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# Residual marine protected areas five years on: Are we still favouring ease of establishment over need for protection?

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## Abstract

1. Marine protected areas (MPAs) are today's cornerstone of many marine conservation strategies. Our 2015 study (Devillers et al., 2015) and others have shown, however, that the placement of MPAs is 'residual' to commercial uses and biased towards areas of lower economic value or interest.
2. In this paper, we explored the impact of our study on marine science, policy and management practice.
3. We reviewed the papers citing our work and compiled expert opinions on some of the impacts of our study.
4. Results indicate a strong general uptake in the scientific community but more uneven impacts on policy and management in different contexts, with a likely smaller impact of the research on conservation practice.

KEYWORDS

extractive uses, marine protected area, marine reserve, ocean management, research impact

## 1 | REINVENTING RESIDUAL RESERVES IN THE SEA

Marine protected areas (MPAs) are widely acknowledged as the cornerstone of marine conservation. They are codified in several international agreements, notably the Conservation on Biological Diversity Aichi Target 11 and the United Nations Sustainable Development Goal 14. Both agreements require signatory countries to increase the coverage of their MPA networks to a minimum of 10% of their territorial waters, targets well below the recommendation of at least 30% protection from the International Union for the Conservation of Nature. While those international agreements have helped accelerate the creation of MPAs in the past decade to about 5% of the world's ocean (MPA Atlas, 2020), many studies have criticized the way those MPAs were created, documenting problems related to their remote nature, low levels of protection, poor enforcement and insufficient funding (e.g. Agardy, Claudet, & Day, 2016; De Santo, 2013; Devillers et al., 2015; Edgar

  

et al., 2014; Gill et al., 2017; Roberts, Duffy, & Cook, 2019; Sala et al., 2018).

In our study (Devillers et al., 2015), we explored how MPAs' geographic locations relate to the locations of extractive activities such as fishing, petroleum extraction and seabed mining. By studying those spatial relationships, we explored the tendency of MPAs to be 'residual', or created in places of low economic interest, irrespective of their value for conservation. Residual MPAs increase the risk of assembling a global network of MPAs that is ineffective at reducing threats to marine species and ecosystems, leading to limited effectiveness in policies and strategies to achieve positive conservation outcomes.

We conducted our study at three different geographic scales. First, at the global level, we considered the role of large-scale MPAs in the current global MPA context. Specifically, at the time our paper was published, the 10 largest MPAs (out of over 10,000 MPAs) accounted for over 53% of the global MPA coverage. We also considered how average fish catch within those MPAs, prior to their creation, compared with the global average, showing that the largest MPAs tended to be placed in areas of low fishing intensity. We also found that many large MPAs were placed in regions with very small human populations, reducing potential impacts on, and conflicts with, local communities. At a finer, national scale, we focused on the 2.3 million $km^2$ network of MPAs in Australian waters, proposed in 2012. The 2012 network design underwent two revisions following a change in government: an independent review released in 2015 and a final plan implemented in 2018. The final plan left open more areas to fishing than the 2012 and 2015 versions (Cockerell, unpublished data). Our analyses revealed great variation in the levels of protection afforded to marine bioregions, also highlighting a bias towards lower protection when MPAs were located closer to the coast. We also considered the locations of the proposed MPAs in relation to fishing and extraction of oil and gas. We showed a strong tendency to create MPAs in places characterized by low fish catch and lower value for oil and gas prior to their creation. Finally, at the scale of an individual MPA, we considered the 2004 rezoning of the Great Barrier Reef Marine Park and how the location of no-take zones related to commercial fishing grounds. Results at this scale indicated that conservation areas were modified after the draft plan stage to minimize the impact on the fishing industry, with potential biases in protection within bioregions. At all three scales, we found that there was little evidence that those biases in protection could be explained by the distribution of species or ecosystems that warranted protection. We consequently proposed a simple four-step framework that planners and policy makers could follow to help avoid further residual MPAs and improve the effectiveness of MPAs globally.

The outputs of our study were intuitive to some members of the marine science community, while alerting others to a problem they might not have understood, providing evidence in different geographic contexts and at different scales of a clear bias in the location of MPAs towards areas of lower economic value or interest. This bias can be explained by the desire of planners and policy makers to minimize the impacts of MPAs on existing extractive activities or on potential future economic opportunities. While we support minimizing the direct and indirect costs and forgone opportunities when creating MPAs, noting that this approach is explicitly encouraged in conservation planning (Day, Kenchington, Tanzer, & Cameron, 2019), it should not be achieved at the cost of inadequate protection of species and ecosystems at risk. Our paper aimed to raise awareness of this issue to help reduce the creation of residual MPAs globally. We suggest that, 5 years on, that need is probably more important than ever, given the pace of MPA expansion and intensifying impacts on marine biodiversity.

## 2 | METHOD

Two main methods were used to assess the potential and realized impacts of our study. First, a systematic review of all the documents that cited our 2015 paper was conducted on 26 August 2019 using Google Scholar and the Web of Science databases. This review was designed to understand the way our paper was used by other studies. The review identified 215 papers, chapters and reports that cited Devillers et al. (2015). Duplicates and publications not in English language or too hard to access (e.g. some PhD theses), or that did not actually cite our paper, were excluded from further analysis here. Publications identified in the initial scan that involved one or more of the authors of our original paper (35 publications) were also removed from the review. The resulting 145 papers were downloaded and analysed using the criteria presented in Table 1, with individual papers meeting one or more criteria. Excerpts of those papers were also used to discuss details on potential impacts of our study.

Second, international experts on MPAs or with direct expertise related to our study were contacted to answer a set of questions that could identify and evaluate potential impacts of our 2015 study. Experts were selected for this survey using two approaches, helping to ensure a diversity of respondents across expertise in this field. First, a search on Web of Science was conducted in July 2019 in order to identify the five experts having the highest number of publications on MPAs. Search keywords included the terms 'Marine Protected Area*' and 'Marine Reserve*'. All five experts identified from this search had each published over 30 papers in this field. Second, a list of 23 experts, including experts from academia, government and non-governmental organizations (NGOs), was compiled by the authors of this present paper to target individuals having a knowledge of the paper or issues related to the paper. Ten experts from this list were selected randomly and contacted individually.

All of the selected 15 experts (e.g. scientists, MPA managers) were asked for their opinions on potential impacts of our study using the same three questions, and invited to provide written responses in free format:

1. Has this study increased awareness of residual marine reserves in the scientific, governmental and non-governmental sectors?
2. Do you think this study has had direct or indirect impacts on marine planning, policy or management (at any level, local to international)?

**TABLE 1** Criteria used for the literature review and number of studies meeting each criterion (out of 145)

| Criteria | Description | Number of papers |
|---|---|---|
| Acknowledgement | Studies acknowledging our study without endorsing or disagreeing with its content | 39 |
| MPA expansion | Studies discussing the recent expansion of MPAs and its uneven nature, including bias towards large MPAs | 21 |
| Past planning (Australia) | Studies referring to the approach used by Australia to plan its MPA system | 1 |
| Threats | Study referring to threats to the marine environment | 2 |
| Low protection | Studies stating that conservation gains can be overstated by referring to zones that are not exempt from extractive uses | 3 |
| Better planning needed | Studies arguing that protecting the marine environment requires improved approaches to MPA planning | 12 |
| Controversy | Studies referring to controversy around the expansion of MPAs, including the critique presented by our study | 18 |
| Residual (general) | Studies agreeing with the general concept of residual MPAs | 53 |
| Residual (specific) | Studies agreeing with the concept of residual MPA, referring to a particular study region | 24 |
| Lack of data | Study recognizing that planning for marine biodiversity relies on surrogate data | 4 |
| Residual (conditional) | Studies acknowledging and perhaps agreeing with our message, but then adding another dimension to the story | 12 |
| Disagreement | Rebuttal of our primary argument | 1 |

3. Do you think this study has had direct or indirect impacts on the conservation of marine habitat or species, or could have such impacts in the future?

All the experts were offered the option to remain anonymous, and were informed that their full responses would be provided in Supplementary Material to our paper. Six experts out of the 15 experts contacted responded to the questions (see Supplementary Material 1 for complete transcripts of their responses). Their answers, together with the literature review from the first stage, were used to support an overall discussion here on potential and realized impacts of our paper.

## 3 | IMPACTS OF THE STUDY ON SCIENCE, POLICY AND MANAGEMENT

Generally, our 2015 paper has been very well cited (215 citations at the time of the systematic review), making it the second most cited paper in the past three years published in the journal *Aquatic Conservation: Marine and Freshwater Ecosystems*. Many papers that cited our study (Table 1; Supplementary Material 2) either simply acknowledged our paper ($n$ = 39) or cited it in the context of the global expansion of MPAs ($n$ = 21). While a large proportion of the papers agreed with the general concept of residual MPAs ($n$ = 53) or its relevance to particular geographic contexts ($n$ = 24), some were more critical, discussing other angles to the problem ($n$ = 12) or disagreeing with our conclusions ($n$ = 1).

Table 2 summarizes key elements of discussion extracted from some of the papers identified in the latter two categories of Table 1, helping to illuminate the discussions that our study stimulated in the scientific community. A number of papers also echoed concerns expressed in our study by calling for better planning practices ($n$ = 12) and criticizing various aspects of MPA designations ($n$ = 18).

Generally, our literature review confirms that our 2015 paper has been well received by the scientific community and has fuelled discussions about the relationship between human activities and MPA planning, particularly about placement and effectiveness. Many studies that expressed caution about the concept of residual MPAs perceived our key message as being a call against very large remote MPAs (e.g. Andrello et al., 2017; Manel et al., 2019; Table 2). While we do criticize the disproportionate contribution that very large, remote MPAs play in some countries' conservation strategies, and hence in perceived global conservation progress, we consider that a balanced

**TABLE 2** Key concerns from studies that provided critical arguments of our 2015 paper

| Study | Key concerns |
|---|---|
| Andrello et al., 2017 | Referring to isolated marine reserves as residual is potentially wrong as the benefit of these types of reserves potentially include species that use long-distance larval dispersal. |
| Claudet, 2017 | MPAs established in remote areas without current need for protection might appear ineffective now, but could serve as insurance against mismanagement and projected changes in human use. |
| Coghlan et al., 2017 | 'the cause of unprofitable fisheries resulting in residual areas need not always be the lack of target species biomass, and may instead reflect economic or technological constraints which are subject to change'. |
| Elise et al., 2017 | Given the absence of real wilderness areas in the Caribbean, remote marine reserves might provide the best baselines available for the region because they benefit from the natural protection offered by their isolation. |
| Fitzsimons & Westcott, 2016, 2018 | 'In particular, there seems to be one most overt dichotomy: the difference between the belief among some that the scientific data should solely determine, or at least be the primary determiner of, MPA location and extent, and the recognition by interested parties from many different sectors that a range of factors … need to be considered in the placement of MPAs'. |
| Gruby et al., 2017 | There is an assumption that remote spaces with few direct uses present easy political wins. As our results demonstrate, however, resource users are not the only stakeholders to affect and be affected by negotiations about large marine reserves. Rather, the geographical and political features of large marine reserves give them the potential to intersect with broader and more diverse populations, including but not limited to people with direct material experiences or uses of the protected spaces. |
| Hutchings & Kenchington, 2017 | Remote and apparently residual marine reserves have substantial values of scale and pre-emption of impacting activities within their boundaries. |
| Maire et al., 2016 | Remote marine reserves offer reference conditions to evaluate management measures or time to recovery and can be emblematic so making publicity for marine protection worldwide. |
| Manel et al., 2019 | Isolated marine reserves with low human pressure are necessary to protect top predators. They also stated that the realization of long-distance dispersal would make a case for the protection of marine reserves isolated from human pressure. 'Generally, it would suggest to reconsider the design of marine reserve networks with fewer but larger reserves, including isolated reserves, to sustain large populations of large individuals, even top predators, that can massively seed larvae towards fishing grounds'. |
| O'Leary et al., 2018 | Although some large marine reserves may currently experience limited direct human impacts, threats remain, and history shows that given increasing human population in resource demand, no unused area can be presumed to remain undisturbed in perpetuity. Proactive protection of ocean wilderness areas against future exploitation could offer large long-term benefits to marine biodiversity and ecosystem services. |
| Singleton & Roberts, 2014 | Just as with the Great Barrier Reef, the apparently residual Coral Sea Park could form the basis of a rezoned area that is more effective for conservation. |

portfolio of MPAs is the most suitable response to the need for protection of different species or ecosystems. Large remote MPAs have their place in such a portfolio given the protection they can afford to specific ecosystems or species such as top predators. Additionally, many very large MPAs undergo marine spatial planning processes that can include significant complexity in terms of zonation schemes that designate areas for specific uses (e.g. Palau National Marine Sanctuary, Cook Islands Marae Moana). Proponents of large remote MPAs also advocate for the importance of protecting relatively pristine sites from potential future threats (e.g. Claudet, 2017; Hutchings & Kenchington, 2017; Table 2). This is a valid argument, but one that relies on the assumption that protection of remote locations will be needed in the future, and this is likely to vary between locations. An isolation-focused approach also puts at further risk the ecosystems and species that are currently most at risk near population centres (Edgar et al., 2008). Here again, we consider that a balanced portfolio of MPAs is important to address both current and imminent threats as well as possible future threats.

Most of the arguments that included conditional support for the concept of MPAs being residual also recognized that the risks in MPA planning were based on logic that can be summarized as follows: marine reserves need to be established in response to the conservation requirements of ecosystems and species, and also the need for extractive uses of the ocean, all at a range of spatial and temporal scales. Such an approach calls for a mixed portfolio of reserves, with appropriate restrictions on extractive activities, with some reserves designed to avert imminent threats and others to serve as insurance against predictable, and perhaps unpredictable, future threats. Ideally, planning for such reserves would be integrated into a single framework, like those being developed on land (Sacre, Bode, Weeks, & Pressey, 2019), based on maximizing overall outcomes for biodiversity within socio-economic constraints.

While our literature review helped to assess the impact of our paper in the scientific community, it did not provide much insight into the uptake of our study by policy and management, which was better assessed using the responses from the key experts. MPA experts who responded to the questions generally confirmed that the study had a positive impact, helping raise awareness of an important issue. One expert mentioned an 'increased awareness about residual reserves, at least within the academic realm', supported by the fact that the 'study

continues to be well-cited in the academic literature'. One academic expert considered the 'paper significantly contributed to the ongoing debate about the real effectiveness of MPAs […] versus the "fake news" about total cover and the achievement of international targets (e.g. Aichi target 11) by a number of countries'. One authority working for a marine conservation NGO felt 'the paper [was] transformative', saying we 'articulated, and provided data for, a position that many [MPA experts] had been putting forward' previously.

The impact of the paper outside academia appears to be less, and more uneven. While some experts thought the study raised far less awareness in governments (e.g. Australia) than in academia, one expert thought 'the paper may have had some limited influence' with the Queensland (Australia) State government owing to its interests in environmental management and protection since 2015. One Canadian government expert stated that in the 'day-to-day as a marine manager [she/he is] pleased to note that the term "residual MPA" is now fairly common, and this conservation reality is now understood by many sectors'. Local impacts on governments seem to be stronger where co-authors of the study are located (i.e. in this case, Canada is the country of the 2015 study's lead author) or in regions where the study focused its attention (e.g. Queensland, Australia). One expert cautioned that 'most government staff don't read journal articles', feeling that 'even impactful papers don't move the needle much' in most cases. Another expert quoted the study from Cvitanovic et al. (2015) which concluded that 'the integration of scientific information into the decision-making process for the management of marine resources remains a significant challenge, with the inaccessibility of primary scientific literature to environmental practitioners identified as a key limiting factor'. Generally, we found no clear evidence of specific policy or management actions that might have been directly influenced by our study, a change that is probably hard to observe only a few years following publication. To fill such a gap, encouraging governance and international conservation organizations to more systematically include independent scientists with relevant and diverse expertise throughout the entire decision-making process could help disseminate recent research findings and improve their application to specific contexts – offering public-facing substance to the more successful achievement of conservation outcomes of the portfolio MPA approach we describe above. In our specific case, such a transfer of research findings into the policy/public realm may have also been more indirect and hence harder to detect. One of the experts suggested that the biggest impact of our paper, and other similar studies, might be 'to energize upcoming conservationists, who may well end up in decision-making positions in the future', thinking it could get 'them to think critically, and to always think through the consequences – intended or not – of policies.' Experts based in Australia, one of the focal regions of our study, considered that recent outcomes (e.g. the 2018 Commonwealth MPA network) suggest little uptake of the study recommendations, arguing that 'governments […] remain focused on a simple quantifiable metric (i.e. area) as an indicator of progress', 'aiming for international percentage targets […] rather than aiming for the best possible conservation outcomes'. Such a perspective on policy seems shared amongst experts, whatever their field of work (academia, government or NGO). Here again, scientists should be encouraged and enabled to go out of the ivory tower and engage openly with societal questions. Greater involvement of independent scientists throughout the construction of international agreements is paramount and would help design international objectives and targets more closely aligned with science to maximize conservation outcomes.

At a very general level, our study called for an increased focus on the quality of the global MPA portfolio instead of the current focus that largely associates success with quantity (i.e. area targets). This message has been echoed by other studies in the past years and seems to be slowly reaching the policy realm, with increasing discussions about the qualitative elements of the Aichi 11 target (e.g. asking for 'effectively and equitably managed, ecologically representative and well-connected systems of protected areas'; e.g. Rees, Foster, Langmead, Pittman, & Johnson, 2018; Zafra-Calvo et al., 2019), or the recent discussions at the International Union for the Conservation of Nature 'Beyond the Aichi Target Task Force' that discusses if new targets could divide the world into zones of different levels of human uses, helping reduce the residual nature of protected areas (Woodley, 2019, personal communication). We are encouraged by those discussions that might lead to new safeguards around the post-2020 targets, and could reduce the risk of establishing further residual MPAs at the expense of more balanced reserve portfolios.

## 4 | POTENTIAL IMPACTS AND OUTCOMES FOR HABITAT AND SPECIES

With our 2015 study, we aspired ultimately to have a positive impact on the conservation of marine species and ecosystems through science, policy and management. One of the experts expressed quite clearly that 'It is difficult to determine the direct or indirect impacts of this study on the conservation of marine habitats and species'. This expert added that 'scientific literature plays less than an appropriate role informing the management of such habitats or species', citing Cvitanovic et al. (2014) who found that 'scientific literature represented only 14% of information cited in management plans'. Nonetheless, the application of appropriately framed science can provide a sound technical basis for MPA planning and outcomes. Our 2015 study aimed to provide evidence of a large problem in conservation planning: the residuality of MPAs, mainly driven by the dominating influence of extractive industries in determining the locations of reserves.

Our 2015 paper was primarily an exercise in awareness-raising, for those not already familiar with the residual nature of MPAs and its adverse consequences for biodiversity. In general, those consequences are that species and ecosystems subject to impacts from extractive activities will continue to decline or at least fail to recover without adequate protection while new MPAs are established in areas with least need for protection in the short or medium terms. As this awareness builds, helped by an increasing number of other studies questioning the value of placing quantity before quality in designating MPAs, several advances in policy and planning are needed:

- High-level policy targets for conservation impact through protected areas (Pressey, Visconti, & Ferraro, 2015) that recognize several limitations of current targets: (a) targets for extent can be counterproductive because they can be most expediently achieved in residual areas; (b) qualitative targets for representation, such as those underpinning Australia's national MPA system, can be achieved nominally while perpetuating residual biases (Devillers et al., 2015); and (c) even quantitative representation targets can fail to achieve impact (Pressey, Weeks, & Gurney, 2017).
- Target-driven pressure on governments, donors, and non-government organizations to focus on quality (conservation impact) over quantity of protected areas.
- Integrated planning to design portfolios of highly protected MPAs that address current or imminent threats and serve as insurance against possible future threats.

We hope our 2015 paper helps to move decision-making in these directions.

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## SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.

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