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Julie Cohen

Sustainable Ocean Development

Earth's vast and vital oceans are a critical source of economic productivity, but issues of space management, interindustry conflict and environmental degradation often limit sustainable commercial development.

Now, researchers have developed a new model that weighs the tradeoffs and opportunities for aquaculture development in the Southern California Bight. The system, created by a group that includes Carrie Kappel, a senior fellow at UC Santa Barbara's National Center for Ecological Analysis and Synthesis, looks specifically at three types of offshore aquaculture as well as existing wild-capture fisheries, scenic views, disease risk and impacts to seafloor communities. The team's findings appear in the journal Nature Communications.

"Our holistic analytical model balances the location, type and intensity of ocean uses across sectors and industries," explained Kappel, a member of the Sustainable Fisheries Group at the Bren School of Environmental Science & Management. "It could herald a new paradigm of environmentally sustainable ocean usage and management."

The model design accounts for and quantifies relevant environmental, industrial and societal interests in a given area. It also allows for a method of planning that supports a variety of harmonious, economically productive activities without condemning a region to ecological disaster. The team applied its model to the development of three representative types of offshore aquaculture farms with industry potential in Southern California: Mediterranean mussels, striped bass and

sugar kelp.

“Our goal was to create a system that can simultaneously plan for multiple uses while optimizing the benefits of those different uses and minimizing the negative impacts on other uses and the environment,” said lead author Sarah Lester, an assistant professor of geography at Florida State University.

The United States — which operated at a $14 billion seafood trade deficit in 2016 — lags far behind other countries in aquaculture development due to complex regulatory policies and social opposition. Moreover, concerns about the environmental impact of offshore aquaculture, as well as potential conflicts with other sectors such as wild-capture fisheries, have worked to limit broad development, even in areas primed for aquacultural success. This made aquaculture the perfect case study for the group’s marine spatial planning models.

To address area-specific stakeholder concerns, the team also accounted for four overarching factors in their computations: the wild-capture California halibut fishery, which draws from the same soft-bottom habitat that would be developed for aquaculture; the environmental health of the flora and fauna that occupy the seabed, which could be harmed by oxygen-poor conditions caused by fish farms; the quality of views from public and private lands that could be blemished by aquaculture structures on the ocean’s surface; and the risk of disease spread among fish farms connected by ocean currents.

By pairing these models with an analytical tradeoff analysis, the researchers were able to identify tens of thousands of optimal spatial plans, a subset of which satisfied all four stakeholder concerns and therefore would be especially instructive for decision-makers. Ultimately, they determined that use of the models could increase sector values by millions of dollars and reduce harmful impacts to less than 1 percent compared to conventional approaches to spatial planning.

The group’s strategy was to develop models that could be applied anywhere, not just to one stretch of the Southern California coastline, and would not be limited to aquaculture. In fact, Kappel and co-author Crow White, of California Polytechnic State University, San Luis Obispo, have applied this analytical approach to the siting of wind farms off the coast of Massachusetts.

“As we continue to look to our oceans for crucial, environmentally tenable economic output, these models could provide an analytical foundation for intelligent and

responsible development," Kappel said.

"I think this is a particularly useful approach when we think of new and emerging uses," Lester said. "There's a trend toward new ocean industries — whether it's aquaculture, alternative energy or deep-sea mining — that could make great use of this approach."

Additional UCSB researchers include Chris Costello, Steve Gaines and Rebecca Gentry of the Bren School, Tom Bell and Rachel Simons of the Earth Research Institute and Libe Washburn of the Marine Science Institute and the Department of Geography.

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