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A baby crocodile at a farm in the Zapata Swamp, Cuba, where the animals are bred before being released into the wild.

ECOLOGY

Cuban crocodiles pose conservation conundrum

Genetic analyses of endangered animals reveal widespread mixing with another species.

BY SARA REARDON, CIÉNAGA DE ZAPATA NATIONAL PARK, CUBA

Dozens of spotted baby crocodiles sit as still as garden statues. Only their swivelling eyes betray their intense interest in passing visitors. Then, suddenly, the animals snap to life, and begin ambling around the Zapata Swamp Captive Breeding Farm in Cuba's swampy Matanzas province.

"They're cute as long as their mouths are closed," says Etiam Pérez, an exotic-fauna researcher at the farm whose leg bears scars from an encounter with an adult crocodile.

The facility is the centrepiece of the Cuban government's 56-year effort to save the critically endangered Cuban crocodile (*Crocodylus rhombifer*). In January, the programme released its first 100 captive-born animals into the wild. But that success has been tempered by genetic analyses that have revealed widespread interbreeding between wild Cuban crocodiles and the more resilient American crocodile (*Crocodylus acutus*).

The findings have prompted Cuban conservationists to rethink their ultimate goal. Should their breeding programme fight to maintain the genetic purity of the two species? Or should they let hybridization take its course, in the hope that an influx of genes from the hardy American crocodile will help the Cuban species to survive as its habitat shrinks and the climate changes? So far, science has not provided a clear answer. "We need to follow our instincts, our ideas, our judgement, and hope that future generations won't criticize us," says Pérez.

Former president Fidel Castro began the effort to breed and conserve the island's reptiles in 1960, not long after the revolution that put him in power. Yet today, just a few thousand Cuban crocodiles remain in the wild. Logging and the expansion of agriculture have eaten away at their habitat, and demand for their valuable leather and meat is high. In Cuba, where the average monthly salary is about US$20, people run towards — not away from — crocodiles, Pérez says, despite the steep fines for killing them.

The animals are more curious and aggressive than other crocodile species, and can leap metres out of the water to catch tree-dwelling rodents called hutias, says George Amato, a conservation biologist at the American Museum of Natural History in New York City.

Cuban researchers have been slow to abandon the traditional method of classifying crocodiles by their head shape in favour of more precise genomic identification — in part because the country's research centres lack modern genetic-research tools. Yoamel Milián-García, a biologist at the University of Havana, discovered that Cuban and American crocodiles were breeding with each other only after taking tissue samples to Canadian and US labs with next-generation DNA-sequencing technology.

His most recent analysis[1] showed that half of the 227 wild Cuban crocodiles he tested were hybrids, compared with just 16% of 137 captive animals. This suggests that the animals' interbreeding has accelerated, and that genetic analyses are now the only reliable way to distinguish between the species to study their behaviour.

Such situations are becoming common, as improved sequencing technologies reveal the extent to which species have interbred through history, says Evon Hekkala, a conservation geneticist at Fordham University in New York City. Her study[2] of Egyptian crocodile mummies that are nearly 2,000 years old or more showed

them to be very different from modern Nile crocodiles (*Crocodylus niloticus*), which are thought to be the descendants of multiple species that have probably died out. Hekkala is now studying fossilized crocodiles from the Caribbean to see what they reveal about the history of the various species there.

To Milián-García, the most important question is whether humans have played a part in the loss of the Cuban crocodile's genetic identity. The Cuban and American species normally occupy different niches: the latter is more tolerant of salt water and nests in holes, whereas the former prefers fresh water and builds nests on mounds. Habitat destruction may be forcing them into the same ecological niche, which could produce hybrids ill-equipped to prosper in a changing ecosystem.

But an influx of genes from the saltwater-tolerant American crocodile could also help Cuban crocodiles to survive as Cuba's rising seas encroach on freshwater rivers and lakes. "Do you want to be judgemental about a species getting by by accessing the genomic resources available to it by hybridization?" Hekkala asks.

While they grapple with such questions, Cuban researchers are using in-depth genetic studies to optimize their breeding programme. Last month, Milián-García, Pérez and their colleagues reported[3] that female Cuban crocodiles can produce single clutches of eggs that contain DNA from multiple fathers. To maximize the amount of genetic diversity in the captive population, he says, the crocodile-breeding farm should allow each female to mate with several males.

Yet conservation research in Cuba remains challenging. Everything from buying fuel to sending samples to other countries requires a US government permit, a consequence of the decades-old US economic embargo against Cuba. "It's the only place you can't solve a problem with money," Amato says.

Despite these difficulties, Cuba's perennially underfunded scientists make do by forging international collaborations and dreaming up homemade solutions to equipment shortages.

And the Cuban government continues to make conservation a priority. In 2014, it closed off 500 hectares of the Zapata Swamp to future development, protecting land that had previously produced 15,000 cubic metres of milled lumber per year. Says Amato: "I give them really high marks." ■

1. Milián-García, Y. *et al. Heredity* **114,** 272–280 (2015).
2. Hekkala, E. *et al. Mol. Ecol.* **20,** 4199–4215 (2011).
3. Milián-García, Y. *et al. Amphibia-Reptilia* **37,** 273–281 (2016).

NEUROSCIENCE

Global brain project sparks concern

Worries include how developing countries could participate.

BY SARA REARDON

In recent years, brain-mapping initiatives have been popping up around the world. They have different goals and areas of expertise, but now researchers will attempt to apply their collective knowledge in a global push to more fully understand the brain.

Thomas Shannon, the US under secretary of state for political affairs, announced the launch of the International Brain Initiative on 19 September at a meeting that accompanied the United Nations' General Assembly in New York City. The United States, Argentina, Japan and Germany are collaborating on the initiative.

Details — including who will pay for it — are still up in the air. However, researchers at a separate, but concurrent, meeting hosted by the US National Science Foundation at the Rockefeller University in New York City discussed which aspects of programmes already in existence could be aligned under the global initiative. The reaction was a mixture of concerns over the fact that the initiative could siphon resources and attention from existing projects, and anticipation over the possibilities for advancing our knowledge about the brain.

"We're still in the neuroscience craft era. Everyone has their secret sauce."

One of several goals for the initiative is the creation of universal brain-mapping tools. Labs tend to make their own variations of experimental tools and often run experiments in their own ways. This makes it hard for different teams to collaborate or exchange information. At the Rockefeller meeting, physicist Michael Roukes of the California Institute of Technology in Pasadena noted that the Industrial Revolution took off only when factories with interchangeable components began replacing companies that had one-off machines. "We're still in the neuroscience craft era," he says. "Everyone has their secret sauce."

Another idea proposed at the meeting was the creation of an International Brain Observatory, with tools such as powerful microscopes and supercomputing resources that scientists from around the world could access. And Joshua Vogelstein, a neuroscientist at Johns Hopkins University in Baltimore, Maryland, suggested creating a virtual International Brain Station that could automatically convert data from human brain scans or animal gene expression into standardized formats that would allow more people to analyse them.

But many attendees worried about marshalling the numerous proposals under one umbrella. Existing brain-research programmes have different priorities: Japan and China, for instance, are investing heavily in primate research, which the United States tends to avoid for ethical reasons. The European Union's flagship Human Brain Project (HBP) is attempting to understand the basic science of how the brain works, whereas Canada is focusing on creating technologies that can be applied to medicine.

Others expressed concerns that some meeting attendees were ignoring existing resources. For instance, Canada's nine-year-old CBRAIN programme serves as a clearing house for data and methods, and is already used by neuroscientists in 22 countries and the HBP.

LEFT OUT

And some worry that the global initiative would exclude developing countries. "If the only way to do international is for each country to put in US$300 million, that will not be international," says Sandhya Koushika of the Tata Institute of Fundamental Research in Mumbai, India.

Valeria Della-Maggiore, a physiologist at the University of Buenos Aires in Argentina and chair of the Latin American Brain Mapping Network, says that she knew nothing about the International Brain Initiative and was surprised to see Argentina among its sponsors. The Rockefeller programme did not include speakers from developing countries, and she is concerned that they are not being consulted in the development of international initiatives.

The point of the Rockefeller gathering, says co-organizer Cori Bargmann, a neuroscientist at the Rockefeller University, was to get a sense of existing programmes, and future meetings will be more focused once organizers know who is to participate in the joint project.

Overall, scientists are hopeful that the new global initiative will enable them to take brain mapping to the next level. Several brain-research projects have been around for a while, so it is easier to compare them and begin to talk pragmatically about what we need to align them, says Christoph Ebell, executive director of the HBP. "I think it is the right moment." ■

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