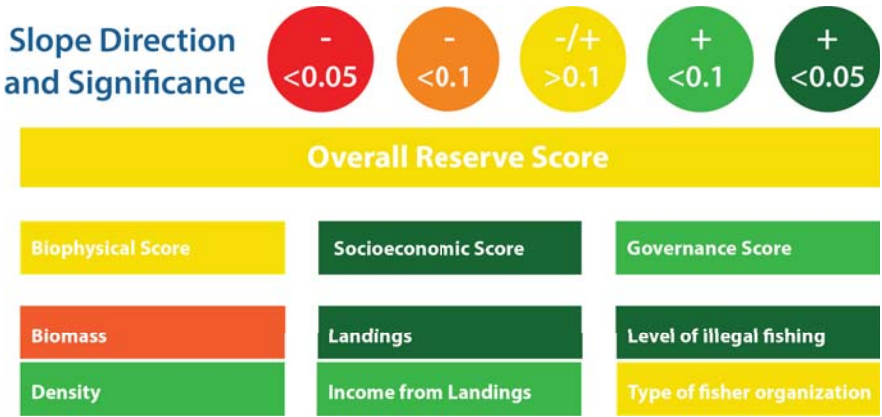
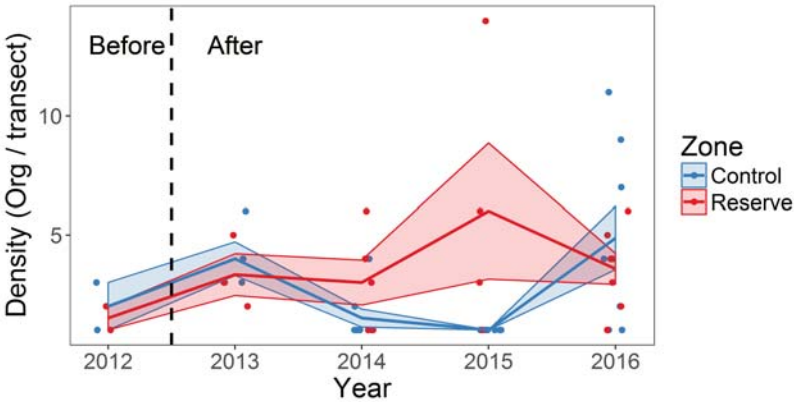




The app produces a color-coded scorecard that helps users interpret results at a glance.



MAREA also generates a technical report that includes graphs of each indicator and regression tables.



CONCLUSION

This framework will be used by COBI and fishers to analyze the effectiveness of existing and future no-take marine reserves. INAPESCA (Mexican fisheries research institute) is interested in implementing our framework as the go-to way of analyzing all no-take marine reserves in Mexico.

Though our framework is designed for Mexican no-take marine reserves, we believe that the methodology of how to select indicators, collect data, and perform appropriate analyses can be applied to no-take marine reserves worldwide. The provided list of biophysical, socioeconomic, and governance indicators, and the real-world examples of how to evaluate reserve success based on these indicators, are applicable to small-scale fisheries across the globe.

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A Framework to Evaluate the Effectiveness of No-take Marine Reserves in Mexico

On the web at www.turfeffect.org

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Comunidad y Biodiversidad A.C.

BACKGROUND

The oceans sustain significant impacts from fishing activities. No-take marine reserves are often implemented to recover overfished stocks worldwide. Comunidad y Biodiversidad (COBI) is an NGO that aims to promote marine conservation by facilitating the participation of fishermen in the design and management of community-based marine reserves in Mexico. COBI has been involved in the creation of 29

community-based no-take marine reserves (21,106 hectares) distributed among 13 different communities in the Gulf of California, Pacific coast of Baja Peninsula, and the Caribbean. They also collaborated with government agencies to design and monitor 10 Marine Protected Areas (617,703 hectares) with no-take marine reserves (58,348 hectares) within their perimeters.



PROBLEM STATEMENT

The extent to which these reserves have met their stated objectives is unclear. Current methods for reserve evaluation are not standardized and rely solely on biological data, excluding socioeconomic and governance dimensions. Existing frameworks

provide a list of possible indicators to evaluate the effectiveness of MPAs, but they are not specific to reserves and do not describe how to select indicators based on reserve objectives nor provide a tool to analyze these indicators.

PROJECT OBJECTIVES

The main objective of the project was to build a framework that enables fishers and managers to evaluate the effectiveness of no-take marine reserves in Mexico.



APPROACH

To achieve our objectives, we divided our project into five steps:



1 Reserve objectives

We developed a framework to evaluate the effectiveness of reserves by matching commonly-stated management objectives to a set of biophysical, socioeconomic, and governance indicators. The list of objectives was identified through a literature review of official documents, regulations, management plans, and decrees. While each reserve -or set of reserves- has its own goals, seven main objectives were identified:

1. Avoid overexploitation
2. Conserve species under a special protection regime
3. Maintain biological processes (reproduction, recruitment, growth, feeding)
4. Improve fishery production in nearby waters
5. Preserve biological diversity and the ecosystem
6. Recover overexploited species
7. Recover species of economic interest

2 Indicators

Indicators were collected through a scientific literature review. Stakeholders from fishing, management, and NGO sectors then reviewed our list of indicators. Biophysical indicators include those that are collected through ecological monitoring of the reserve and control sites.

Socioeconomic indicators measure the performance of the fishery. Governance indicators compile information about the governance under which each community operates.

Biophysical Indicators

1. Total Biomass

2. Objective Species Biomass

3. Total Density

4. Objective species density

5. Density of mature organisms

6. Mean trophic level

7. Richness

8. Shannon diversity index

9. Natural disturbance

Socioeconomic Indicators

1. Income from total landings

2. Income from obj. species landings

3. Total landings

4. Obj. species landings

5. Alternative economic opportunities

Governance Indicators

1. Access to the fishery

2. Illegal harvesting

3. Internal regulation

4. Legal recognition of the reserve

5. Management plan

6. Membership to fisher organizations

7. Number of fishers

8. Perceived effectiveness

9. Reasoning for reserve location

10. Representation

11. Reserve enforcement

12. Reserve type

13. Size of the reserve

14. Social impact of reserve

15. Type of fishers organizations



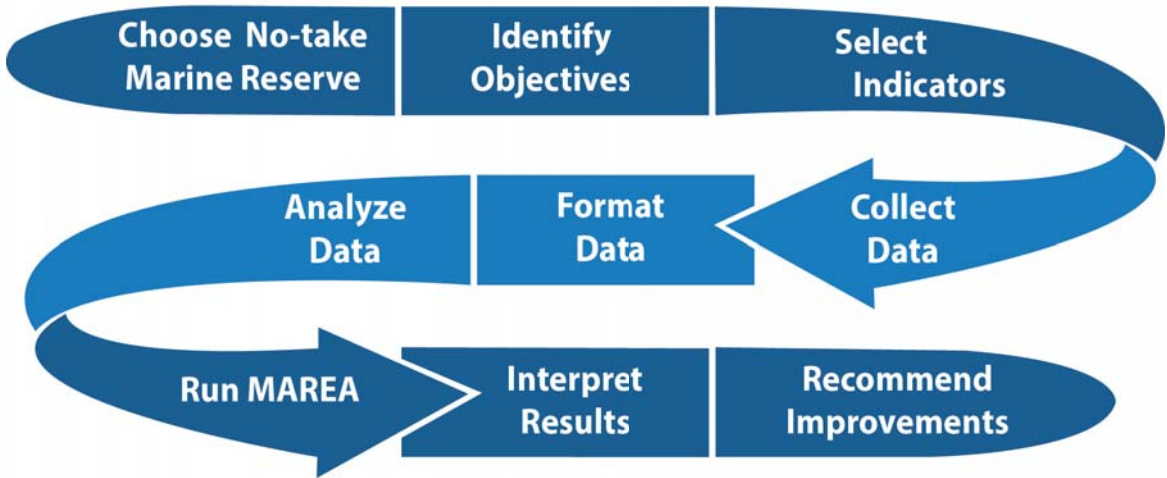
3 Analyses

We developed a set of standarized methods to analyze each type of indicator:

- **Biophysical** indicators are evaluated with a Difference-in-Difference analysis, estimating the net effect of the reserve.
- Linear regression models are fitted to **socioeconomic** indicators through time, testing for the difference in trends before and after the implementation of the reserve.
- **Governance** indicators are analyzed based on literature, identifying common governance structures and their associated effectiveness.

4 Guidebook

We created a guidebook that walks fishers and managers through implementing our framework. The guidebook describes how to match the objectives of their reserves with our proposed indicators. It then describes how users can collect and analyze data for each indicator, interpret results, and provides recommendations for how to improve reserve effectiveness.



5 MAREA

We developed a user-friendly application named MAREA (Marine Reserve Evaluation Application) that automates the necessary analyses to evaluate the effectiveness of the marine no-take reserves.



turfeffect.shinyapps.io/marea/