REEF RESILIENCE | Motivating Investments in Coral Restoration

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THE PROBLEM

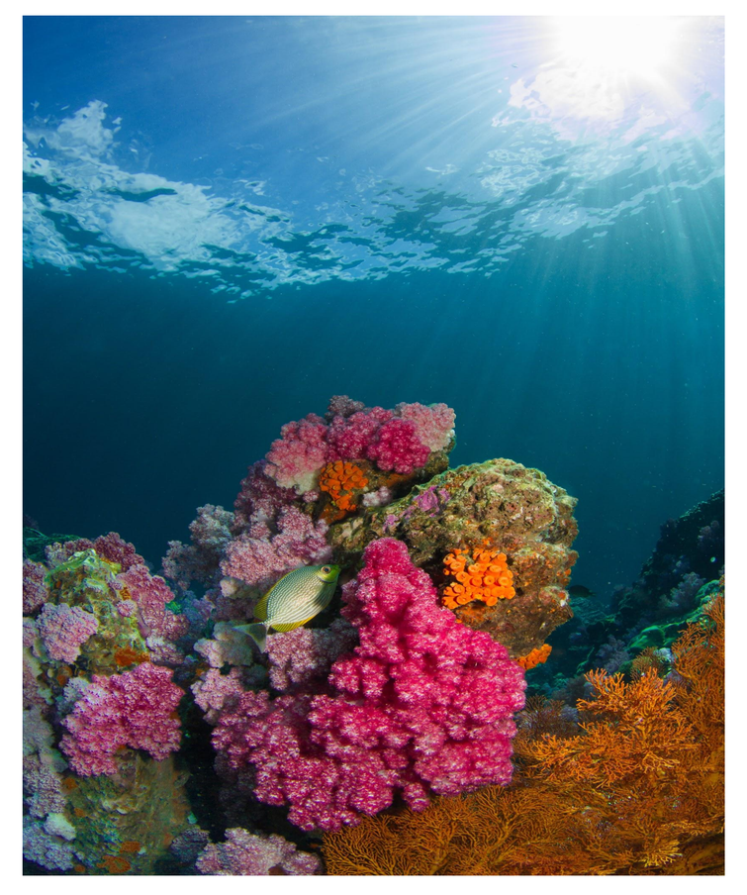
- Coastal communities are threatened by storm damage
- Climate change leads to storms increasing in intensity and frequency, which will also increase coastal property damage
- Grey infrastructure is the traditional solution to protect vulnerable coastal areas
- Nature-based solutions are an alternative, but are currently not utilized due to lack of information

NATURE-BASED SOLUTIONS

- Coral reefs can reduce wave energy by up to 97%[1]
- Coral reefs protect approximately 258,000 people, US$6 billion dollars of built capital, and 470 km^2 of land from flood damages[2]
- Coral reefs provide additional benefits such as ecotourism, recreation, fishing, and erosion control
- Hotels are an industry that benefit from coral reefs and can be targeted for investment

PROJECT SIGNIFICANCE

The results of our three objectives may be used to incentivize coastal property owners to invest in coral reef restoration not only for storm protection, but also for the ecotourism and beach preservation benefits coral reefs provide.



RESEARCH QUESTION

How do coral co-benefits impact hotel profit, and where are viable locations for future restoration efforts in the Caribbean?

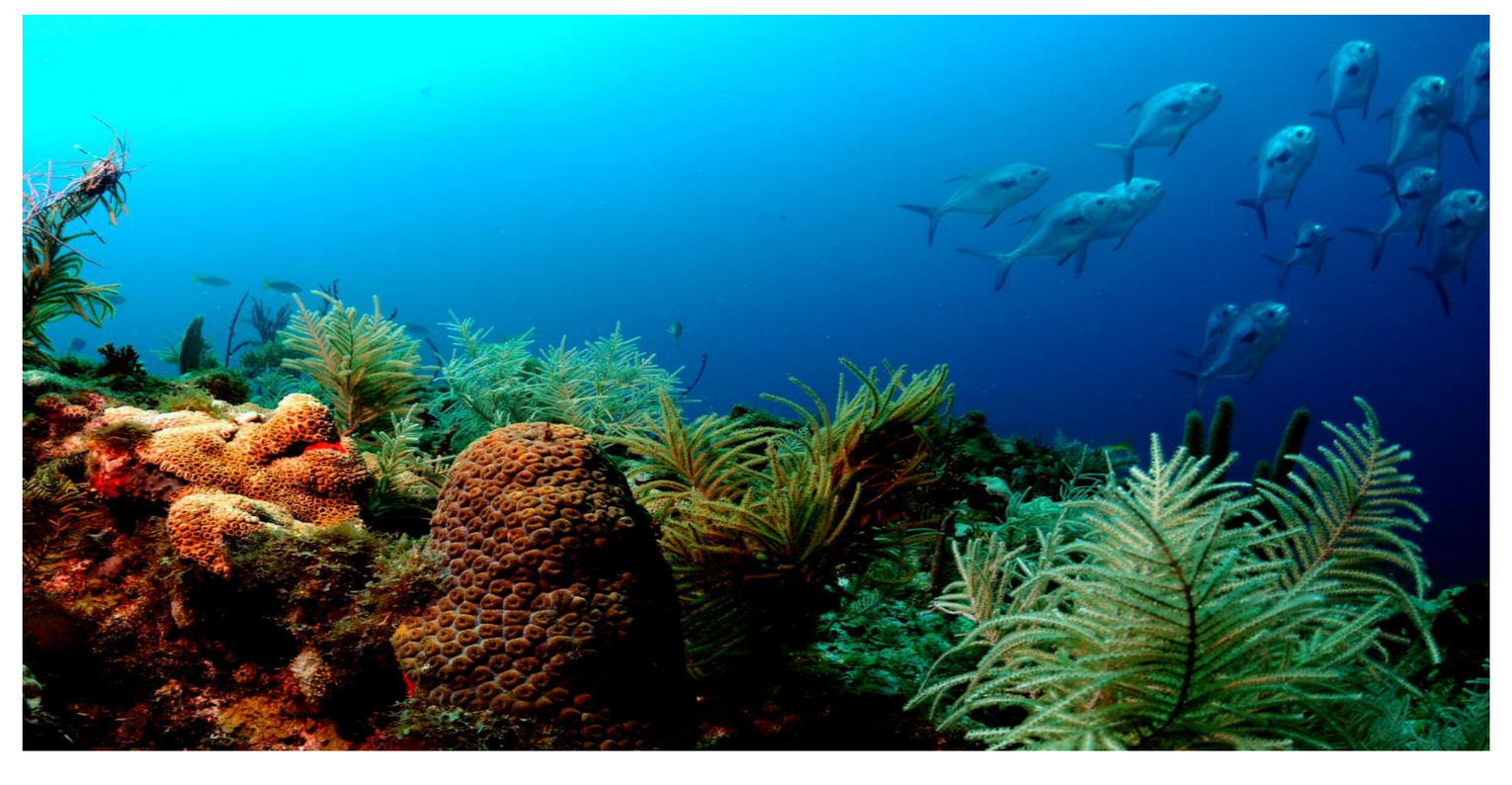
OBJECTIVES

Develop Approach for Valuing Coral Reef Co-Benefits

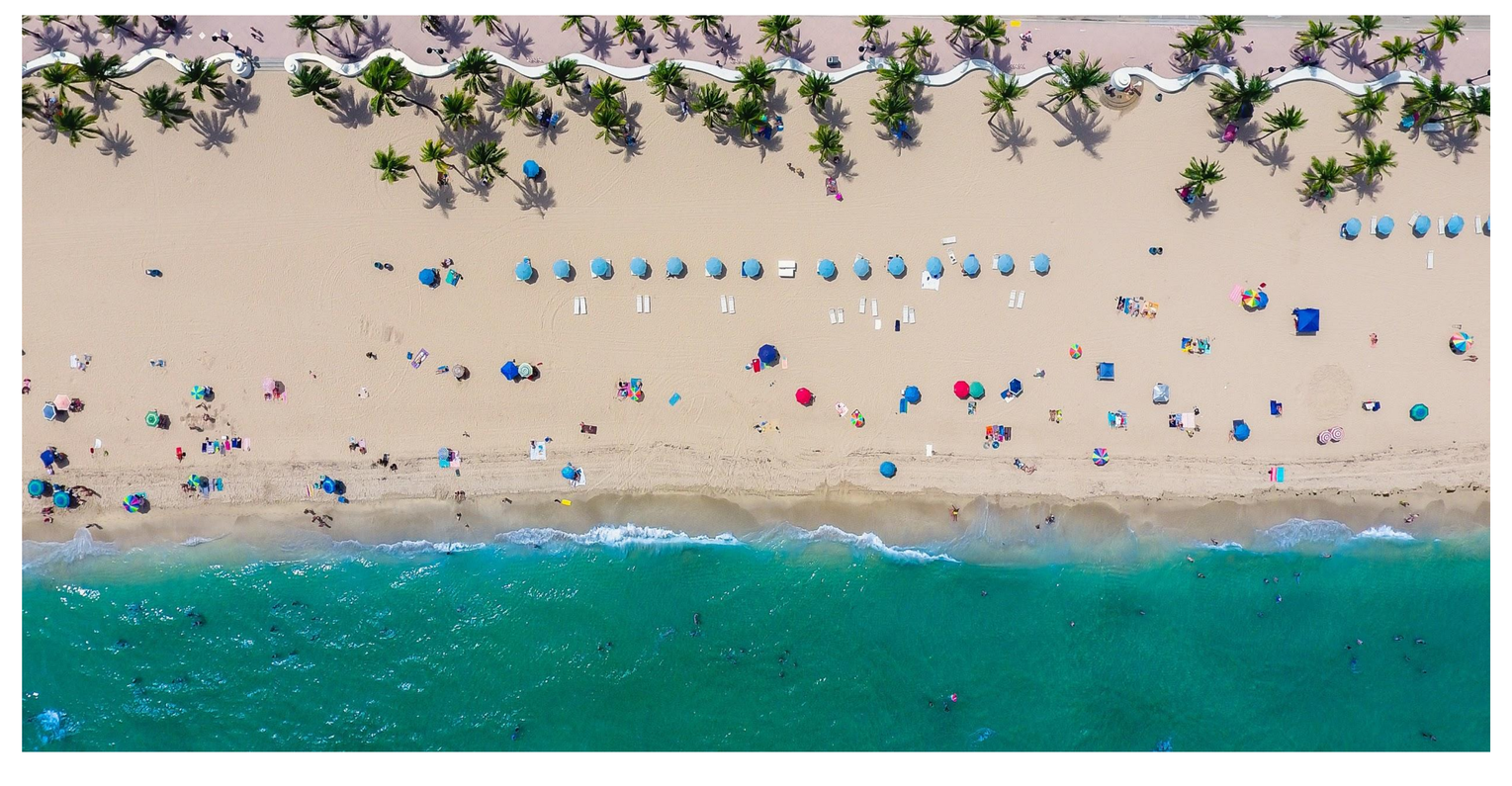
Determine Grey and Natural Infrastructure Cost

Identify Future Suitable Habitat for Coral Restoration

CORAL REEF CO-BENEFITS TO HOTELS



Ecotourism

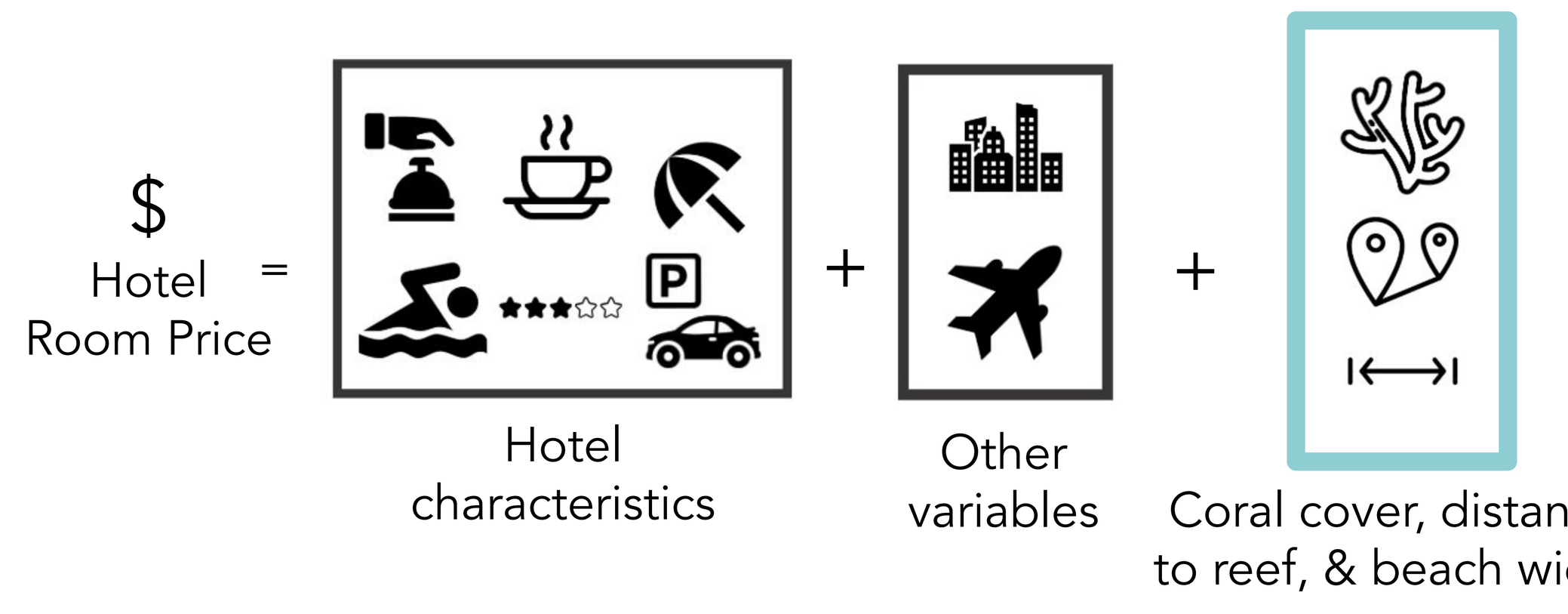


Beach Erosion Control

METHODS

Regression Analysis

Used regression analysis in 5 Southeast Florida cities to isolate the effect coral cover has on hotel price via the co-benefits of ecotourism & beach erosion control.



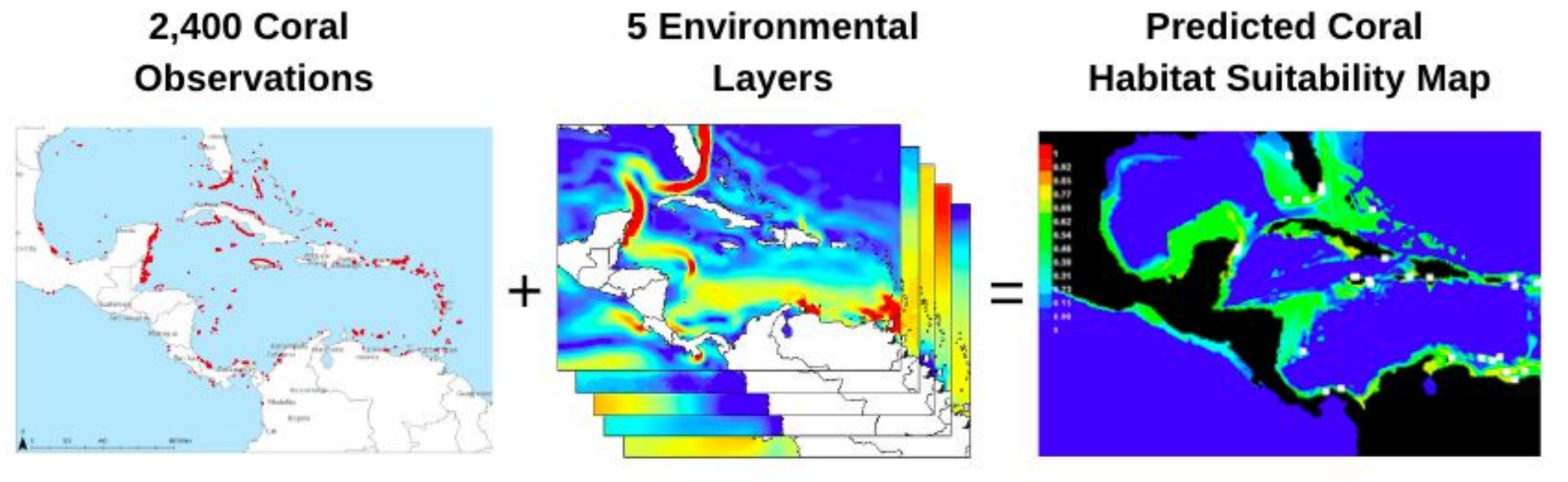
Lit Review & Expert Interviews

Telephone interviews with reef restoration professionals and grey infrastructure engineers to discuss the overall costs of their projects.

Suitability Analysis

Used the species habitat suitability model program *Maxent* to predict shifts in habitat ranges of future coral species. Compared coral suitability in the Caribbean for three time periods: 2005-2015, 2040 - 2050, and 2070 - 2080 under two climate scenarios: **RCP 8.5** (business as usual) and **RCP 4.5** (curbed greenhouse gas emissions).

Maxent Species Distribution Modelling



RESULTS

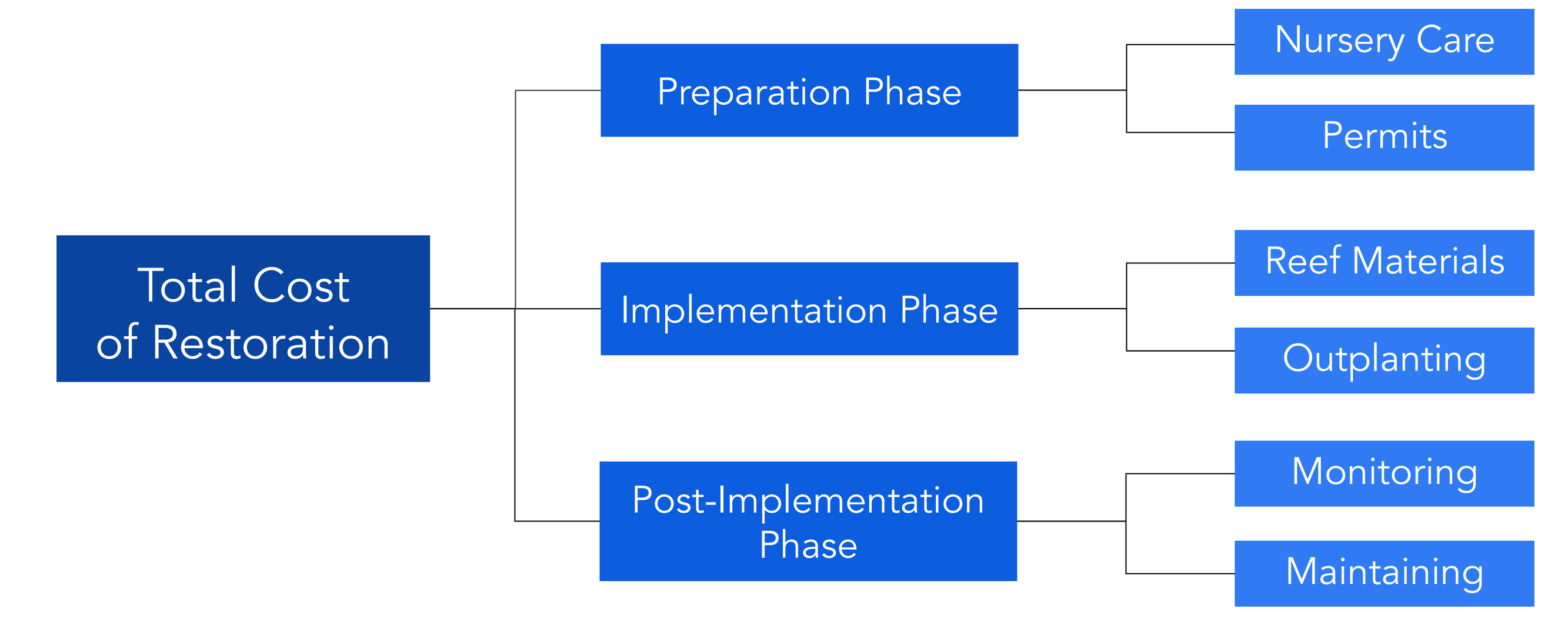
Hotels can expect an additional increase in revenue of $3.97 per 1 km^2 increase in coral cover and $0.37 per 1 m increase in beach width. However, these variables were only positively correlated with hotel price in Fort Lauderdale.

Fort Lauderdale hotels could expect a:

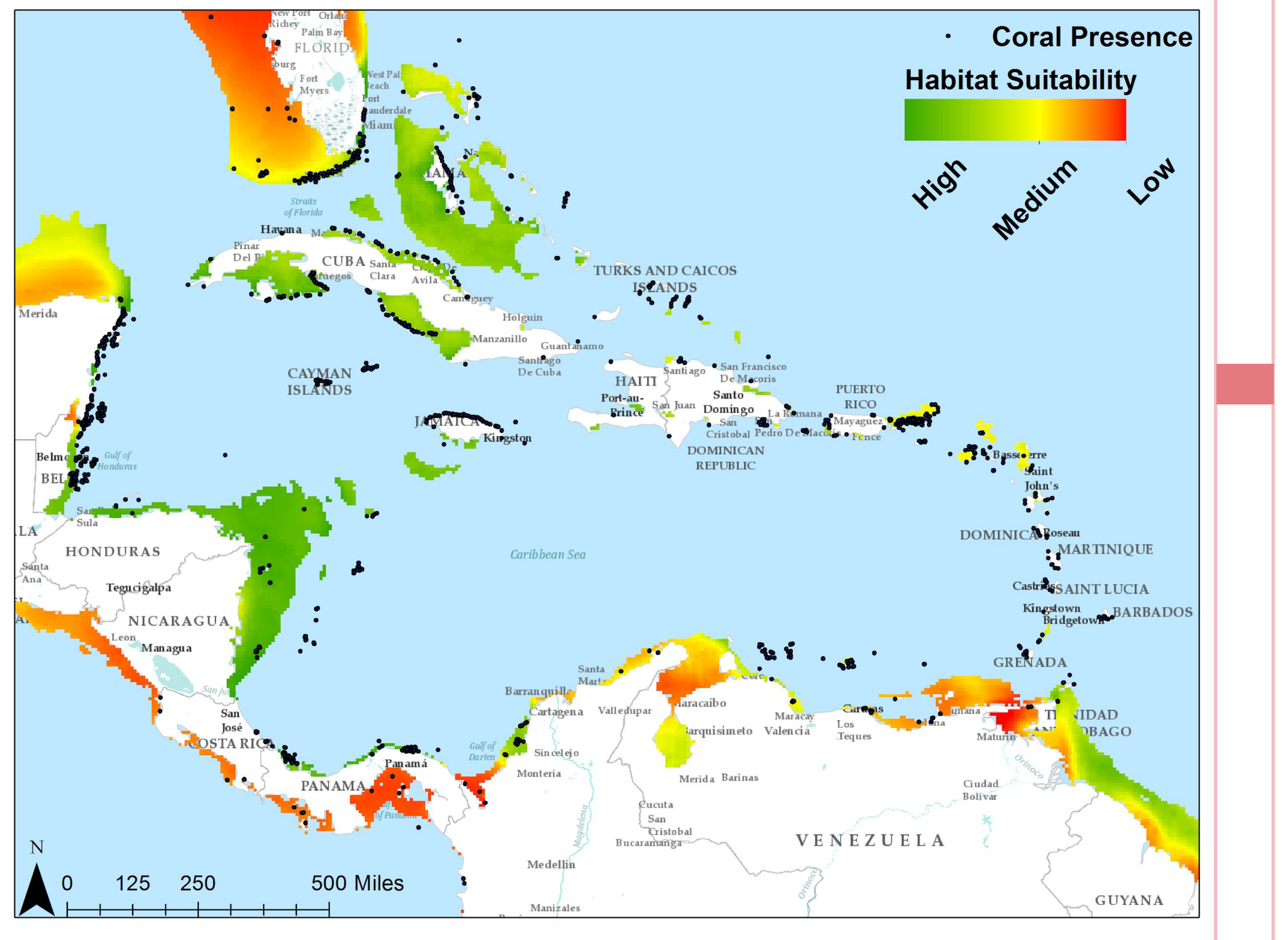
$34.15 million revenue increase per km^2 of coral cover

$1.28 million revenue increase per m of beach width

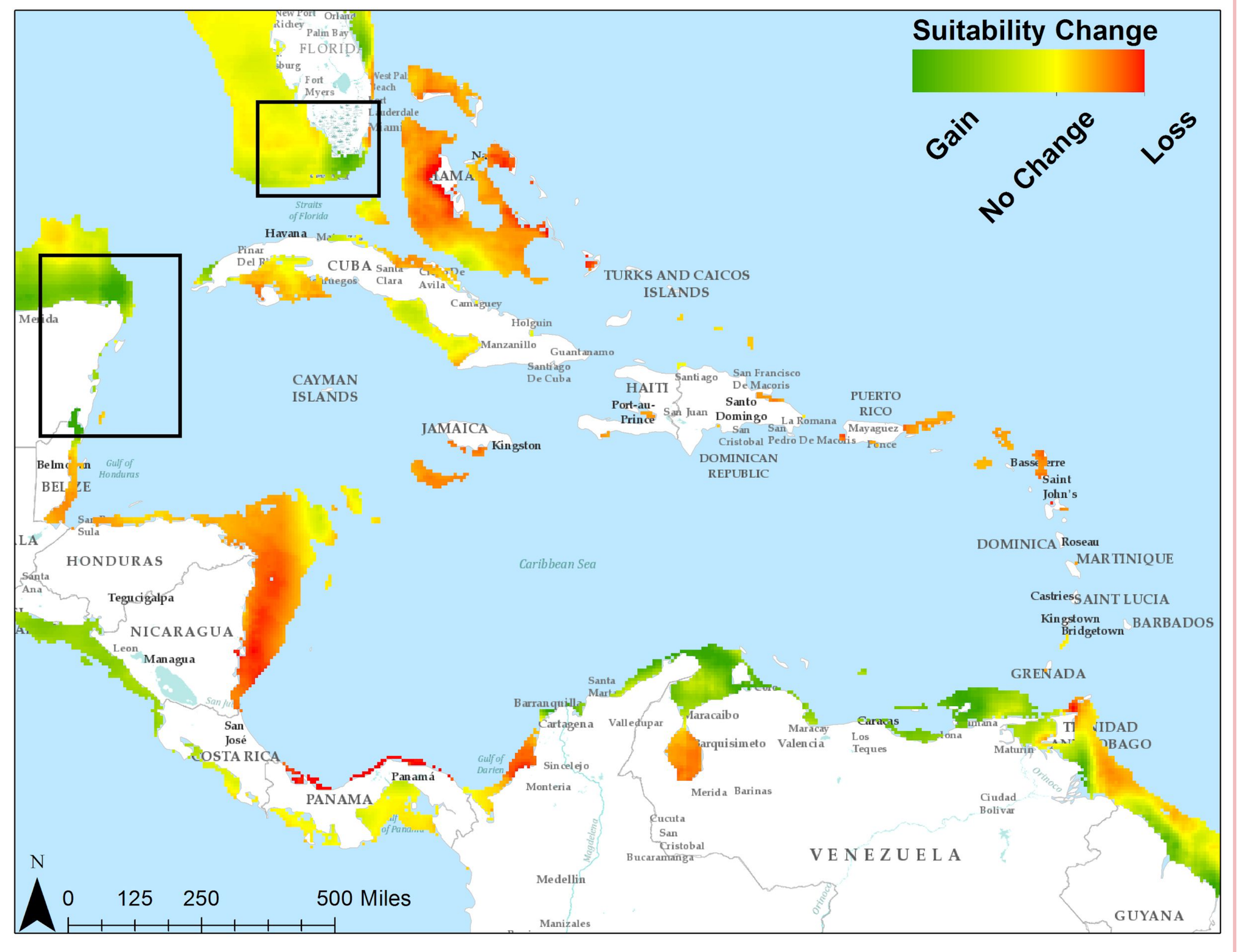
- Cost is highly variable based on location, organization, and growing and planting technique
- We developed a model with all components of restoration to produce an overall cost
- The model will allow organizations to construct an accurate total restoration cost and provide investors with a more complete budget for a given project
- Coral restoration costs ~ **$60-90 per m^2**



Present Coral Suitability (2005 - 2015)



RCP 8.5 Suitability Change (2070 - 2080)



CONCLUSIONS & SIGNIFICANCE

Both **coral cover and beach width are significantly positively correlated with hotel price.** Our valuation of co-benefits can be used together with risk reduction data from TNC to enable hotels to make informed investment choices in preparation for a changing climate and more frequent and severe storms.

Both our interviews and literature review revealed that **the cost of reef restoration is significantly lower than the cost of grey infrastructure.** The cost model we developed will help hotels project financial return on investments in coral reefs, which is a vital step in incentivizing restoration projects.

We found that there will be an **increase in habitat suitability in all time steps and climate scenarios in certain regions of the Caribbean**, particularly the southern tip of Florida along the Keys and the Yucatan Peninsula. Our suitability maps will allow TNC to make strategic decisions to ensure restoration projects implemented today will be successful in the future.

Together, our co-benefit valuation approach, cost model, and suitability analysis will allow TNC to identify areas with promising investment opportunities for hotels that may result in coral reef restoration via an insurance mechanism.

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[1]Beck MW, Losada IJ, Menendez P, Reguero BG, Diaz-Simal P, Fernandez F (2018) The global flood protection savings provided by coral reefs. Nature Communications 9: 2186. doi: 10.1038/s41467-018-04568-z.

[2]Ferrario F, Beck MW, Storlazzi CD, Micheli F, Shepard CC, Airoldi L (2014) The Effectiveness of Coral Reefs for Coastal Hazard Risk Reduction and Adaptation. Nature Communications, 5. Crossref, doi:10.1038/ncomms4794.