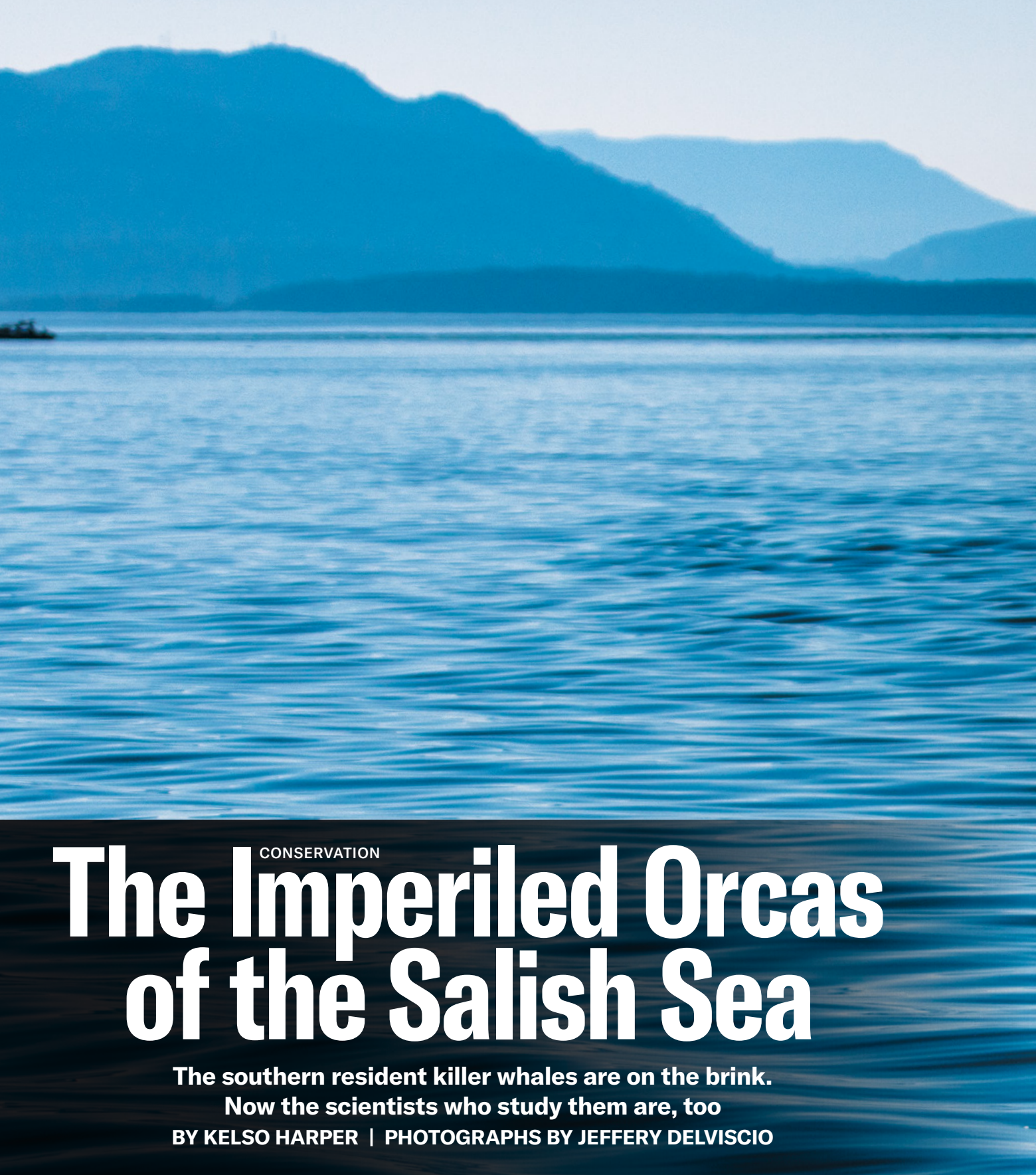


CONSERVATION

The Imperiled Orcas of the Salish Sea

The southern resident killer whales are on the brink. Now the scientists who study them are, too

BY KELSO HARPER | PHOTOGRAPHS BY JEFFERY DELVISCIO

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Eclipse (J41) is one of 74 orcas remaining in the southern resident population.

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LIKE MANY PEOPLE WHO VISIT SAN JUAN ISLAND, I came here for the orcas. This little patch of forest and farmland off the coast of Washington State is one of the best places in the world to encounter them. But you can't schedule an orca sighting, so on a sunny July day I was killing time, wandering a lush meadow, when a bolt of adrenaline struck: I had missed three calls from Deborah Giles, a researcher at the SeaDoc Society, a marine science nonprofit. The southern residents had been spotted nearby for the first time in months. I had 40 minutes to meet her on the far side of the island.

The southern resident orcas have lived off the coast of the Pacific Northwest for thousands of years. They don't associate with any of the estimated 50,000 other orcas living around the world, even those who share the same home waters. They have their own language, customs and culture, and they are the most studied population of orcas on Earth. But because of human encroachment on the shores and waters of their territory, they are in dire trouble.

I arrived at Giles's mooring just moments before she did. She lives on whale time, meaning she will drop anything to get on the water with southern residents, the focus of her research. She told me she hasn't taken a vacation away from San Juan Island in years—it's just not relaxing. What if the southern residents appear while she's gone?

"Come on, pup, let's go!" Giles called, urging a little brown-and-white dog down the metal dock. The pup, named Eba, appeared immune to being rushed and trotted behind at the farthest extent of her leash, tongue lolling, black eyes squinting in the afternoon sun. As Giles climbed into a small motorboat and took her place behind the wheel, her husband and research partner, Jim Rappold, lifted Eba onto the bow, placing her on a carpeted platform that he built specially for her. Giles's research assistant Aisha Rashid handed everyone life vests and strapped a peach one around Eba. I hunkered down in the back near the boat's onboard wet lab—a large metal box that holds a centrifuge, various vials, and other research equipment.

We sped off through Haro Strait on the western side of the island. The southern residents used to spend so much time swimming up and down this channel that the locals took to calling the routine the "west side shuffle." The whales would use the strait's steep underwater canyon to corner their preferred cuisine: big, fatty Chinook salmon. But as Chinook populations have declined, so have southern resident sightings near the island.

Over the past century the world around these whales has changed dramatically. Metropolitan centers bloomed on their coastlines, and their core habitat transformed into a bustling waterway. The Salish Sea grew toxic from pollutants, and the fish the orcas evolved to hunt with deadly precision became scarce. In a single whale's lifetime, humans have put the southern residents on a path toward extinction.

Kelso Harper is a senior multimedia editor at *Scientific American.*

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Deborah Giles has cataloged the southern resident killer whales that inhabit the waters around the San Juan Islands in the Pacific Northwest for more than two decades. She is an orca reseacher at the SeaDoc Society.

Giles and other scientists have devoted their careers to understanding and reversing the decline of this ancient population. By building out a picture of the whales' health, habits and diet, researchers are deciphering the many ways humans impact their lives and guiding conservation actions that may mean life or death for the orcas. But the research itself is now at risk, too. Actions by the Trump administration threaten to stall, diminish or stop a swath of conservation studies at a crucial juncture for southern residents—and for other populations that hang by a human-made thread. "The science is endangered now," Giles said, "just like the whales."

ORCAS, LIKE HUMANS, are cosmopolitan animals. We live on every continent; orcas live in every ocean. Much like us, the whales have adapted to environments from the icy Antarctic to the balmy Gulf of California by being smart, social creatures. They pass down knowledge about where to forage and how to hunt. They share food and collectively care for their young. They even have their own cultural trends. In the 1980s, as human teens donned parachute pants and leg warmers, southern resident adolescents took to wearing dead salmon "hats" on their heads.

With big, wrinkly brains and high levels of intelligence, orcas seem likely to have complex internal lives. "They're clearly very smart animals; they're just different from us," says Amy Van Cise, an assistant professor at the University of Washington, who studies orcas and other cetaceans. "Killer whales don't write books, but killer whales can echolocate. Can you echolocate?" In 2018 a southern resident whale named Tahlequah made headlines for carrying her deceased newborn for 17 days in what became known as a "tour of grief." The mother traveled nearly 1,000 miles with her baby draped over her forehead or held gingerly in her mouth; in January 2025, when another calf died, Tahlequah repeated the ritual.

Also like us, orcas are deeply familial creatures. Resident killer whale offspring stay with their mothers for their entire lives, forming a nearly inseparable family group called a matriline. A handful of matrilines together form a pod; pods are led by older females, who can live for a century, more than twice as long as most males.

The southern residents comprise three pods: J,

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K and L. Historically the pods spent much of April through October in the Puget Sound and near the San Juan Islands, often gathering as a "superpod." In colder months the pods tend to split up and spend more time on the outer coasts of Washington State, Oregon and even California. No matter how far apart, though, the pods are tied together by their shared language, diet, habits and behaviors—a culture distinct from that of any other population.

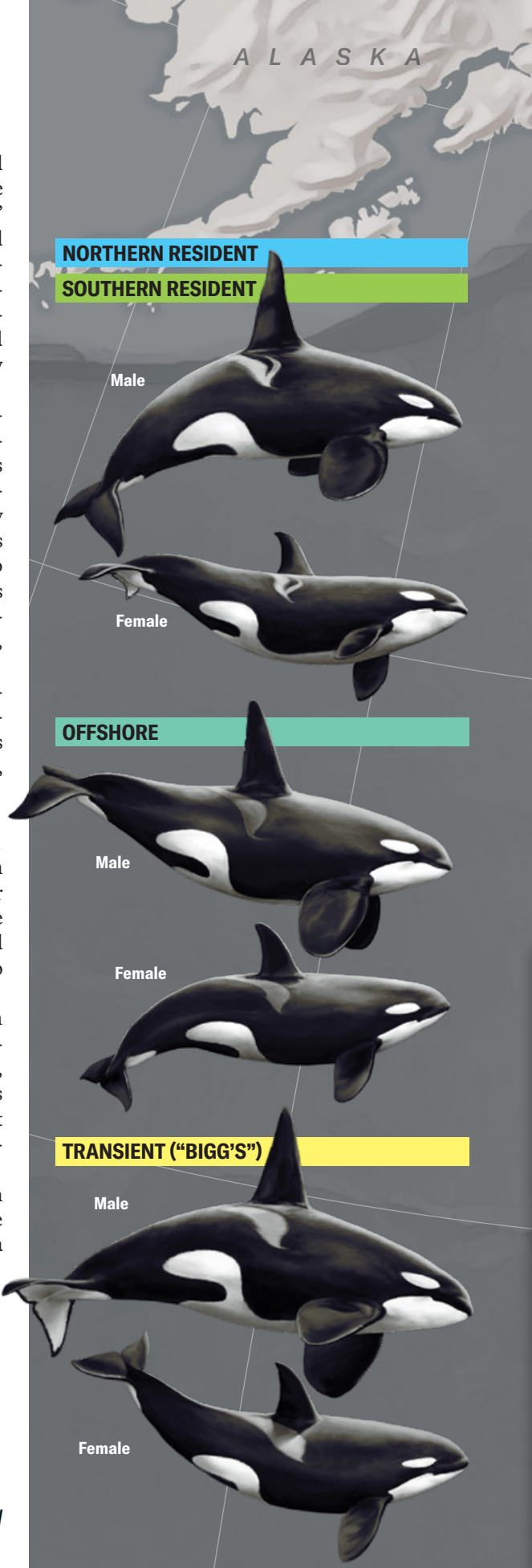
Humans and killer whales share a long, complicated history. Indigenous communities of the Pacific Northwest lived peacefully alongside orcas for thousands of years. Each tribe has its own relationship with the animals, whom they generally view as sacred—often as guardians of the sea or as family members under the waves. But settlers who arrived in the 1800s took a different view: orcas became feared and reviled as a source of competition for fishers, a vermin species to be avoided or, better yet, exterminated.

Then, in 1965, the world's first captive performing orca, Namu, opened hearts—and wallets—at the Seattle Marine Aquarium. The whale's surprisingly gentle nature (he even let his captor, Ted Griffin, ride on his back) shocked and enraptured onlookers. Soon aquariums around the globe began putting in orders for their very own killer whale, and over the next decade more than 50 orcas were captured from the Salish Sea or killed in the process. Most of these whales were southern residents. By the time the practice ended in the mid-1970s, the population had shrunk to just 71 whales.

Scientists initially had hope that the southern residents would recover. Their numbers rebounded to 98 whales by the mid-1990s. "Then, all of a sudden, we started to see this decline," says Kim Parsons, a supervisory research biologist at the National Oceanic and Atmospheric Administration's Northwest Fisheries Science Center.

At the time, Parsons was studying the southern residents as an undergraduate and could recognize every individual. Over the course of six years a fifth of southern residents died, including Parsons's favorite whale, J3. "He had this really cool dorsal fin," Parsons says. "It almost

"Killer whales don't write books, but killer whales can echolocate. Can you echolocate?"
—AMY VAN CISE *UNIVERSITY OF WASHINGTON*

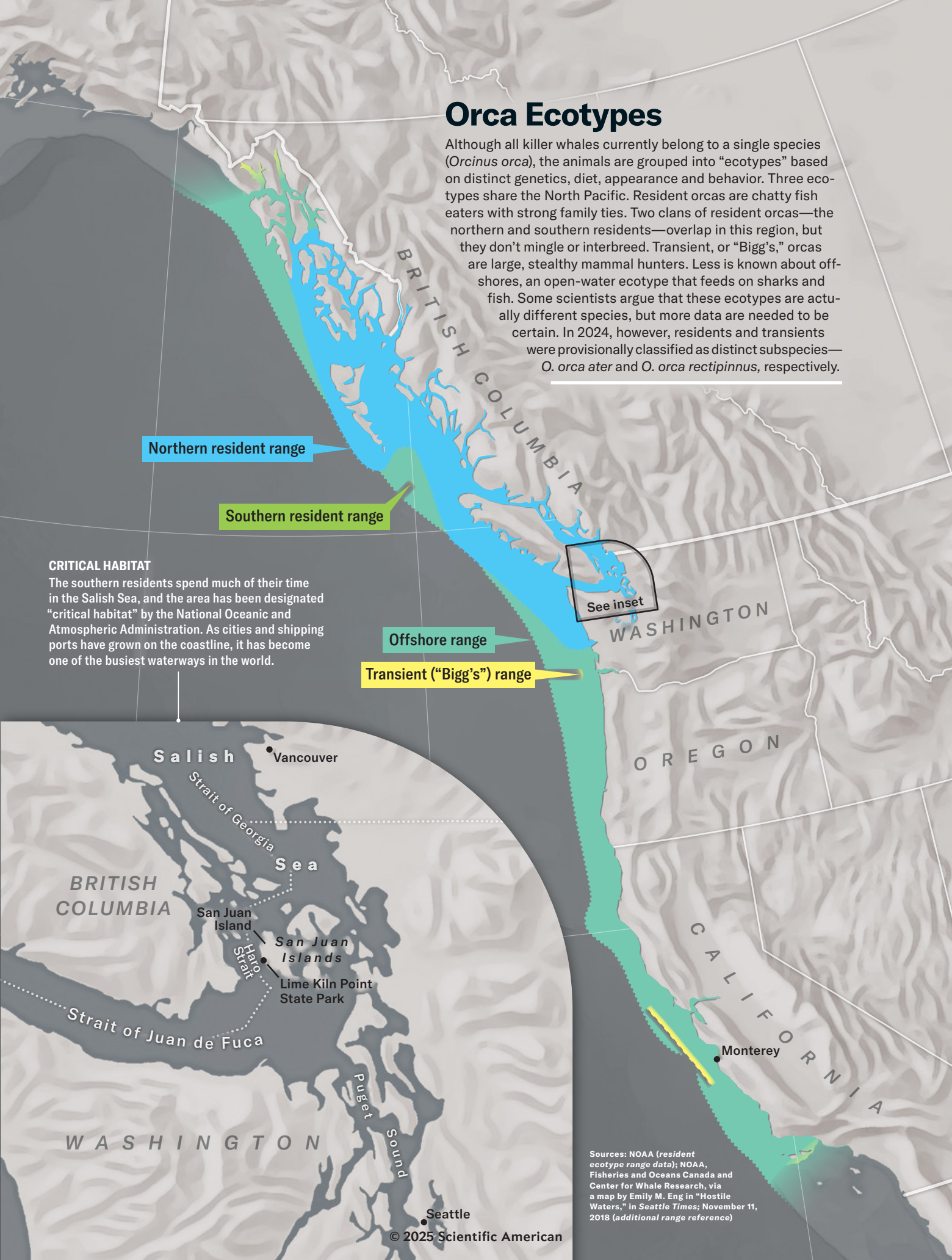


Map by Daniel P. Huffman, Illustrations by Ken Naganawa

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Orca Ecotypes

Although all killer whales currently belong to a single species (*Orcinus orca*), the animals are grouped into "ecotypes" based on distinct genetics, diet, appearance and behavior. Three ecotypes share the North Pacific. Resident orcas are chatty fish eaters with strong family ties. Two clans of resident orcas—the northern and southern residents—overlap in this region, but they don't mingle or interbreed. Transient, or "Bigg's," orcas are large, stealthy mammal hunters. Less is known about offshores, an open-water ecotype that feeds on sharks and fish. Some scientists argue that these ecotypes are actually different species, but more data are needed to be certain. In 2024, however, residents and transients were provisionally classified as distinct subspecies—*O. orca ater* and *O. orca rectipinnus,* respectively.



CRITICAL HABITAT

The southern residents spend much of their time in the Salish Sea, and the area has been designated "critical habitat" by the National Oceanic and Atmospheric Administration. As cities and shipping ports have grown on the coastline, it has become one of the busiest waterways in the world.

Sources: NOAA (*resident ecotype range data*); NOAA, Fisheries and Oceans Canada and Center for Whale Research, via a map by Emily M. Eng in "Hostile Waters," in *Seattle Times;* November 11, 2018 (*additional range reference*)

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Research biologist Kim Parsons first studied the southern resident orcas in the early 1990s, just before the population experienced a steep decline. Parsons works at NOAA's Northwest Fisheries Science Center.

looked like it was on backward." The precipitous decline couldn't be explained by the generational losses of the captive era alone. What was going on with the southern residents?

After millennia of relative quiet, the Salish Sea is now one of the busiest waterways in North America. Around nine million people live in the surrounding drainage basin, meaning ample urban, industrial and agricultural runoff has made its way into the water. When researchers began digging into the southern residents' decline, they found an alphabet soup of toxic chemicals in the whales' blubber: polychlorinated biphenyls (PCBs), polybrominated diphenyl ethers (PBDEs), dichlorodiphenyltrichloroethane (DDT). Pollutants accumulate in the flesh of animals at every level of the food chain, but they get concentrated at higher levels, and orcas sit at the very top.

But this couldn't have been the full story, because neighboring orcas that share much of the same habitat didn't experience the same decline. These other whales, known as transients—also called "Bigg's" killer whales after pioneering orca researcher Michael Bigg—eat mammals, which are a level higher on the food chain than the fish eaten by residents, so they tend to accumulate even more pollutants. The key difference: Transient orcas had plenty to eat. Southern residents did not.

Transients' favored prey—such as seals, sea lions and porpoises—have proliferated since the Marine Mammal Protection Act of 1972 made hunting them illegal. But a combination of river damming, habitat destruction, overfishing and pollution has caused numbers of the southern residents' preferred prey, Chinook salmon, to plummet since the 1980s. Eight populations of Chinook made their way onto the endangered and threatened species lists before the southern residents joined them in 2005.

In her early research, Giles found that the southern residents' lack of prey is compounded by the nearly constant disturbance the orcas experience from boats in and near the Salish Sea. The jetlike sounds of container ship engines can reverberate for miles, and many boat engines emit noise in the same frequency range that the whales use to communicate. In 2008 Giles helped to develop an acoustic device that she attached to the backs of orcas with suction cups, allowing her to eavesdrop on the whales as they hunted. She found that in

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noisy waters, "females will just say, 'Screw it. I'm not even going to try to forage,'" she says. "Males will try but miss because if vessel noise is too loud, it masks the whales' ability to echolocate and find food." The northern resident killer whales provide another comparison: they spend more time in quieter, less polluted waters off the coast of British Columbia, and their numbers have doubled since the capture era.

Today 74 southern residents remain. Decades of research have identified these three factors—pollution, vessel disturbance and lack of food—as central to the decline of the southern residents. But each of these evolving threats is a universe unto itself, with countless variables and unknowns.

THE BOAT MOTOR ROARED, and a whitewater mist prickled my skin as we neared the northern edge of Haro Strait. The sea was smooth, protected on all sides by forested islands. A towering container ship heaved across our path, and its exhaust joined a yellow-green haze that hung low across the otherwise cloudless sky. Then, just after we cleared the ship's roller-coaster wake: "Whale!" Rappold shouted.

I whipped around just in time to glimpse a giant black-and-white body crashing back into the sea. Giles smiled—we had found the southern residents.

Like corn kernels in slowly heating oil, the orca sightings began sparse and unpredictable. But at some imperceptible moment, things shifted; suddenly black fins, white tails and entire submarine-like bodies were popping out of the water just a few hundred feet away.

Giles called out behaviors for Rashid to document. "Spyhop!" she yelled when a whale periscoped its enormous head out of the water and sank back down. "Tail slap!" Giles shouted as an orca's fluke rose up and smacked the water's surface.

As the boat neared the whales, Giles pulled out three laminated sheets from behind the steering wheel. They bore photographs of a few dozen gently rounded dorsal fins—snapshots of each of the southern residents. Giles examined the fins and saddle patches (a swirly white marking behind the dorsal fin) to identify these whales as part of J-pod. But we'd found only a handful of the 27 pod members, which was unusual. Giles told me that the pods had been splitting up more in recent years, perhaps as a "divide and conquer" strategy to make the most of scarce food.

"Baby breach!" Giles called as a small body (by orca standards) shot out of the water, arced in the air and smacked back down with a belly-flop splash. A second, roughly one-ton baby followed suit. In a stroke of luck, we'd found the two southern resident calves who had survived this year. Two others hadn't made it.

At the bow of the boat, Rappold watched Eba closely. The dog's demeanor was shifting. Her body became stiff, alert, and her ever-wagging tail dropped low. She stretched over the bow, leaning her snout as close to the glassy surface as she could manage. An orca leapt out of the water in the distance, but no one looked up. All eyes were on Eba now—she had caught the scent of killer whale poop.

"Let's find it!" Rappold said, egging Eba on.

It is hard to collect whale poop. First, of course, you have to find the whales. Then one has to poop, and you need to find that poop before it sinks, gets dive-bombed by seagulls or breaks up in rough water. That's where Eba comes in: her powerful nose helps Giles home in on scat while she follows the whales at a distance.

But orca poop is worth the effort because it is a data treasure trove. With just a pea-size glob of scat, biologists can genetically decode which individual whale produced the sample. They can measure that whale's levels of toxic chemicals and catalog the bacteria and parasites in its microbiome. Hormone analysis reveals whether the whale was pregnant, and successful pregnancies are a key marker of population health. As they accumulate data over years, researchers are fleshing out a picture of southern resident health to clarify exactly how pollution, vessel disturbance and lack of prey cumulatively impact the orcas' bodies. This work may also reveal new threats—a new contaminant or bad bacteria, perhaps—and identify struggling whales early on.

> "The science is endangered now, just like the whales."
> —DEBOARAH GILES *THE SEADOC SOCIETY*

Scientists also use scat samples to get a detailed look at what these orcas eat. Until the early 2000s, researchers could study orca diets only by cutting open the stomachs of recently deceased animals or happening on them mid-hunt. Scat samples are easier to come by (relatively speaking) and provide more detailed information.

By checking fragments of DNA in a sample against a library of fish genomes, Parsons and Van Cise can identify the exact species a whale ate over a roughly 24-hour period and in what relative amounts—for instance, 60 percent Chinook

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As a scent-detection dog, Eba helps Giles home in on floating killer whale poop for collection and analysis. The researchers can measure a given orca's levels of hormones and toxic chemicals, among other factors.

salmon, 30 percent chum salmon, 10 percent halibut. Their research has shown that although the southern residents eat mainly Chinook, they also rely on a mix of other species that fluctuates throughout the year. Chum and coho salmon in particular appear to be more important than previously thought in the late summer and early fall. But the researchers still need more samples, especially between October and April, to get a full picture of the southern resident diet. Giles says it's important to know all of what the whales eat—and where and when—to ensure that they have what they need year-round. If, for example, fishery managers knew the southern residents typically eat a lot of chum in the Puget Sound in November, they could theoretically adjust the harvest of that stock to account for the whales' needs.

Whining softly, Eba began crab-shuffling over to the right side of the bow. Giles turned the boat to follow her path. When Eba shuffled back to the left, Giles swerved again. They followed this zigzag pattern to stay in the "scent cone" of the feces, homing in closer with each pass.

Eba became even more restless. She propped her front paws on the bow and yelped like a capuchin. (I silently wondered whether that's how she got her nickname, "Fluffy Monkey.") We had to be getting close. Giles slowed the boat, and Rappold searched the water intently.

"Hit, hit, hit!" Rappold yelled. He tossed a handful of cereal puffs in the water to mark what he saw. Giles cranked the boat back around, leaned out from behind the steering wheel and squinted past a bright glare on the water. A trail of bubbles floated in a choppy slick, iridescent in the slanting sunlight.

"Well, what do you think?" Rappold asked Eba softly. He turned back to Giles.

"It's very weird," Giles said. They scanned the dark surface for any signs of scat. The boat bobbed idly, water lapping against it. The outboard engine hummed. Eba barked. The hopeful, frenetic energy from moments before began to fade with the slick. Giles decided there was nothing for us to collect; we should move on.

Giles turned the boat around and pointed us back toward the orcas. Eba grew frenzied as we pulled away, yelping and barking, stomping around the bow and looking up expectantly at Rappold. She had sniffed admirably, but Eba doesn't get her

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reward—playtime with a rope toy—until Giles successfully collects a scat sample.

Giles tried to console Eba. "Good job, let's find the next one!" Eba barked at her twice. "Phew, she's mad," Giles murmured, steering us toward the dorsal fins on the horizon.

As important as other species might be in the southern residents' diets throughout the year—and as eager as Giles and her collaborators are to know about them—Chinook still make up the bulk of the orcas' diets. But Chinook conservation is enormously complex. There are dozens of Chinook populations across hundreds of rivers from California to Alaska, each facing unique challenges, such as impassable dams, overfishing and urban development. And at each stream and tributary, it takes a lot of research, time and effort to demonstrate that Chinook conservation is a worthwhile priority for the species itself and for the whales.

To this end, Parsons and Van Cise are working to tease even more detail from the genetic mayhem of whale poop and identify which salmon runs the southern residents rely on most. "If we can target our management to specific rivers," Van Cise says, "that might make it easier to conserve the right populations." With proper funding, she says, they could probably tackle this genomic conundrum in the next few years. But with the way science funding plummeted in 2025, it might not happen at all.

Days after Donald Trump took office in 2025, his second administration began hollowing out federal science agencies, and it aims to shrink them further in 2026. Already the administration has canceled thousands of research grants totaling billions of dollars. "I've watched funding source after funding source just shutter its doors," says Van Cise, who relies almost entirely on funding from NOAA, the National Science Foundation (NSF) and the Office of Naval Research. She says she's lucky that she hasn't lost any current grants, but she also hasn't received any new grants—and her funding is starting to run out. This is a crucial time for her; as an early-career research professor, she is just now establishing herself in the field. "If research funding continues the way that it is," Van Cise says, "I could watch my career die before it really even gets off the ground."

In March 2025 Giles applied with partners at the San Diego Zoo Wildlife Alliance for an NSF grant to fund three years of an ongoing research project. Together, the researchers use drones to fly through an orca's blow and collect samples of its





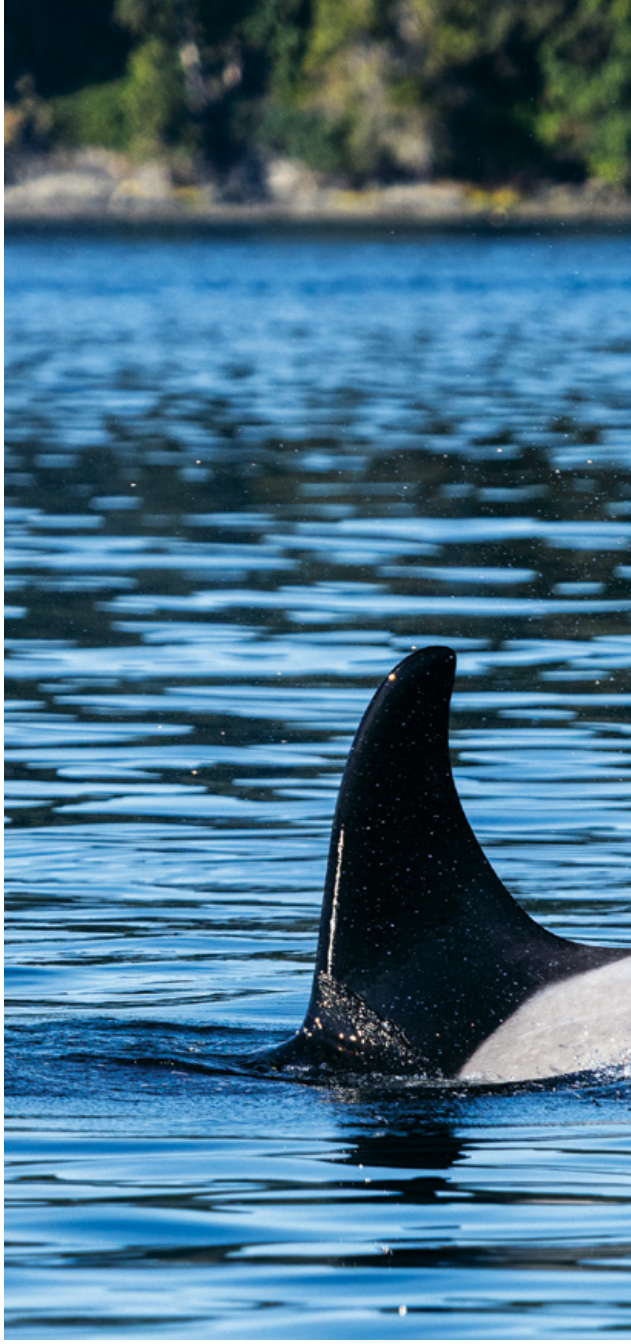
With just a small amount of scat, scientists such as Amy Van Cise can examine the state of an orca's health and analyze its diet in great detail. Van Cise teaches at the University of Washington.

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breath, which adds a new dimension for studying the animal's health and microbiome. They are also beginning to use infrared cameras to see whether the whales are suffering from illness or injury (hot spots can signal inflammation). But less than a month after the group submitted its application, the NSF returned it—unopened. Giles was told that was the fate of more than half of NSF applications at the time.

NOAA is central to the conservation of all endangered marine species. Staff scientists conduct research, and managers craft recovery plans, designate critical habitat, and work with states, tribes, and other nations to preserve vulnerable species. In 2025 the Trump administration thinned the agency by more than 2,000 employees through layoffs, early retirements and a deferred-resignation program. One such employee was Lynne Barre, the southern residents' recovery coordinator for two decades. Barre hadn't been planning to retire at 55 years old, but with the mass firings of probationary employees, the frozen budgets, "the uncertainty and the chaos," she felt it was her best option. Barre says a colleague likened the situation to being on a pirate ship that someone lights on fire: "Then your choice is to walk the plank and either jump off yourself or be stabbed in the back [until you] jump off." The Northwest Fisheries Science Center and the West Coast Regional Office—where the majority of NOAA's southern resident work takes place—lost almost 30 percent of their staff in 2025, including many researchers with decades of expertise. "That's a huge hit to our workforce," Barre says.

So where does that leave the southern residents? All the scientists I spoke to agree: the southern residents don't have time to spare. "It's a critical time," Parsons says. "The population has been at this fairly low-level status for a long time, and that's not a great sign." In 2025 Washington State enacted a new regulation requiring boats to stay at least 1,000 yards away from the southern residents; at that distance a whale tail looks smaller than a sesame seed. (Research vessels like Giles's can travel within 50 yards of the whales.) The goal is to allow the whales to hunt more easily, without a cacophony of boat motors muddying their echolocation. Van Cise says it took years of research to support this intervention, and it will take years—and more research—to see what impact it has. Barre says the same will be true for any actions related to the whales' health or diet. "If we don't have that strong foundation of science, we're not going to make very good decisions," she says, and with such a small group of whales, there is a thin margin between recovery and the "vortex of extinction"—the point of no return.



TOWARD THE END of our encounter with the southern residents, a mother and baby beelined toward our boat. Their slick black bodies surged rhythmically out of the water every 10 yards or so. Giles turned off the motor, and we all fell silent—except Eba, who yelped and whined. The whales emerged with heavy sighs just a few yards away. The baby tumbled around at the surface, flipping her white belly to the sky and rubbing up against her mother's back. She rolled onto her side and flapped one little pectoral fin out of the water. When her mother ducked back down and began to swim away from us, she followed.

FROM OUR ARCHIVES
The Orca's Sorrow. Barbara J. King; March 2019. Scientific American.com/archive

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A J-Pod baby and mother play in the Salish Sea. Southern resident killer whales have strong family ties and rarely separate from their close relatives.

Giles didn't collect any scat samples that day. As the whales headed south at sunset, we peeled off toward San Juan Island. There were no southern resident sightings for the rest of the week.

On my last night with Giles, we visited the place where locals used to see orcas almost every day of the summer: Lime Kiln Point State Park. It sits on the western side of the island and is home to a stately white lighthouse, a food truck (The Blowhole: Snacks with a Porpoise) and the spot we were headed to—Orca Whale Watching Point. It's where Giles saw orcas for the first time, in 1987.

Giles led us to a craggy mound of rock at the edge of the water. The last ripe orange rays of sun snuck under her hat and tangled with the wind in her hair. She sat quietly, gazing just offshore at tasseled heads of bull kelp bobbing in the surf.

"I remember looking out to the ocean, and all of the southern residents were right there," Giles recalled, "foraging just right here, right off the kelp bed." Below the dark, jagged water in front of us, the seafloor plummeted to nearly 1,000 feet—the deepest channel in the San Juan Islands. It was a rare place where both humans and orcas gather, just a few yards apart.

"Four decades of time that I've known about these whales, and I have just watched them fail to recover," Giles said, looking down at a photo of her 18-year-old self kneeling on the same rocks, an orca frozen mid-breach behind her. "I'll just keep trying to figure out how to help them so we can see breaching whales right off Lime Kiln again, every day."●

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