

It is crucial to note that there is a window of time in all evaluated marine reserve network scenarios where catch is less than the business as usual scenario, also known as the transition period. This period will likely be challenging for local communities where small-scale fishing is a common form of employment and critical to local livelihoods. We suggest a portfolio of responses to help alleviate this inevitably challenging transition period; however, expert knowledge should be called upon to proactively address this transition period.

**1. Improve monitoring and enforcement:** Illegal fishing contributes to overfishing. We recommend that the local government enforce laws governing illegal fishing, and both monitor and enforce marine reserve boundaries.



**2. Coupled management:** Pairing a marine reserve network with other management programs will increase regional fish biomass and subsequent catch. Realigning incentives through rights-based fisheries management could be explored.



**3. Alternative livelihoods:** Some fishers could be displaced or lose their jobs as a result of marine reserve network implementation. The local government could consider implementing local job training and assistance programs to help fishers transition into new industries.



**4. Technology:** There are many technological advancements that can be used to increase the value of regional fish catch, such as sophisticated refrigeration systems. Fishers can sustain their livelihoods with less catch when market value is enhanced, thus reducing overall ecosystem impacts.



## ACKNOWLEDGEMENTS

We would like to express our gratitude to our client Comunidad y Biodiversidad (COBI), specifically to Stuart Fulton and Jorge Torre Cosio. We would also like to thank our faculty advisor Dr. Hunter Lenihan, PhD advisor Erin Winslow, external faculty advisor Dr. Chris Costello, and our project advisors at the Sustainable Fisheries Group: Dr. Reniel Cabral, Dr. Chris Free, Juan Carlos Villaseñor-Derbez, and Tracey Mangin. Finally, we would like to thank the staff and faculty at the Bren School of Environmental Science & Management.

# PROS IN PROCRASTINATION?

## Consequences of delaying marine management

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## ABOUT THE PROJECT



The Gulf of California has been historically characterized by high levels of marine biodiversity and productive small-scale fisheries. These characteristics are threatened by overfishing. Enhanced marine management is needed to reverse ecological degradation and sustain the ecosystem's capacity to provide goods and services, including vital fisheries. Marine reserves are a management tool that close off areas of the ocean to fishing, allowing fish inside the reserves to increase in size and number. Theoretically, spillover occurs when fish move across the boundary of a reserve where fishers can benefit. Comunidad y Biodiversidad (COBI) presented a marine reserve network design to the Mexican government in 2015 that would protect 5% of the Midriff Islands. To date, the marine reserve network has not been implemented.

## RESEARCH QUESTION

Trade-offs associated with marine reserves are believed to have played a key role in the network's delayed implementation; potential long-term gains in sustainable fishing and the conservation of biodiversity likely generate short-term losses in fishery revenue due to fishery closures. The trade-offs between conservation and livelihood led our team to ask: what are the consequences of delaying the implementation of a reserve network, and how much area should be protected to enhance both fish biomass and catch?

## Main Findings

- 1 A marine reserve network that protects 30% of the region will provide substantial benefits to conservation, food security, and livelihoods in the Midriff Islands. Benefits are further increased when illegal fishing is accounted for.
- 2 Procrastinating the implementation of marine reserves delays short-term losses in fishery catch, but decreases long-term ecosystem and fishery benefits.
- 3 There is a window of time in all evaluated marine reserve network scenarios where catch is less than business as usual. This transition period likely will be challenging for local communities. Therefore, the government should proactively enact policy measures to help alleviate the challenges of this transition period.



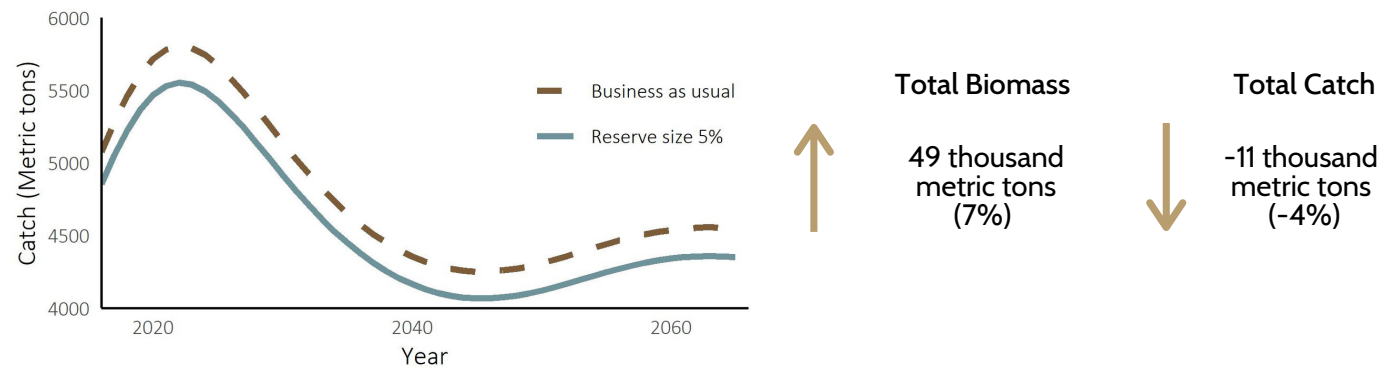
# 1 APPROACH

We developed a bioeconomic model to quantify the consequences of delaying the implementation of the marine reserve network on conservation (fisheries biomass), livelihoods (transition period), and food security (fish catch).

1. We assessed the stock status of 12 small-scale fisheries relative to maximum sustainable yield in 2015 via a catch-only stock assessment method. These 12 fisheries comprise over 90% of the total small-scale fish catch in the Midriff Islands.
2. We used our bioeconomic model to estimate how the biomass and catch of these 12 fisheries will change over a 50-year timeframe under different, and interacting, marine reserve scenarios:
  - A. Business as usual (BAU) where the marine reserve network is never implemented;
  - B. Reserve network size covering 5%, 30%, or 50% of the region;
  - C. Reserve network implemented in 2015, 2020, or 2030;
  - D. Illegal fishing is accounted for and/or addressed.

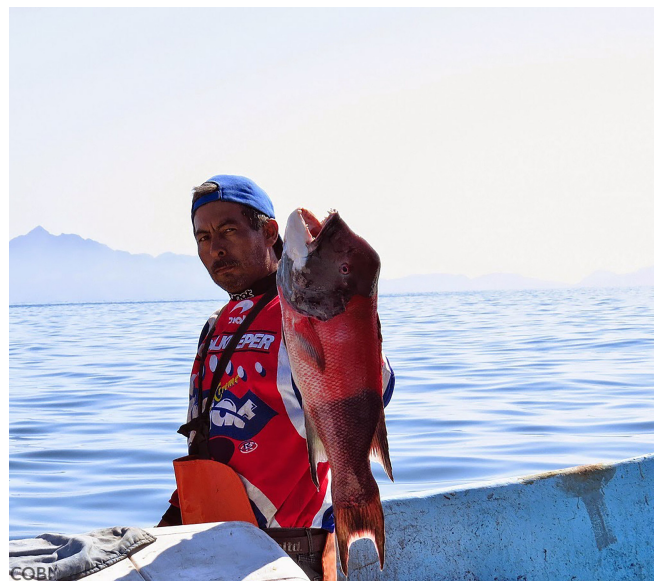
# 2 COBI'S MARINE RESERVE DESIGN

**5%** Implementation of a marine reserve network that protects 5% of the region does not provide livelihood nor food security benefits to local communities over a 50-year timeframe regardless of implementation date, unless illegal fishing is accounted for and addressed.



## Summary of COBI's Design

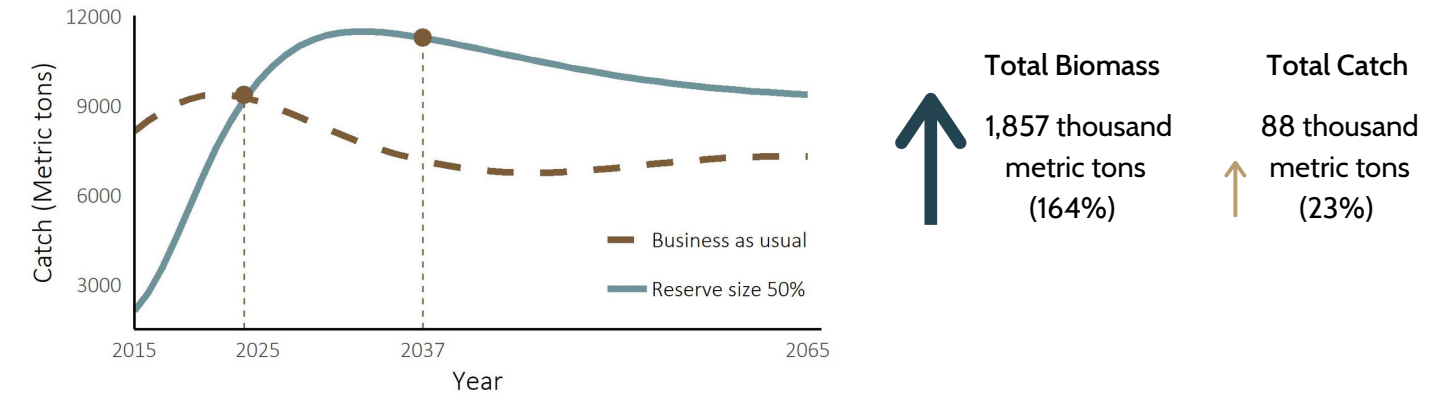
In this scenario, aggregate biomass increases in the 12 fisheries, but aggregate catch and profits decrease relative to business as usual in every implementation year. The catch lost from reserve network implementation is never recovered and local communities are not made better off.



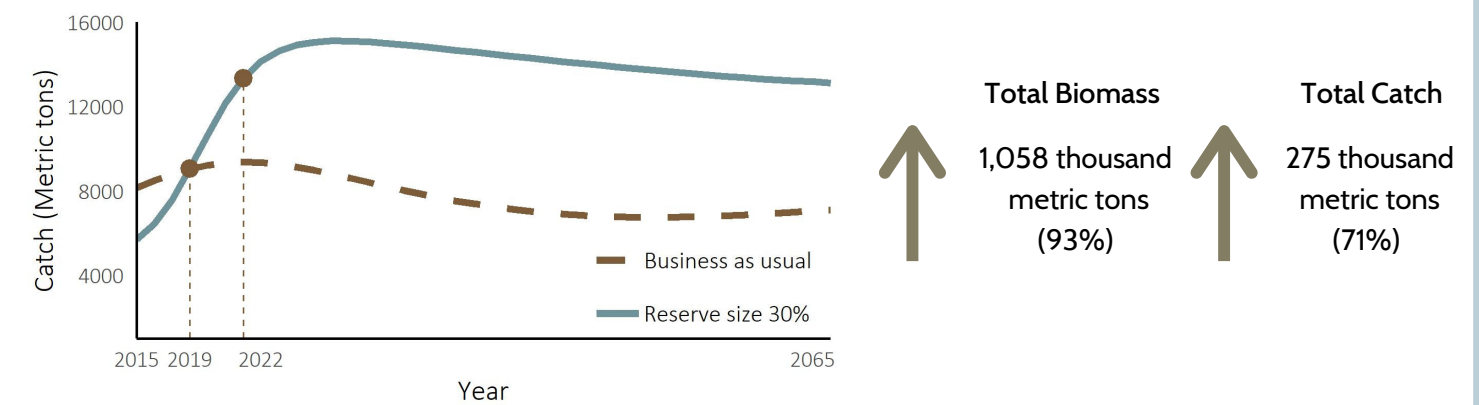
# 3 OPTIMAL MARINE RESERVE DESIGNS



**Conservation:** If the proposed design is increased to protect 50% of the region, implemented in 2015, and illegal fishing is accounted for and addressed, the transition period ends in 2025, and the lost catch due to the closure of fishing grounds will be recovered by 2037.



**Livelihood and Food Security:** if the proposed design is increased to protect 30% of the region, implemented in 2015, and illegal fishing is accounted for but not addressed, the transition period ends in 2019, and the lost catch due to the closure of fishing grounds will be recovered by 2022.



Note: Absolute and percent change of biomass and catch are aggregated from 2015-2065 relative to the business as usual result scenario (i.e. when the reserve network is not implemented).

## Take Aways

- 1 A marine reserve network can provide substantial benefits to conservation, food security, and livelihoods in the Midriff Islands under specific implementation year and size scenarios, and when illegal fishing pressures are accounted for and/or addressed.
- 2 COBI's proposed reserve network is not large enough to provide fishery benefits. However, protecting 30% of the area in marine reserves can help rebuild depleted fisheries, achieving conservation and food security goals.
- 3 The Midriff Islands region can still benefit from the future implementation of a marine reserve network that protects 30% of the region. However, the benefits to regional fish biomass and catch relative to business as usual are projected to decrease as implementation continues to be delayed. Benefits are maximized at the earliest implementation date.