needed. This article presents an initial rather than exhaustive research agenda, and we therefore encourage other social scientists and managers to build on these considerations to develop a more comprehensive, shared agenda that explores linkages between social and ecological processes and outcomes in LMPAs.

LMPAs are at an early stage in what promises to be a globally significant, long-term transformation of ocean conservation and governance. Experience with conventional MPAs suggests that social science research conducted "too little, too late" can result in unintended negative consequences and missed opportunities (Christie *et al.* 2003). There is a time-sensitive opportunity for social science to increase understanding of the potential and limitations of LMPAs in order to inform the design and management of existing sites and deliberations on whether, where, and how to initiate new ones.

Scoping the human dimensions of LMPAs

The human dimensions of conventional MPAs—social, economic, institutional, political—are well researched, and the importance of taking them into account is widely accepted by academics and practitioners (Bunce *et al.* 2000; Mascia 2003; Pomeroy *et al.* 2004; Charles & Wilson 2009). MPAs and MPA networks are increasingly recognized as systems that are partly social and partly natural (Jentoft *et al.* 2007), or social–ecological systems (Pollnac *et al.* 2010), whose links can be complex and dynamic.

Although most conventional MPAs are relatively small areas located in coastal and inshore waters, many LMPAs include extensive offshore and open ocean areas (Palumbi 2004; Toonen *et al.* 2013). This geographic difference is contributing to a conceptual distinction whereby LMPAs, in contrast to conventional MPAs, are commonly imagined, represented, and advanced as unpeopled "marine wilderness areas" (Graham & McClanahan 2013) or "pristine seas" (National Geographic 2015).[7] A number of interviewees were puzzled by our questions about the human dimensions of LMPAs; it was their struggle to recognize the relevance of social science concerning spaces where there are "no people" that motivated the inclusion of this section.

Understanding marine nature as conceptually and physically separate from humans is reminiscent of the wilderness ideal that has long been challenged in terrestrial conservation and more recently in marine conservation as both practically and ideologically problematic

(Cronon 1996; Campbell *et al.* 2009). We suggest that the extension of LMPAs into deeper waters and more remote locations means that their human dimensions may be different and less visible, not irrelevant or nonexistent. For instance, trips to remote LMPAs, even if infrequent, can be culturally valuable experiences (Richmond & Kotowicz 2015). In other examples, conservationists who support the protection of marine wilderness through LMPAs value the preservation of these areas despite rarely if ever visiting them, while seabed mining companies may value LMPA spaces for future rather than current extractive uses. In general, the moment a discussion begins about whether, how, and where to designate a LMPA, the realm of human dimensions has been entered. In short, LMPAs, like conventional MPAs, are "peopled seascapes" (Shackeroff *et al.* 2009) that embody a range of social processes, meanings, and values that should be taken into account in design and management. At present, however, the specific forms and functions of these human dimensions remain little understood in many places.

As a first step, social scientists should help to scope the range of social, political, economic, and institutional processes, meanings, and values relevant to LMPA systems in diverse contexts. They should also identify and interrogate discourses of human/nature relationships that underlie LMPA practices and offer alternative conceptual models where appropriate. Overlooking the human connections to the ocean spaces of LMPAs may result in social inequities and conflicts that may ultimately threaten well-meaning conservation efforts (Richmond and Kotowicz 2015). Alternatively, understanding LMPAs as social spaces and/or social–ecological systems, for example, may provide opportunities to protect valued oceanic cultures, enroll support for marine conservation activities, minimize conflict, and enhance the fit between LMPAs and diverse social–ecological contexts (Steinberg 2008; Wilhelm *et al.* 2014; Richmond & Kotowicz 2015).

Governance

Social scientists have underscored the importance of diverse, context-specific approaches to MPA governance (Jentoft *et al.* 2007; Jones *et al.* 2013; Jones 2014). However, they have also identified some cross-cutting challenges and lessons. For example, Fox *et al.* (2012) identify four elements of MPA governance that are especially important for the design of effective MPAs: resource use rules, monitoring and enforcement systems, conflict resolution mechanisms, and decision-making arrangements. There is now widespread awareness, if not application, of "rules of thumb," such as the importance of participatory decision-making arrangements and

clearly defined access and boundary rules (Mascia 2003; Charles & Wilson 2009).

The unique characteristics of LMPAs raise questions about their governability and the extent to which existing insights—derived mainly from research in smaller, coastal MPAs—scale up (Gruby & Basurto 2013; Evans *et al.* 2014). As systems-to-be-governed (Jentoft *et al.* 2007), LMPAs encompass far more extensive areas with potentially greater connectivity (i.e., entire ecosystems) and diversity in habitat (e.g., pelagic and deep benthic) (Wagner *et al.* 2013). They are also more likely to interact with social systems that are less visible, less accessible, and less familiar than those in conventional MPAs. Below we draw attention to three key considerations unique to LMPAs as interlinked systems-to-be-governed and governing systems (Jentoft *et al.* 2007) by way of an introduction to the extensive and diverse research needs in this area.

First, there are legitimate questions about how LMPA governing systems can monitor and enforce such large areas (Pala 2013). In an effort to support and legitimize LMPA governance, and marine conservation governance more generally, NGO and civil society groups are developing new technologies of surveillance and visualization. Google, Skytruth, and Oceana (2014) have launched *Global Fishing Watch*, which translates satellite data from the Automatic Identification System on vessel location and movement into a public online visualization platform that can depict where fishing activity is taking place relative to LMPA boundaries, among other things. The Pew Charitable Trusts in partnership with Satellite Applications Catapult have developed *Eyes on the Seas*, which merges satellite tracking and imagery data with fishing vessel databases and oceanographic data for use in identification of 'suspicious activities' in a "Virtual Watch Room" (The Pew Charitable Trusts 2015). The Virtual Watch Room has been launched in Easter Island and Palau, where Pew's Global Ocean Legacy team has been advocating for the development of LMPAs, and will also be used to monitor the proposed Pitcairn Islands Marine Reserve. The underlying logic of these efforts—"if you can see it, you can change it" (Skytruth 2012)—raises practical and theoretical questions about the politics of knowledge for LMPAs and how what we know interacts with how we govern. There is a need to reflect on what is made visible through these new technologies, as well as what is not, and to think creatively and critically about how new and diverse ways of knowing the ocean may inform innovative, progressive conservation governance—through LMPAs and otherwise.

Second, in contrast to the participatory emphasis in conventional MPAs, a number of LMPAs are being developed through top-down processes that neglect or

delay stakeholder engagement (De Santo *et al.* 2011; Richmond & Kotowicz 2015). Exclusive decision-making, although expedient, has led to conflict in a number of sites (e.g., Motu Motiro Hiva Marine Park, Marianas Trench Marine National Monument), whereas a more participatory approach has been linked to effective LMPA governance (e.g., Great Barrier Reef Marine Park) (Day & Dobbs 2013; Gaymer *et al.* 2014; Richmond & Kotowicz 2015). Although it seems likely that conclusions about the value of participatory decision-making would scale up to LMPAs, managers have found that adequate consultation is more challenging for larger sites (Wilhelm *et al.* 2014). There is uncertainty about who should be part of LMPA decision-making and how to effectively engage potentially large numbers of geographically dispersed stakeholders (questions raised repeatedly by interviewees). Social science can help to inform these efforts by scoping relevant stakeholder groups, diverse approaches to engaging them (or not) in decision-making, and the associated long- and short-term trade-offs (e.g., expediency, legitimacy, cost). Research on this topic may draw from emerging experiences with LMPAs as well as the relatively longer history of large-scale conservation in terrestrial contexts.[8]

Third, although policy interactions have not been a major focus in the MPA governance literature, we believe this issue warrants special attention for LMPAs. While the specific access and withdrawal rules vary across LMPAs, closing significant portions of an exclusive economic zone (EEZ) will affect preexisting and future resource access agreements (e.g., for seabed mining, tuna fishing, etc.) in ways that smaller MPAs would not. For example, Palau's proposed marine sanctuary bans fishing in 80% of their EEZ (over 500,000 km^2) and prohibits purse seine fishing in 100% of their EEZ (Office of the President, Republic of Palau 2014). Although a small inshore MPA may shift fishing elsewhere *within* Palau's EEZ, bans of this scale may shift industrial tuna fishing *outside* of their EEZ. Whether and how this fishing effort shifts will depend in part on whether Palau is permitted to sell or trade the vessel days allocated to them under the regional Nauru Agreement to other nations. Less obvious interactions—for example, among LMPA policies and international political or development agreements that provide for foreign fishing access (common in the Pacific region)—are also likely. Although cross-level policy interactions are not always predictable, they can have significant consequences for both biological and institutional diversity (Young 2006). Achieving desirable patterns of interplay will require continuous and systematic analysis of interactions among LMPA rules and other agreements at local, national, and international levels, and an adaptive approach to governance that treats LM-

PAs as policy experiments to be monitored and adapted over time (Ostrom 2005).

Politics

Closely related to governance are questions of politics and power. As marine spatial management tools, MPAs necessarily rework access to marine resources, a political (power-laden) process. As a result, many conventional MPAs have generated serious, ongoing conflicts, which can undermine their social and ecological objectives (Stonich 2003). Local stakeholders often oppose MPAs, a consequence of insufficient benefits and/or excessive costs, the uneven distribution of benefits and costs among diverse stakeholder groups, and actual or perceived exclusion from both resources and decision-making processes (Stonich 2003; Bennett & Dearden 2014; Segi 2014). However, they may also support MPAs if they serve to protect local access to resources or otherwise advance local interests (Young 2001). Similarly, states may support or undermine conservation efforts depending on how they intersect with other state interests (Young 2001; Chhatre & Saberwal 2005). In a neoliberal era, in which the role of international environmental NGOs in both the funding and management of MPAs has increased, the relationships between states, communities, and NGOs have been further complicated as each actor seeks to assert its interests and control in MPA processes (Levine 2007). Research on conventional MPAs clearly demonstrates the need to be attentive to political motivations, processes, and outcomes.

Relative to conventional MPAs, we expect that the politics of LMPAs will be higher profile, higher level (i.e., national and international), and substantively distinct in important ways. The move to scale up MPAs has been read, in part, as a response to global protected area targets (e.g., De Santo 2013), but there is also a broader geopolitics at play. For example, LMPAs located in the EEZs of small island states or territories dwarf the islands themselves, often visible on global maps when the islands are not. In this sense, LMPAs could make society, at least at the level of the state, more visible in oceans; small island states with LMPAs become large ocean states with globally valued resources. This visibility coupled with the rise of marine conservation on global agendas may enable less powerful groups—small islands and overseas territories in particular—to push back against colonial legacies and globalization processes that undermine their independence and authority (Gray 2010; Gruby & Campbell 2013). Of course, the opposite is also possible. A significant number of established and developing LMPAs are in overseas territories of France, the United Kingdom, and the United States, for example. The development of

LMPAs by powerful western governments in their overseas territories may also be used to reinforce their sovereignty, as may be the case with the contentious LMPA in the British Indian Ocean Territory (De Santo 2013).

It is not only states that are involved in LMPA territorial politics. NGOs, philanthropic foundations, and the private sector are supporting, and sometimes underwriting costs of, LMPA establishment, research, and/or enforcement, with support from high-level politicians. The two largest nongovernmental programs to support LMPAs include the Pew Charitable Trusts Global Ocean Legacy program, funded by foundations, and National Geographic's Pristine Seas program, supported through foundation and private sector funds. Through these programs and others, particular LMPAs become enrolled in projects through which foundations and NGOs demonstrate commitment to and influence on ocean conservation. Local indigenous communities are also asserting claims to preserve their traditional and future rights in the context of what Leenhardt *et al.* (2013) describe as advancing state sovereignty claims via LMPAs.

Diverse political motivations to establish and contest LMPAs, and the extent to which gains are made by governments, NGOs and donors, and/or citizens are important topics for empirical research. Although in some cases territorial claims have arguably supported neo-colonial interests and further disenfranchised displaced peoples with alternative claims (De Santo *et al.* 2011; Sand 2012), other paths are possible. LMPAs offer excellent cases through which to advance understandings of the processes and politics of ocean territorialization and emerging forms of environmental governance, whereby states enter into partnerships with global public–private networks in the production of "governance states" (Duffy 2006). From an applied conservation perspective, it will be critical to consider how the political context of LMPAs intersects with long-term sustainability objectives.

Social and economic outcomes

A large literature has documented a range of social and economic outcomes associated with conventional MPAs and analyzed their relationship with ecological outcomes and effectiveness. Benefits include increased food security (Mascia *et al.* 2010), economic benefits associated with tourism (Thorpe *et al.* 2011), livelihood benefits, and enhanced ecosystem services (Potts *et al.* 2014). Costs include opportunity costs for fishers (Smith *et al.* 2010), inequitable distribution of benefits (Walmsley & White 2003), increased social conflict as a result of fisher opposition (Fiske 1992; Jones 2006), local resistance to

an external agenda (Pajaro *et al.* 2010), or disagreement over goals (Jentoft *et al.* 2011).

The social and economic outcomes of LMPAs—direct and indirect, actual, and perceived—may diverge from those of conventional MPAs in conceptualization and substance. There is a common but unsubstantiated assumption that LMPAs will be economically, politically, and socially less costly than conventional MPAs, with fewer challenges or conflicts (Balmford *et al.* 2004). Although McCrea-Strub *et al.* (2011) found that LMPAs are less expensive to establish per unit area than smaller MPAs, the paper does not address the full range of administration, management, enforcement, and opportunity costs. It is true that the unique human and geographical dimensions of LMPAs, especially those far offshore, suggest that their benefits and costs may not include some common to conventional MPAs (e.g., livelihood benefits/costs for small-scale fishing communities). However, again, this does not mean that benefits and costs are nonexistent. Some familiar social outcomes have already been noted in LMPAs, such as conflict and resistance surrounding perceived external agendas (Richmond & Kotowicz 2015). Furthermore, we expect LMPAs to impact new and broader groups of stakeholders (e.g., seabed mining industry, foreign governments and fishing fleets, presidents, and other high-ranking officials), with potentially farther-reaching effects (e.g., on national and international economies). Below we discuss a few specific knowledge gaps and research needs surrounding economic and social outcomes of LMPAs.

Some of the same island nations that called for a "blue economy" in which they capture a greater share of the economic benefits from commercial tuna fishing in their EEZs (Silver *et al.* 2015) are now considering or implementing LMPAs that reduce or eliminate fishing, reasoning that lost revenue from fishing will be offset by tourism (e.g., Cook Islands and Palau) and/or other conservation finance mechanisms involving philanthropic and/or private-sector donors (e.g., Kiribati). However, experiences in the Great Barrier Reef Marine Park have shown that the economic costs of expanding no-take areas can be much higher than expected (Fletcher *et al.* 2015; Devillers *et al.* 2014). Decision-makers are in need of rigorous and comprehensive economic analyses that consider the full range of establishment, maintenance, and opportunity costs and benefits of LMPAs both within and outside of the EEZs in which they are declared (Rotjan *et al.* 2014). Consideration of opportunity costs should take into account not only the immediate costs of foregoing existing activities in current political economies, but also the possible costs

Table 1 Examples of specific research questions that may be raised within four thematic areas of a social science research agenda on and for LMPAs

Scoping human dimensions

- What human—social, cultural, political, economic, and institutional—dimensions are relevant to LMPA systems in diverse contexts?
- What conceptualizations of human/nature relationships underlie LMPAs as conservation tools, and with what implications?
- What alternative conceptualizations are possible (e.g., LMPAs as social–ecological systems or social spaces)? What opportunities might these create for achieving broader consensus about LMPAs?

Governance

- Who are LMPA stakeholders?
- How have stakeholders been identified, included, or excluded in LMPA decision-making processes?
- What are the short- and long-term trade-offs of different approaches to stakeholder engagement?
- What opportunities and limitations do new technologies of visualization and surveillance offer for the design and enforcement of LMPAs?
- How does LMPA governance interact with governance arrangements at other levels, and with what implications?

Politics

- What are the political motivations for designating and opposing LMPAs? To what extent are these shared among diverse stakeholder groups?
- How do LMPAs shift power relations among diverse actors at global, national, and sub-national levels, and with what implications?

Social and economic outcomes

- What is the full range, magnitude and distribution of actual and perceived social, cultural, political, and economic benefits associated with LMPAs?
- What is the full range, magnitude and distribution of actual and perceived social, cultural, political, and economic costs associated with LMPAs?
- What is the range of future potential uses and benefits that an LMPA enables and precludes?

of a potentially narrowed range of future options for resource use and development.

Social costs and benefits of LMPAs extend beyond economics, of course. Wilhelm *et al.* (2014), for example, report that LMPAs "provide unique opportunities to protect cultural seascapes and long practiced oceanic traditions." Equity is another important consideration. Although a few recent studies have identified negative justice and equity implications (De Santo *et al.* 2011; De Santo 2013; Richmond & Kotowicz 2015), other outcomes are possible. Place-based understanding of existing and potential social, cultural, and other noneconomic benefits and costs, and their distribution among different groups, is needed.

The social and economic costs of unfulfilled promises or expectations for LMPAs can be high. Failing to account for their benefits is also problematic as the current reliance on spatial definitions of success (i.e., success as square kilometers protected) has opened LMPAs to critique about their value (Devillers *et al.* 2014). Attention should be paid not only to the outcomes of established LMPAs but also to the potential costs and benefits—for present and future generations—of *failing* to establish LMPAs in the context of current and predicted threats to marine biodiversity, fisheries, and ecosystems. Social science research—economic and otherwise—can clarify and enrich understanding of the benefits and costs of LMPAs and, more generally, what social success and failure means for LMPAs from a variety of perspectives and within particular contexts. This research should include baseline data that can be used at later stages to assess whether and how promises or expectations were fulfilled.

Global applications for LMPA social science

We have argued here that LMPAs, as objects of governance created through political and policy processes, are always more than "lines on a map." They are, and should be understood as, a global movement with meaning and significance at multiple scales. However, while the social sciences have become well integrated into conventional MPA research and practice, human dimensions considerations have not been an early priority in the LMPA movement. Social science research on the unique human dimensions of LMPAs can inform deliberation and decision-making at all stages of the policy process, empowering decisionmakers to appraise avoidable conflicts and unintended consequences before they occur.

Specifically, research on LMPA stakeholders and interests, governance, political dynamics, and social and economic outcomes can contribute to effective policy by informing decisions about: planning and stakeholder engagement processes; design features, such as boundaries, placement, objectives, and access and enforcement rules; and meaningful metrics by which to evaluate policy outcomes. Examples of specific research questions that may be raised within each of these themes are included in Table 1. More fundamentally, human dimensions

research can contribute to reflective, effective, and informed decision-making—by donors, NGOs, governments, and others—about the selection and investment in LMPAs as a marine conservation tool, and the long- and short-term tradeoffs that the large-scale protected area model offers relative to other approaches. Research and theory "does not eliminate the need to view all policies as ongoing experiments that need to be monitored, evaluated, and adapted over time" (Ostrom 2005). However, learning from the conventional MPA experience, social science can improve the potential for LMPAs to impart the positive social outcomes upon which sustained ecological outcomes will ultimately depend (Christie 2004).

When pressed for details at the World Parks Congress on the LMPA under development in the Cook Islands, Prime Minister Henry Puna replied: "I think we need to take things a step at a time. For me the thing is to get the processes moving, get the initiatives in place, and then we can look at how we can make those initiatives work." It is time to translate relevant insights from decades of social science research on conventional MPAs to LMPAs and generate new knowledge, where necessary, to help make these initiatives work. We hope the agenda outlined here will be used as a starting point from which scientists and managers work together to develop and carry out a comprehensive, shared research agenda on and for LMPAs to advance theory and science-based conservation policy.

Acknowledgments

References

Agardy, T., di Sciara, G.N. & Christie, P. (2011) Mind the gap: addressing the shortcomings of marine protected areas through large scale marine spatial planning. *Mar. Policy*, **35**, 226-232.

Balmford, A., Gravestock, P., Hockley, N., McClean C.J., Roberts C.M. (2004) The worldwide costs of marine protected areas. *Proc. Natl. Acad. Sci.*, **101**, 9694-9697.

Bennett, N.J. & Dearden, P. (2014) Why local people do not support conservation: community perceptions of marine protected area livelihood impacts, governance and management in Thailand. *Mar. Policy*, **44**, 107-116.

Bunce, L., Townsley, P., Pomeroy, R., Pollnac R. (2000) *Socioeconomic manual for coral reef management*. Australian Institute of Marine Science, Townsville, Australia.

Campbell, L.M., Gray, N.J., Hazen E.L., Shackeroff J.M. (2009) Beyond baselines: rethinking priorities for ocean conservation. *Ecol. Soc.*, **14**, 14. [online] URL: http://www.ecologyandsociety.org/vol14/iss11/art14/.

Charles, A. & Wilson, L. (2009) Human dimensions of marine protected areas. *ICES J. Mar. Sci.*, **66**, 6-15.

Chhatre, A. & Saberwal, V. (2005) Political incentives for biodiversity conservation. *Conserv. Biol.*, **19**, 310-317.

Christie, P. (2004) Marine protected areas as biological successes and social failures in southeast Asia. Pages 155-164 in J.B. Shipley, editor. *Aquatuatic protected areas as fisheries management tools. Designs, use, evaluation of these fully protected areas*. American Fisheries Society, Bethesda, MD.

Christie, P., McCay, B., Miller, M., *et al.* (2003) Toward developing a complete understanding: a social science research agenda for marine protected areas. *Fisheries*, **28**, 22-26.

Cronon, W. (1996) The trouble with wilderness: or, getting back to the wrong nature. *Environ. Hist.*, **1**, 7-28.

Day, J.C. (2002) Zoning – lessons from the Great Barrier Reef Marine Park. *Ocean Coast. Manag.*, **45**, 139-156.

Day, J.C. & Dobbs, K. (2013) Effective governance of a large and complex cross-jurisdictional marine protected area: Australia's Great Barrier Reef. *Mar. Policy*, **41**, 14-24.

Devillers, R., Pressey, R.L., Grech, A., *et al.* (2014) Reinventing residual reserves in the sea: are we favouring ease of establishment over need for protection? *Aquat. Conserv. Mar. Freshw. Ecosyst.*

De Santo, E.M. (2013) Missing marine protected area (MPA) targets: How the push for quantity over quality undermines sustainability and social justice. *J. Environ. Manage.*, **124**, 137-146.

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. Policy*, **35**, 258-260.

Duffy, R. (2006) Non-governmental organisations and governance states: The impact of transnational environmental management networks in Madagascar. *Env. Polit.*, **15**, 731-749.

Dulvy, N.K. (2013) Super-sized MPAs and the marginalization of species conservation. *Aquat. Conserv. Mar. Freshw. Ecosyst.*, **23**, 357-362.

Evans, L.S., Ban, N.C., Schoon, M., Nenadovic M. (2014) Keeping the great in the Great Barrier Reef: large-scale governance of the Great Barrier Reef Marine Park. *Int. J. Commons*, **8**, 396-427.

Fernandes, L., Day, J., Lewis, A., *et al.* (2005) Establishing representative no-take areas in the great barrier reef: large-scale implementation of theory on marine protected areas. *Conserv. Biol.*, **19**, 1733-1744.

Fiske, S.J. (1992) Sociocultural aspects of establishing marine protected areas. *Ocean Coast. Manag.*, **17**, 25-46.

Fletcher, W.J., Kearney, R.E., Wise, B.S., Nash W.J. (2015). Large-scale expansion of no-take closures within the Great Barrier Reef has not enhanced fishery production. *Ecol. Appl.*, **25**, 1187-1196.

Fox, H.E., Mascia, M.B., Basurto, X., *et al.* (2012) Reexamining the science of marine protected areas: linking knowledge to action. *Conserv. Lett.*, **5**, 1-10.

Gaines, S.D., White, C., Carr, M.H., Palumbi S.R. (2010) Designing marine reserve networks for both conservation and fisheries management. *Proc. Natl. Acad. Sci.*, **107**, 18286-18293.

Gaymer, C.F., Stadel, A.V, Ban, N.C., Cárcamo P.F., Ierna J., Lieberknecht L.M. (2014) Merging top-down and bottom-up approaches in marine protected areas planning: experiences from around the globe. *Aquat. Conserv. Mar. Freshw. Ecosyst.*, **24**, 128-144.

Graham, N.A.J. & McClanahan, T.R. (2013) The last call for marine wilderness? *BioScience*, **63**, 397-402.

Gray, N.J. (2010) Sea change: exploring the international effort to promote marine protected areas. *Conserv. Soc.*, **8**, 331-338.

Gruby, R.L. & Campbell, L.M. (2013) Scalar politics and the region: strategies for transcending Pacific Island smallness on a global environmental governance stage. *Environ. Plan. A*, **45**, 2046-2063.

Gruby, R.L. & Basurto, X. (2013) Multi-level governance for large marine commons: politics and polycentricity in Palau's protected area network. *Environ. Sci. Policy*, **33**, 260-272.

Jentoft, S., Chuenpagdee, R. & Pascual-Fernandez, J.J. (2011) What are MPAs for: on goal formation and displacement. *Ocean Coast. Manag.*, **54**, 75-83.

Jentoft, S., van Son, T.C. & Bjørkan, M. (2007) Marine protected areas: a governance system analysis. *Hum. Ecol.*, **35**, 611-622.

Jones, P.J.S. (2006) Collective action problems posed by no-take zone. *Mar. Policy*, **30**, 143-156.

Jones, P.J.S. (2014) *Governing marine protected areas: resilience through diversity*. Routledge, New York.

Jones, P.J.S., Qiu, W. & DeSanto, E.M. (2013) Governing marine protected areas: social-ecological resilience through institutional diversity. *Mar. Policy*, **41**, 5-13.

Leenhardt, P., Cazalet, B., Salvat, B., Claudet J., Feral F. (2013) The rise of large-scale marine protected areas: conservation or geopolitics? *Ocean Coast. Manag.*, **85**, 112-118.

Levine, A. (2007) Staying afloat: state agencies, local communities, and international involvement in marine protected area management in Zanzibar, Tanzania. *Conserv. Soc.*, **5**, 562-585.

Mascia, M.B. (2003) The human dimension of coral reef marine protected areas: recent social science research and its policy implications. *Conserv. Biol.*, **17**, 630-632.

Mascia, M.B., Claus, C.A. & Naidoo, R. (2010) Impacts of marine protected areas on fishing communities. *Conserv. Biol.*, **24**, 1424-1429.

McCrea-Strub, A., Zeller, D., Rashid Sumaila, U., *et al.* (2011). Understanding the cost of establishing marine protected areas. *Mar. Policy*, **35**, 1-9.

National Geographic. (2015) About Pristine Seas [WWW Document].

Ostrom, E. (2005) *Understanding institutional diversity*. Princeton University Press, Princeton.

Pajaro, M.G., Mulrennan, M.E. & Vincent, A.C.J. (2010) Toward an integrated marine protected areas policy: connecting the global to the local. *Environ. Dev. Sustain.*, **12**, 945-965.

Pala, C. (2013) Giant marine reserves post vast challenges. *Science*, **339**, 640-641.

Palumbi, S.R. (2004) Marine reserves and ocean neighborhoods: the spatial scale of marine populations and their management. *Annu. Rev. Environ. Resour.*, **29**, 31-68.

Pew Charitable Trusts. (n.d.). Global Ocean Legacy: Marine Conservation For a New Century.

Pollnac, R., Christie, P., Cinner, J.E., *et al.* (2010) Marine reserves as linked social-ecological systems. *Proc. Natl. Acad. Sci.*, **107**, 18262-18265.

Pomeroy, R.S., Parks, J.E. & Watson, L.M. (2004) *How is your MPA doing? A guidebook of natural and social indicators for evaluating marine protected area management effectiveness*. IUCN, Gland, Switzerland.

Potts, T., Burdon, D., Jackson, E., *et al.* (2014) Do marine protected areas deliver flows of ecosystem services to support human welfare? *Mar. Policy*, **44**, 139-148.

Richmond, L. & 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. *Appl. Geogr.*, **59**, 117-124.

Rotjan, R, Jamieson, R, Carr, B., *et al.* (2014) Establishment, Management, and Maintenance of the Phoenix Islands Protected Area. In *Advances in Marine Biology*, edited by Magnus L. Johnson and Jane Sandell, 1st ed. London: Elsevier Ltd. **69**, 289-324.

Sand, P.H. (2012) Fortress conservation trumps human rights? The "marine protected area" in the Chagos Archipelago. *J. Environ. Dev.*, **21**, 36-39.

Sandbrook, C., Adams, W.M., Büscher, B., Vira B. (2013). Social research and biodiversity conservation. *Conserv. Biol.*, **27**, 1487-1490.

Segi, S. (2014) Protecting or pilfering? Neoliberal conservationist marine protected areas in the experience of coastal Granada, the Philippines. *Hum. Ecol.*, **42**, 565-575.

Shackeroff, J.M., Hazen, E.H. & Crowder, L.B. (2009) Oceans as peopled seascales. Pages 33-54 in K. McLeod & H. Leslie, editors. *Ecosystem-based management for the ocean*. Island Press, Washin gton, D.C.

Silver, J.J., Gray, N.J., Campbell, L.M., Fairbanks L.W., Gruby R.L. (2015). Blue Economy and Competing Discourses in International Oceans Governance. *J. Environ. Dev.*, **24**, 135-160.

Singleton, R.L. & Roberts, C.M. (2014) The contribution of very large marine protected areas to marine conservation: Giant leaps or smoke and mirrors? *Mar. Pollut. Bull.*, **87**, 7-10.

Skytruth. (2012). http://skytruth.org/

Skytruth, Oceana & Google. (2014) Global Fishing Watch http://globalfishingwatch.org/.

Smith, M.D., Lynham, J., Sanchirico, J.N., Wilson J.A. (2010) Political economy of marine reserves: understanding the role of opportunity costs. *Proc. Natl. Acad. Sci.*, **107**, 18300–18305.

Spalding, M., Wood, L., Fitzgerald, C., Gjerde, K. (2010) The 10% target: where do we stand? Pages 25-40 in C. Toropova, I. Meliane, D. Laffoley, E. Matthews & M. Spalding, editors. *Global ocean protection: present status and future possibilities*. IUCN, The Nature Conservancy, UNEP-WCMC, UNEP,. UNU-IAS, Agence des aires marines protégées, Gland.

Spalding, M.D., Meliane, I., Milam, A., Fitzgerald C., Hale L.Z. (2013) Protecting marine spaces: global targets and changing approaches. Pages 213-248 in A. Chircop, S. Coffen-Smout & M. McConnell, editors. *Ocean Yearbook 27*. Martinus Nijhoff.

Steinberg, P.E. (2008) It's so easy being green: overuse, underexposure, and the marine environmentalist consensus. *Geography Compass*, **2**, 2080-2096.

Stonich, S.C. (2003) The political ecology of marine protected areas: The case of the bay islands. Pages 121-147 in S. Gössling, editor. *Tourism and development in tropical islands: political ecology perspectives*. Edward Elgar Publishing Ltd., Cheltenham.

The Pew Charitable Trusts. (2015) Fact Sheet. The virtual watch room: pioneering technology to monitor and protect marine reserves [WWW Document].

Thorpe, A., Bavinck, M. & Coulthard, S. (2011) Tracking the debate around marine protected areas: key issues and the BEG framework. *Environ. Manage.*, **47**, 546-63.

Toonen, R.J., Wilhelm, T.A., Maxwell, S.M., *et al.* (2013) One size does not fit all: the emerging frontier in large-scale marine conservation. *Mar. Pollut. Bull.*, **77**, 7-10.

Wagner, D., Wilhelm, A., Friedlander, A., *et al.* (2013) *A shared research agenda for large-scale marine protected areas*.

Walmsley, S.F. & White, AT. (2003) Influence of social, management and enforcement factors on the long-term ecological effects of marine sanctuaries. *Environ. Conserv.*, **30**, 388–07.

Wilhelm, T.A., Sheppard, C.R.C., Sheppard, A.L.S., *et al.* (2014) Large marine protected areas – advantages and challenges of going big. *Aquat. Conserv. Ma*, **24**, 24–30.

Wood, L.J., Fish, L., Laughren, J., *et al.* (2008) Assessing progress towards global marine protection targets: shortfalls in information and action. *Oryx*, **42**, 340-351.

Young, E. (2001) State intervention and abuse of the commons: fisheries development in Baja California Sur, Mexico. *Ann. Assoc. Am. Geogr.*, **91**, 283-306.

Young, O. (2006) Vertical interplay among scale-dependent environmental and resource regimes. *Ecol. Soc.*, **11**, 27 [online] URL: http://www.ecologyandsociety.org/vol11/iss21/art27.

Endnote

1. LMPAs have been variously defined as MPAs larger than 30,000 km^2 (De Santo 2013), 100,000 km^2 (Spalding *et al.* 2013) and 250,000 km^2 (Toonen *et al.* 2013). For the purposes of this article, we define LMPAs as MPAs larger than 100,000 km^2.

2. We define LMPAs under development as those that have been publicly declared or committed by an official government representative, but not yet legally formalized.

3. South Georgia and South Sandwich Islands Marine Protected Area, British Indian Ocean Territory Marine Protected Area, and Motu Motiro Hiva Marine Park.

4. We recognize that "conventional" MPAs are heterogeneous and of varied sizes; here our distinction between conventional MPAs and LMPAs is based on a spatial definition as greater or less than 100,000 km^2. Relative to LMPAs, most "conventional" MPAs are much smaller. The average size of marine protected areas in 2008 was 544 km^2 (skewed high by 10 relatively large MPAs that constituted 68% of global coverage at the time), whereas the median size was 4.6 km^2 (Wood et al. 2008).

5. Interviewees included six government officials, sixteen NGO staff, and two scientists.

6. Authors conducted participant observation in 22 LMPA-related events at the World Parks Congress. Data collected at events include: audio recordings, descriptive and interpretive notes, photos, documents, and notes from short, informal interviews with participants.

7. Although common, this conceptualization is not universal. For example, there was an event organized at the World Parks Congress called "Enhancing large scale marine management through indigenous participation, knowledge, and practice," in which presenters conveyed the importance of engaging local and

indigenous stakeholders in LMPA management in Hawaii, Australia, and Chile.

8. Although care must be taken to contextualize these lessons given the important differences between terrestrial and marine systems (Agardy *et al*. 2011).

9. Shape files used to produce this map were downloaded from the World Database on Protected Areas online interface in May 2015 (ProtectedPlanet.net).

10. There are conflicting reports about the size of the Franz Josef Land Zakaznik. The World Database on Protected Areas reports its size to be 42,000 km^2 while De Santo (2013) and Spalding et al.(2010) report its size as 123,877 km^2. Also of note, while the North-East Greenland National Park includes both marine and terrestrial areas, only the marine portion of the park is depicted on this map.