

# Trade-Off Analysis

*Ecosystems are rich with complex connections, which can cause one management decision to have unintentional and unexpected consequences on another. Managers now have tools to calculate the 'cost' of a decision and to evaluate the trade-offs that various choices might entail.*

## Why focus on trade-offs?

Our coasts and oceans provide a suite of benefits that humans want and need. These services range from seafood and clean water to intangible benefits like aesthetic and cultural value, and they are often connected in complex ways. Most management choices have unintended ripple effects on connected services - these can be positive or negative, major or minor. Sometimes it is obvious (building a harbor to improve transportation may decrease water quality) and other times it is not (rebuilding a fish species that preys heavily on crabs might devastate commercial crab operations).

As human populations increase and we create new uses for our coasts like wave energy and offshore aquaculture, we are faced with the increasingly difficult task of trying to understand how all our activities interact and what the full cost of a decision might be. We need integrated management approaches that explicitly consider tradeoffs so that decisions are better-informed and more transparent. Understanding trade-offs is critical if we hope to maintain ocean environments in the healthy state required for them to produce the ecosystem services we value.



## How do we calculate trade-offs?

In an upcoming paper, scientists from the California Current Ecosystem-Based Management Initiative have borrowed ideas from economic theory to create a new tool to evaluate tradeoffs in decision-making. It compiles data about ecosystem functions, social factors, and the possible interactions among and between them, producing graphs to visually represent trade-offs between two or more services of interest. This allows users to explore how management choices might affect connected resources and ecosystem components.

## Benefits of trade-off analysis

Trade-off analysis can help identify the services likely to be most difficult to manage jointly, and therefore help pinpoint interactions that warrant more attention. By evaluating trade-offs, management options that might produce similar or better results with less conflict can be more effectively considered.

One example of a real-world challenge that could benefit from this tool is the establishment of marine protected areas (MPAs). Some of the fiercest arguments concern whether the benefits of MPAs are sufficient to offset the profits that are lost when an area is closed to fishing. Trade-off analysis of this problem can yield surprising results. A case study in California found that though there may be an initial drop in fishery profit, the relationship between protection and profit is not linear as expected, and the MPA ultimately produces effects that, over the long-term, boost fisheries and thus profits.

**Overall, trade-off analysis improves our understanding of the full ramifications of management choices. This knowledge is critical for maintaining healthy ecosystems and the essential services they provide.**