THE SKIMMER ON MARINE ECOSYSTEMS AND MANAGEMENT

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The EBM Toolbox: New tool can help ocean planners find best locations for wide range of ocean uses: Learn how it is different and what you need to use it

Editor's note: The goal of The EBM Toolbox is to promote awareness of tools and methods for facilitating EBM and MSP processes. It is brought to you by the EBM Tools Network (www.ebmtools.org), a voluntary alliance of tool users, developers, and training providers.

A new method helps ocean planners and stakeholders find the best locations for a wide range of ocean uses, while minimizing negative interactions among ocean uses and environmental impacts. This method was described in a recent article in Nature Communications. MEAM learned from authors Sarah Lester, an assistant professor of geography at Florida State University, and Crow White, an assistant professor with Center for Coastal Marine Sciences at the California Polytechnic State University, what makes this technique different from other marine spatial planning tools and what sorts of data sets are needed to use it.

MEAM: Can you tell us a little bit about the analysis you used to look at the potential for offshore aquaculture development in the Southern California Bight?

Lester and White: We developed a new analytical framework for marine spatial planning. A key aspect of this framework is identifying the best locations for particular ocean uses so that negative interactions with other uses and damaging impacts on the environment are minimized, while benefits from the development of new activities are allowed.

We illustrated this approach using a case study of offshore aquaculture development – the farming of aquatic plants and animals in ocean waters – along the coast of southern California. In our study, we modeled the production and profitability of different types of aquaculture farms – growing mussels, seaweed, and fish – and modeled farms' interactions with a wild capture fishery as well as associated impacts on the health of seafloor ecosystems, the risk of fish disease outbreaks, and alteration of scenic views for coastal residents and visitors. We then identified optimal spatial plans for balancing aquaculture development with other management objectives.

Importantly, we found that at relatively low levels of development (less than 50 km^2 of offshore farms), strategic spatial planning can allow for aquaculture development that will result in very significant quantities of seafood and revenue, with no or very minimal impacts to existing uses and the environment.

MEAM: What is new about this approach?

Lester and White: Previous analytical approaches for guiding marine spatial planning often combine different management objectives into a single metric (e.g., summing impacts to multiple fisheries into a single fisheries impact metric), which can compromise precision compared with a comprehensive approach that considers each objective's response individually. Our approach quantifies seven distinct management objectives and evaluates the interactions among them (three types of aquaculture, a wild-capture fishery, benthic health, viewshed quality, and disease risk). Also, our approach is flexible, such that in future case studies it can be expanded or contracted to fit the number of objectives pertinent to each case study.

Previous approaches also typically site sectors or activities one at a time, instead of siting them in coordination. Our approach enables the simultaneous siting of three types of aquaculture.

Lastly, other approaches tend to consider tradeoffs among management objectives only implicitly (e.g., by trying to avoid areas of overlap of ocean use, without explicitly quantifying how the uses will respond to a specific development plan). In contrast, our approach derives optimal spatial plans by using an analytically-defined objective function that considers explicitly the response of each sector or objective.

While some previous approaches have incorporated one or two of these advances, our study is the first to utilize all three together.

MEAM: What sorts of additional marine spatial planning questions could you address with this technique, and what sorts of data sets do you would need to use it? Are there any limitations on the number of sectors that you can consider?

Lester and White: Our approach could be applied in any marine spatial planning context where decisions are being made about where to locate one or more activities. We used three types of aquaculture as an example, but it could also be applied to protected areas for conservation, wind or wave energy facilities, designated fishing zones, mining areas, recreational use zones, etc.

In order to be incorporated into our approach, activities or objectives must be quantified - in terms of value or impact - but multiple objectives do not need to be quantified in the same units. For example, in our paper, we considered annuities for aquaculture and fishing, number of people impacted for viewshed quality, and a measure of low oxygen conditions for impact to the marine benthos. The reliability of the results depends on whether there are sufficient data and scientific understanding to be able to develop a spatial model of the activity and how it interacts in space with other management objectives.

There are no limits on the number of sectors that can be considered, although more computing power is required for a large number of sectors and/or a large number of planning units (locations). Multi-dimensional tradeoffs are difficult to visualize, and results can suggest a vast number of optimal spatial plans, but in our paper, we presented a number of ways to synthesize complex results so that they can more easily be used in decision-making contexts.

Read the full article: S. E. Lester et al. Marine spatial planning makes room for offshore aquaculture in crowded coastal waters, Nature Communications (2018). DOI: 10.1038/s41467-018-03249-1

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