Intensely harvested for their translucent shells, giant clams, like this one at Tecas Reef in the Philippines, are growing scarce.

MARINE CONSERVATION

Shell trade pushes giant clams to the brink

With elephant tusks harder to obtain, the "jade of the sea" is the new ivory in China

By **Christina Larson**, *in Tanmen, China*

At the Xiaobao Craft Store in Tanmen on Hainan Island, in southern China, co-owner Mo Xiaobao gestures to glass cabinets filled with white and yellow bead necklaces, translucent bracelets, and pendants strung with dragons or Buddhas. "All this is carved from giant clams," he says, proudly. Behind him, wooden shelves hold ornate statues up to a meter tall: leaping fish, eagles with spread wings, grapevines intertwined with fruit. Prices approach $3000. Mo is eager to make a sale, but don't try to leave China with one of these curios, he warns: "You might have trouble with foreign customs."

As countries crack down on the trade of elephant tusks, constricting illegal ivory exports to China, shells of giant clams—the "jade of the sea"—have become the new rage in scrimshaw. In China, "there's huge demand, which has pushed up giant clam prices," says Zhang Hongzhou, an expert on the trade at Nanyang Technological University in Singapore. And that is taking a heavy toll on the mollusks, which can span a meter and play a key role in reef ecosystems. The main giant clam species targeted—*Tridacna gigas*—is considered vulnerable to extinction based on survey data from 20 years ago. Its status has since eroded considerably, says Mei Lin Neo, a marine biologist at the National University of Singapore. "There is a wide-scale consensus among numerous nations that clam numbers have declined over the past 10 years," she says.

For centuries, Hainan fishers harvested giant clams for meat, which is considered an aphrodisiac in China and a delicacy in France, Japan, and elsewhere. Found throughout the tropical Indo-Pacific, the mollusks thrive in the South China Sea, which is an "especially important" part of their habitat, Neo says. Trade in the shells—translucent white, sometimes streaked with yellow or red, and weighing up to 200 kilograms—began about 20 years ago, Zhang says, when a Taiwanese entrepreneur showed locals how to carve intricate designs.

But only in the past few years has the handicraft industry taken off. Fueling the boom, Zhang says, are improved carving techniques, Hainan's popularity with tourists, the growth in e-commerce and the domestic wholesale market, and rising demand as ivory sources dry up. Tanmen, once a sleepy fishing village, is the epicenter of the trade: According to Zhang, it now has at least 460 shops and 100 workshops, and the industry supports nearly 100,000 people on Hainan. Prices paid to fishers for large raw giant clam shells have leaped 40-fold in 5 years, from a few thousand yuan a few years ago to 80,000 yuan ($12,100) today, he says. A Hainan government report states that especially fine and large carvings can fetch up to 700,000 yuan ($106,000).

To feed the booming industry, Chinese fishers are pillaging the South China Sea for the creatures. That's adding to the tension in the region, which is already a geopolitical flashpoint because of China's expansive territorial claims. As stocks dwindle, Chinese fishers are ranging more widely into disputed waters. Ed Gomez, a marine biologist at the University of the Philippines, Manila, says he has examined recent footage taken by divers showing Chinese fishers operating at Scarborough Shoal—claimed by China, Taiwan, and the Philippines—"digging

A dragon carved from a giant clam shell. Carvings can fetch more than $100,000.

PHOTOS: (TOP TO BOTTOM) AMAN SANTOS/CTI-SOUTHEAST ASIA/FLICKR; C. LARSON

up the reef looking for shells, and loading up huge cargo boats chock-full of giant clam shells."

The harvest damages reef ecosystems, biologists say. Giant clams, which may live for 80 or more years, are food for predators such as eels and starfish and provide shelter for fish and shrimp species. The clams are also a reservoir for specialized microalgae—zooxanthellae—that symbiotically help them glean energy from photosynthesis. A giant clam "is a whole ecosystem by itself, like a mini coral reef," Gomez says.

Giant clams are particularly vulnerable to depletion because the hermaphroditic creatures are slow to mature and reproduce. Although they can produce sperm at 2 or 3 years, they take up to 10 years to reach sexual maturity as a female. "Because they are being harvested at such a rapid rate, there is not time for them to naturally reproduce," Neo says. "If we don't have giant clams in the reefs, the reef's role will diminish with time," she says. "There will be a reduction in biodiversity."

Harvesting them inflicts collateral damage on reefs as well. When a giant clam is spotted, divers will push it to shallower water, dislodging coral and other species along the way, and then hoist it into a boat.

The illicit trade stays largely in China, which adds to the challenge of stopping it. Giant clams are protected under the Convention on International Trade in Endangered Species of Wild Fauna and Flora, but the treaty can't deter domestic traders or smugglers because it works mainly by requiring an export permit for trade in threatened species. "It's hard to use international obligations to stop [the trade]," Neo says. "It has to come from the Chinese side."

The Chinese government faces what Zhang calls "a great dilemma" in deciding how forcefully to crack down. China's own laws classify the giant clam as endangered, which makes it officially protected. On the other hand, he says, the fishers are pawns in the political drama playing out in the South China Sea. When President Xi Jinping visited Tanmen in April 2013, Zhang says, he encouraged the fishers to build bigger ships and range farther in the South China Sea.

In a hopeful development, Tanmen's government last March banned the harvest, transport, and sale of giant clams. One local trader says that police periodically inspect fishing vessels and seize the clams. But Tanmen's curio shops remain open, and another storeowner says she has no trouble buying raw giant clamshells. Overcoming patriotic fervor and market forces to save the embattled species will not be easy. ■

The University of Oxford received more research funds from a recent E.U. program than did any other U.K. university.

PHOTO: © JOHN ALEXANDER/ROBERT HARDING/CORBIS

EUROPEAN UNION

Debate sharpens over U.K. threat to leave Europe

Many researchers worry about a loss of funds and influence, but some say the fears are overblown

By **Tania Rabesandratana** *and* **Erik Stokstad**

After Britain's Conservative Party won a surprisingly large majority in the House of Parliament on 7 May last year, Prime Minister David Cameron promised a referendum on a contentious topic: Should the United Kingdom pull out of the European Union? Now, campaigners are gearing up for a major debate about the pros and cons of a "Brexit"—including its impact on British science.

Leading scientific institutions say that hundreds of millions of pounds in research funding are at stake, along with the country's influence on E.U. science programs. "The importance of engagement with Europe is paramount," Leszek Borysiewicz, vice-chancellor at the University of Cambridge in the United Kingdom, said on 19 January at a hearing of the science and technology committee of the House of Lords.

But a much smaller group of researchers says U.K. science would actually gain from leaving the European Union because it would escape bureaucracy and regulations, for instance on clinical trials. The campaign to stay in the Union has been "all emotion without thinking about the cold hard facts," says Angus Dalgleish, an oncologist at the University of London who represents Leave.EU, a pro-Brexit group.

The referendum could take place before the summer. A vote for departure would not affect U.K. membership in non-E.U. science organizations, such as CERN, the European Space Agency, and the European Molecular Biology Laboratory. Public opinion is split and could be influenced by the outcome of Cameron's negotiations with the European Union; at a summit with heads of state next month, he will seek concessions on issues such as curbs on welfare for migrants and more national sovereignty.

Advocates for staying in the European Union point out that U.K. research institutions have benefited greatly from access to the European Union's science programs. For instance, about €7 billion has flowed into the United Kingdom from across the English Channel as part of Framework Programme 7 (FP7), a grants scheme that ran from 2007 to 2013, according to the European Commission. U.K. applicants had a 22.8% success rate in FP7—higher than the E.U. average of 20.5%—and the United Kingdom ranked second among the Union's 28 member states in number of participants and cash received. A divorce would also reduce the United Kingdom's influence over E.U. science policies, says Mike Galsworthy, a science policy expert who leads the campaign Scientists for EU in London.

Dalgleish and other E.U. critics say that the money and influence come with oner-