New model helps boost fishery profits and sustainability

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By identifying the most efficient fishing practices and behaviors, a new model developed by economists at Duke University and the University of Connecticut could help fishermen land larger paychecks while reducing the risk of fishery depletion.

"We're not talking about a trivial improvement. In some cases, we found that identifying the most efficient practices led to a 20 percent annual increase in total revenues if the fishery is managed differently," said Martin D. Smith, professor of environmental economics at Duke's Nicholas School of the Environment.

"Under perfect conditions, you could see up to a 49 percent increase in profits on average," he said.

The empirical bioeconomic model developed by Smith and Ling Huang, assistant professor of economics at the University of Connecticut, is the first of its kind. It was created using six years of previously unavailable fine-scale fishing data from the North Carolina shrimp fishery, provided to the researchers by the North Carolina Division of Marine Fisheries.

"Every single vessel that went out was tracked—what it caught, when it fished, what price it sold its catch for, and what equipment was used," Smith said. "We also tracked daily weather conditions, fuel prices, fishery closures and other external factors that affect fishermen's decisions of whether to fish or not."

Smith and Huang analyzed the flood of data using recently developed econometric modeling techniques to identify which individual fishing practices and decisions led to profitable and sustainable catches, and which led to low returns and overexploitation.

The results yielded some surprises.

"Conventional wisdom says that congestion—having too many boats out at the same time—is bad because it makes it harder for individual fishermen to catch at the level they're used to, so profits drop," Smith said. "We found this is true in the short run, but there's a potential long-term benefit fishery managers may be overlooking.

"When people's profits drop due to congestion, they tend to fish less. This means more of the shrimp left in the water get to grow to larger sizes and can be harvested later in the season for higher prices," he said. "So in some cases, congestion can actually increase potential late-season profits and reduce the risk of fishery depletion."

Smith and Huang's study focused primarily on the open-access N.C. shrimp fishery, but insights from it could help improve how other fisheries are managed as well.

"We're leaving substantial profits on the table due to the way we're managing many fisheries," Smith said. "The standard one-size-fits-all management approach of allocating sustainable catch limits to individual fishermen on an annual basis is not universally efficient. In some cases, it's actually counterproductive because it forces fishermen into a 'race to fish' early in the season that leads to falling profits, overexploitation and, eventually, tragedy of the commons."

The key to avoiding this, Huang said, is to match the management approach of each individual fishery to the daily, fine-scale dynamics of

its fishermen, its seasonal patterns, and the life history of the species being harvested.

"Our analysis shows there's a sweet spot between having too much bureaucracy—such as daily quotas—and too little. That's the spot we have to hit if we want to maximize profits and sustainable catches," she said. "To get there, you have to dig down to the fine scale."

More information: "The Dynamic Efficiency Costs of Common-Pool Resource Exploitation," by Ling Huang and Martin D. Smith. American Economic Review, Dec. 3, 2014. dx.doi.org/10.1257/aer.104.12.4071

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