

## Valuing climate change impacts on coral reef ecosystem services

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*Fish on a Hawaiian reef. Image courtesy T. Grabowski/ [CC BY-NC-SA 2.0](#)*

It is difficult to imagine Hawai'i without its reefs. The colorful corals and fish and the white coral sand beaches attract millions of visitors a year, and are a source of recreation, food, and livelihood for many residents. However, coral reefs are also increasingly threatened. Local issues such as run-off pollution and overfishing as well as global issues like climate change threaten Hawaiian reefs. This is especially problematic given that the majority of coral reefs in the United States are found in Hawaiian waters, and that many of the shoreline areas on the main Hawaiian Islands are under heavy development pressure. Resource managers must make complex decisions when developing adaptation plans that maintain coral reef function but still allow human use and development. It may be unclear which land or water management strategies can best protect reefs while still permitting use and access, especially since priorities and desired outcomes vary between management agencies.

**We** developed a tool to consider the effects of management strategies on reef ecosystems, and used it to compare several example management plans coupled with moderate and severe climate change projections. Our results clearly show the interaction of local management strategies and global impacts of future climate change. Reef health, tourism value, and fisheries production were least impacted under more

stringent management practices in the less severe climate change scenario. However, the beneficial effects of locally implemented, island-wide management strategies disappear in a more severe global climate change future. This suggests that while local actions can have a significant impact on the health of our ecosystem goods and services, the large-scale impacts of climate change can supersede management strategies that are not proactive and stringent enough.

Our modelling tools and outputs allow us to visualize alternative futures based on management choices and provide a good way to compare possible actions. We can also determine which areas provide the most critical coral reef services, so that management funds and effort can be allocated effectively. Our hope is that watershed managers, resource agencies, and communities can use this tool to evaluate a variety of adaptive management strategies to determine which areas to focus on and how best to protect Hawaiian reefs in the context of a changing climate.



*Erosion control plantings such as these on Kaho'olawe can help keep soil on the land and off the reefs. Photo courtesy Forest and Kim Starr/ [CC BY 3.0](https://creativecommons.org/licenses/by/3.0/)*

### Quick Summary:

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- Hawaiian coral reefs are of great ecological, cultural, and economic value, but they face serious threats including overfishing and pollution as well as larger-scale changes due to climate change.
- Our predictions suggest that stringent local protections can help support coral reef function into the future but cannot compensate fully for regional or global climate changes.
- Preservation of functional coral reefs is more likely with strong proactive local efforts including establishment of marine protected areas, beach restoration, and watershed management. It may be cost-effective to focus protection effort on reefs that have been identified as providing the most critical ecosystem services.



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