

THE *Current*

October 8, 2025

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Farmed totoaba could curb poaching

The trade of totoaba has all the intrigue of a crime thriller. Dollars and drugs change hands as a criminal cartel vies against the government. Communities and endangered species are caught in the crosshairs of a lucrative illicit trade. It may then come as a surprise that the totoaba is a fish.

The totoaba is a large, yet unassuming, species of fish native to the Gulf of California. But its mundane appearance belies incredible value on the black market. “Totoaba swimbladder can sell for up to \$80,000 USD per kilogram in Chinese end-markets making it worth more than gold or cocaine,” said marine biologist [Julia Lawson](#), who earned her doctorate from UC Santa Barbara’s Bren School of Environmental Science & Management. This buoyancy-regulating organ is used for luxury food, expensive gifts and speculative investments in China.

And poaching is thriving despite an international ban on totoaba trade since 1977. Researchers at UCSB and AgroParisTech analyzed market dynamics and the species’ life history to predict what might happen if farmed totoaba were legalized for export. Their [results](#), published in Nature Partner Journals Ocean Sustainability, suggest that a market-based solution, namely aquaculture, may be better suited to curb poaching pressure than a strictly regulatory approach.

A worrying state of affairs

Despite the 50-year trade ban, Mexico exports hundreds of tons of totoaba every year. So Lawson, co-lead author Simon Jean (AgroParisTech) and their colleagues investigated the market and conservation viability of totoaba aquaculture.

There's nothing new about farming totoaba; there are already operations raising the fish for seafood. "If you went to Mexico City you could get totoaba ceviche," said Lawson, who was affiliated with UCSB's Environmental Markets Lab (emLab) during her time at UCSB. However, domestic fishing and international trade are still illegal.

Ironically, the totoaba population appeared stable in the most recent assessment. But the trade in its swimbladder has profoundly affected the region. The Sinaloa Cartel currently has a monopoly on poaching and international trade, and the syndicate's activities (e.g. extortion, violence, drug trafficking, etc.) have destabilized the area. What's more, entanglement in totoaba nets has driven the vaquita porpoise to the brink of extinction. A survey in 2024 identified only six to eight of these small whales left in the world.

Another concern is the instability of the totoaba fishery itself. When Lawson and her co-authors modeled the current monopoly under different cost structures, fishing efforts showed three distinct equilibria: one that produced a large and stable totoaba population, and two at critically low population levels. "There's a chance that a small change in the system could push the population toward collapse," Lawson said.

Unexpectedly good intel

The cartel keeps the trade going by extorting fishing communities into working for them. That said, the job can be prestigious and lucrative for fishermen. So despite the complex relationship between the communities and the cartel, poaching is just a way of life in many fishing villages along the Gulf of California. Because of this, it was relatively straightforward to get information on the fishery, the black market and aquaculture operations.

Several Bren masters students traveled to Mexico to interview fishermen and farmers. The team was able to estimate the operational costs of poaching, like bribes, wages, boat fuel and supplies. They also measured totoaba growth rates in captivity to compare with rates in the wild. This enabled them to estimate the time

and money required to grow a fish to a competitive size. Meanwhile, there's a wealth of data on price per weight from seizures by the Mexican government.

"I was really proud of how rigorous our data are," Lawson said. "It's unusual in an illegal trade to have such detailed information."

Four criteria for success

The team combined farming and fishing costs with economic factors and the biology of the totoaba to create an analytic model of fishery and market. For conservation farming to successfully reduce poaching, it must meet four criteria. Poaching must have a high cost of entry, and farming must be competitive, ideally cheaper. Customers need to view the products as equivalent, and demand must remain relatively the same even after legal trade is opened.

Poaching can be essentially free in some wildlife trades, requiring only a few dozen wire snares. "If it's free to poach a species, farming is never going to work," Lawson said. But totoaba fishing has significant costs. Meanwhile, totoaba show high growth rates in captivity, so they are amenable to farming in a way that, say, rhinoceros aren't.

Farming is currently cheaper than poaching, according to the analysis. And a subsidy program of \$6 million per year by the Mexican government could keep the trade of farmed totoaba cheap, preventing a decrease in their wild population, said Jean, an economics professor at AgroParisTech.

But it's important that customers view swimbladders from wild and farmed fish as equivalent. If they don't, then legalizing trade in farmed totoaba would simply create a parallel market, rather than add an additional supplier to the existing market. Conventional wisdom holds that consumers prefer wild products. But Jean suspects this likely isn't the case. To gauge this notion, he hopes to conduct consumer preference surveys in China.

Lawson and Jean are, however, concerned about how this proposal may interact with the Convention on International Trade in Endangered Species (CITES). Although there is precedence, the CITES may be reluctant to open the trade of a farmed counterpart to an illegal wild product. If they were to do so, they require the farmed

product to be clearly marked. There is wisdom in this practice, as it prevents poachers from passing off illegal items as farmed. But the authors are concerned this may prevent customers from viewing farmed products as legitimate substitutes for the wild ones.

The success of legal aquaculture also requires demand to remain relatively stable or increase only slightly. Unfortunately, legalizing farmed totoaba swimbladder could induce new demand by reducing prices, increasing availability and decreasing the stigma that surrounds the currently illegal product. According to Lawson and Jean, an increase in demand above 20%, combined with lower substitutability, would cause this proposal to fail. If trade is opened, they recommend that governments finance education campaigns to reduce demand for totoaba swimbladder.

Predicting market response

The authors also investigated how the cartel might respond to legalized totoaba aquaculture. A black market behaves differently than a conventional market. The high costs and risks lead to fewer sellers and buyers. As a result, sellers and buyers have a stronger influence on each other's behavior, Jean explained. For instance, a perfectly competitive market price is dictated by the preferences of consumers and the costs of producers. But suppliers on a black market can manipulate prices in response to consumer behavior.

Two scenarios emerged from legalizing farmed totoaba. In one case, a price war could break out where the cartel tries to undercut the price of farmed totoaba by flooding the market. In this scenario, the syndicate is willing to accept short-term losses in order to push the competition out of business and regain total marketshare. This would not be good for wild totoaba.

On the other hand, the sellers could accept the new state of affairs and adjust the quantity of goods they sell to match their new, lower marketshare. This keeps prices relatively high, ensuring a healthy profit. The addition of aquaculture means there's slightly more production than in a monopoly, but a lot less than in a price war. What's more, poaching decreases. Fortunately, both scenarios shift the system into a single equilibrium, eliminating the instability currently facing the totoaba population under the monopoly.

Either case would also be a blow to the Sinaloa Cartel's revenue stream. "In the quantity adjustment scenario, the cartel will likely lose \$192 million a year," Jean said. "But in the price war, they would lose \$310 million a year."

That said, it's difficult to account for the violence, intimidation and coercion the cartel employs. And the syndicate often infiltrates even legal fisheries. So what would happen if they seized control of aquaculture?

"If aquaculture is taken over by the cartel, it produces even better results for totoaba than what we had first anticipated because they can leverage the whole farming operation," Jean said. The syndicate has much less incentive to pour their resources into costly, illegal poaching if they're operating a less expensive, legal enterprise.

Lawson and Jean see their results as a strong case for policy reform, but recognize there's still uncertainty in how their proposal might play out. They maintain that any change would also need a failsafe that could immediately rescind the legal trade of totoaba in case the results go south. "Sometimes, the best way to curb over-harvesting is to adjust existing market mechanisms, rather than depend only on strict governmental and international rules," Jean said.

Tags

[Ocean and Beaches](#)

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