

Carlton Supandi  
ENST 310  
Professor Ginsburg  
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## Under What Conditions Do Marine Protected Areas Improve Fisheries Outcomes, and When Do They Fall Short?

### Introduction

A marine protected area is a tool governments utilize to protect the ecosystems and the stability of diverse populations in the ocean. Focusing on MPAs in California, these invisible boundaries keep out boats and other harmful activities away from the area. Under the waters of these boundaries are divers collecting data and monitoring different factors like larger rockfish, denser schools, and more complex reef communities than those found in adjacent fished areas. On the surface, these MPAs seem to be the one size fits all strategy to improving fisheries. However, an important question remains. While ecological recovery within MPAs is increasingly documented, do these protected zones actually improve fisheries outcomes for communities that depend on them? Through using monitoring data and fisheries studies, this report will examine the conditions in which MPAs improve fish populations and ultimately support the fishery ecosystem. The report will also examine under which circumstances they fall short of those expectations.

### Ecological Outcomes Inside MPAs

Monitoring data from California's Marine Protected Areas indicate measurable ecological changes within reserve boundaries over time. In the first five years following implementation, the density of previously fished species increased by approximately 50% inside protected zones, while both the abundance and body size of predator species were significantly greater inside reserves compared to adjacent unprotected areas (Grundy and Garcia 2023). These findings suggest that reduced fishing pressure allows exploited species to recover not only in numbers but also in population structure.

Looking at the long term monitoring trends, it clearly supports the early gains mentioned previously. Shown in Figure 1, the diversity indices from 2007-2020 show that there is a higher diversity value inside MPAs compared to reference sites. Diversity within protected areas increased steadily through the early 2010s, peaking around 2013–2014 before declining in later years, this however would most likely reflect environmental changes

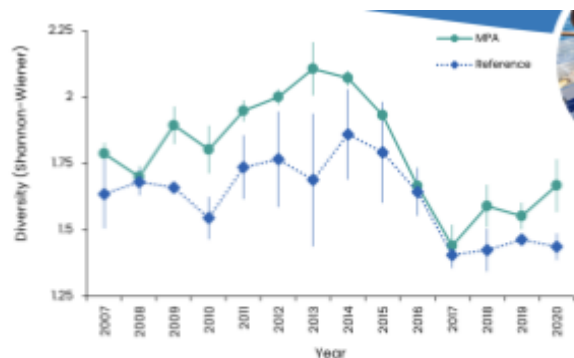


Figure 1. Shannon–Wiener diversity index for fish communities inside Marine Protected Areas and adjacent reference sites from 2007–2020. (“MPA Management Program”)

rather than a reserve failure. Critically, MPAs show that maintained sites have higher diversity levels than unprotected areas across the years in the data.

Also mentioned by Grundy and Garcia, the increase in predator size and density is ecologically meaningful because larger individuals tend to produce more offspring and in turn, have a top down control within the food webs. With these factors taken into account, the results indicate that MPAs can rapidly alter community structure, and increase overall ecosystem health within their boundaries. However, these recoveries are only seen within the barriers of the MPAs. The benefits that these would benefit areas outside the protected zones remains a separate and more complicated question.

### **Spillover Studies**

Scientific evidence showed that MPAs can present measurable ecological changes within their boundaries, especially when protection is strong and long term. A recent analysis of large MPAs found an increase in biomass within protected areas and detectable spillover effects into nearby fisheries. Fishing methods like purse seine fisheries that target tuna saw a higher catch per unit effort (CPUE) by around 12-18% near the boundaries, with a decline as distances from the MPA increases (Lynham & Villaseñor-Derbez, 2024). This findings highlights that a well designed and effectively enforced MPA can rebuild fisheries that were exploited and help the overall ecology further out of the MPAs.

Similarly, long term evaluations of MPA networks show that fully protected reserves tend to have stronger ecological responses than partially protected areas. Through using a before and after control impact approach, harvested fish species displayed significant increases in both density and biomass inside fully protected MPAs compared to the reference sites (Thiault et al., 2019). The study also found that recovery was more pronounced for species that were previously targeted by fisheries, suggesting that reduced fishing pressure directly contributes to population rebuilding. These results emphasize that the level of protection plays a critical role in determining ecological success. When MPAs restrict extraction completely, they are more likely to support measurable increases in fish abundance, biomass, and overall community structure within their boundaries.

### **When do MPAs fall short**

Although MPAs have shown measurable gains, they don't always deliver consistent fisheries benefits. One limitation that can be seen is when protection is weak or poorly enforced, they are just seen as "paper parks", where regulation exists, but there is no enforcement and individuals are not liable for damages, reducing the ecological recovery (Pendleton et al., 2017). Ecological factors can also constrain success. Spillover benefits depend heavily on species mobility, habitat continuity, and reserve design. If protected areas are too small relative to species' home ranges, or if habitat boundaries restrict movement, benefits to adjacent fisheries

may be minimal (Pinillos & Riera, 2022). Additionally, MPAs cannot fully buffer against external stressors such as climate change, warming waters, and pollution. With all the issues stacked together, these are the challenges that cause MPAs to fall short.

### **Conditions for success**

MPAs are most effective when specific design and management conditions are met. Fully protected, no take zones consistently have stronger increases in fish density and biomass than partially protected areas (Thiault et al., 2019). Long term enforcement and monitoring also determine success, as ecological benefits often strengthen over time and require sustained compliance. MPAs are also most effective when there are management tools in place such as catch limits, seasonal closures, and gear restrictions. When these are enforced properly, MPAs can support both ecosystem recovery and fisheries sustainability.

### **Conclusion**

Marine Protected Areas have shown clear ecological benefits, including increases in fish biomass, density, and overall community structure within protected boundaries. However, the evidence suggests that these gains do not automatically translate into improved fisheries outcomes. The effectiveness of MPAs depends heavily on the level of protection, enforcement, ecological design, and integration with broader fisheries management strategies. When thoughtfully implemented and maintained over time, MPAs can contribute to rebuilding exploited populations and strengthening ecosystem resilience. When poorly designed or weakly enforced, their impact is far more limited. We have to keep in mind that MPAs are not universal solutions, but when applied under the right conditions, they are an important and scientifically supported tool for sustainable fisheries management.

## Works Cited

- Grundy, Ben, and Karla Garcia. "A Photographic Tour of California's Marine Protected Areas." *Environment California*, 7 Apr. 2023, [environmentamerica.org/california/resources/a-photographic-tour-of-californias-marine-protected-areas/](https://environmentamerica.org/california/resources/a-photographic-tour-of-californias-marine-protected-areas/). Accessed 28 Feb. 2026.
- Lynham, John, and Juan Carlos Villaseñor-Derbez. "Evidence of Spillover Benefits from Large-Scale Marine Protected Areas to Purse Seine Fisheries." *Science*, vol. 386, no. 6727, 13 Dec. 2024, pp. 1276–1281, <https://doi.org/10.1126/science.adn1146>.
- "MPA Management Program." *Ca.gov*, 2022, [wildlife.ca.gov/Conservation/Marine/MPAs/Management/Decadal-Review%23566381264-2022-review-report](https://wildlife.ca.gov/Conservation/Marine/MPAs/Management/Decadal-Review%23566381264-2022-review-report). Accessed 28 Feb. 2026.
- Pendleton, Linwood H, et al. "Debating the Effectiveness of Marine Protected Areas." *ICES Journal of Marine Science*, vol. 75, no. 3, 31 Aug. 2017, pp. 1156–1159, [academic.oup.com/icesjms/article/75/3/1156/4098843](https://academic.oup.com/icesjms/article/75/3/1156/4098843), <https://doi.org/10.1093/icesjms/fsx154>.
- Pinillos, Fernando, and Rodrigo Riera. "The Influence of Boundary Habitat Continuity on Spillover from a Mediterranean Marine Protected Area." *Thalassas: An International Journal of Marine Sciences*, vol. 38, no. 1, 28 Jan. 2022, pp. 687–696, [link.springer.com/article/10.1007/s41208-022-00396-7](https://link.springer.com/article/10.1007/s41208-022-00396-7), <https://doi.org/10.1007/s41208-022-00396-7>. Accessed 1 Mar. 2026.
- Thiault, L., et al. "Ecological Evaluation of a Marine Protected Area Network: A Progressive-Change BACIPS Approach." *Ecosphere*, vol. 10, no. 2, Feb. 2019, <https://doi.org/10.1002/ecs2.2576>.