

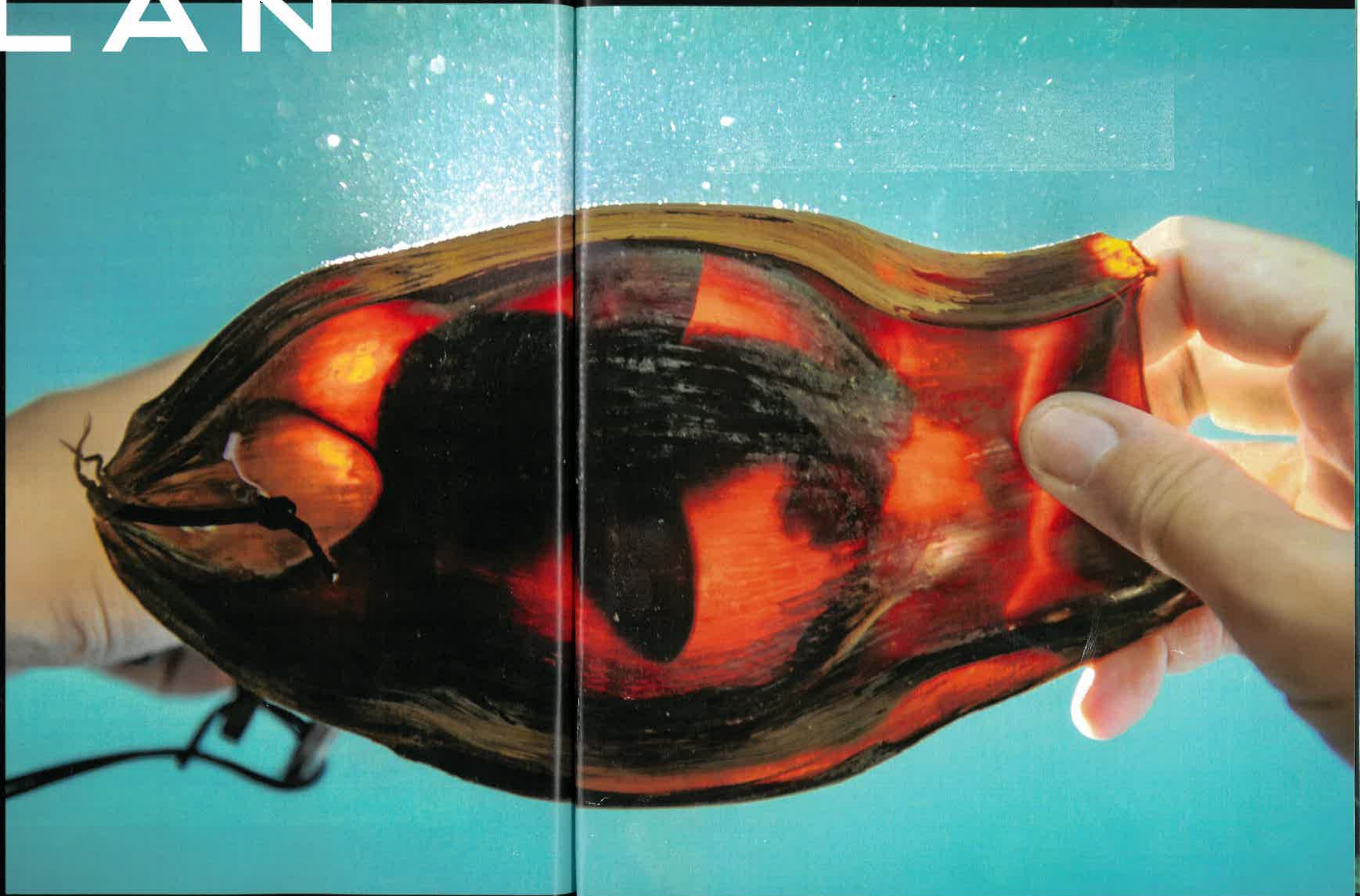
A WILD PLAN


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A zebra shark embryo, illuminated from behind, curls inside an egg within a protective pouch, known colloquially as a mermaid's purse, at a shark nursery in Indonesia. After hatching, it will be taken to the wild to help resurrect endangered shark populations in the Raja Ampat Islands.

Aquariums around the world are raising endangered sharks and releasing them into the sea. It's an unprecedented mission. And it just might work.

BY CRAIG WELCH
PHOTOGRAPHS BY DAVID DOUBILET AND JENNIFER HAYES





Nesha Ichida, an Indonesian marine scientist, gently ferries a juvenile zebra shark through a sea pen at the Raja Ampat Research & Conservation Center on the island of Kri. A team of "shark nannies," or caretakers, will weigh and measure the animal as part of a final health check the day before it's released.

N

NESHA ICHIDA knelt in a turquoise lagoon in Indonesia's Raja Ampat Islands and gently cradled a baby shark. The creature twisting beneath her fingers looked like something imagined by a child. It was thin and muscular, with dark spots, and ringed with a mix of pale stripes and circles that spiraled down a tail that seemed to go on forever.

This was a 15-week-old zebra shark. Like all zebra sharks, it developed in an egg. But that egg was laid in an aquarium in Australia, then shipped by air to Indonesia, where it hatched in a tank at a new shark nursery.

The young pup's parents had been collected years earlier off northern Queensland, where zebra sharks are common. But here in Raja Ampat, roughly 1,500 miles northwest, zebra sharks are nearly gone, victims of the global shark trade. Between 2001 and 2021, despite more than 15,000 hours of searching, researchers counted only three.

This shark was the product of a big idea. Scientists at dozens of the world's best known aquariums had agreed that breeding multiple species of endangered sharks and rays in captivity and releasing their offspring around the world could help restore ocean predators—and perhaps the sea itself. Zebra sharks would go first. Ichida, an Indonesian marine scientist, was here to set the first one free.

So on a hot January day below the towering limestone formations of the remote Wayag Islands, some 90 miles by boat from the nearest town, I watched the young creature swaying beneath her grip. Ichida, normally outgoing and cheerful,



The National Geographic Society, committed to illuminating and protecting the wonder of our world, has funded Explorer David Doubilet's underwater photography since 2012. Doubilet and Jennifer Hayes document both the beauty and devastation in our oceans.

ILLUSTRATIONS BY JOE MCKENDRY

Zebra sharks are considered endangered globally, but several aquariums with captives, including Shedd Aquarium in Chicago, are letting adults mate and produce eggs for shipment to Indonesia.

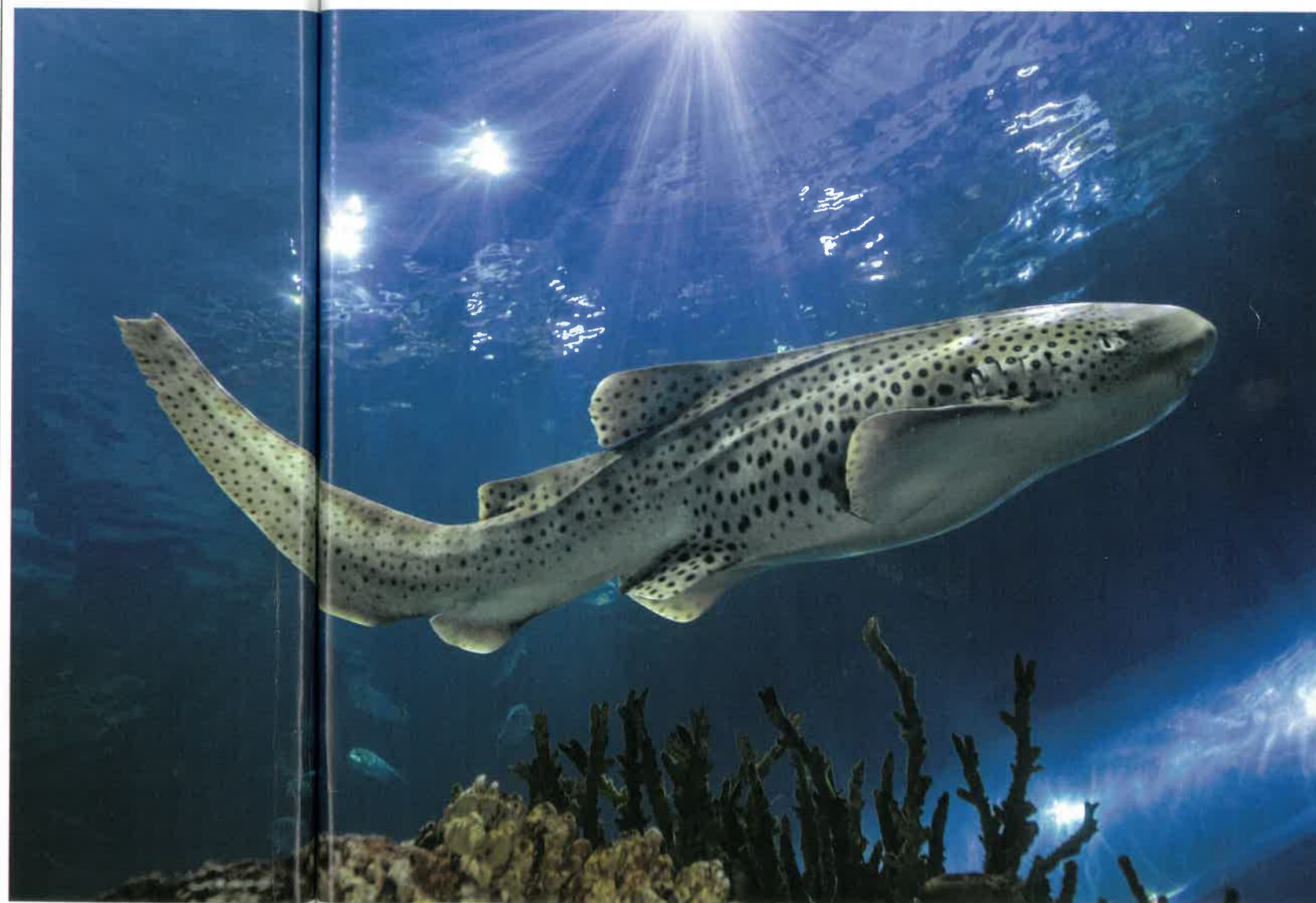
was subdued. She'd spent months readying this shark for a new life. He'd even been given a name—Charlie. Now it was time to say goodbye.

Her palms opened, and Charlie slipped away, his long tail curling as he dived toward the sandy bottom and an unfathomable future.

ONE OF EVERY 11 MARINE PLANT and animal species assessed by the International Union for Conservation of Nature is now threatened with extinction. That includes dugongs, some abalones, some corals, some gobies, some rockfish, some tuna, some whales. But few creatures are being killed off quite as fast as sharks and rays.

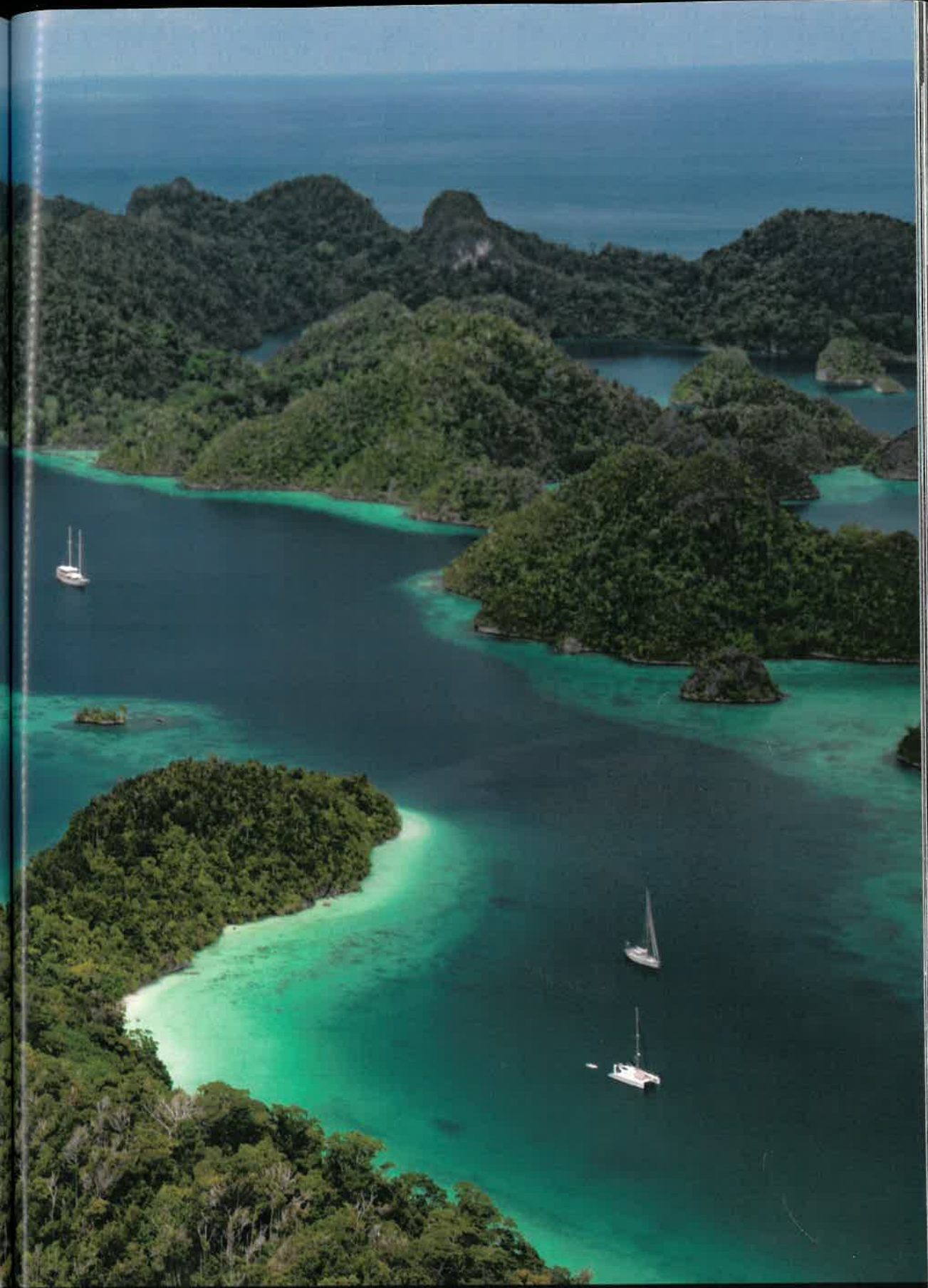
Despite having survived four mass extinctions over 420 million years, today, among vertebrates, only amphibians are disappearing faster. An estimated 37 percent of shark and ray species face extinction risks, according to research led by Nicholas Dulvy, a leading shark expert with Simon Fraser University, in British Columbia.

Overfishing is the driving cause. Legal or illegal fishing contributes to the risks faced by every threatened shark species and is the *only* major threat for two-thirds of them. Every year, millions of sharks are consumed the world over for their meat. And shark fins are used for soup, primarily in Asia.





The Wayag Islands in northern Raja Ampat are a labyrinth of sandy beaches, turquoise lagoons, and atolls broken by limestone towers. Fishing boats once packed these remote waters, nearly wiping out zebra sharks. Now a marine protected area patrolled by rangers provides a refuge for sharks, rays, turtles, and other marine life.



PROTECTED WATERS

Scientists expect the re-introduced zebra sharks will stay in their preferred habitat—sandy shallows—near Southeast Asia's first shark and ray sanctuary.



Sharks are essential to the marine world. They keep ocean food webs in check, preying on smaller creatures that might otherwise grow too numerous and destroy natural systems that feed billions of people. To protect sharks, overfishing must be stopped. But in the meantime could some of the damage that's already been done be repaired? Could sharks be brought back from the brink by rearing them in captivity and then returning them to the wild—not haphazardly but by using the best available science? Those were the questions that drove Mark Erdmann, an ocean scientist with Conservation International, to persuade several aquariums to come together and form ReShark.

The group, now made up of 75 partners from 15 countries, including 44 major aquariums, aims to release 585 baby zebra sharks in Raja Ampat over 10 years. The goal is to seed a self-sustaining wild population, then apply the same technique to other shark species—not just a few but as many as possible, said Lisa Hoopes, senior director of research and conservation at Atlanta's



Georgia Aquarium, a ReShark partner. Scientists often fight extinctions by reintroducing species. They've done so with giant pandas in China, golden lion tamarins in Brazil, condors in California. Pilots in the United States taught captive-born whooping cranes to migrate in the wild by leading them with ultralight aircraft. Almost 30 years after gray wolves were reintroduced to Yellowstone National Park, the canines have thoroughly woven themselves back into the park's ecological fabric.

But marine reintroductions are complex and rare. Oceans are vast, and marine life is difficult to track. Threats are tough to manage. "Everything is harder when the ocean is involved," said David Shiffman, marine biologist and author of *Why Sharks Matter: A Deep Dive With the World's Most Misunderstood Predator*.

In 2017 researchers tried capturing vaquitas—tiny, rare porpoises in the Gulf of California that were being killed as bycatch by illegal gillnetters. They'd hoped to relocate the animals to sanctuaries, then reintroduce them once the Mexican government got fishing under control. Instead, scientists abandoned the effort when stress killed the first adult vaquita they caught.

Even so, there's growing recognition among scientists that captive animals may be key to rewilding the sea. The year after the vaquita died, an IUCN commission urged experts to keep looking for safe ways to capture dolphins because reintroductions may well be needed to save other species, such as South America's La Plata dolphins or West Africa's Atlantic humpback dolphins.

It's not as if young sharks haven't been put back into the sea. An aquarium in Malta rears and releases baby sharks, hatched from eggs gathered from dead sharks sold in nearby fish markets, into the Mediterranean Sea. Another in Sweden sets baby cat sharks loose in a fjord. But these measures, however well intentioned, are more akin to zoos opening cages and setting excess parrots free than they are programs designed to build back depleted populations. They're tiny in scope and often don't even involve endangered species. Typically, they also skirt the thorniest issue: Until overfishing is stopped where sharks are released, adding more won't bring species back.

That's why Dulvy, who'd spent 11 years as the co-chair of the IUCN's shark specialist group, initially was skeptical of ReShark's plan. He knows

RAISE AND RELEASE

The international ReShark collective seeks to restore threatened shark and ray species to their known historic ranges, a boon for marine ecosystems. Its first project: to rewild Indonesian waters.

How sharks reproduce

44% lay eggs 55% give birth 1% Unknown

The zebra shark—docile, endangered, and egg-laying—is an ideal first candidate for reintroduction. Eggs are easier to transport than live sharks.

Adult 8 ft

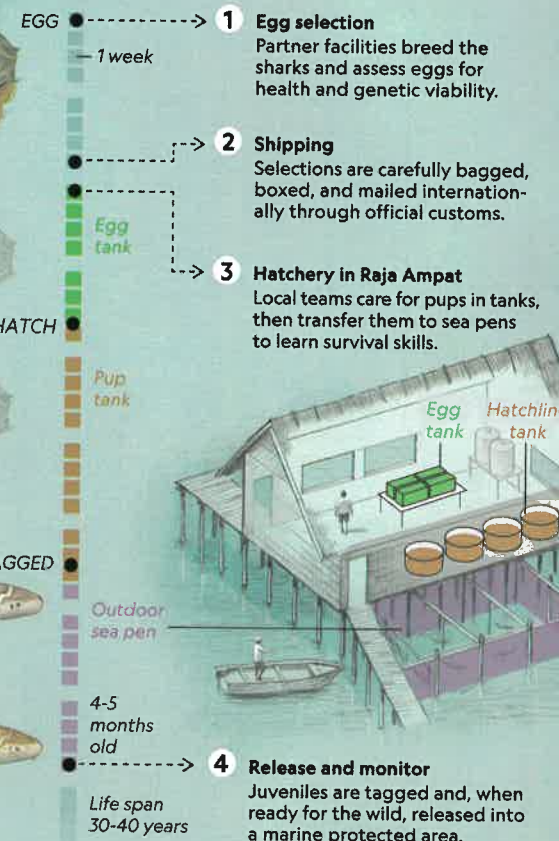
Ovary

Uterus

One or more eggs laid

LIFE CYCLE

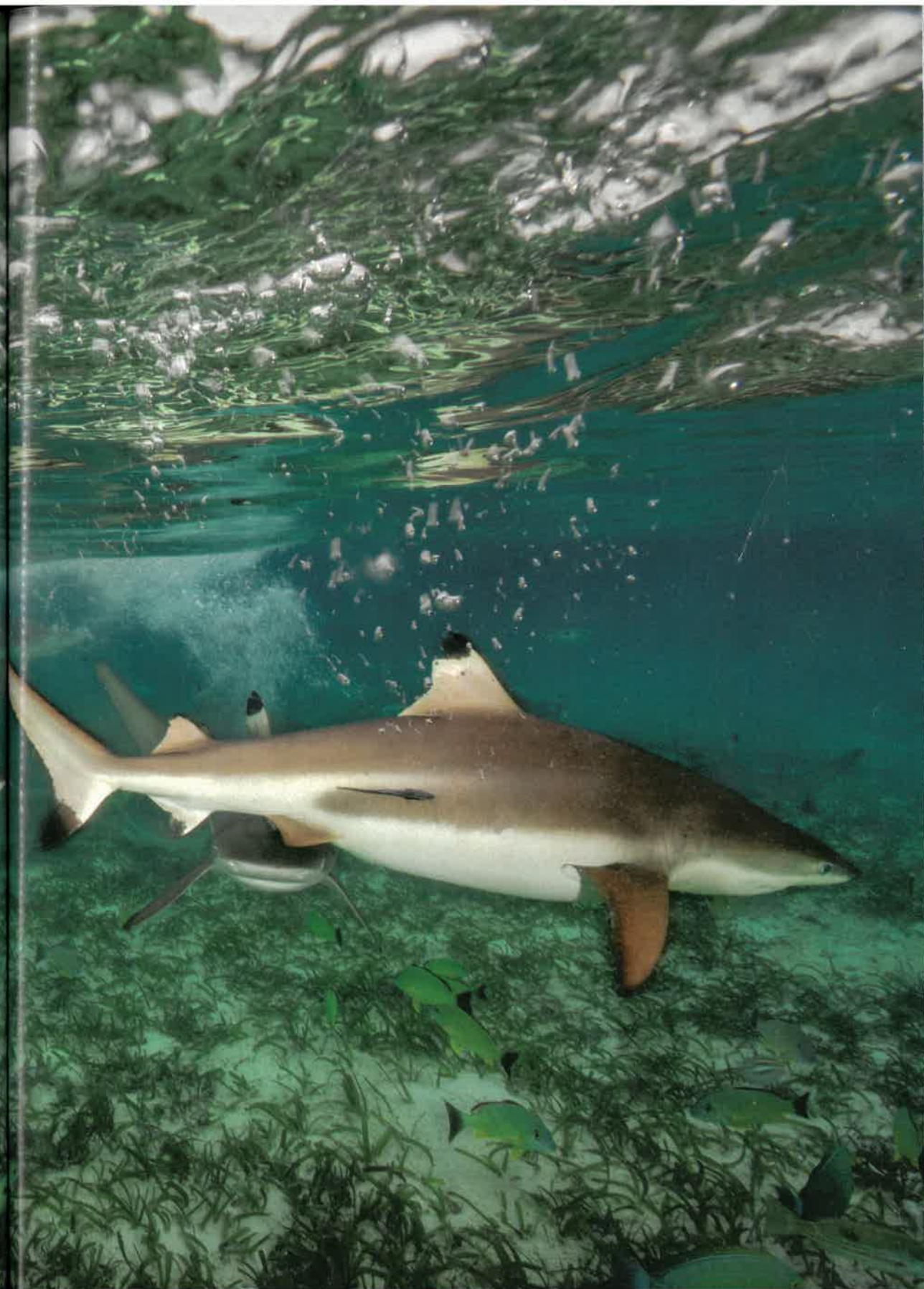
REWILDING



FERNANDO G. BAPTISTA, NGM STAFF; LAWSON PARKER
SOURCES: NICHOLAS K. DULVY, SIMON FRASER UNIVERSITY; ERIN MEYER, SEATTLE
AQUARIUM; KADY LYONS, GEORGIA AQUARIUM; JENNIFER WYFFELS, RIPLEY'S AQUARIUMS;
CHRISTINE DUDGEON, UNIVERSITY OF QUEENSLAND



Blacktip reef sharks patrol shallow seagrass beds near Kri. Now common, these sharks were rarely seen before Raja Ampat adopted a network of marine protected areas. So many zebra sharks had been killed that scientists suspect too few remained to find mates.



rebuilding shark populations requires more than dumping animals in the ocean. He'd seen too many poorly constructed experiments. "I was getting jaded by these hopeful but useless projects," he told me. So he asked tough questions—and came away surprised. "This initiative is different."

His IUCN successor, Rima Jabado, agrees. She calls it the first shark reintroduction she's seen that "may provide an opportunity for species not to go extinct."

FROM THE AIR, Raja Ampat seems almost mystical. Lush lowland forests of palm, scrub mahogany, and tropical fruit trees rise from hundreds of limestone islands. Atolls, sandy cays, and emerald mangrove bays give way to deep blue where the Indian and Pacific Oceans meet.

These are among the planet's most species-rich waters. Barracuda zip past yellow sweetlips, while electric blue fusiliers glide by giant sea fans. Some 1,600 fish species call this home, along with three-fourths of Earth's known hard coral species. "Not only is everything completely covered and teeming and moving, literally, with life, but the color diversity would blow your mind," said Erin Meyer, vice president of conservation programs and partnerships at the Seattle Aquarium, which helps manage the zebra shark project.

Meyer was pacing a jetty outside a new shark nursery offshore from the island of Kri, 65 miles south of Wayag. Beside her, Ichida, her colleague, huddled in a waist-deep sea pen where Charlie was getting his last physical the day before his release. Another shark, Kathlyn, who would be released 30 minutes after Charlie, swirled around Ichida's legs.

Meyer and Ichida live 16 time zones apart but jointly manage this operation. Ichida, who also serves as program director for the Indonesian nonprofit Thrive Conservation, is the on-the-ground problem solver. She shepherded the first shark eggs through customs in Jakarta. She procured pumps and installed pipes at the nursery. When new fiberglass shark tanks, built on the island, were too big to load onto boats to deliver to the nursery, her team climbed in and paddled them over like canoes. Ichida also manages a team of "shark nannies" who make sure the animals slurp snails and clams. (The crew at first tried feeding the sharks shrimp, which the sharks initially ignored. "We're like, 'You're supposed to be a predator—eat it!'" Ichida said, exasperated.)

Back in Seattle, Meyer coordinates almost

A female juvenile zebra shark in a sea pen off Kri preys on a snail. Raja Ampat residents and shark nannies gather snails from nearby waters, which are then weighed and distributed throughout the pen to encourage natural foraging behavior.



everything else. She looks for funding, finds aquariums to provide eggs, and manages an ever expanding roster of partners.

It was a conversation with Erdmann, who'd worked in Raja Ampat for about 15 years, that set her on her path.

Zebra sharks are supposed to cruise the seafloor from South Africa to Oceania in the Pacific and as far north as Japan. Instead, they're endangered nearly everywhere outside Australia and Fiji. But more than a hundred aquariums have them on display. Erdmann wondered, Could their offspring be reintroduced? "My initial reaction was like, Oh, that's a fantastic idea," Meyer told

me. By the spring of 2020, she was leading a committee crafting a plan to make that happen.

There was reason to think it might work in Raja Ampat. Sharks were decimated here, after years of overfishing. But in the late 1990s, Raja Ampat established the first of what eventually would become nine marine protected areas covering a region half the size of Switzerland, some 8,000 square miles. In 2012 fishing for sharks and rays was also banned across the whole of Raja Ampat. Villagers and in some cases armed officers began patrolling for illegal fishing nets and boats. By then, some shark populations were recovering, especially gray, blacktip, and whitetip reef

species. But not zebra sharks.

Despite their reputation as ferocious predators, few sharks are aggressive toward humans, and zebra sharks are less menacing than most. Even when their numbers were healthy, they probably never were numerous. Scientists suspect fishing killed so many that too few lived to find mates. Now, after three years of preparation, the moment was at hand. In the pen, Ichida snatched Charlie and turned him over, a trick that makes zebra sharks go still, "like when a cat comes over to you and they want their belly rubbed," Meyer said. "You rub their belly, and then they hang out like that."



Cardinalfish and glassy sweepers pulse and swirl around a sea fan beneath a coral ledge in Wayag. Raja Ampat is home to some 1,600 species of fish and three-quarters of the world's hard coral species. Wayag is among its most spectacular regions.





Ichida releases a zebra shark in Wayag. This effort was led by ReShark, a group of 44 aquariums in 13 countries that hopes to rebuild many populations of endangered sharks around the world by reintroducing animals raised in captivity.

A shark nanny measured Charlie one last time: 29 inches. He was large enough now, Meyer and Ichida hoped, to avoid being swallowed by a hungry blacktip. He'd learned to hunt his own dinner. A pair of transmitters implanted under his skin would let scientists track his movements. Meyer choked up, a nervous parent preparing to send her young charges into the world.

At dawn, the two sharks would be loaded into coolers on a 22-foot speedboat for the multihour voyage to their release site. Meyer would put together a snack pack for the journey, making sure the sharks each had the same number of treats: 13 snails.

GLOBALLY, WE'RE KILLING SHARKS faster than aquariums could ever replace them. And reintroduction won't work for all species anyway. Many—great whites, for example—are too high energy for captivity. They also need space to build up speed to keep enough water flowing over their gills. Some travel so far it will be hard to adopt no-fishing zones large enough to ensure released young avoid nets. (Scientists hope a proposed treaty to protect the high seas might help.)

Reintroductions also can fail. Young sharks can succumb to disease, get eaten by bigger sharks, or struggle to find food. And most shark

species give birth to live young, which are more challenging and expensive to ship.

But dozens of potentially suitable sharks reside in places, from Mozambique to Thailand to the Maldives, where this approach might work. The ReShark team is already debating which other species it might ultimately try to reintroduce. Options include angel sharks in the Canary Islands and Wales, nurse sharks in East Africa, and sawfish, noted for the toothy, bladelike appendages on their snouts. Several weeks after leaving Indonesia, I visited Meyer at a special holding facility a couple of miles from the Seattle Aquarium. In two enormous tanks swam nine of

the strangest beings I'd ever seen. They had enormous flaring heads, like manta rays attached to long, dual-finned bodies—as if a shark had been joined with a horseshoe crab. These were critically endangered bowmouth guitarfish pups—siblings, just six months old. Meyer watched the females circling. “Even seeing four together like this—you don’t see that in the wild,” she said.

Found along Indo-Pacific coasts, bowmouth guitarfish are so highly sought after for their meat and fins that it's estimated the species' numbers have plummeted more than 80 percent in 45 years. Unlike zebra sharks, these rays are rare in aquariums, with only about 40 in captivity. The animals are in such desperate straits they'd been among the first the ReShark team considered reintroducing. But it seemed too risky. “We don't actually know that much about them,” Meyer said.

Zebra sharks have been studied for decades. Scientists know less about guitarfish, including where they roam, how often they breed, how genetically distinct their populations are from one another, or what they eat over the course of their lives. It's not even clear how best to design marine reserves to protect them. Plus, they give live birth. “There's a lot to learn,” Meyer said.

That these creatures ended up in Seattle is a quirk of fate. Taiwanese fishing companies leave nets anchored to the seafloor, and last June a pregnant female bowmouth guitarfish swam into one. A fish broker who recognized the animal bought it and helped provide it with temporary shelter. “He was keen to keep this animal out of the food trade,” Meyer said. The female gave birth to pups, and the broker, who knew about ReShark, shipped them to Seattle.

The plan is to fill in the blanks in their story while finding—or creating—a protected place where they'd thrive. Scientists plan to connect the guitarfish with genetically appropriate mates. In several years, they hope, the rays will begin producing offspring that can be reintroduced. (By May, eight of the pups had been sent to aquariums around the U.S.) Meyer's team is moving fast given the state of this species in the wild. But for one moment, she was content just being able to watch them swim. “They're adorable and beautiful. That's where I'm at right now,” she said. “If we wait, we may lose them.” □

Senior writer **Craig Welch** reported on changes in nature's timing for the April 2023 issue.