Aquaculture, Ahoy!

Watermen harvest salmon at Fish Farm Nelson in South Island, New Zealand. Right: A thriving fish farm in the azure waters of the Greek Islands.

Fish farming is becoming the fastest growing industry in agriculture

BY RONA KOBELL

DAVE HARP

FOR DECADES, JOHNNY Shockley fought the winds and the tides on the Chesapeake Bay, dredging along its silted bottom to bring up the plumpest, rounded oysters he could find. He did it for the same reason his father did it, and his grandfather before him: Oystering made for a good living in the small watermen's village where the Shockley men were born and raised.

But in 2009, Shockley found that the tide had turned—not just on his beloved Hooper's Island, but on the entire Maryland coast. Oyster populations had reached less than 1 percent of their historic levels. Because oysters are important filter feeders that help reduce pollution, the state was moving to close nearly a quarter of the public oyster grounds in

Top: Working the floats at a Choptank River oyster farm in Cambridge, Md. Above: Johnny Shockley shows off his crop of "Chesapeake Gold" oysters on Hooper's Island. Many aquafarmers "tumble" their oysters to give them a rounder, smoother shell.

Aquaculture in the World

The seafood we get at the local place down the road is often anything but local. The crabmeat at a seaside shack in North Carolina may be from Thailand; the salmon at an upscale Oregon bistro may have been raised in a Chilean pond. Increasingly, customers want to know where their fish is coming from, and upscale grocery labels sometimes tell them when it's caught in the wild. But often, the answer is a pond, somewhere far away. Here's a look at aquaculture around the world.

Asia
The Chinese were reportedly the first to raise fish in ponds 5,000 years ago, and they are the world leaders in aquaculture. China accounts for two-thirds of the world's fish production. Its main export is the common carp. In 2005, the value of China's aquaculture was close to $40 billion, about half of the worldwide value of aquaculture. In Asia, India is the second-ranked producer of seafood.

Canada
Canada's waters support fresh salmon and its Great Lakes are home to a variety of trout. But in aquaculture, salmon are down and mussels are up. In 2009, salmon sales dropped about 9 percent, while mussel sales increased by about that amount. Operating revenues for the country jumped 20.8 percent, to $908.2 million. Canada continues to grow large numbers of Great Lakes species to stock for the thriving sport-fishing industry on both sides of the border.

Central and South America
Aquaculture is thriving in the Southern Hemisphere. Top producers include Brazil, Chile, Peru, Mexico and Argentina. Chile is the largest producer of farmed salmon, after Norway. Increasingly, Peru is a major producer of fishmeal—ground-up wild fish that farmers feed to the farm-raised crops. Argentina's main export is rainbow trout, with oysters and mussels gaining ground as top crops. Brazil and Mexico are known for their tilapia production. All these countries have a competitive advantage with their warm climates.

Europe
Norway has been raising fish for nearly half a century. In 2003, its production of salmon was valued at $350 million. Salmon accounted for 80 percent of Norwegian fish farming, followed by rainbow trout, halibut and cod. Norwegians also raise mussels and oysters. More than 90 percent of the fish farms throughout Europe are small, family-style operations. Norway accounts for 23 percent of Europe's aquaculture operations, followed by France at 17 percent. The French are known for their cultivation of oysters, and farmers from all over the world travel to the French coast to learn from those operations.

Source: Food and Agriculture Organization of the United Nations

hopes of bringing the population back.

In the midst of the cuts, Maryland officials threw watermen a lifeline. They relaxed century-old rules prohibiting oyster and clam aquaculture. Though Maryland watermen had resisted the practice of raising shellfish since the late 1800s, watermen in Virginia had long been successful at it. And, with a new cultured oyster that could grow more than twice as fast as a wild one, they were getting even better.

Shockley drove south to take a look. Within a year, his aquaculture business, the Hooper's Island Oyster Co., had set up at the end of a winding island road near the offices of his partner, seafood buyer Ricky Fitzhugh. On Tar Bay's bottom, Shockley is growing millions of oysters in cages. He's calling them Chesapeake Gold.

"It's a change from what we're used to," Shockley says of aquaculture. "But when people see how this plays out, it's going to make sense."

To scientists, it already does. Dr. Mark Luckenbach, a Virginia Institute of Marine Science oyster biologist, likes to say that, for most places, aquaculture isn't the future: It's the present.

"To the best of my knowledge," he says, "there are no wild oyster fisheries in the world that aren't going in the same direction as ours."

That's true for most aquaculture. In Asia, shrimp and fish farming is a global business. China and Thailand produce most of the world's shrimp in tanks and ponds throughout the countryside. The French have grown oysters in cages and bags for close to a century, while the states along the Mississippi River in the United States have long raised catfish in ponds. Governments have gotten into aquaculture, too: Canadian authorities spend several million dollars each year to raise and culture fish, which they then deposit in the Great Lakes and rivers to support the recreational trout and salmon fishery.

In some cases, aquaculture can provide a product that consumers love but can no longer find in abundance. In other cases, consumers are looking for healthy options but want to know that the fish or shellfish is grown sustainably.

"We're running out of fish," says Dr. Yonathan Zohar, chair of the Department of Marine Biotechnology at the University of Maryland,

Aquaculture has brought fish that had been scarce back to the menu, notes Yonathan Zohar, who is seen here with Mediterranean sea bream.

Baltimore County (UMBC). "Fish are the last hunt-and-gather live crop. You don't go into the wild to harvest your chickens, your bovines, but you do with fish. And as a result of that, aquaculture has become the fastest growing agriculture industry in the United States."

Zohar, a marine endocrinologist who was born in Israel and educated in Paris, grows fish in a basement lab at Baltimore's Inner Harbor. He started with sea bream, graduating to bronzini and cobia. A veteran of many international conferences on the topic, Zohar says that small-scale and sustainable aquaculture not only provides employment opportunities—it also brings species on the verge of disappearing back to the menu.

Sea bass is an example of a well-loved fish that became scarce. Chilean Sea Bass, which was originally called the Patagonian toothfish, used to grace the plates of the finest restaurants. Then it became very difficult to stock, after conservationists warned that the fish was in danger of extinction.

That led enterprising farmers to raise different varieties of sea bass in ponds thousands of miles from Chile—from Australia to India to Poland. In the Philippines, Finfish Hatcheries Inc. is the country's largest commercial fry hatchery, and the only source of sea bass fingerlings, according to *Agriculture Business Week*.

It takes a sea bass about one year to grow from fingerling to table size (400 to 600 grams or 0.9 pound to 1.3 pounds). During their first month, the fingerlings grow from 1 inch to 4 inches in a nursery setting, eating ground fish or fry mash. Then fish farmers move them to a sea pond known as a "transition pond," where they spend two or three months as juveniles. Finally, they enter marine cages, where they subsist on baitfish and continue to grow until reaching maturity.

Finfish Hatcheries notes that farming sea bass is relatively easy—and profitable. "This type of fish rarely schools or moves," says a FHI spokesman, "and they can grow in a very wide range of salinity." Stocking a pond with 1,000 sea bass fingerlings will produce about 5,000 kilograms (roughly 11,000 pounds) of matured sea bass, according to a study by the Brackishwater Aquaculture Center of the University of the Philippines.

Of course, there are some drawbacks to growing fish. Aquaculture can introduce unwanted invaders that become expensive problems for ecosystems. For example, catfish farmers on the Mississippi River brought in Asian carp to eat the algae fouling the ponds. The carp escaped after a flood in the 1990s and got into the Mississippi where, absent any natural predators, they ate their way through the food chain. Now, scientists believe that the carp have invaded the Great Lakes, though no one is certain of the numbers or the damage they could do.

"That is probably the biggest issue, [introducing] an invasive species when

you're bringing in a new species to grow. A flood comes along, and that spreads the fish all out," says Dr. Jim Diana, director of the Michigan Sea Grant program and a longtime professor of fisheries and aquaculture at the University of Michigan in Ann Arbor. "So the technique is not to culture things outside of their native areas, or individuals that are not viable."

Profits on the Half Shell

Shellfish aquaculture is the fastest growing segment of the United States' aquafarming industry, according to the National Oceanic and Atmospheric Administration. And within shellfish, oysters are a major growth area.

The sterile oyster has become a game-changer in Virginia, where oyster geneticist Dr. Standish Allen began producing them in large quantities six years ago as part of a government-financed experiment. Only bred in labs and hatcheries, sterile oysters have three chromosomes instead of two. Since they put all their energy into growth and none into reproduction, they reach market size in 12 to 18 months instead of the three years it takes an oyster in the wild.

That quicker growth rate is key. Disease began to hit Chesapeake Bay oysters in the 1950s; by the 1990s, populations were devastated. The three-chromosome oyster is not immune to the parasites—known as MSX and Dermo—that attacked the native oysters. But it can outrun them; disease usually hits in the second or third year, and the sterile oysters have already reached market size by then.

Once entrepreneurs showed what they could do, more farmers jumped in. In 2005, Virginia oyster culturists planted 6.2 million oysters. By 2009, that number increased nearly fivefold, to 28.3 million, according to the Virginia Shellfish Aquaculture Crop Reporting Survey.

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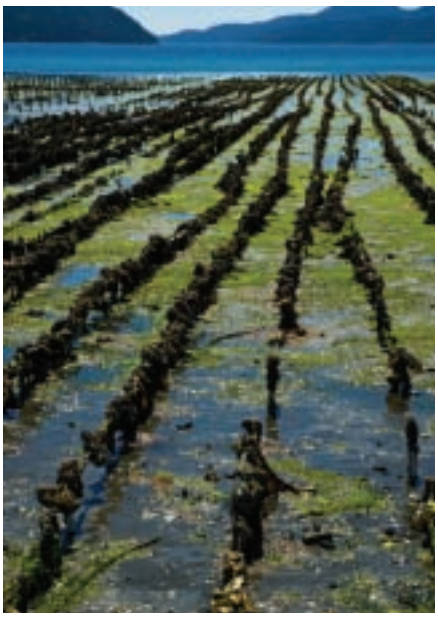
Farmers grow oysters in two ways. The oldest method is spat-on-shell. In a tank, when the temperature is ready for spawning, oysters shoot sperm and eggs at each other. Once the gametes fertilize, they become oyster larvae and swim freely for one to two weeks. Then they search for a place to spend the rest of their lives. They'll find it in a shell that is placed in the tank, usually within a plastic mesh bag. Then the farmer takes the shell bags out to a leased bed, opens the bags, and plants them on the bottom of the bay. In about two years, the oysters will reach market size.

Spat-on-shell is cheap, because equipment costs are low and nature does most of the work. But it has limitations. Growers can't control conditions. And because the oysters grow clumped together, they don't look as pretty on a plate. They are ideal for the shucking houses, but they need to be managed consistently if they are going to restaurants.

Consequently, some oyster growers have turned to cultchless oysters. In this method, the hatchery seed settles not on a large shell but in a tiny sliver known as microcultch. These oysters must be nurtured in a nursery system until they are large enough to plant. These nurseries, called upwellers, pipe in seawater to feed the oysters. Different sized screens let the water enter and prevent the oysters from leaving.

When they're large enough, cultchless oysters can be grown in floats on top of the water, in cages or in bags on top of racks—a technique known as rack-and-bag that's common in New England and France.

In all of these methods, the farmers have a lot of quality control. They can take out the oysters, wash them, tumble them and move them around. That control can be expensive, as upwellers can run as high as $9,000 and sorting and tumbling systems can be twice that. But the advantage is a higher price at market. These are the oysters gracing



Left: Hundreds of trout swim in two pools at a trout farm in Abruzzo, Italy. Right: An oyster farm at low tide on Orcas Island in Washington state.

Left: Cage culture, in which oysters are grown in mesh bags, is becoming increasingly popular. Right: Oyster farmer Perry Raso shucks oysters at his restaurant, Matunuck Oyster Bar, in Rhode Island. His oyster grounds are available for tours.

the tables of high-end restaurants at $12 for a plate of six.

Floats have one major disadvantage: Wealthy waterfront neighbors would rather not look at them. In the case of the Choptank Oyster Co. in Cambridge, Md., managers had to move their floats after neighbors complained.

In Virginia, and increasingly in Maryland, cage culture is becoming more popular. In this method, the oysters are grown in mesh bags—one on each side of a cage placed several inches off the Bay bottom. Passers-by cannot see the cages. Oystermen put their crops in ever larger bags as they grow, washing the product and running them through a tumbler to make sure they are round and smooth.

Unlikely Farmers

Aquafarmers come from all walks of life. They are bankers, engineers, scientists and teachers. Increasingly, though, they are commercial watermen and fishermen like Shockley, which doesn't surprise anyone who's worked on the water. Tommy Leggett, an oyster grower in Virginia, used to ply the Bay in a small boat dredging for clams and oysters. He earned a master's degree in fisheries science and, in 1996, started his own aquaculture business. He also runs the Chesapeake Bay Foundation's oyster demonstration farm near Hampton Roads, Va.

Watermen and fishermen, Leggett says, are riggers. "They know how to figure things out."

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In Rhode Island, clam farmer Perry Raso saw the potential for oyster aquaculture when he was just 23 years old. He started with one acre in 2002; now, his Matunuck Oyster Farm includes a popular restaurant, Matunuck Oyster Bar.

Raso invested $90,000 during the first three years in his business; during that time, he says, he didn't make much money. Perhaps that's why aquaculturists joke that the way to make a small fortune in the business is to start with a large one.

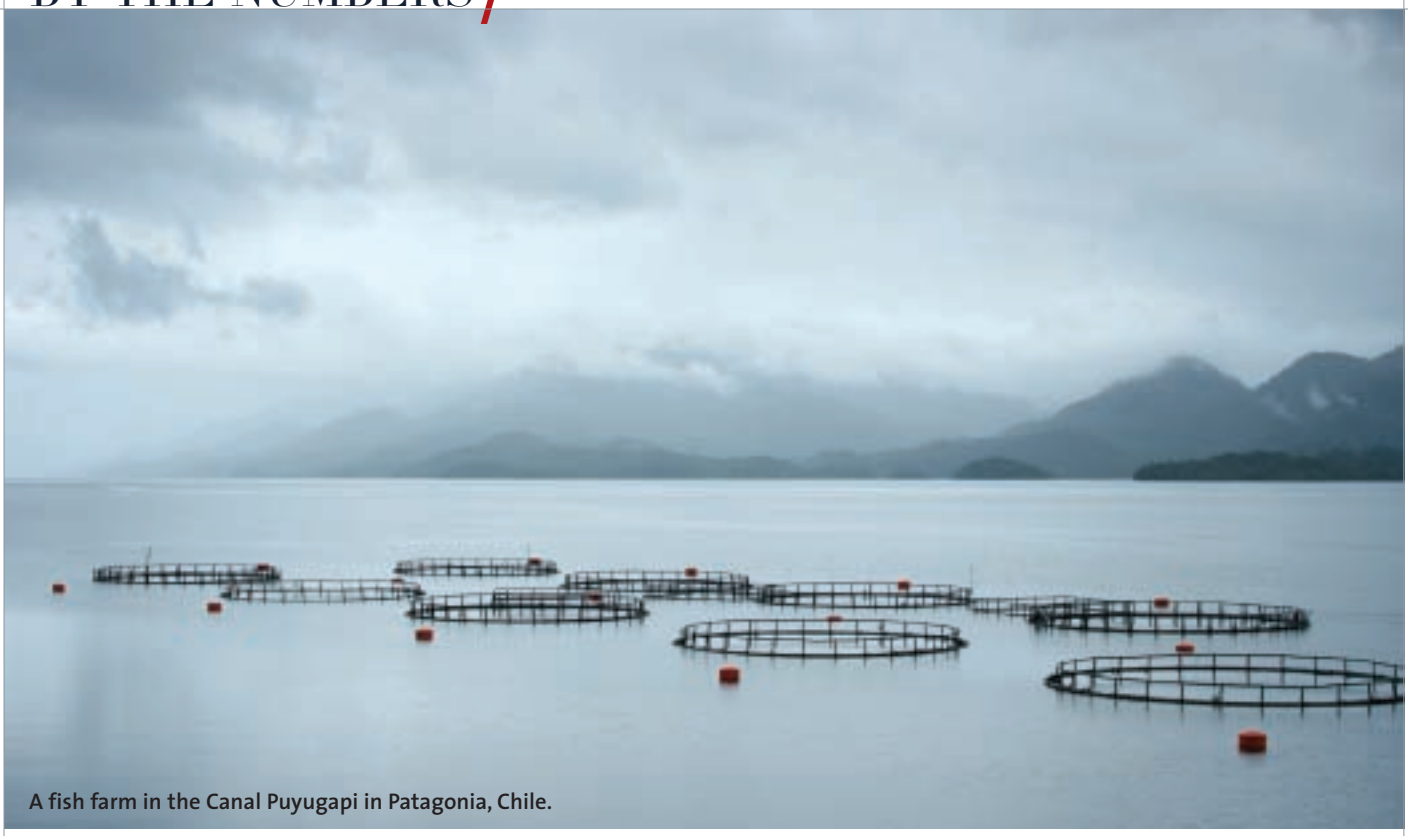
"You can't just quit your job and say you're going to start an aquafarm, because you're not going to get paid for two years," Raso warns.

But eventually, he says, you will get paid, and not just with cash. Matunuck earns raves for its consistently fresh seafood, and environmentalists have praised Raso's oyster grounds, which are available for tours.

Raso raises about half a million oysters a year for the restaurant market. In Washington state, Taylor Shellfish Farms, the largest oyster company on the West Coast, produces about 100 million oysters a year.

Shockley would like to be one of the big guys, selling not just oysters but also nurseries, cages and the other equipment he's taught himself how to construct. Once other watermen see that they can succeed, Shockley believes he'll have a ripe equipment market. And he's not worried about competition; there is a big enough market for everyone to have a bite.

"This is where we have a leg up," Shockley says of the watermen. "This is why we're going to be great at it. We can do all these things. To us, this is easy."



A fish farm in the Canal Puyugapi in Patagonia, Chile.

Aquaculture

is the art of growing fish and shellfish in closed marine systems. Though close to 5,000 years old, this ancient Asian practice only came to the United States about 100 years ago. It has been growing steadily since the 1960s. The National Oceanic and Atmospheric Administration recently announced a new policy to encourage aquaculture across the nation, in part to help the U.S. catch up with places like China and Latin America, where the practice has thrived for decades. Here's a look at aquaculture by the numbers:

- Aquaculture is one of the fastest-growing industries worldwide, growing at about 6.5 percent each year.
- China produces 61 percent of the world's aquaculture products.
- More than 50 percent of the fish consumed worldwide is grown in ponds and tanks.
- The value of U.S. aquaculture production is more than $1.3 billion a year. U.S. aquaculturists produce more than 500,000 metric tons of plants and animals each year.
- Some 84 percent of the seafood Americans consume is imported, according to the NOAA.
- The No. 1 fish species grown in the United States? Catfish, largely raised in the South. Tilapia and rainbow trout are a distant second and third.
- Shellfish is one of the fastest growing aquaculture segments in the United States, according to NOAA. Nearly 80 percent of marine aquaculture in the U.S. is shellfish: oysters, crayfish, clams or shrimp.

Source: NOAA; Fish Technology Associates