

# Response to Reviewers

PONE-D-17-38653

A User-Friendly Tool to Evaluate the Effectiveness of No-Take Marine Reserves

## Editor

### Comment 1

*Please ensure that your manuscript meets PLOS ONE's style requirements, including those for file naming. The PLOS ONE style templates can be found at [http://www.journals.plos.org/plosone/s/file?id=wjVg/PLOSOne\\_formatting\\_sample\\_main\\_body.pdf](http://www.journals.plos.org/plosone/s/file?id=wjVg/PLOSOne_formatting_sample_main_body.pdf) and*

*[http://www.journals.plos.org/plosone/s/file?id=ba62/PLOSOne\\_formatting\\_sample\\_title\\_authors\\_a  
ffiliations.pdf](http://www.journals.plos.org/plosone/s/file?id=ba62/PLOSOne_formatting_sample_title_authors_affiliations.pdf)*

We have reviewed PLOS ONE's style requirements and modified pertinent file names. Additionally, we have modified the way in which Table titles and legends were used to match these requirements.

### Comment 2

*It was noted by our internal staff that Figure 3 in your manuscript have been previously copyrighted.*

This is a misunderstanding. Figure 3 is a map showing the Baja California Peninsula and part of Continental United States and Mexico, as well as a zoom-in to Isla Natividad and its marine reserves and control sites. We understand that previous work related to Isla Natividad has created similar maps to describe the study area, but this map was independently created from raw shapefiles and coordinates of the respective polygons. We have included sources of this information in the figure legend, but emphasize the fact that the map was constructed by us. The R code that generates the map (and the manuscript) can be found [here](#) for verification.

## Reviewer #1

*The paper by Villaseñor-Derbez, et al. presents the Marine Reserves Evaluation Application (MAREA), a tool to test marine reserves' performance. The paper begins with a description of marine reserves' objectives and relative biological, socioeconomic and governance indicators considered in MAREA and used to assess reserves' performance; it briefly details the input data and statistical models used to calculate indices and their change in space and time; then the paper gives an overview of MAREA; and last, presents a case study.*

*The paper is well written and easy to understand. The topic is interesting, and the work is timely given the increasing focus on the use of ecological data and indicators to test management performance, and the need of developing user-friendly tools for fishers and managers. However, I found that some information essential to understand and judge the approach is missing or not clear. My main suggestions are:*

### Comment 1.1

*The introduction may benefit from more detailed information and examples supporting some of the claims.*

*Paragraph 2 is quite bare and lacks explanations and contextualisation of before-after-control-impact sites, and information that would help the reader better understand if and why they are always needed and therefore to judge whether the studies cited fully fail in testing reserves' performance (Line 50 – 'these analysis do not estimate the effect of the reserve' is a strong sentence that questions the validity of these studies. Could this sentence be rephrased or supported by further information?). For instance, a study could be based on control-impact comparisons across multiple regions, with the strength of the results being their consistency across these regions. Examples specific to some of the studies cited would also be helpful to clarify concepts and support statements.*

The sentence in line 50 has been rephrased so that it does not question the validity of the cited studies. This paragraph is intended to communicate that many studies use a Before-After comparison approach that ignores system-level changes, or Control-Impact approaches that do not address temporal variability. The paragraph has been modified to express this, and an example [1] of BACI design to evaluate marine reserves has been included.

*Paragraph 3 – the structure and aim of this paragraph is unclear. The first two sentence should be part of the paragraph above, and **may include explanation and examples on 'economic outcomes'**. The aim of the paper would be better stated only once (in line 79) and after issues on standardisation, science accessibility/replicability are presented.*

The first two sentences of the paragraph have been appended to the previous paragraph for cohesion. The aim of the paper has been moved to the last paragraph, as suggested.

*Paragraph 4 – this paragraph is unclear. It is more about the need for a user-friendly tool than on ‘challenges on how to standardise marine reserve evaluation’. The concept here is that there are similar tools (and some also allow for replicability and scalability of the analysis), but they are not targeting the non-scientific community.*

The phrasing has been modified to show that standardization of the evaluation of marine reserves is not new, but that previous efforts have fallen short in providing i) ways to rigorously infer causality from the measured indicators, and ii) user-friendly tools that enable resource users (often lacking a technical background) to perform the evaluation in a reproducible and rigorous way.

#### Comment 1.2

*Still related to paragraph 4, I am struggling understanding how MAREA can be used to ‘standardise marine reserve evaluation’ (implied). As discussed earlier in the introduction, a rigorous and standardised evaluation depends on the sampling protocol used to collect data in various reserves, but there is no specific information here and very little information in the methods on the sampling protocol and data that MAREA depends on, nor on whether sampling guidelines are provided in the application. MAREA as described in this manuscript seems a tool for data analysis and interpretation rather than sampling planning or both. So, I suggest adding information in the introduction, as well as material and methods, that would clarify this point. See also comments 4 and 5.*

MAREA is a tool for data analysis and interpretation, rather than for sampling planning. In this study, we refer to evaluation as the process of analyzing existing data to evaluate the effect of the intervention. On the other hand, we refer to the process of data collection as monitoring or sampling. We believe that by incorporating other suggestions (Comments 1.4 – 1.6, and 1.8, see below) we have addressed this issue in the “Data and analyses” section

#### Comment 1.3

*Tables 1 and 2 should be rearranged for clarity. An easy way would be to merge the 2 tables by adding indicators’ name as columns’ fields in Table 2 (otherwise it’s a constant back and forth between tables). The info reported in table 1 (data type and unit) is technical and not essential to understand concepts of this paper and thus could be given as supplementary.*

We considered this in an earlier version of the manuscript. However, we decided to divide the information and have each table serve a different purpose. Table 1 provides an overview of all the indicators, mentioning data types and units. This helps readers anticipate how each indicator might be analyzed, and makes the differentiation between qualitative and quantitative indicators easier, as requested in Comment 1.6. Table 2 allows the reader to match stated objectives with performance indicators, which were previously defined in Table 1. We recognize that using indicator codes as column names in Table 2 might imply revisiting Table 1. However, had the name of the indicators been included as column names for this table, we would have had either a table with extremely wide columns, or 90° rotation in the text to accommodate all columns, resulting in a visually unappealing table.

*Please also note that table 2 is incomplete and indicators S-G are all missing. The meaning of the sentence ‘all governance indicators should always be used’ is unclear, and there is a typo (allways).*

Table 2 shows all Biological (n = 9) and Socioeconomic (n = 5) indicators. Governance indicators (n = 15) are intentionally excluded from Table 2. Our suggestion is to use all governance indicators on any evaluation, regardless of the objectives of the reserve. Including the 15 Governance indicators in Table 2 would populate all cells under Governance indicators (*i.e.* There would be an additional 105 cells filled with “x”). We believe that exclusion of Governance indicators from the table allows the user to focus on identifying Biological and Socioeconomic indicators.

We have furthered our explanation of “*all governance indicators should always be used*” and explained why Governance indicators are excluded from Table 2 in the paragraph.

#### Comment 1.4

*Line 149 and below - Instead of presenting the specific case of Mexico, which is described also later, this paragraph could be generalised to a description of the sampling method and protocol, of the biological/ecological/social and governance data that MAREA requires (e.g. sampling effort; data fields; are all fields required? How does MAREA cope with missing data/fields, and can it still be used to calculate some indicators? see also comments 2 and 5), and of how these data is used to calculate indices. How is, for example, social impact of reserve calculated and which specific data are needed?*

*I understand that this is a lot of information, but could be summarised in tables or perhaps given in a supplementary document, as sampling protocol, data collection and indices calculation are fundamental steps of the process and all ensure standardisation and comparability of results.*

The paragraph has been generalized to explain how biological data is commonly collected for any marine reserve.

As per expanding on other topics regarding data collection and formatting, we have included a reference to [MAREA’s guidebook](#) [2]. The guidebook thoroughly explains sampling designs, monitoring protocols, and data formatting and handling, as well as calculation of indicators. The document –also accessible through MAREA’s interface in English and Spanish– is written in a non-technical language to allow interpretation by non-expert users.

#### Comment 1.5

*Eqn. 1. – the model requires a large amount of observations and data to trustfully estimate the effect of 6 plus covariates on one indicator. As mentioned in comments 2 and 4, more details on data needed should be provided. Also, data availability should be discussed or mentioned as a potential issue when MAREA is used for other case studies.*

A paragraph on limitations to estimate coefficients of Eqn. 1 due to data requirements has been included in the discussion. We explain two sources of limitations (absence of BACI design or lack of enough data to estimate coefficients in Eqn. 1), and discuss how these can be avoided by properly accounting for data requirements during the design and implementation of a reserve.

*Please use before-after instead of pre-post implementation for consistency through the text (or vice versa).*

All instances of pre- and post- have been changed for before and after, respectively.

#### Comment 1.6

*Line 201-204 - this is quite important and I was wondering how MAREA would estimate governance indicators since those were first mentioned. It would be best to introduce this qualitative/quantitative distinction early on (somewhere in paragraph in line 130?)*

We agree that it is important that the reader identifies these differences early on the text. A brief example of quantitative and qualitative indicators has been included in the suggested paragraph. However, we believe it is better to leave the specificities of data types and analyses of each to the “Data and analysis” section.

#### Comment 1.7

*Line 205 – this section is very clear and helps to understand the practicality of the application. Only if feasible, it would be nice to move it just after the introduction and then delve into all the details of the data and models.*

We agree that this section provides an overview of the practicality of the application. This section preceded others in an early version of the manuscript. However, it also mentions the results generated, and refers to the coefficients that determine the colors in the scorecard. While the paragraphs that outline the application could be moved just after the introduction, we believe it is better to have an entire section dedicated to the tool’s environment and results.

#### Comment 1.8

*Line 366 - MAREA was built and is focused on objectives and sampling design related to marine reserves in coastal areas of Mexico, but here and through the paper it is stated that the application can be used around the world. Although this may be true, it should be stressed that the application may need adjustments (e.g. addition of other marine reserve objectives and therefore indicators) to meet the needs of fishers and managers in other regions, and that it should be further tested on other case studies before being considered a user-friendly tool for fishers and managers around the world. Adjustments such as the addition of other marine reserve objectives and therefore indicators (as briefly touched in line 423) require the work of scientists rather than fishers and managers.*

This first sentence of the discussion has been changed to: “We have developed and presented a user-friendly, automated approach for evaluating the effectiveness of marine reserves in Mexico, and perhaps around the world”. Moreover, we have expanded on the world-wide applicability of MAREA in the paragraph (previously) starting in line 423 by stating that further testing in other areas should take place. Also, the last paragraph of the discussion touched on the long-term utility of the tool, and now mentions additions and modifications that may be included in subsequent releases of the application to improve its applicability and ease of use.

#### Comment 1.9

*The discussion is balanced and considers strengths as well as limitations. Besides comment 8, I would just suggest to add few sentences on the importance of sampling protocol and data input for a correct interpretation of MAREA outputs, and hence problems related with data availability (based on comments 2,4, and 5).*

As stated in Comment 1.5, the discussion now includes a paragraph on limitations related to data availability and sampling protocols.

#### Other minor comments:

*Line 45 – could ‘protected’ be deleted? it is repeated in MPA*

The suggestion has been included.

*Line 48 – other factors, such as? Please expand.*

We have included two examples of factors that might confound a reserve’s effect if no control sites are used. Szuwalski et al. [3] show how removal of predators can have cascading effects that result in large-scale increases in system productivity, which can sustain high levels of fishing effort and mask the true levels of overexploitation in a system. Chavez et al [4] describe how basin-scale oscillations in environmental variables can drive changes in productivity, having differential effects on fish stocks.

*Line 55 - Can idiosyncratic be simply ‘different’?*

The suggestion has been included and idiosyncratic has been changed to different.

*Line 166 - Isn't this always the case, as long as sampling is standardised between control and impact and through time?*

It is true for all numeric biological indicators. Indicator B5 “Natural Disturbance” is not numeric, and is thus not analyzed with the generalized linear model. This was a misunderstanding caused by the phrasing and has been fixed by removing reference to Indicator B5 and simply stating that the approach is used on all numeric biological indicators.

## Reviewer #2

*Overall I find this manuscript well-structured and clearly written – it really was a pleasure to read it - and the topic both novel and of broad interest. The manuscript is somewhat unusual in that it presents a framework and an online tool directed towards management rather than posing and investigating a specific research question. The authors have identified a large number of ecological, socio-economic and governance-related indicators, and developed an online tool for stakeholder-driven evaluations of the effectiveness of marine reserves. This tool has a great potential not only for improving the management of marine reserves, but also for advancing research by providing a structure for data collection and a generic framework for analysis.*

### Comment 2.1

*43: Stating that the effects of marine reserves are “mixed” gives an overly negative impression as a vast majority of studies demonstrate positive effects. Could you rephrase this sentence a bit?*

We have removed this statement from the paragraph.

### Comment 2.2

*79: There is no need to mention that the tool is “user-friendly” at every possible instance*

We have reduced the number of times that “user-friendly” is used to the minimum.

### Comment 2.3

*79-80: Marine reserves may in many cases regulate other activities than just fisheries. It would therefore be useful to clarify here, or elsewhere, that in your case only fisheries are considered*

We have included a statement indicating that MAREA is meant to evaluate the effectiveness of no-take marine reserves in terms of fisheries and marine conservation objectives. This is now aligned with our first paragraph of the introduction and the list of objectives presented in the “*Marine Reserve objectives and indicators*” section.

### Comment 2.4

*100-101: For many marine reserves clearly stated objectives may be missing. It would be useful with some consideration (in the Discussion section) of how to deal with these situations. Is it fair, as suggested in the manuscript, to assume that the objectives are the same in all marine reserves?*

It was not our intention to imply that marine reserves are implemented to achieve all the objectives listed. Instead, we propose that any reserve might have been implemented to achieve at least one or more of these objectives. The text in those lines has been modified to reflect this. Furthermore, the discussion section now touches on limitations of the proposed objectives and indicators.

#### Comment 2.5

*103: Rather “recovery of”*

The suggestion has been incorporated.

#### Comment 2.6

*106: “suggests”*

We have changed “suggest” to “suggested”.

#### Comment 2.7

*122-123: You refer to a literature review without providing any information on what literature you included. Can you provide more information on the review in an appendix for example, as you do for the governance part?*

We have included the citation to the main literature from which we drew our indicators. In the case of biological and socioeconomic indicators, the reasoning is much simpler than for Governance indicators, and thus we believe there is no need to further expand this in an appendix. For example, if the stated objective is to “*Recover species of economic interests*”, it is intuitive to use indicators that measure the abundance of the resource (*i.e.* Biomass or Density).

#### Comment 2.8

*124: Removing potential indicators from the list, because data was not available in Mexico may perhaps make the list less generic and more difficult to apply to other parts of the world. A discussion on this question would be fair.*

This point is in line with comments by Reviewer #1 (Comment 1.8), and we agree that further discussion on this would be fair. We believe that the eighth paragraph of the discussion now addresses the shortcomings related to the fixed list of objectives and indicators identified for Mexico.

#### Comment 2.9

*Table 1: B3 and B4 may miss some density-related objectives of marine reserves, for example relating to the density of very large fish (important for example for the reproductive output, and/or for sport fishing) or relating to the reproduction (density of juveniles). Maybe you can expand a bit on this question?*

Indicators B3 (Density of mature organisms) and B4 (Density) attempt to measure these important density-related objectives of marine reserves, but in different ways. Indicator B3 is meant to look only at the density of organisms above length at first maturity, which is important for the reproductive output, as noted by the reviewer). Indicator B4 simply looks at the overall density of a species, regardless the life stage of their individuals. We have expanded on this on the paragraph leading to Table 1.



#### Comment 2.10

*Table 2: Correct spelling of “allways”. Also, could you rephrase the sentence, since it is not clear what you mean by “should always be used”*

This comment was also brought up by Reviewer #1 (Comment 1.3). We have corrected the typo and included more information in the paragraph leading to Table 2, to explain why all governance indicators should be used regardless of the objectives of the reserve.

#### Comment 2.11

*170: As far as I can judge you do not use any “before”-data in the analysis, i.e. you have used a control-impact approach comparing the difference in slope between sites after the implementation of the reserves. Is this correct? Still you refer to a study by Moland et al at several instances, although they have used a BACI-design, and this is obviously confusing.*

We are using a BACI design with one sampling event before the implementation of the reserve (total of 42 transects distributed between reserve and control sites). We have modified the second paragraph of the “Case Study” section to reflect that reserves were implemented after the first sampling event: “In 2006, the Isla Natividad community implemented two community--based marine reserves within their TURF after establishing a baseline for the soon--to--be reserves and control sites”.

#### Comment 2.12

*192: change spelling to “coefficients”*

The spelling error has been fixed.

#### Comment 2.13

*193: I was not familiar with the term “heteroskedastic–robust standard errors”. Could you please provide a reference/explanation?*

We have included a reference addressing heteroskedastic-robust standard errors in the text [5].

#### Comment 2.14

*210: A translation widget is of course helpful, but if you want the app to become widely used you would need to spend a little time on producing an English version as well. There is always a risk of misunderstandings if automatic translations are used.*

It is true that online translation services still exhibit discrepancies and ambiguities, especially when context-dependent meanings are not identified. However, this is less of a concern within MAREA, where full sentences are largely absent. Instead, it is only needed to translate individual and unambiguous words (*e.g.* Biomasa into Biomass, or Densidad into Density). In this sense, most of the translation is accurate enough to allow interpretation of the results; this is especially true when translating into English, but less so in other languages.

However, it is worth mentioning that it is in our best interest to provide a better experience to all users, and a full translation into other languages will be part of subsequent releases. Further development of MAREA will address important accessibility features, like color-blind friendly colors. For now, we have touched on this issue in the last paragraph of the discussion.

#### Comment 2.15

*214-215: You say that “Users can also manually modify selected indicators based on their interests and data availability”, which sounds like a very useful function. Could you add some sentence to explain how this is done, since this will probably be a part of central interest for many readers?*

We have explained how users can select or deselect indicators by “clicking” on the checkboxes next to each indicator.

#### Comment 2.16

*Fig 3: For improved clarity, please make the rectangle in the left-hand map an exact match to the enlarged right-hand map.*

We have adjusted the map so that the black rectangle in the reference map matches the bounding box of the right-hand map (*i.e.* xlim = c(-115.22, -115.14), ylim = c(27.85, 27.90)).

#### Comment 2.17

*Fig 4: The scorecard needs to be translated into English*

The scorecard was translated into English

#### Comment 2.18

*Table 3: Model-based estimates of effect sizes (where the effects of environmental variability has been removed), for example expressed as % change over time of the indicator, would be a valuable addition to the information already provided by Marea. Is it possible to either add that information to the results section or bring up the potential need for that kind of metric in the discussion.*

It is not feasible to incorporate such changes in MAREA for the first release. However, we do consider it important to provide information in different ways that allow broader interpretability of the results. Expressing effect sizes as % can certainly be incorporated in further releases of MAREA. As suggested, this has been incorporated in the discussion as a future improvement of MAREA.

#### Comment 2.19

*366: The discussion would gain from a short comparison of MAREA to other similar initiatives, such as the “How is your MPA doing?” mentioned in the introduction, to illustrate potential merits and possibilities for further development.*

We have included a paragraph in the discussion, where we explain the value of past contributions and how we build up from them to assist in management. We also touch on how open science may help address technical gaps by connecting researchers with resource managers.

#### Other modifications

- Multiple instances of hyphenation have been corrected to use proper dashes.
- We have performed a modification to Table 2, which matched objectives to the wrong indicators. This problem was caused during the preparation of the manuscript, when the first column of said table was sorted alphabetically, but all other columns were not modified. Table 2 now accurately represent the relation between objectives and indicators.

## References

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