



They spend decades in rivers and lakes, then  
cross oceans and spawn in secret.

MYSTERY TRAVELERS

# eels

Year-old "glass" eels hole up in Maine's Pemaquid River.





At dusk, lights guide Yvonne Carey (far left) and daughter Genna as they dip eels from Nova Scotia's East River and store them in a blue-topped bag. Licensed to fish nine rivers, the Careys truck their catch home to holding tanks to await live shipment to Asia.



As a kid, I encountered eels more often in crossword puzzles or Scrabble (a good way to unload e's) than in the wilds near my Connecticut home. But in the flesh, when my friends and I caught them by mistake on fishing outings, they were alien and weird, unnameable things—snakes, maybe, or what?—and we were afraid to retrieve our hooks from their mouths.

One day an old man casting nearby told us they were fish. I knew that if this was true, eels were fish like no others.

For much of my life I had little occasion to pay attention to eels. Then six years ago, while heading down Route 17 in the Catskills of New York State on a cold November day, I decided to follow a sign that said, "Delaware Delicacies, Smokehouse." Past the Cobleskill quarry, down a sinuous dirt road through a shadowy hemlock forest, I came to a small tar-paper shack with a silver smokestack, perched on a high bank overlooking the East Branch of the Delaware River. A man with a pointy white beard and a ponytail, who resembled a wood imp, hopped from behind the plywood door of the smokehouse. His name was Ray Turner.

Every summer when the river is low, Turner—slippery, resilient, and a bit mysterious himself—refurbishes the V-shaped stone walls of a weir that funnels water through a wooden rack designed to trap fish. It takes him the better part of four months to finish the work, in preparation for the eel run that occurs during just two nights in September, around the dark time of the new moon, when maturing eels swim downstream toward the ocean. The run often corresponds with floods brought on by storms during hurricane season, when the sky is at its blackest and the river at its highest. As Rachel Carson observed, the eel is "a lover of darkness."

We paddled in a canoe upstream from Turner's house toward the weir. "There's Baldy," he said, pointing to a bald eagle circling low, keeping an eye on the rack, looking to snag any fish before Turner did. In this broad valley, reminiscent of a Hudson River school painting, the weir made

an impressive piece of land art. Turner spoke of it in metaphorical terms. "This is the womb," he said, as we perched on the rack. "Those are the legs." He gestured toward the stone breakwaters stretching diagonally on either side of the river. "You see? It's a woman. All the river's life comes here."

When the September run is good, Turner can take up to 2,500 eels. "Every year I let the biggest girl back in the river," he said. (Assuming the eel is a female and that she makes it out to sea to spawn, she will lay up to 30 million eggs.) Turner hot smokes his eels and sells them to passersby, as well as to restaurants and retailers, earning him up to \$20,000 a year. "I consider the eels to be the best quality protein in my line—a very unique flavor of fish, applewood smoke, and a momentary

Ray Turner stirred the water, agitating

lingering of dark, fall honey. All the fish I smoke, trout and salmon, are farm raised, except the eels. The eels are wild. They're like free-range."

Back at the smokehouse, Turner showed me the two concrete-block chambers where the eels—dressed and brined in salt, brown sugar, and local honey—are hung on rods. Behind each chamber is a 55-gallon-drum stove with a door on the front and a chimney hole with two pipes in the back. Once the fire is going in the stove, Turner directs the heat and smoke into the chamber, and the eels are cooked at 160 to 180 degrees Fahrenheit for a minimum of four hours.

He ushered me through the back door, past

neat stacks of hand-split applewood, to a wooden tank, like a giant wine cask cut in half, covered in moss and dripping water through its swollen slats. I peered over the chicken wire around the rim into a clear pool. Turner stirred the water with a net, agitating some 500 silvery eels, most about as big around as a dollar coin and up to three feet long. They were lithe and sensuous—just magical.

FRESHWATER EELS, OF THE GENUS *Anguilla*, are ancient fishes. They began evolving more than 50 million years ago, branching into 16 species and three subspecies. Most migratory fish, such as salmon and shad, are anadromous, spawning in fresh water and living as adults in salt water. The freshwater eel is one of the few fishes that do the opposite, spawning in the ocean and spending their adulthood in lakes, rivers, and estuaries—a life history known as catadromy. In general, female eels are found upstream in river systems, while males stay in the estuaries. Eels may spend decades in rivers before returning to the ocean to spawn, after which they die. No one has ever been able to witness freshwater eels spawning, and for eel biologists, solving this eel-reproduction mystery remains a kind of holy grail.

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In biology class we were told that the eels we caught in creeks and ponds had emerged from eggs suspended in the ocean, specifically the Sargasso Sea, the southwestern part of the clockwise gyre in the North Atlantic—an idea that required more faith than imagination. We know that freshwater eels reproduce in the ocean because larvae have been found drifting near the surface thousands of miles from any shore. Eel larvae—tiny, transparent creatures with thin heads, bodies shaped like willow leaves, and outward pointing teeth—were thought to be a separate species of fish until 1896, when two

Italian biologists watched one in a tank metamorphose into an eel.

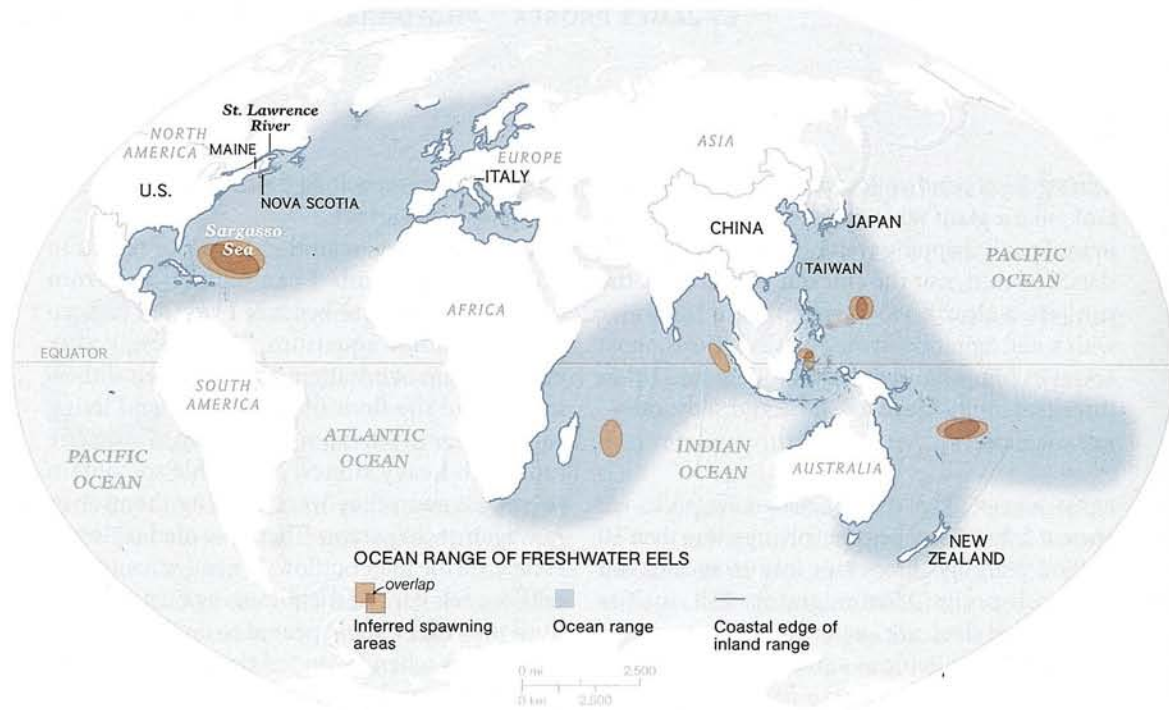
Eels are relentless in their effort to return to their oceanic womb. I can tell you this from personal experience because I've tried to keep them in a home aquarium. The morning after the first night of my attempt, I found eels slithering around the floor of my kitchen and living room. After securing a metal screen over the tank with heavy stones, I was able to contain them, but soon they were rubbing themselves raw against the screen. Then one died trying to escape via the filter outflow. When I screened the outflow, eels banged their heads against the glass until they had what appeared to be seizures and died. That's when I stopped trying to keep eels.

They're wondrous in their ability to move. They show up in lakes and ponds and postholes with no visible connection to the sea, leaving the inquisitive shaking their heads. On wet nights eels have been known to cross land from a pond to a river by the thousands, using each other's moist bodies as a bridge. Young eels have been seen climbing moss-covered vertical walls. In New Zealand it's common for cats to bring eels to the doorsteps of farmhouses, having caught them in grassy paddocks.

"How many animals are there that live in such diverse habitats?" David Doubilet mused while photographing eels in New Zealand, knee-deep in a spring-fed creek, watercress dangling from his mask and snorkel. "Here we have a fish that is born in the deepest, darkest depths of the ocean, and yet here you have them in a farm paddock with cows."

French farmers in Normandy say that eels will leave rivers on spring nights and find their way to vegetable patches to feed on peas. That's a fable, but eels are one of the only fishes that will emerge from the water to take offerings of





## From Sea to Stream

Scientists know where some of the 16 freshwater eel species and three subspecies spawn, but no one has ever reported seeing eel reproduction in the wild. Larval eels ride ocean currents to lagoons, estuaries, rivers, and lakes. Many eels—almost exclusively females—move far inland. Years or even decades later adult eels return home by unknown routes to spawn and die.

food—canned mackerel or dog food—on riverbanks. I've observed them doing this at sacred Maori eel-feeding sites in New Zealand. Under normal circumstances, an eel's diet is quite varied—everything from aquatic insects and fish to mussels and other eels.

Adaptability aside, the migrations millions of adult eels make from rivers across oceans must be among the greatest unseen journeys of any creature on the planet, spanning thousands of miles. Along the way they face a long list of dangers: hydroelectric dams, river diversions, pollution, disease, predation (by striped bass, beluga whales, and cormorants, among others), and increasingly, fishing by humans. Now, with climate change, another potential disaster looms: shifts in ocean currents that may confound eels during their migrations. Regrettably, although sublime in the eyes of some, the eel is not likely to be the poster child for a conservation movement anytime soon.

FROM ARISTOTLE TO PLINY THE ELDER, Izaak Walton to Carl Linnaeus, naturalists put forward various theories as to how eels came to be: that the young emerged from the mud, that eels multiplied by rubbing themselves against rocks, that they were born from a particular dew that falls in May and June, that they bear live young. One problem was that no one could identify sperm or eggs in eels. Over a 40-year period in the late 1700s, at the famous eel fishery at Comacchio, Italy, more than 152 million adult migratory eels were caught and cleaned, not one of which was found carrying eggs. No one could say for sure whether eels even had gender, because no one could identify their reproductive organs. (It turns out that the sex organs of eels become enlarged with eggs and sperm only after the adults leave the mouths of rivers for their oceanic spawning grounds and disappear from sight.)

In the late 1800s in Trieste, Italy, a medical student named Sigmund Freud was assigned to



investigate the testes of the male eel, postulated to be loops of white matter festooning the body cavity. (Freud's paper on eels was his first published work.) This was confirmed in 1897, when a sexually mature male eel was caught in the Strait of Messina.

In 1904 Johannes Schmidt, a young Danish oceanographer and biologist, got a job aboard the *Thor*, a Danish research vessel, studying the breeding habits of food fishes such as cod and herring. One day that spring, a larva of the European eel, *Anguilla anguilla*, showed up in one of the expedition's trawls west of the Faroe Islands. Was it possible that eels living in the creeks of Denmark spawned way out in the middle of the Atlantic Ocean?

A year earlier Schmidt had made what would end up being an auspicious betrothal to the heiress of the Carlsberg Brewery, a Danish company that donated generously to marine research. Outfitted with schooners capable of ocean crossings, he amassed data showing that the farther from the European coast, the smaller the eels. Schmidt asserted that eels must spawn in the southwestern part of the North Atlantic, in the Sargasso Sea. "No other instance is known

Yoshiaki Miyamoto hooked just one eel on his morning stint on Lake Biwa, near Kyoto. The Japanese believe eels boost energy and cool the blood in summer; local stocks are in decline.

among fishes of a species requiring a quarter of the circumference of the globe to complete its life history," he wrote in 1923. "Larval migrations of such extent and duration... are altogether unique in the animal kingdom."

After Schmidt's death in 1933, some scientists cast doubt on his Sargasso proposition. They showed that he had concealed certain data to make his case more plausible, and they questioned how he could say with any certainty that this was the only eel breeding ground, since he hadn't witnessed an actual hatching and had barely looked for eels anywhere else. Yet such criticism does little to diminish the profound story of eels he conveyed, which still appears to be true.

In 1991 an expedition headed by Katsumi Tsukamoto of the Atmosphere and Ocean Research

James Prosek celebrates eels in a book for HarperCollins, out in October. David Doubilet photographed clownfish for the January issue.





New Zealand's longfin eels are giants, some topping six feet and 80 pounds, that can live for decades. Traditional Maori prize them as guardians of sacred spaces—and as dinner. These females at South Island's Willowbank Wildlife Reserve could be 30 years old.



Institute of the University of Tokyo that included Michael Miller, then a graduate student at the University of Maine, made another breakthrough. On a dark night in the Pacific Ocean west of Guam, the team found hundreds of larvae of the Japanese eel, *Anguilla japonica*, within days of their hatching, thus locating the spawning area of this species for the first time. Nineteen years later Tsukamoto and Miller are still searching the oceans for spawning eels.

When I met Miller in his Tokyo office, he ruefully acknowledged that he and Tsukamoto have come tantalizingly close to finding the parents of Japanese eel hatchlings. But, he said, "you could be 50 meters away and not find anything. It's an issue of scale—the ocean is huge. To get where eels are spawning, it's statistically very low probability. Almost impossible. You'd have to be very lucky." What's more, he added, every year that he and Tsukamoto go looking, they seem to run afoul of the elements. "I can't remember a single eel cruise when there hasn't been a typhoon that's caused us to change course. It's almost like Poseidon is trying to keep the eels secret."

THAT'S THE GREATEST BEAUTY I find in eels: the idea of a creature whose very life beginnings can remain hidden from humans. It makes it all the harder for me to accept the thought that we may lose this creature before its life picture can be completed. Populations of American, European, and Japanese eels are all declining, some precipitously. As John Casselman, a biologist at Queen's University in Kingston, Ontario, told me, "It is truly a crisis. A crisis of concern."

In November 2004 two brothers, Doug Watts, a freelance journalist who lives in Augusta, Maine, and Tim Watts, a janitor at a college in Easton, Massachusetts, petitioned the U.S. Fish and Wildlife Service (FWS) to list the American eel, *Anguilla rostrata*, as a threatened, or even endangered, species. They were motivated by Casselman's documentation of the collapse of eel populations in the upper St. Lawrence River: From the mid-1980s to the middle of the past decade, the number of juveniles there fell by almost 100 percent. The region encompassing

the upper St. Lawrence River system and Lake Ontario and its tributaries is North America's largest eel nursery, where it is thought that female eels alone once made up 50 percent of the inshore fish biomass.

One problem for the eels was the earlier construction of the Beauharnois and Moses-Saunders hydroelectric dams, which have blocked their migrations to and from the upper St. Lawrence River system and Lake Ontario. Even if a young eel, aided by fish ladders, succeeds in getting upriver, when she comes downriver as an adult, she may be sucked into a dam's electricity-generating turbines. "Some eels come out with their skin pulled off, like a sock off your foot," Doug Watts told me. The bigger the eel, the greater the danger. In New Zealand, where longfins grow to six feet or more, turbines mean certain death.

In February 2007 the FWS announced in a 30-page report that listing American eels under the Endangered Species Act was "not warranted," in part because some eels have been found to spend their whole lives in salty estuaries. "The findings basically said that eels don't need freshwater habitat to survive," Watts said, throwing up his hands in exasperation. "That's like saying bald eagles don't need trees to nest in—they can

In one Maori myth, eels come from the

use telephone poles." Because eels have always been ubiquitous and abundant, Watts says, no one seems to believe they could ever go extinct. "That's what they said about cod as recently as the 1990s, when stocks were collapsing. 'There's no way you can fish out cod—that's insane!' they said." He paused. "You can only beat an animal so hard before it finally just gives up."

EELS THAT SURVIVE DAMS may not survive Earth's top predator. The international trade, driven largely by Japan's appetite for grilled eel, called *kabayaki*, is a multibillion-dollar industry. In Japan, eel is believed to increase one's stamina

in the heat, and Doyo Ushi No Hi, eel day, usually falls in late July. During that month in 2009 at Tokyo's famed Tsukiji seafood market, more than 111,500 pounds of fresh eel were sold. Eel is almost always eaten in eel-only restaurants, because of the difficulty in cleaning and cooking the fish. It is never served raw: The blood contains a neurotoxin that's neutralized when cooked or hot smoked. (A tiny amount of eel-blood serum injected into a rabbit causes instant convulsions and death.)

The eel is grilled on bamboo skewers over a hot wood fire, repeatedly dipped in water, and returned to the fire to steam the meat. Then it's glazed with a sauce of soy, mirin (sweet rice wine), and sugar and sprinkled with *sansho*, mountain pepper. This dish, most often a single eel split and splayed over a bed of rice in a black, lacquered box with a red interior, is called *unaju*. No part of the fish goes to waste. The liver is served in a soup, and the spine is deep-fried and eaten like a cracker. Though it may be part of Japan's food folklore, it is said that in Tokyo the eel is filleted along the back to avoid mimicking the samurai warrior's ritual knife-in-the-belly suicide. In Kyoto, where there were fewer samurai, it is filleted along the belly. Kyoto

sky, having fallen when the heavens became too hot. On Earth,

some say, the movements of eels make the rivers flow.

people say that the women in their city have such beautiful skin because they eat plenty of eel. Indeed, the meat is high in vitamins A and E, and because of its high concentration of omega-3 fatty acids, it has been found to help prevent type 2 diabetes.

An eel served in a restaurant in Manhattan may have hatched in the Atlantic Ocean, been netted in a river mouth in the Basque region of France, flown to Hong Kong, raised at a farm in nearby Fujian or Guangdong Provinces, cleaned, grilled, and packaged in factories near the farms, and finally flown to New York City. Ready eels for

market usually involves catching babies—called glass eels because of their transparency—when they arrive in fresh water from the ocean and shipping them to warehouse-style farms in China for fattening up. The trade remains dependent on the capture of wild fish because no one has figured out how to reproduce eels profitably in captivity.

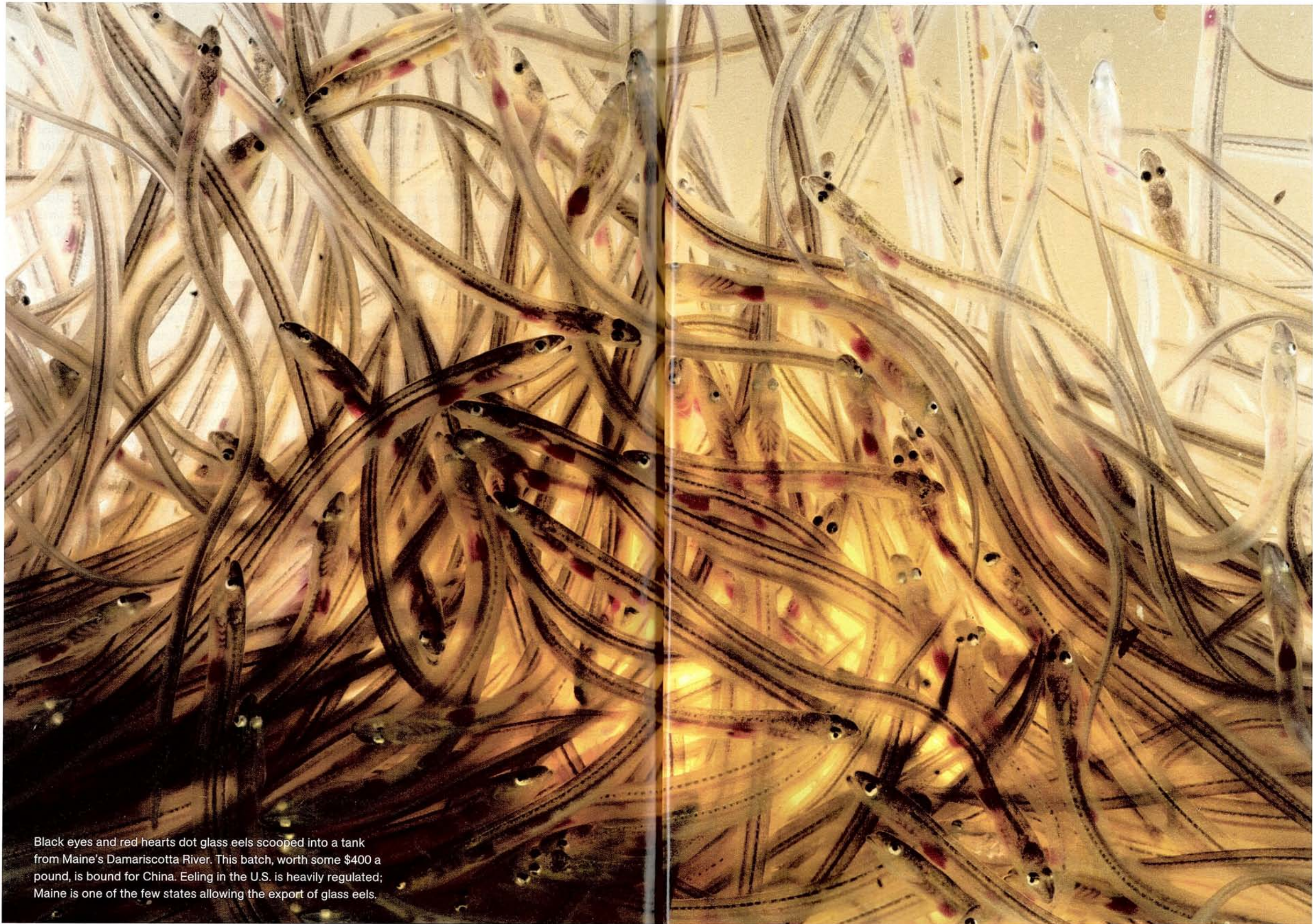
IN THE U.S. DURING THE 1970S, when aquaculture farms were burgeoning in China, eel fishing to supply the Asian market went on pell-mell from January through June in every East Coast state. Pat Bryant of Nobleboro, Maine, was one of the first in the state to catch glass eels for export to China. By day she ran a hairdressing salon in the coastal town of Damariscotta, and at night, to make a little extra money, she went down to the mouth of the Pemaquid River to check her nets.

The commercial operation in Maine grew explosively from the mid-1980s to the mid-1990s, when the more than 1,500 fishers with permits could each make several thousand dollars a night at the dock for their catch. People began stealing and vandalizing nets and pulling .357 Magnums to stake out or preserve fishing territories. In one creek, fishermen had a net called the green

monster. "It went clear across the river," Bryant said in her raspy voice, ashing her cigarette in a scallop shell. "It was a goddamn fiasco." She and a few others appealed to the state, "just out of our own preservation." Today the allowable eel take in Maine—the state with the most active fishery—is restricted to a few locations and a short season, from March 22 to May 31.

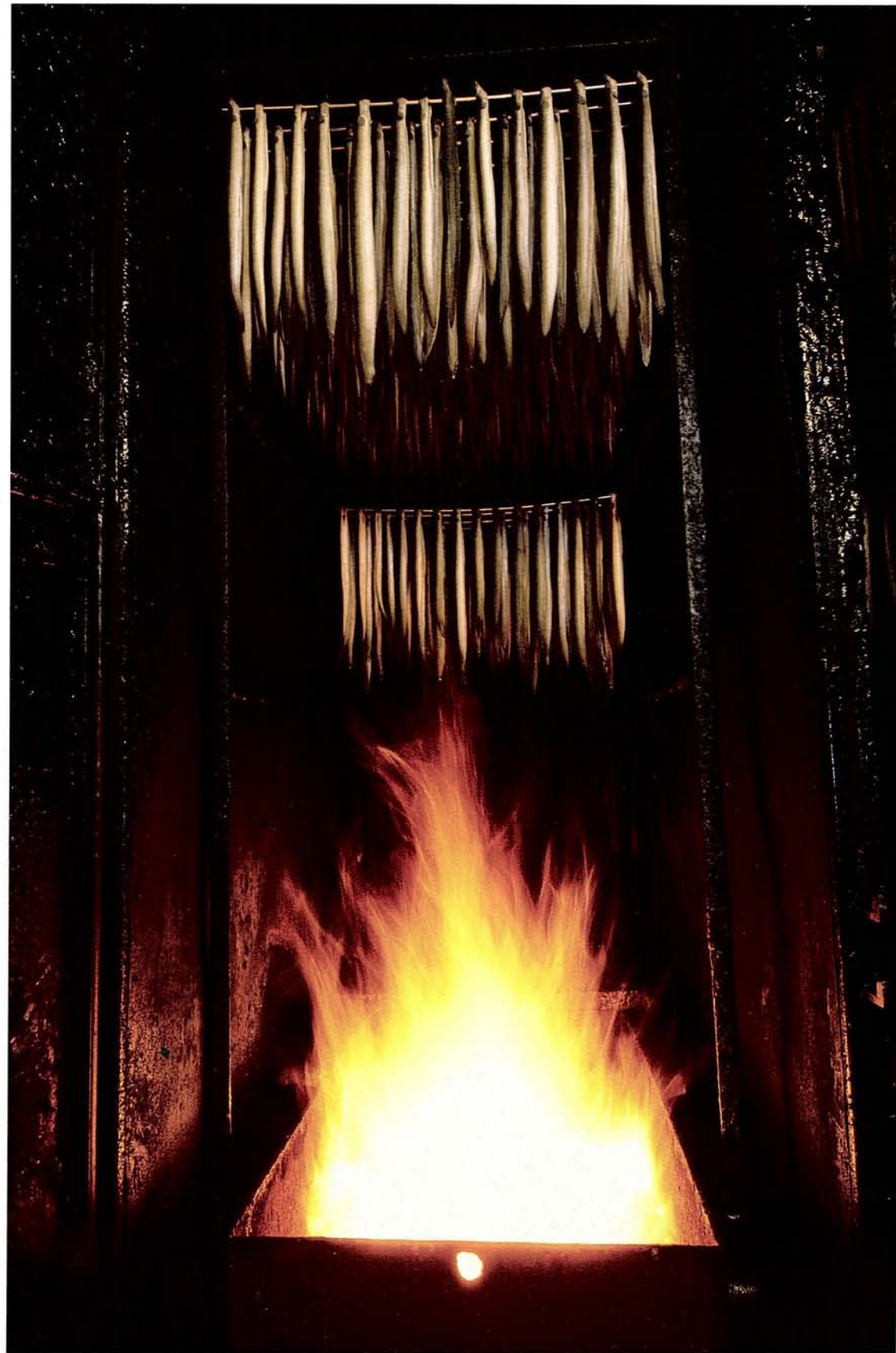
In 1997 record-low catches of prized Japanese glass eels sent prices soaring—a single kilo (2.2 pounds), about 5,000 of them, sold for as much as \$16,500, making eel more valuable at the time than gold. When the supply of Japanese





Black eyes and red hearts dot glass eels scooped into a tank from Maine's Damariscotta River. This batch, worth some \$400 a pound, is bound for China. Eeling in the U.S. is heavily regulated; Maine is one of the few states allowing the export of glass eels.





**Eels cook over a beech and oak fire at Dutchman Alex Koelewijn's smokehouse. They melt in your mouth like fine chocolate, he says. "It's the oily and smoky taste that gives the most joy."**

glass eels crashed, the price for American glass eels briefly increased tenfold—the eel gold rush, as Bryant calls it. Japanese connoisseurs weren't happy. "American eels are not as tasty," Shoichiro Kubota, who runs a 120-year-old eel restaurant in the Akihabara district of Tokyo, told me. (His father was eel handler to Emperor Hirohito.) "Even the French eels are not as good—like American cherries. Not as tasty. We like our native things."

Bryant buys glass eels from fishermen up and down the Maine coast and babysits them in tanks near her home until they're ready for shipment from Boston to Hong Kong, live, in plastic bags filled with oxygenated water and packed in foam containers. Until recently, Jonathan Yang, a dealer from Taiwan, was the middleman between Bryant and eel farmers in China and Taiwan, buying eels from her by the kilo and selling them by the piece, or individual eel. He paid cash, typically wiring a million dollars to a bank in Maine at the end of the season.

When the selling was good, Yang doubled his money, but more often than not he had to accept a modest profit. "This is a very big business, very risky," he said. If the price for adult eels fell during the 14 to 18 months it took to raise a glass eel for market, his Chinese buyer could go bankrupt. "One year the farm sells high—they all drive Mercedes-Benzes," Yang said. "Next year price falls—they're riding bicycles."

Before he went into eels, Yang was in the lucrative business of selling shark fins in China for soup. He says he quit when he saw dolphins, caught accidentally on longline hooks, being dragged aboard ship, beaten to death, and thrown back into the sea. "When they take the dolphins on the ship," Yang said, "you know they're weeping—you can see the tears." He put his hand over his heart. "When I look at eels, I feel good. When they move, they look very nice."

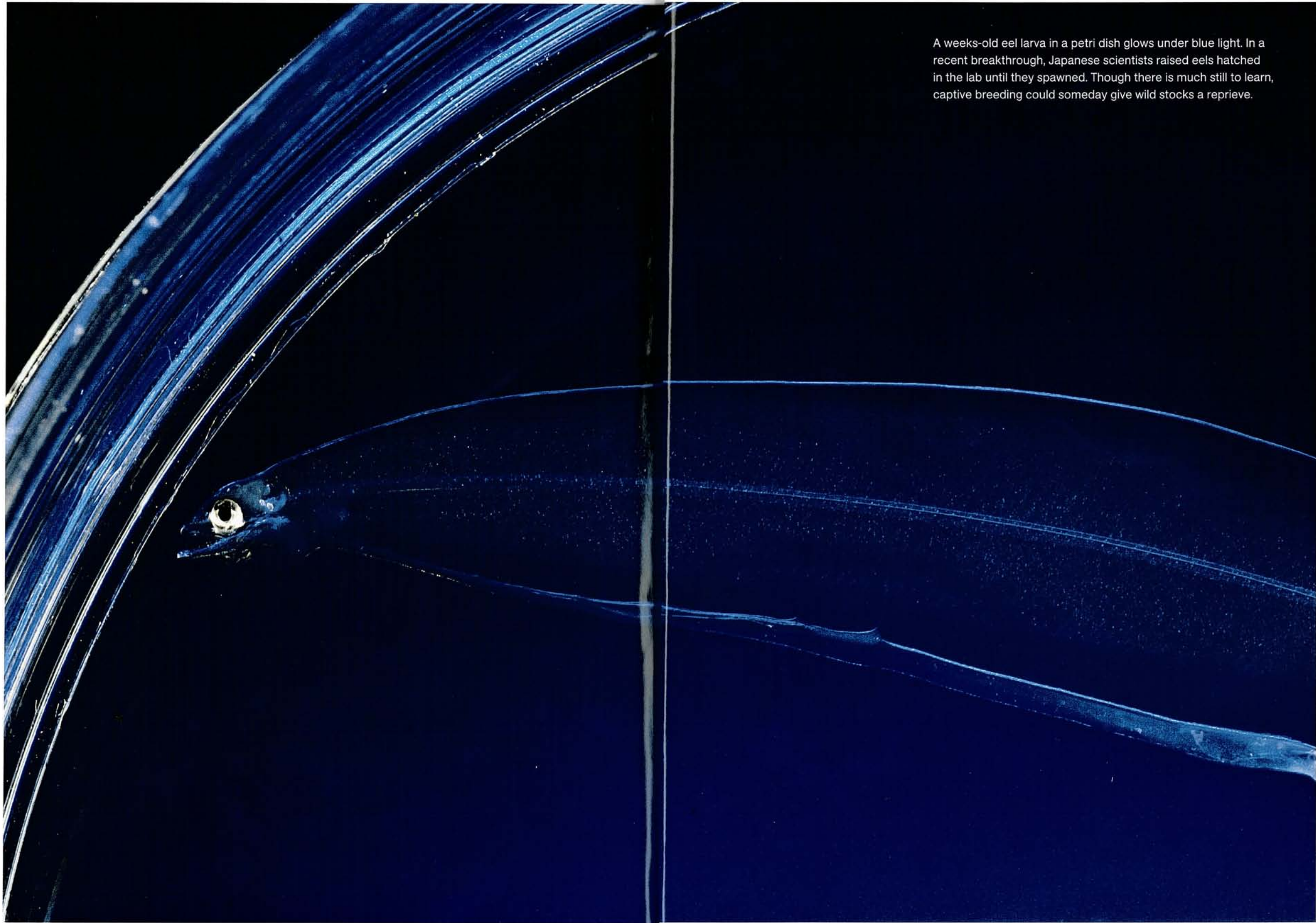
LIKE JONATHAN YANG, I get a good feeling from eels. The times I've spent with them, especially during the fall migration, have pulsed with energy. Standing in Ray Turner's weir on a cool September night on the eve of the new moon, watching veinlike ropes of eels fill his womb of wood and stone, I could almost believe the Maori's yarns about encounters they've had with the *taniwha*—the water guardian or monster. For many indigenous people throughout the Polynesian Islands, the eel is a god that replaces the archetypal snake in creation myths, an important source of food, and an erotic symbol—the word many islanders use for eel, *tuna*, is synonymous with "penis." In one Maori myth, eels come from the sky, having fallen when the heavens became too hot and inhospitable for them. On Earth, some Maori say, the movements of eels make the rivers flow. The eel is integral to everything.

We allow ourselves to believe we can understand nature by organizing and explaining it through systems of taxonomy and computerized studies of genes and DNA, fitting everything into neat categories. With each passing year, researchers peer deeper into the hidden lives of eels; in 2006 and again in 2008, scientists released adult eels from the west coasts of Ireland and France outfitted with pop-up tags, hoping to track them to the Sargasso Sea. But "knowledge," as we amass it (ever available, at our fingertips), can hinder imagination and the wonder that can come from our own observation. Eels—with their simplicity of form, their preference for darkness, their gracefulness—have helped me embrace the unnameable and get to the essence of experience, that which cannot be cataloged or quantified. They have been my way back.

The immense pressures on eels today will test their ability to adapt and survive. A Maori bush guide named Daniel Joe spoke of the staying power of eels as we sat by a campfire on the Waipunga River. "He's an old fish, and he's absolutely relentless," Joe said. "The eel is *morehu*," a survivor. "I think they will be there till the end of the world as we know it."

I hope he's right. □





A weeks-old eel larva in a petri dish glows under blue light. In a recent breakthrough, Japanese scientists raised eels hatched in the lab until they spawned. Though there is much still to learn, captive breeding could someday give wild stocks a reprieve.