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# Reimagining the Coral Market

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By JOSIE GARTHWAITE

**A coral farm in a highly industrialized area in Banyuwangi, in the Bali Strait off Java**

In the international trade in live coral, most of which ships to the United States for ornamental marine aquariums, the source is quickly shifting from wild harvesting to farming, researchers report in a new study.

This shift suggests that, contrary to the conventional view that the live coral trade is a threat to coral reef ecosystems, the buying and selling of corals could help create a powerful incentive for protecting reefs in many small island communities, these scientists say.

“The difference in a year is staggering,” said the study’s lead author, Andrew Rhyne, an assistant professor of marine biology at Roger Williams University and a research scientist at the New England Aquarium.

Particularly in Indonesia, the world’s largest supplier of stony corals and home to more coral reef areas than any other nation, many producers have “learned that if you collect a really beautiful, interesting coral, if you export that, you get to export it one time,” Dr. Rhyne said. “If you keep it and farm it, you get to export it forever.”

Published last week in the Conservation Letters journal, the study comes less than a month after the National Oceanic and Atmospheric Administration proposed listing 66 species of coral as threatened or endangered under the Endangered Species Act.

The paper documents trends in American imports of stony corals from 1990 to 2010, and found that a majority of corals imported to the United States are still collected from the wild, but a small but growing fraction comes from aquaculture.

From 1990 until around 2007, the volume of coral reef livestock imported into the United States climbed by more than 8 percent a year. Imports fell sharply after 2007, by about 9 percent annually - a trend that the researchers attribute to the global economic downturn, a likely increase in domestic aquaculture production and advances in lighting and filtration technology that allow hobbyists to keep smaller tanks with less live rock.

Imports of corals in the genus Acropora, which are among the easiest to cultivate and the most widely farmed, dropped most sharply. “Other taxa are going to catch up,” Dr. Rhyne said, “but this will take a bit of time.”

The threat to corals remains dire, however. "The big picture is that coral reefs are in crisis," said Shaye Wolf, climate science director at the Center for Biological Diversity, the organization that pushed for NOAA's recent action by filing a petition to list 83 coral species under the Endangered Species Act.

The gravest threats, including ocean acidification, rising ocean temperatures and disease, are linked directly or indirectly to greenhouse gas emissions and global climate change, NOAA says.

"Then layered on top of it are all the local threats that corals have suffered from over the last century or more," like water quality issues, overfishing, coastal development, and destructive collection practices, Dr. Wolf said.

Commercial trade in stony and reef-building corals has been regulated under the international treaty known as Cites, the Convention on International Trade in Endangered Species, for nearly 30 years. At this point, according to NOAA's Coral Reef Conservation Program, a failure to address carbon dioxide emissions and the impacts of climate change could in the long term "make many other management efforts futile." Yet local issues cannot be ignored, it adds.

In its assessment of the major threats to reefs, "there is evidence that alleviating more local stressors can help improve resiliency for many coral species," the agency says.

"Everybody wants to protect the reefs," said Dr. Rhyne, whose co-authors for the paper were scientists affiliated with Boston University, the New England Aquarium and the environmental group Conservation International. "The argument comes in how you best go about doing that."

Dr. Rhyne and his colleagues describe coral farming in small island communities as a potential tool for conservation at the local level. But it's a tool they worry "is at risk of being lost due to the well-intended but rigid rules of the E.S.A."

Although production methods vary, many coral farmers use a process known as fragmentation, or "fragging," which involves cutting or collecting small segments of live coral. These segments can come from wild reef colonies, damaged reefs or from previously "fragged" mature corals.

The segments can then be planted in large tanks on land, where they are eventually cut up and affixed to concrete for transplanting offshore. Smaller operations like those maintained in villages in the Solomon Islands may initially cultivate fragments on a boat, and then lower them into the ocean to grow on racks, Dr. Rhyne said. Ornamental pieces can be ready for sale within four months.

Coral farming is not only a business endeavor. Since the 1990s, scientists have worked to develop coral nurseries for restoration projects. In 2009, the federal government awarded more than $3.3 million for an effortto plant at least 5,000 colonies of the Acropora species staghorn and elkhorn, which NOAA has just proposed reclassifying as endangered. (They have been listed as threatened since 2006.)

Part of the goal is to both repopulate degraded areas and increase the genetic diversity of reefs along the Florida coast, with the expectation that a reef seeded with 35 nursery-raised Acropora colonies a year could restore the reef's coral cover to 1970s levels in a decade, compared with the estimated 30 years or more that it takes for natural recovery.

Commercial growers, of course, have different aims. Coral farmers, Dr. Rhyne said, can develop product lines based on the colors or shapes that consumers like, perceive as rare and are willing to pay top dollar for - up to about $500 per piece, according to the study, or hundreds of dollars per kilogram of biomass.

"This is one reason for the massive change," he said. "Growing corals is fast, not that technically difficult, and allows the exporter to save the best-looking pieces and make copies of them."

Indonesia's shift away from wild harvesting even as other exporters (notably Australia) expand theirs, is hardly due to chance. As Dr. Rhyne put it, "We have some stick and some carrot in play here."

The country has been working with NOAA, the Ocean Foundation and the Indonesia Nature Foundation to improve its coral trade. Most production in the country has already moved to sites clustered around major airports, and the country is on track to source some of the most common types of coral entirely from aquaculture within a few years, Dr. Rhyne said.

That means a greater supply of coral for restoring damaged reefs, too, said one of the co-authors, Michael Tlusty, director of research for the New England Aquarium. Indonesia and the Philippines jointly supply 85 percent of the world's coral reef products; Indonesia requires 10 percent of any coral producer's output to be transplanted to the wild.

"If the country as a whole sells a million of pieces of coral," Dr. Tlusty said, "there are 100,000 pieces that are available to be used for restoration projects."

The notion that aquaculture practices are verifiably sustainable and that protections under the Endangered Species Act would be overly rigid stirs some skepticism. "It's not just that once a coral gets listed, all trade stops," Dr. Wolf said. "The point of listing these corals as endangered or threatened is giving them the kind of safety net that they need so that we have corals into the future."

NOAA, she added, has the flexibility to restrict imports based on its assessment of whether trade is harming the corals listed as threatened.

Dr. Rhyne's team acknowledged in last week's study that the aquarium trade "has the potential to cause overharvesting, collateral damage to coral reef habitat and introduction of exotic species."

But in a year of only modest progress on international climate agreements, the researchers said, the Endangered Species Act protections may be like a Band-Aid fix for a broken bone.

"We're taking this sort of E.S.A. action to get at the issue of climate change," Dr. Tlusty said. "It's one of these things where we're not taking the real big, significant action, and then we're doing these little tiny things, hoping that would be best."

In NOAA's final management report on the proposed listing, released Nov. 30, the agency ranked 19 threats to reef-building corals generally, and found ornamental trade to be of low importance. Still, Dr. Rhyne said, if the potential ecological, social and economic benefits of the live coral trade are to be realized over the long term, more information and closer data tracking will be necessary.

Dr. Wolf, too, urges close study. "Trade has proven to be a threat to many corals, and there needs to be a high level of accountability and documentation of trade, including aquaculture," she said.

The driving question, she said, is this: "Are these corals that are proposed as threatened or endangered - are they indeed threatened by that trade?"

"If so, let's ban or limit trade on those corals, because it doesn't do anybody any good - it doesn't do the reefs any good, it doesn't do the people that are harvesting them any good - if what they're harvesting is just declining to extinction."

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