Zewail City of Science and Technology's university began admitting students, tuition-free, in 2013.

pay for the construction costs. The university's first class is due to graduate next year, and, for the initial round of students, the tuition has been free.

Zewail managed to recruit Egyptian scientists abroad to return to head most of the research institutes, which focus on research themes such as nanotechnology, energy, and biomedicine. Next year, the city is set to complete phase one of its building projects with 10 teaching and research facilities. According to Ashraf Badawi, Zewail City's dean of student affairs, the science city is still planning and fundraising for a second phase, which calls for an additional four research buildings. Eventually, the university could grow to as many as 5000 students, Zewail said in April. But specific plans for such a large expansion are yet to be drafted.

Prior to his death, Zewail said that he had already helped raise nearly $1 billion of the project's eventual $2 billion goal. Much of that came through Zewail's personal contacts with business and political leaders both inside Egypt and abroad, as well as direct appeals to the Egyptian public. "He knew everyone," Badawi says, and encouraged them all to contribute to the project. In 2011, for example, an Egyptian pharmaceutical executive, Hassan Abbas Helmy, gave 250 million Egyptian pounds ($42 million) for a pharmaceutical research institute.

"We are hoping this will continue" despite Zewail's death, Badawi says. In any case, he says, there's enough funding in place for the foreseeable future. "The city should be fine for several years." At Zewail's funeral, held with full military honors on 7 August in a Cairo suburb, Egyptian President Abdel-Fattah el-Sisi insisted the government would see the project through to completion "one way or another," according to an article in *The New York Times*.

Others at Zewail City's university say they are shaken by Zewail's passing but determined to sustain his vision. "He meant a lot to us," says Reem Khidr Arafa, a U.S.-trained professor of biomedical sciences at Zewail City whom Zewail recruited from Cairo University to join the faculty in 2014. Shortly after learning the news, Arafa says, the university faculty had a brief meeting. "Everyone was in shock," Arafa says. "Now, everyone feels the responsibility to continue the mission. We believe in his dream." That dream, Zewail said back in April, "is a new experiment for Egypt. We need a couple of more years to finish the job. But we are moving in the right direction." ■

PHOTO: FLIP NICKLIN/MINDEN

CONSERVATION BIOLOGY

Can captive breeding save Mexico's vaquita?

Scientists mull a risky strategy to save an imperiled porpoise

By **Ben Goldfarb**

Species don't come much more endangered than the vaquita, a child-sized porpoise that is threatened by fishing nets in the northern reaches of Mexico's Gulf of California. Just 60 remain, experts warned earlier this year, solidifying *Phocoena sinus*'s status as the world's most endangered marine mammal. That grim assessment now has researchers pondering a controversial strategy: capturing a handful of vaquitas and breeding them in captivity.

"Given the crisis we're in, we need to explore all of our options," says biologist Barbara Taylor of the National Oceanic and Atmospheric Administration's Southwest Fisheries Science Center in San Diego, California, who serves on the International Committee for the Recovery of the Vaquita (CIRVA). "Keeping some individuals in a sanctuary is one of those options."

The idea is fraught with practical and political difficulties. No one has ever tried to capture, transport, or care for the animals. And some conservationists fear a captive breeding program will undermine efforts to save the species in the wild. "I don't like this idea at all," says Omar Vidal, director general of the environmental group World Wildlife Fund (WWF) Mexico in Mexico City. "The risk of killing a vaquita while catching them is very high. With only 50 or 60 animals left, we can't play with that."

The population of vaquitas, the world's smallest cetaceans at 1.5 meters long, has been declining by an estimated 34% annually since 2011, almost entirely because of fishing with gillnets, which entangle and drown the animals. In April 2015, the Mexican government imposed a temporary 2-year ban on gillnets within the vaquita's range, and on 22 July it made the ban permanent, a move long recommended by CIRVA's scientists. Illegal nets still pose a threat, however, as poachers pursue a fish called the totoaba, whose bladder fetches up to $20,000 in China. Poachers killed at least three vaquitas this past March alone.

Set to capture sharks and other fish, a gillnet also snared a vaquita, a small, endangered porpoise.

Given the continuing danger, researchers say they must consider captive breeding. The strategy has helped save the black-footed ferret of the western prairies and the California condor, whose populations had both dwindled to about 20 animals. But it has never been tried with a cetacean, and although some small marine mammals, such as bottlenose dolphins, thrive in captivity, porpoises are ill-suited for confinement. "They're very sensitive to stress and noise, and they have high heart rates," says Frances Gulland, a CIRVA member and senior scientist at the Marine Mammal Center in Sausalito,

California. "We think of them as the hummingbirds of the marine mammal world."

In recent years, however, researchers in Denmark, the Netherlands, and elsewhere have shown that some porpoises can be captured and kept in captivity. Those advances convinced Gulland that it was worth exploring the strategy with the vaquita, and last year she convened an expert team in the Netherlands to assess the idea's feasibility.

Each phase of the process would pose challenges, the team concluded. Locating the elusive cetaceans in the choppy, murky waters of the gulf is tricky; the team even suggested exploring the use of trained bottlenose dolphins, such as those kept by the U.S. Navy, to help with the hunt. Once located, the team envisions herding vaquitas into lightweight surface gillnets, which are safer than conventional nets—a tactic that's been used to place satellite tags on harbor porpoises in Greenland. Then, they would use a moist stretcher to transport each animal to a soft-sided net pen, and likely later a large artificial pool, along the gulf's coast. There, they would figure out how to feed and care for the animals, and attempt to persuade them to breed. The ultimate goal would be to release some parents and offspring back into the wild once the threat of gillnets has been mitigated.

The first vaquita capture could occur in 2017, if further study supports the idea, a recent CIRVA report notes. The likely first target would be a young male, Gulland says, because a loss in that demographic group would be least harmful to the population if things go awry.

WWF's Vidal fears, however, that the strategy could take the pressure off Mexican authorities to crack down on illegal fishing. "Species need to recover in the wild," he adds. Vidal notes that Mexico's Guadalupe fur seal, which was hunted nearly to extinction in the 19th century, has rebounded without captive breeding.

CIRVA biologists acknowledge the strategy's limitations. "There's no point in putting vaquitas into a sanctuary if they're just going to be killed once you release them," Gulland says. But they say capturing a few vaquitas—rather than the entire population, as was done with condors and ferrets—could provide an insurance policy against extinction.

If history is any guide, they'll have to act fast. In 2006, Taylor was on a team that hoped to capture baiji, an endangered freshwater dolphin that lived in China's Yangtze River, and relocate the animals to protected lakes. But it was too late: The researchers never found any baiji, and the species was declared functionally extinct. ■

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BIOETHICS

NIH plans to fund human-animal chimera research

Agency would subject experiments—such as growing human organs in pigs—to extra ethical review

By **Jocelyn Kaiser**

Last September, in a move that took researchers by surprise, the National Institutes of Health (NIH) announced it would not fund controversial experiments that add human stem cells to animal embryos. Now, the agency says it is ready to move forward with some so-called chimera studies as long as they pass a special agency ethics review. In a draft policy released last week, NIH said it will take an especially close look at studies that add human cells to very early embryos of certain animals or insert them into an animal's brain.

Biomedical scientists generally welcomed the proposal, which could open the way to growing human organs in animals or studying human brain disease in monkeys. "I applaud the actions NIH is taking to advance this area of research in a responsible and timely manner," says developmental biologist Juan Carlos Izpisua Belmonte of the Salk Institute for Biological Studies in San Diego, California, whose application for a prestigious NIH research award was put on hold last fall because of the moratorium on chimera studies. But some were left trying to parse exactly what NIH's policy will mean. "We still don't know what the outcome will be case by case," says Sean Wu, a stem cell researcher at Stanford University in Palo Alto, California, who coauthored a letter to *Science* last year opposing the moratorium.

At issue are experiments in which scientists introduce human pluripotent stem cells—cells that can turn into any kind of tissue—into early embryos of mice and other laboratory animals and then let the animals develop. Such experiments can be used to study human development, generate disease models, and potentially grow human organs and tissues for transplantation. Several scientists, including Izpisua Belmonte, have already begun using non-NIH research funds to inject stem cells into pig or sheep embryos, in an effort to grow human pancreases or other organs inside the animals. But the public has been leery of such experiments, with some scientists and ethicists worrying that they could produce an animal with humanlike cognitive abilities or lead to a human embryo growing inside an animal. Several countries already restrict this research by law (see table, below).

Responding to growing interest in using chimeras to produce human organs, NIH decided last fall to suspend reviews of new funding applications while the agency

The legal landscape for chimera studies

Most countries don't explicitly permit or forbid human-animal chimera research, but a few have relevant laws or policies on funding for such work.

COUNTRY	POLICY
France	Law forbids creating a chimeric human embryo, but is less clear on whether adding human cells to animal embryos is allowed.
United Kingdom	Regulations issued in January require extra ethical review for human-animal chimera experiments that involve nonhuman primate cells, germ cells, or the brain, or that affect an animal's appearance or behavior.
Germany	Law forbids combining a human embryo with animal cells, but not the introduction of human cells into an animal embryo.
Japan	Law limits research on human-animal chimeric embryos, not allowing development beyond the appearance of the primitive streak or transfer into an animal. A bioethics panel recently proposed more permissive, case-by-case review.
United States	No legal prohibition, but advisory bodies have recommended limits on breeding chimeras and adding human cells to primate embryos. After a funding pause, the National Institutes of Health now proposes case-by-case review.

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