



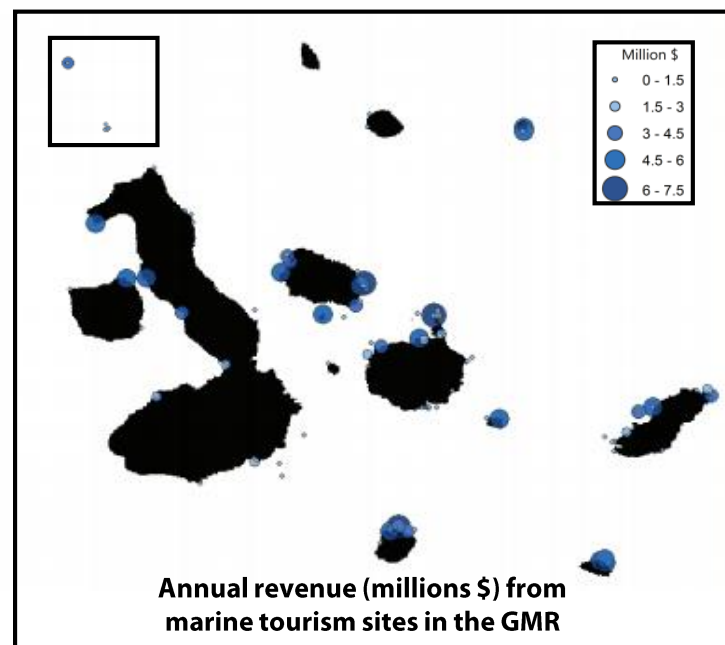
### Approach & Methods

We evaluated the spatial distribution of annual revenues generated by marine tourism at every site in the GMR. Using ESRI ArcGIS, we quantified the value of marine ecotourism and established the relationship between the number of visits to a marine tourism site and the ecological characteristics of each site. We used this information to identify three priority regions for the placement of NTZs based on the abundance of economically important species. We assessed the spatial distribution of fishing profits to understand the costs borne by fishermen due to the closing of sites in each hypothetical NTZ. Finally, we explored how to leverage tourist fees to offset the costs to the fishing industry and explored long term management options for NTZs.

## Research Questions & Results

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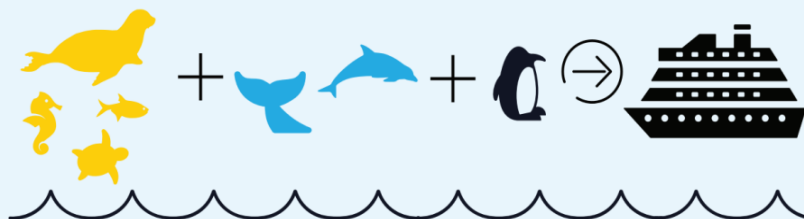
**How important is marine-based tourism to the Galapagos economy?** The GMR hosts over 839,000 tourist site visits annually. Both sites visits and revenues are distributed heterogeneously across the GMR. Marine-based tourism generates about \$178 million in annual revenues while land-based tourism generates about \$80 million in annual revenues.



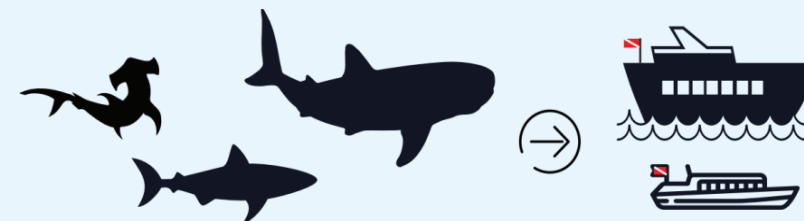
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**What factors influence the spatial distribution of marine-based tourism across the GMR?** There are three tourism categories: cruise ships, dive cruises, and daily diving. Total species richness, cetaceans, endemic species, and shark abundance are important to visitors and influence which sites they visit.

Tourists from cruise ships are disproportionately visiting sites with high total species richness, high occurrence of cetaceans, and high incidence of endemic species.

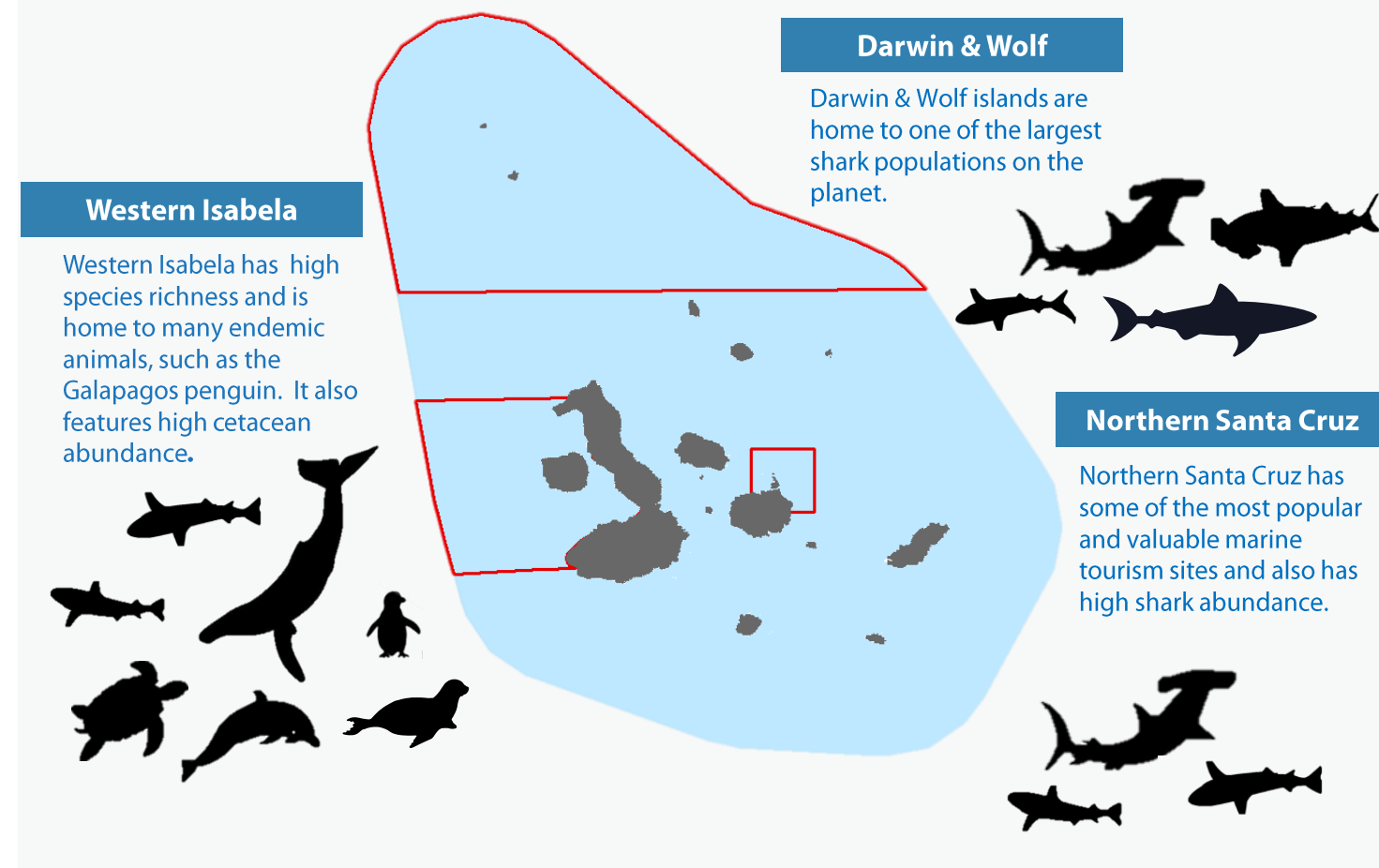


The number of visits from tourists in the dive cruise and daily diving categories was positively and significantly correlated with the relative abundance of sharks.



3

**Where should the government prioritize the placement of no-take zones to best benefit the Galapagos economy?** We used ecological data to identify which areas in the marine reserve to prioritize for conservation. These areas support the resources that attract tourists and contribute most substantially to the Galapagos marine tourism industry.



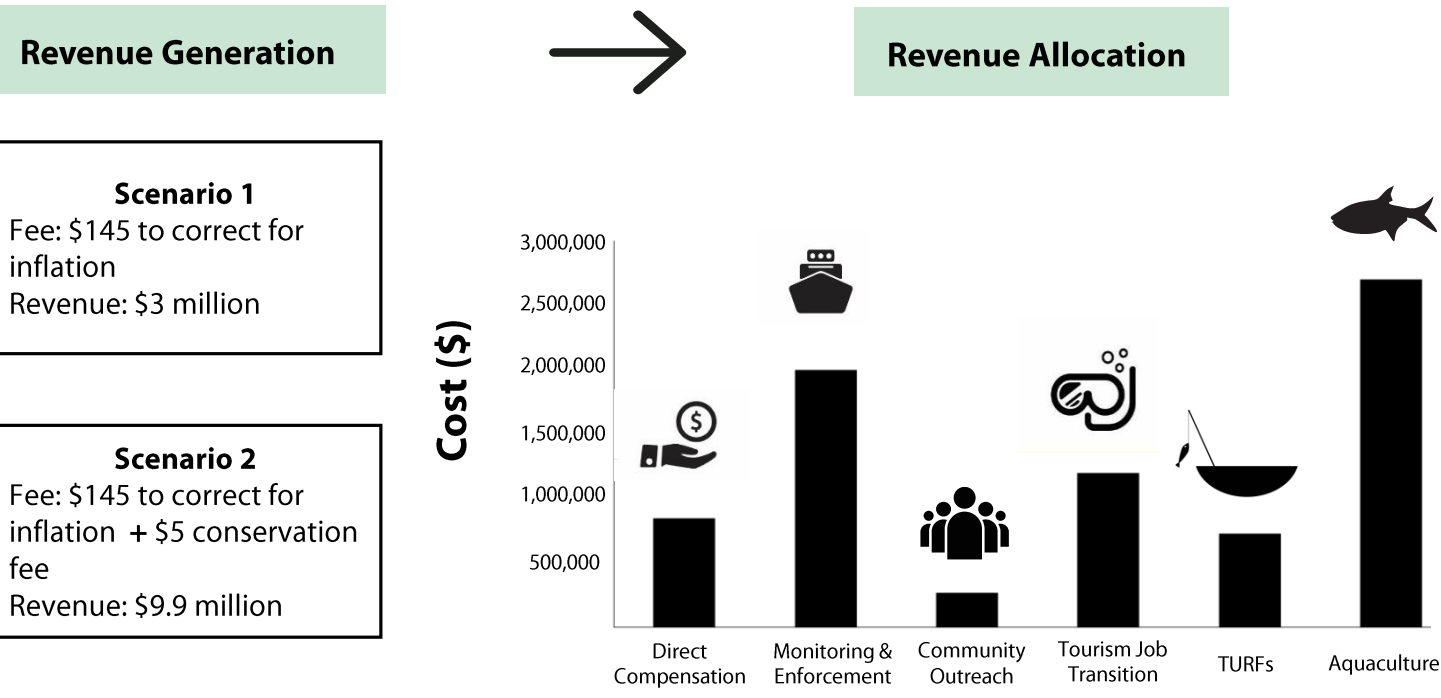
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**What is the cost and feasibility of implementing these no-take zones?** No-take zones reduce fishing grounds and consequently, profits, for fishermen. We estimated fishers' profit losses based on how much fishers currently profit from the three proposed NTZs.

The total cost to fishers of closing all three NTZs is \$200,000 per year. These profit losses can be completely compensated if every international visitor to Galapagos pays just one dollar extra upon entry.

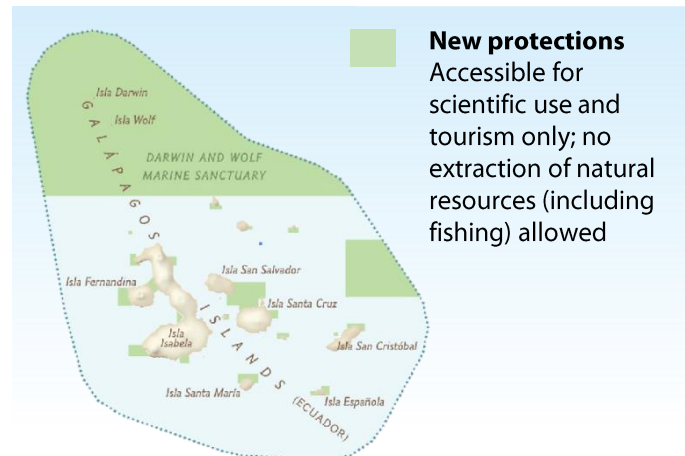
Total Cost		Cost per Area
\$97,830	<b>Darwin &amp; Wolf</b>	\$2.50/km <sup>2</sup>
\$98,260	<b>Western Isabela</b>	\$7.70/km <sup>2</sup>
\$4,660	<b>Northern Santa Cruz</b>	\$2.80/km <sup>2</sup>

**How can the direct costs to Galapagos fishers be offset?** There are many available options to offset fishers' losses and invest in effective conservation using revenue generated by tourist fees. Revenue can be generated over time by raising the current \$100 entrance fee for international visitors, which has not been adjusted since its introduction in 1998 (5% is allocated to GMR). We demonstrated how additional revenues from higher entrance fees could be allocated to directly compensate fishers, improve marine reserve monitoring and enforcement, and invest in long term projects that benefit the fishing community.



**March 21st 2016: Success!**

**No-take zones were established in the areas we identified for conservation. Now, 44,000 square kilometers, or one third of the area of the Galapagos Marine Reserve, is protected.**



**Acknowledgements**

There are many people who assisted and supported us in this project. We would especially like to extend our gratitude to our faculty advisor, Chris Costello and our client, Enric Sala. We thank our external advisors: Steve Gaines, Daniel Viana, and Dan Ovando. Thank you to all of the people who supported us from the Galapagos National Park, the Charles Darwin Foundation, Conservation International, WWF, and the Ecuadorian Ministry of Tourism. In addition, we thank all the researchers and managers who collected and shared datasets that were the results of many years of hard work.

1) Ficha Galapagos. 2014. Ministerio de Turismo del Ecuador. 2) Epler. 2007. "Tourism, the Economy, Population Growth, and Conservation in Galapagos." Charles Darwin Foundation. 3) Carr et al. 2013. "Illegal Shark Fishing in the Galapagos Marine Reserve." Marine Policy. 4) Lynham, Costello, Gaines, and Sala. 2015. "Economic Valuation of Marine and Shark-Based Tourism in the Galapagos Islands." Photo credit: Enric Sala, National Geographic; Tim Laman, National Geographic; Juan Mayorga, Bren School of Environmental Science & Management; Galapagos Conservation Trust. Map credit: Lauren C. Tierney, National Geographic. Contact us: www.natgeomar.weebly.com or geomar@lists.bren.ucsb.edu

**FINDING A PLACE FOR CONSERVATION**

A bioeconomic analysis to inform the rezoning of the Galapagos Marine Reserve

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**Overview**

The Galapagos Marine Reserve (GMR) is one of the largest in the world, encompassing 138,000 km<sup>2</sup>. However, until 2016, only 1% was protected from extraction. Our project examined the feasibility of increasing no-take zones (NTZs) as a management strategy to ensure the long term protection of the archipelago's ecologically and economically important marine resources. We evaluated the spatial distribution of revenues from tourism and fishing and the ecological characteristics of the marine reserve that draw hundreds of thousands of visitors to Galapagos every year. Our economic analysis led us to identify three priority areas for the implementation of NTZs. Further, we explored how costs of NTZs borne by fishermen could be offset by leveraging fees on international tourists. Ultimately, our results influenced the rezoning process – on March 21st, 2016, NTZs were implemented in the priority areas we had identified.

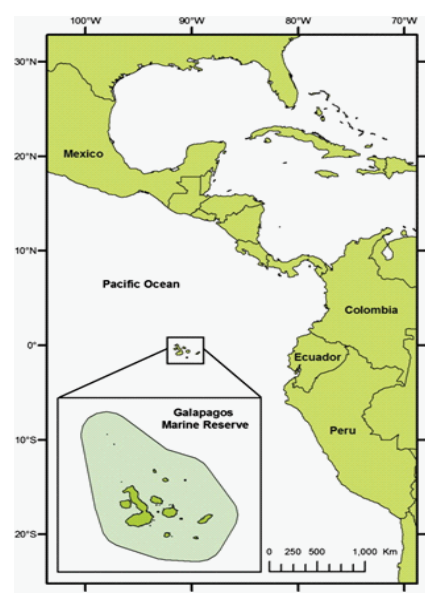
**Project Motivation**

The goal of our analysis was to provide information on the economic implications of rezoning the GMR, which was previously lacking protection. Through a series of biological and economic analyses we clarified the economic importance and costs of protecting the marine resources of Galapagos through the expansion of NTZs.

**Introduction**

**The Galapagos Archipelago**

Over 200,000 tourists visited Galapagos in 2014 to experience its distinct geography and unique assemblage of creatures. The islands are also home to a rapidly growing human population of over 20,000. Humans have significantly impacted the state of Galapagos marine resources. Overfishing has caused the collapse of the sea cucumber fishery, and the spiny lobster fishery is in decline. An estimated 105,000 tons of sharks have been harvested from Galapagos since 1950. Shark harvesting is illegal, but their high abundance and market value makes Galapagos a hotspot for shark fishing.



**Galapagos Marine Reserve**

Formal protection of the marine resources in Galapagos has been historically weak. The patchy nature of the few NTZs within the GMR has made monitoring and enforcement difficult. In 2015, the Galapagos National Park began the process of rezoning the GMR to improve protection of marine resources.

