As increasing global demand for shrimp continues to drive destructive harvesting and farming practices, strategic planning is needed to evaluate new potentially sustainable alternatives...

Spatial Planning and Bio-Economic Analysis for Offshore Shrimp Aquaculture

Shrimp: *Small animal, Big problems*

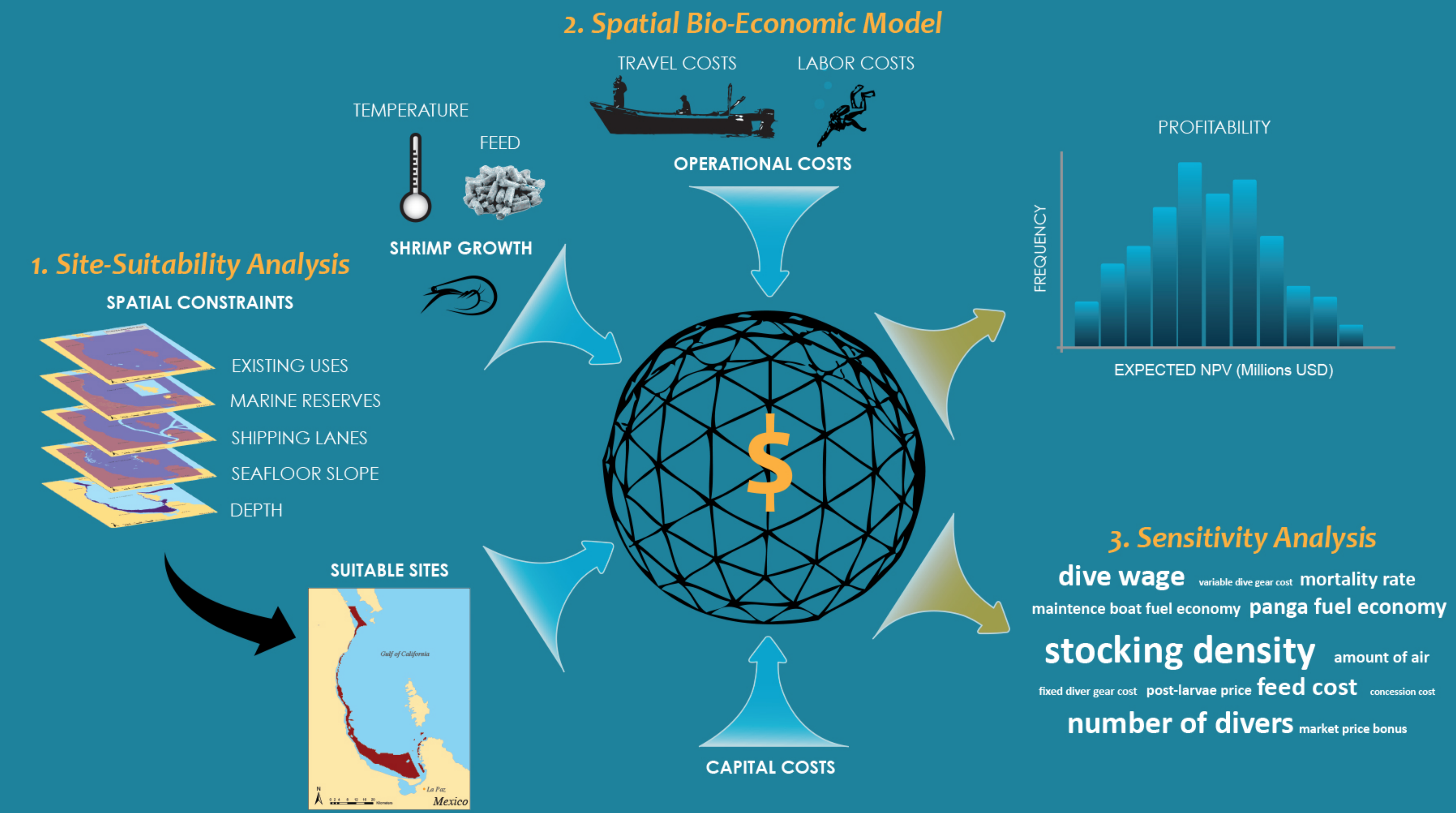
Shrimp is one of the most highly demanded seafood commodities around the world. Approximately six million tons of shrimp are traded annually and shrimp is the highest valued internationally traded fishery commodity[1]. In Mexico, it is the most valuable seafood export, with shrimp industries providing many regional jobs and economic benefits[2]. However, current harvesting practices of bottom trawling and traditional shrimp farming through land-based aquaculture are frequently environmentally and economically unsustainable. Shrimp trawling causes seafloor habitat damage and results in high levels of non-target species bycatch[2]. Land-based aquaculture often degrades valuable coastal habitat and results in the discharge of excess nutrients, antibiotics and other pollutants into the environment[3].

Aquapods: *An emerging alternative to meet increasing shrimp demand*

Offshore aquaculture shows promise for reducing or eliminating many concerns embedded in existing capture fishery and aquaculture practices. Offshore operations result in little habitat destruction and may benefit from strong offshore currents, which could flush out wastes and bring in nutrients and oxygen for the shrimp. Aquapods are a new offshore aquaculture cage system that could provide a path to sustainable shrimp production, but little is known regarding the optimal placement strategy or economic viability of this new technology.

Developing a strategic plan for Aquapod implementation

We used an innovative spatial bio-economic analysis to provide a strategic framework for implementing offshore shrimp aquaculture with greater certainty of success. To better inform the planning, management and research priorities of Aquapod operations in Northwest Mexico, this project couples marine spatial planning with bio-economic modeling and sensitivity analyses to identify suitable sites for Aquapod implementation and evaluate the economic viability of Aquapod operations in La Paz.



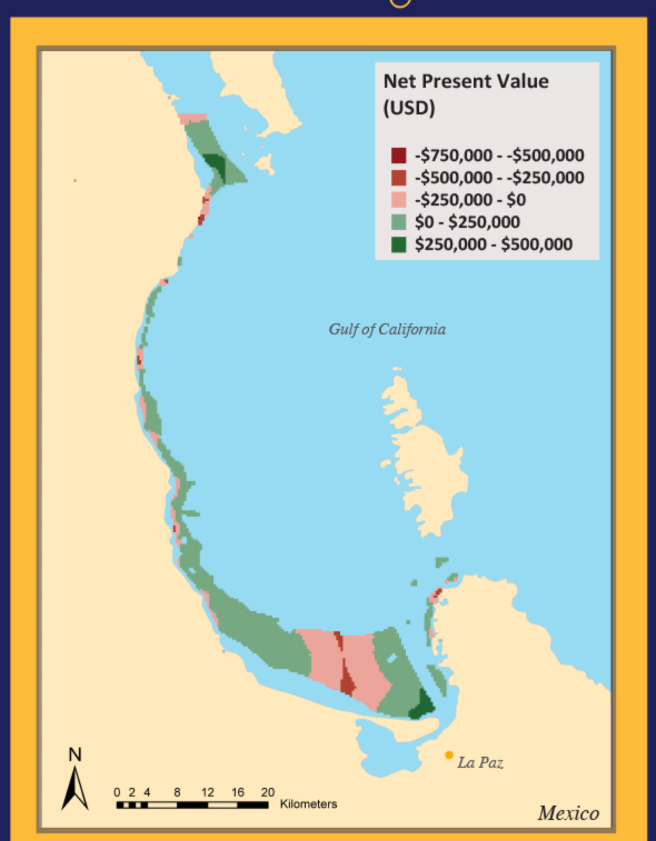
Project Objectives

- Identify suitable deployment sites for Aquapod implementation in three study areas.
- Determine how spatial variability, biological growth, and socioeconomic parameters affect profitability of Aquapod operations.
- Inform future research priorities and best management practices for Aquapod operations.

Case Study: Improving Operational Efficiency to Increase Economic Viability of Aquapods

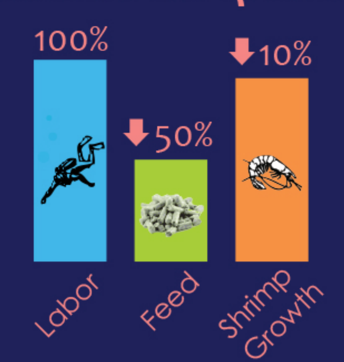
While seven percent of the study area in La Paz is suitable for Aquapod siting, none of the suitable sites are expected to be profitable under a "business as usual" scenario. Consequently, we explored several alternative management scenarios that reduce costs to improve the economic viability of Aquapod operations. Feed and labor costs are major drivers of profitability in our model and may be reduced by utilizing by-product feed sources, decreasing the amount of artificial feed used, or installing automatic feeders.

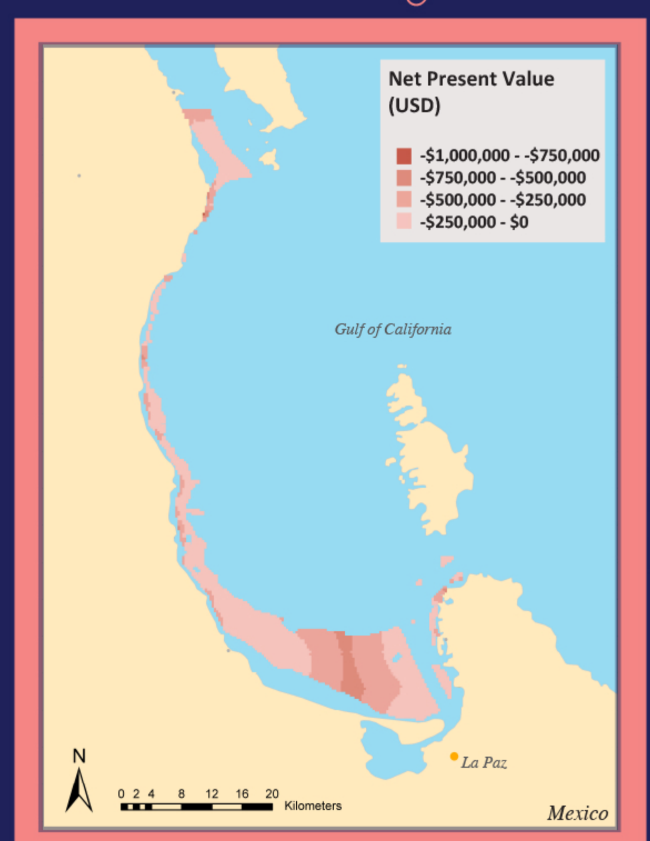
Reduced Feed Cost



Feed costs could be cut by using cheaper by-product feed sources. A 50% reduction in feed costs resulted in 66% of the suitable sites being profitable.

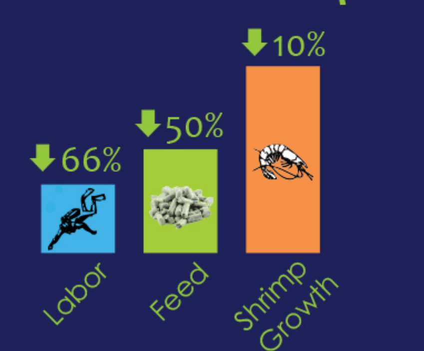
Reduced Feed Quantity



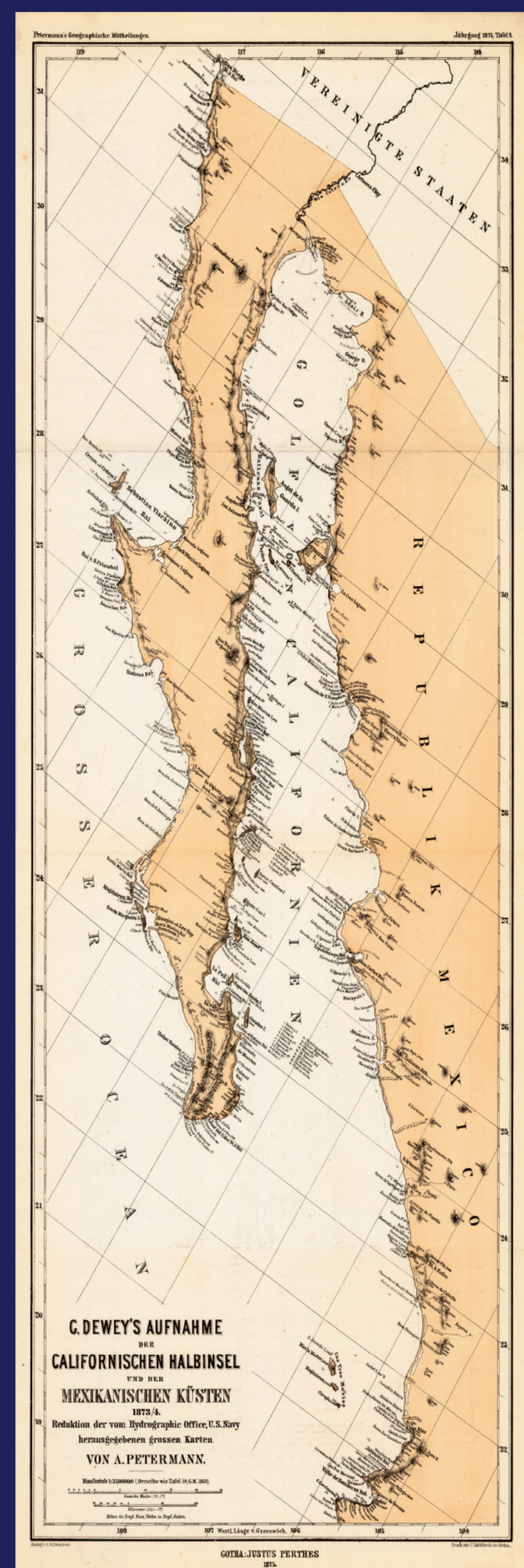


Feed costs could also be offset by reducing the quantity of artificial feed through dependence on naturally occurring ocean nutrients, but this option may negatively impact shrimp growth rates. A 10% reduction in shrimp growth rates caused all the suitable sites to become unprofitable once again.

Reduced Labor and Feed Quantity



Reducing the amount of feed or installing automatic feeders could reduce the required number of diver hours, thereby decreasing labor costs. With a 66% reduction in labor costs, 100% of the suitable sites became profitable.



Recommendations to Olazul

- Focus future research and pilot trials in La Paz.
- Collect data to increase the probability of successful placement.
- Investigate environmental impacts of Aquapods.
- Collaborate with local stakeholders to gain a better understanding of competing uses and risks.
- Research the feasibility of implementation of alternative management scenarios.

Conclusions

Trial-and-error implementation of a new technology can be economically and environmentally costly, which highlights the value of planning and innovative forecasting. Our project demonstrates how careful planning, modeling, and analysis can improve the potential success of offshore aquaculture operations. Our analysis reduces the cost, time, and conflict that would have resulted from alternative implementation methods such as haphazard or trial-and-error implementation.

Project Members:
Michaela Clemence
Frank Hurd
Heather Lahr
Asma Mahdi
Audrey Tresham
Jeffrey Young

Project Advisors:
Steve Gaines
Chris Costello
Sarah Lester
Laura Dee

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