



An orca encounter
at SeaWorld in San
Diego, California.

AN OASIS FOR ORCAS

Advocates dream of flying killer whales to an ocean sanctuary, but experts clash over whether science supports the move

By David Grimm

How do you retire a 5-ton whale? That's a question some advocates and scientists have been asking themselves in the wake of SeaWorld's historic decision in March to stop breeding the 29 orcas in its care. Although the chain of theme parks says it will hold onto the animals until they die—which for many could be decades from now—a few groups want to fly them to a sanctuary in the sea, a kind of wildlife refuge for these intelligent and far-ranging creatures. The problem? No such sanctuary exists.

But the groups are laying plans. Last week, about three dozen scientists, veterinarians, and engineers announced the formation of the Whale Sanctuary Project (WSP), a Washington, D.C.-based non-

profit. The group is scouting sanctuary locations along North America's coasts—including coves and small groups of islands that could be cordoned off—with fundraising to follow. Other organizations have proposed similar ideas.

"There's enough known about how to do this that we could put up a facility in the next 3 to 5 years if we had the resources," says WSP President Lori Marino, a biopsychologist based in Kanab, Utah. "We're moving pretty quickly."

But critics say such plans are premature—and that they might not actually help the whales. Placing an orca that has spent its entire life in a sterile, concrete tank into an ocean filled with creatures and conditions it has never encountered before could be dangerous not just for

the whale, but for the previously whale-free ecosystem, says Shawn Noren, a physiologist at the University of California (UC), Santa Cruz, who has studied orca biology at marine parks for nearly 20 years. And the costs are mammoth—perhaps tens or hundreds of millions of dollars. The challenges, she says, "are mind-boggling."

BOTH SIDES OF THE ORCA captivity debate agree that killer whales are remarkable animals. They can travel thousands of kilometers and dive more than 600 meters. Their large, complex brains, like those of chimps, are twice as big as would be expected for their body size. And the orca neocortex, a brain region linked to self-awareness, communication, and problem-

solving, is among the most highly developed in the animal kingdom. Orcas are also social creatures that live in tight-knit family units led by their mothers. They communicate in dialects of clicks and whistles that can vary by region. What's more, according to a study published last year, they're one of only three animals—besides humans and pilot whales—known to go through menopause, an adaptation that may free older females to care for their extended families.

All of this, advocates say, makes killer whales spectacularly unsuited for the relatively small, isolated tanks found in theme

parks and aquariums. Marino and others have argued that such enclosures stunt the animals' physical and psychological growth, leading to stress, disease, and aggression toward other whales and even humans. Tilikum, a SeaWorld orca now in poor health, has been implicated in the deaths of three people, inspiring the 2013 documentary *Blackfish*, which played a major role in the company's decision to stop breeding its killer whales and displaying them in shows.

SeaWorld has countered that its orcas are healthy and well cared for, and that much of what we know about the species wouldn't

have been possible without captive research. It has strongly resisted calls to release its whales to the wild, noting that they have spent most of their lives in pools, and would likely die in the open ocean. Many anti-captivity advocates actually agree. So, instead, they're pushing for a middle ground—something between a tank and the deep blue sea.

AN ORCA SANCTUARY has been attempted once before. In 1998, advocates loaded a killer whale named Keiko (star of the 1993 film *Free Willy*) onto a giant military cargo aircraft and flew him to a remote island cove off the southwest coast of Iceland. Individuals working with the Free Willy-Keiko Foundation hoped to eventually return the 20-year-old whale to the open ocean. But first they had to build him a sea home.

It did not go smoothly. Workers fashioned a sea pen out of foam-filled plastic pipe. Encircled by a deep net, it was about two-thirds the size of a football field, anchored to the ocean bottom with more than 100 tons of chain. About a year and a half later, the foundation opened up Keiko's sea cage and gave him access to the entire cove, which had been cordoned off with a 300-meter-long net. But fierce weather and heavy currents regularly struck the cove, fraying the net and ripping bolts from the sea floor.

Then there was the herculean task of caring for the whale. At its peak, the facility employed more than 20 people, including veterinarians, security officers, and trainers who taught Keiko to hunt for himself and took him on "walks" in which he accompanied a boat in the open ocean, says Michael Parks, who was chief of marine operations for the project and is now with WSP. The cove was inaccessible by road, so everything had to be done by boat, including shipping in frozen herring by the ton to satisfy the orca's 300-fish-per-day appetite. Yearly costs were estimated at \$3 million, and Keiko was there for nearly 4 years. But Parks says that while in the cove, Keiko got off the medications he had been on and grew more muscle.

In 2002, Keiko was given more access to the open ocean, and he soon joined up with a wild pod of orcas and left the cove for good. Satellite tracking showed that he made his way to Norway, but continued to seek human contact, and never fully integrated with his wild kin. He died of pneumonia in late 2003. No orca sanctuary has been attempted since.

MARINO'S GROUP HOPES to change that. And it's not being modest with its plans. Marino, whose academic research helped show that dolphins are capable of self-awareness, became an anticaptivity advocate about 10 years ago (*Science*, 29 April 2011, p. 526). She envisions multiple sanc-

Sanctuary in the sea

Advocates hope to create an ocean refuge for captive orcas, to offer them a more natural life while protecting them from the open sea. Here's what it might look like compared with their current digs.

Containment nets

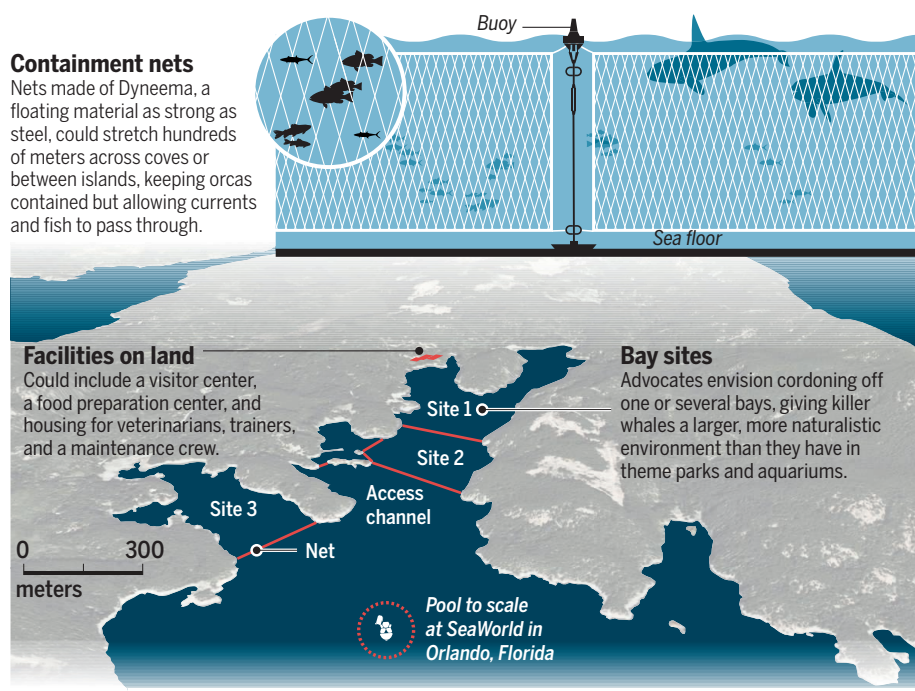
Nets made of Dyneema, a floating material as strong as steel, could stretch hundreds of meters across coves or between islands, keeping orcas contained but allowing currents and fish to pass through.

Facilities on land

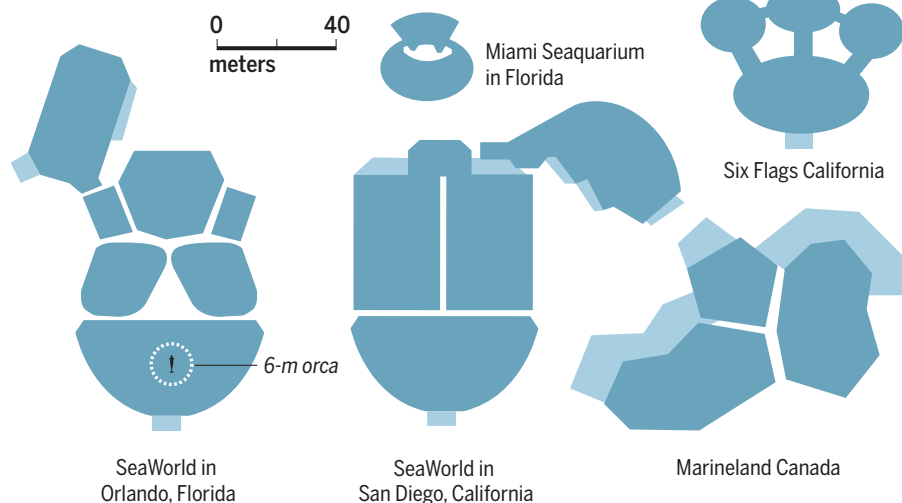
Could include a visitor center, a food preparation center, and housing for veterinarians, trainers, and a maintenance crew.

Bay sites

Advocates envision cordoning off one or several bays, giving killer whales a larger, more naturalistic environment than they have in theme parks and aquariums.



Some typical theme park tanks





Keiko's temporary sea home, Klettsvik Bay off Iceland's Heimaey island, with his sea pen in the distance.

tuaries that could hold up to several orcas, created by drawing a net between islands or cordoning off a cove like Keiko's, but in a calmer location. The enclosure would be "as open and naturalistic as possible," she says. "It will never be ideal, but it will be enormously different than a theme park." A sanctuary won't be able to replicate orca social life, Marino admits, but at least the whales could communicate acoustically with wild orcas, as Keiko did.

Roping off a stretch of water is just the beginning, however. Marino envisions a special area for veterinary care, a visitor education building (which could feature viewing platforms and underwater critter cams), a food preparation center, and housing for staff. "In some ways, we have to replicate what SeaWorld already has," she says. "We have to be prepared to take care of them for the rest of their lives." She estimates costs of up to \$200 million per sanctuary and is counting on rich donors—and perhaps even SeaWorld itself—for help.

Howard Garrett thinks he can do it cheaper, at least for one whale. He's the founder and director of the Orca Network, a small nonprofit based in Freeland, Washington, that has been trying to remove an orca named Lolita from the Miami Seaquarium in Florida, where she has lived since 1970. The group has already selected a site—a calm bay in the San Juan Islands off Washington state.

Garrett envisions a simpler undertaking with no facilities for visitors. A local salmon hatchery would provide most of Lolita's food, and staff would be limited to feeders and the occasional veterinarian. He estimates about \$1 million to create the enclosure and set the whale up there, and about \$250,000 a year to care for her. "It's not a high-tech operation," he says. "It's a common sense operation."

For her part, Marino says Garrett's group hasn't conducted proper environmental as-

sessments and has vastly underestimated costs. But critics say both groups have oversimplified things.

"WE ALL LIKE THE IDEA of retirement," says SeaWorld's chief zoological officer, Christopher Dold, a marine veterinarian in Orlando, Florida, who has worked with orcas for more than 20 years. But he says the park's whales already live comfortable, stimulating lives, and moving them to an ocean enclosure would be dangerous, for both them and the environment. "We're not willing to conduct that kind of experiment with the health and well-being of our killer whales."

Dold notes that the ocean can be unpredictable, citing the storm damage to Keiko's enclosure as well as pollution, ship noise, and disease—all new for captive whales. And it's not just the impact of the environment on the orca; it's the impact of the orca on the environment. "You're talking about putting killer whales in places they don't usually live," UC Santa Cruz's Noren says. What if they eat the local wildlife? "And what's the impact of all that whale poop?"

Plus, Noren says, we don't really know what these animals want. She worked with Keiko at an Oregon aquarium before he moved to Iceland, studying his diving behavior and metabolism. "He would stare at us through the window, even after our experiments were done. We were his social crew," she says. "Who knows if he really wanted to go to Iceland? You can't get inside the brain of a killer whale."

Then there's the cost. "It kind of makes me angry," says Richard Connor, an animal behaviorist at the University of Massachusetts, Dartmouth, who studies wild dolphins. He notes that threatened whales and dolphins worldwide need more resources to help save them. "I'd rather see that money spent protecting marine areas and conducting basic

science." Still, Connor says that such sanctuaries might open up new research opportunities. "We've just scratched the surface of what we know about these animals."

John Ford, a marine mammal scientist at Fisheries and Oceans Canada in Vancouver, agrees. Studying orca vocalizations and feeding patterns is more accurate in an ocean setting, says Ford, who has researched killer whales in their natural environment for more than 40 years. Scientists would also have better access to the orcas in ocean sanctuaries than in the open sea. They could strap recorders to the whales and even take breath samples—things that are much easier to do with trained animals in a confined space, he says. "You could do research you can't do in captivity or the wild."

For now, however, efforts to retire the 29 orcas at SeaWorld and another 27 at aquariums and theme parks around the world remain a pipe dream. SeaWorld says it is focused on improving its captive habitats—making tanks more stimulating and naturalistic, for example with currents the orcas could turn on themselves, and perhaps even live fish.

In the meantime, anticaptivity advocates will continue to lobby SeaWorld and other facilities to retire more marine mammals, like seals and dolphins. "What we learn about retiring orcas will be used as a blueprint for others," Marino says.

Nor will the conversation stop with marine animals. Whether it's orcas, chimpanzees, or elephants, "the more cognitively advanced the creature, the more we have to think about the environment we place them in," says Stephen Ross, who oversees great ape research at the Lincoln Park Zoo in Chicago, Illinois, and also serves on the board of a chimp sanctuary. "These types of questions have always been there," he says. "They're just rising closer to the surface." ■

An oasis for orcas

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Science **352** (6286), 641-643.
DOI: 10.1126/science.352.6286.641

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