

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

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1 **Abstract**

2

3 1 Marine protected areas (MPAs) are today's cornerstone of many marine conservation
4 strategies. Our 2015 study (Devillers et al., 2015) and others have shown, however, that the
5 placement of MPAs is 'residual' to commercial uses and biased towards areas of lower
6 economic value or interest.

7 2 In this paper, we explored the impact of our study on marine science, policy and management
8 practice.

9 3 We reviewed the papers citing our work and compiled expert opinions on some of the impacts
10 of our study.

11 4 Results indicate a strong general uptake in the scientific community but more uneven impacts
12 on policy and management in different contexts, with a likely smaller impact of the research on
13 conservation practice.

14

15

16 **Keywords:** marine reserve; marine protected area; extractive uses; research impact; ocean
17 management

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20 for protection?

21

22 1. Reinventing residual reserves in the sea

23 Marine protected areas (MPAs) are widely acknowledged as the cornerstone of marine
24 conservation. They are codified in several international agreements, notably the Conservation on
25 Biological Diversity (CBD) Aichi Target 11 and the United Nations Sustainable Development
26 (SDG) Goal 14. Both agreements require signatory countries to increase the coverage of their
27 MPA networks to a minimum of 10% of their territorial waters, targets well below the
28 recommendation of at least 30% protection from the International Union for the Conservation of
29 Nature (IUCN). While those international agreements have helped accelerate the creation of
30 MPAs in the past decade to about 5% of the world's ocean (MPA Atlas, 2020), many studies have
31 criticized the way those MPAs were created, documenting problems related to their remote
32 nature, low levels of protection, poor enforcement, and insufficient funding (e.g. Agardy, Claudet
33 & Day, 2016; Devillers et al., 2015; De Santo, 2013; Edgar et al., 2014; Gill et al., 2017; Roberts,
34 Duffy, & Cook, 2019; Sala et al., 2018).

35

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

43

44 We conducted our study at three different geographic scales. First, at the global level, we
45 considered the role of large-scale MPAs in the current global MPA context. Specifically, at the
46 time our paper was published, the 10 largest MPAs (out of over 10,000 MPAs) accounted for over
47 53% of the global MPA coverage. We also considered how average fish catch within those MPAs,
48 prior to their creation, compared to the global average, showing that the largest MPAs tended to
49 be placed in areas of low fishing intensity. We also found that many large MPAs were placed in
50 regions with very small human populations, reducing potential impacts on, and conflicts with, local
51 communities. At a finer, national scale, we focused on the 2.3 million km² network of MPAs in
52 Australian waters, proposed in 2012. The 2012 network design underwent two revisions following
53 a change in Government; an independent review released in 2015 and a final plan implemented
54 in 2018. The final plan left open more areas to fishing than the 2012 and 2015 versions (Cockerell,
55 unpublished data). Our analyses revealed great variation in the levels of protection afforded to

56 marine bioregions, also highlighting a bias towards lower protection when MPAs were located
57 closer to the coast. We also considered the locations of the proposed MPAs in relation to fishing
58 and extraction of oil and gas. We showed a strong tendency to create MPAs in places
59 characterized by low fish catch and lower value for oil and gas prior to their creation. Finally, at
60 the scale of an individual MPA, we considered the 2004 rezoning of the Great Barrier Reef Marine
61 Park and how the location of no-take zones related to commercial fishing grounds. Results at this
62 scale indicated that conservation areas were modified after the draft plan stage to minimize the
63 impact on the fishing industry, with potential biases in protection within bioregions. At all three
64 scales, we found that there was little evidence that those biases in protection could be explained
65 by the distribution of species or ecosystems that warranted protection. We consequently proposed
66 a simple four-step framework that planners and policy makers could follow to help avoid further
67 residual MPAs and improve the effectiveness of MPAs globally.

68
69 The outputs of our study were intuitive to some members of the marine science community, while
70 alerting others to a problem they might not have understood, providing evidence in different
71 geographic contexts and at different scales, of a clear bias in the location of MPAs towards areas
72 of lower economic value or interest. This bias can be explained by the desire of planners and
73 policy makers to minimize the impacts of MPAs on existing extractive activities or on potential
74 future economic opportunities. While we support minimizing the direct and indirect costs and
75 forgone opportunities when creating MPAs, noting that this approach is explicitly encouraged in
76 conservation planning (Day, Kenchington, Tanzer, & Cameron, 2019), it should not be achieved
77 at the cost of inadequate protection of species and ecosystems at risk. Our paper aimed to raise
78 awareness of this issue to help reduce the creation of residual MPAs globally. We suggest that,
79 5 years on, that need is probably more important than ever, given the pace of MPA expansion
80 and intensifying impacts on marine biodiversity.

81 2. Method

82 Two main methods were used to assess the potential and realized impacts of our study.

83
84 First, a systematic review of all the documents that cited our 2015 paper was conducted on August
85 26th 2019 using Google Scholar and the Web of Science databases. This review was designed
86 to understand the way our paper was used by other studies. The review identified 215 papers,
87 chapters and reports that cited Devillers et al. (2015). Duplicates and publications not in English
88 language, too hard to access (e.g. some PhD theses), or that did not actually cite our paper, were
89 excluded from further analysis here. Publications identified in the initial scan that involved one or
90 more of the authors of our original paper (35 publications) were also removed from the review.
91 The resulting 145 papers were downloaded and analysed using the criteria presented in Table 1,
92 with individual papers meeting one or more criteria. Excerpts of those papers were also used to
93 discuss details on potential impacts of our study.

94
95 Second, international experts on MPAs or with direct expertise related to our study were contacted
96 to answer a set of questions that could identify and evaluate potential impacts of our 2015 study.
97 Experts were selected for this survey using two approaches, helping to ensure a diversity of

98 respondents across expertise in this field. First, a search on Web of Science was conducted in
99 July 2019 in order to identify the five experts having the highest number of publications on MPAs.
100 Search keywords included the terms “Marine Protected Area*” and “Marine Reserve*”. All five
101 experts identified from this search had each published over 30 papers in this field. Second, a list
102 of 23 experts, including experts from academia, government and NGOs, was compiled by the
103 authors of this present paper to target individuals having a knowledge of the paper or issues
104 related to the paper. Ten experts from this list were selected randomly and contacted individually.

105
106 All the selected 15 experts (e.g. scientists, MPA managers) were asked for their opinions on
107 potential impacts of our study using the same three questions, and invited to provide written
108 responses in free format:

- 109 1. Has this study increased awareness of residual marine reserves in the scientific,
110 governmental, and non-governmental sectors?
- 111 2. Do you think this study has had direct or indirect impacts on marine planning, policy or
112 management (at any level, local to international)?
- 113 3. Do you think this study has had direct or indirect impacts on the conservation of marine
114 habitat or species, or could have such impacts in the future?

115
116 All the experts were offered the option to remain anonymous, and were informed that their full
117 responses would be provided in Supplementary Material to our paper. Six experts out of the 15
118 experts contacted responded to the questions (see Supplementary Material 1 for complete
119 transcripts of their responses). Their answers, together with the literature review from the first
120 stage, were used to support an overall discussion here on potential and realized impacts of our
121 paper.

122 3. Impacts of the study on science, policy and management

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

131
132 Table 2 summarizes key elements of discussion extracted from some of the papers identified in
133 the latter two categories of Table 1, helping to illuminate the discussions that our study stimulated
134 in the scientific community. A number of papers also echoed concerns expressed in our study by
135 calling for better planning practices (n=12) and criticizing different aspects of MPA designations
136 (n=18).

137
138 Generally, our literature review confirms that our 2015 paper has been well received by the
139 scientific community and has fuelled discussions about the relationship between human activities

140 and MPA planning, particularly about placement and effectiveness. Many studies that expressed
141 caution about the concept of residual MPAs perceived our key message as being a call against
142 very large remote MPAs (e.g. Andrello et al., 2017; Manel et al., 2019; Table 2). While we do
143 criticize the disproportionate contribution that very large, remote MPAs play in some countries'
144 conservation strategies, and hence in perceived global conservation progress, we consider that
145 a balanced portfolio of MPAs is the most suitable response to the need for protection of different
146 species or ecosystems. Large remote MPAs have their place in such a portfolio given the
147 protection they can afford to specific ecosystems or species such as top predators. Additionally,
148 many very large MPAs undergo marine spatial planning processes that can include significant
149 complexity in terms of zonation schemes that designate areas for specific uses (e.g. Palau
150 National Marine Sanctuary, Cook Islands Marae Moana). Proponents of large remote MPAs also
151 advocate for the importance of protecting relatively pristine sites from potential future threats (e.g.
152 Hutchings & Kenchington, 2017; Claudet, 2017; Table 2). This is a valid argument but one that
153 relies on the assumption that protection of remote locations will be needed in the future, and this
154 is likely to vary between locations. An isolation-focused approach also puts at further risk the
155 ecosystems and species that are currently most at risk near population centres (Edgar et al.,
156 2008). Here again, we consider that a balanced portfolio of MPAs is important to address both
157 current and imminent threats as well as possible future threats.

158
159 Most of the arguments that included conditional support for the concept of MPAs being residual
160 also recognized that the risks in MPA planning were based on logic that can be summarized as
161 follows: marine reserves need to be established in response to the conservation requirements of
162 ecosystems and species, and also the need for extractive uses of the ocean, all at a range of
163 spatial and temporal scales. Such an approach calls for a mixed portfolio of reserves, with
164 appropriate restrictions on extractive activities, with some reserves designed to avert imminent
165 threats and others to serve as insurance against predictable, and perhaps unpredictable, future
166 threats. Ideally, planning for such reserves would be integrated into a single framework, like those
167 being developed on land (Sacre, Bode, Weeks, & Pressey, 2019), based on maximizing overall
168 outcomes for biodiversity within socio-economic constraints.

169
170 While our literature review helped to assess the impact of our paper in the scientific community,
171 it did not provide much insight into the uptake of our study by policy and management, which was
172 better assessed using the responses from the key experts. MPA experts who responded to the
173 questions generally confirmed that the study had a positive impact, helping raise awareness of
174 an important issue. One expert mentioned an "increased awareness about residual reserves, at
175 least within the academic realm", supported by the fact that the "study continues to be well-cited
176 in the academic literature." One academic expert considered the "paper significantly contributed
177 to the ongoing debate about the real effectiveness of MPAs [...] versus the "fake news" about total
178 cover and the achievement of international targets (e.g. Aichi target 11) by a number of countries."
179 One authority working for a marine conservation NGO felt "the paper [was] transformative", saying
180 we "articulated, and provided data for, a position that many [MPA experts] had been putting
181 forward" previously.

182

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

220
221 At a very general level, our study called for an increased focus on the quality of the global MPA
222 portfolio instead of the current focus that largely associates success with quantity (i.e. area
223 targets). This message has been echoed by other studies in the past years and seems to be
224 slowly reaching the policy realm, with increasing discussions about the qualitative elements of the
225 Aichi 11 target (e.g. asking for “effectively and equitably managed, ecologically representative
226 and well-connected systems of protected areas”) (e.g. Reis et al., 2017; Zafra-Calvo et al., 2019),

227 or the recent discussions at the IUCN “Beyond the Aichi Target Task Force” that discusses if new
228 targets could divide the world into zones of different levels of human uses, helping reduce the
229 residual nature of protected areas (Woodley, 2019, personal communication). We are encouraged
230 by those discussions that might lead to new safeguards around the post-2020 targets, and could
231 reduce the risk of establishing further residual MPAs at the expense of more balanced reserve
232 portfolios.

233 4. Potential impacts and outcomes for habitat and species

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

244
245 Our 2015 paper was primarily an exercise in awareness-raising, for those not already familiar with
246 the residual nature of MPAs and its adverse consequences for biodiversity. In general, those
247 consequences are that species and ecosystems subject to impacts from extractive activities will
248 continue to decline or at least fail to recover without adequate protection while new MPAs are
249 established in areas with least need for protection in the short or medium terms. As this awareness
250 builds, helped by an increasing number of other studies questioning the value of placing quantity
251 before quality in designating MPAs, several advances in policy and planning are needed:

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

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

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383 **Tables**

384
 385 Table 1: Criteria used for the literature review and number of studies meeting each criterion (out
 386 of 145)
 387

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

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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 and Westcott 2016 and 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 and 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 realisation 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 and 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.