how the presence of strangers affects their behavior, findings that may influence how much access sanctuaries allow the public.

Hansen is also studying how the chimps adapt to the sanctuary’s environments, including corrals and a 2-hectare forest where the animals can climb trees and poke sticks into artificial termite mounds. At Chimp Haven, she has access to 10 times the number of chimpanzees she would at the zoo, and, unlike in the wild, there’s no danger of losing track of an animal. “You’re getting the best of both worlds,” Ross says.

In return, the sanctuary gets a full-time scientist. Research director Amy Fultz says her team is lucky to collect 6 hours of data on the chimpanzees per week. Hansen can do 3 hours a day and tackle a variety of projects. “It enhances what we can do, and it enhances our mission,” Fultz says.

Some biomedical studies may even be possible. Chimp Haven’s president, Cathy Spraetz, says the sanctuary would consider sharing blood and other tissues collected during routine procedures with outside scientists. It has also agreed to donate the brains of deceased animals.

Still, sanctuary research faces big challenges. Most animals at Chimp Haven have spent their entire lives in labs, where some were injected with viruses like hepatitis and HIV and regularly had organs biopsied and blood drawn. That could complicate research on how normal chimps think and behave, says David Watts, a Yale University primatologist who has studied chimpanzees in Uganda for more than 20 years. “We see some puzzling findings with these [captive] animals in cognition research,” he says, like chimps asking humans to do things for them—which would never happen in the wild.

But the biggest hurdles are cultural. Ross would like to eventually move on to more substantive studies of behavior and cognition at the sanctuary. That could include giving the animals touchscreens and puzzles to play with. Spraetz is open to such experiments, as long as they don’t interfere with the animals’ normal lives.

But Molly Polidoroff, who runs Save the Chimps—North America’s largest chimpanzee sanctuary, based in Fort Pierce, Florida—is less comfortable with such work. “We don’t test hypotheses with our chimps.”

Given that resistance, Georgia State’s Beran questions whether sanctuaries can do weighty science. “These facilities could have a very large impact on the field, but only if they can find a way to do this work without conflicting with their retirement mission,” he says. “It would be a real shame if in 10 years the only research that was being done was, ‘What diet should they be on?’”

And if Chimp Haven truly wants to beef up its research program, it will need to find more money. The National Institutes of Health owns most of the chimpanzees here and pays for their care, but it doesn’t fund research on them. So the collaboration will have to expand its reliance on donors and private foundations. Ross also hopes that scientists who have lost their lab chimps will come to sanctuaries to continue their work—and bring their own money.

For now, sanctuaries seem open to the idea of conducting more research. Even Save the Chimps’s Polidoroff has just hired a nationally known scientist to head up a formal behavioral research program. “We see the potential for doing more,” she says. Hare is optimistic, too. “I think research on great apes will flourish,” he says. “There’s a happy page being turned here.”

CONSERVATION BIOLOGY

Rethinking the North American wolf

Genome sequencing suggests two endangered wolf species are coyote hybrids

By Virginia Morell

When is a wolf a wolf? For more than 30 years, the question has dogged scientists, conservationists, and policymakers attempting to restore and protect the large wild canids that once roamed North America. Now, a study of the complete genomes of 28 canids reveals that despite differences in body size and behavior, North American gray wolves and coyotes are far more closely related than previously believed, and only recently split into two lineages. Furthermore, the endangered red and eastern wolves are not unique lineages with distinct evolutionary histories, but relatively recent hybrids of gray wolves and coyotes, the scientists report online this week in Science Advances.

That could be a problem for the wolves. The red wolf is currently protected under the U.S. Endangered Species Act (ESA), and some conservationists would like to see the eastern wolf listed as well. (It is protected in Canada.) But as hybrids, they may not qualify for protection under U.S. law. The study “helps with more data but hurts by giving less protection to [the] two wolf types,” says Doug Smith, the leader of Yellowstone National Park’s wolf restoration project in Mammoth, Wyoming.

The research team argues that red and eastern wolves should still be protected, and urges reconsideration of our black-and-white species concept. “People think that species should be genetically pure, that there should be tidy categories for ‘wolf’ and ‘coyote.’ That’s not what we found,” says Bridgett vonHoldt, an evolutionary biologist at Princeton University and the study’s lead author. “The study shows that mixed ancestry is common, even in animals [in the western United States] we’ve traditionally identified as ‘pure,’” adds Linda Rutledge, a postdoc in VonHoldt’s lab who was not involved in the study and doesn’t accept all its findings. “It shows how outdated the endangered species policy is with respect to hybrids.”

Bethany Hansen observes retired chimps in an outdoor play area at Chimp Haven in Keithville, Louisiana.
Gray wolves (Canis lupus) and the smaller, narrow-snouted coyotes (C. latrans) have long been accepted as North America’s two large canid species. But some scientists recognize two additional wolf species—the red (C. rufus), found in the southeastern United States, and the eastern wolf (C. lycaon), which ranges from the Great Lakes into eastern Canada (see map, below).

The United States Fish and Wildlife Service (FWS) counts both as species. It put the red wolf on the endangered list in 1973 and started a captive breeding program for it in 1980, but reintroducing the animals has proven difficult, because they readily mate with coyotes. The agency has not put the eastern wolf on the endangered list, although it is restricted to a small portion of its former range. (In a controversial move in 2012, FWS used the existence and range of the eastern wolf as a technicality that could invalidate the gray wolf’s protections, because if the eastern wolf is a real species, then the gray’s range in the original ESA filing was incorrect.)

Other researchers have suspected, however, that both “species” are, in fact, wolf-coyote hybrids that arose after the gray were hunted almost to extinction. To help sort out the North American wolves’ muddled history, VonHoldt’s team sequenced the whole genomes of nearly 3 billion bases each—of 28 large canids; they included wolves from Asia, Mexico, Canada, and the United States, plus coyotes, domesticated dogs, and a golden jackal. Comparing the genomes let them “look back at the canid’s deep evolutionary history,” VonHoldt explains, “and to find each species’ closest relative, and when they diverged.”

Using a molecular clock based on differences in the genomes to calculate when coyotes and gray wolves split, the team got a surprise: These canids separated from the Eurasian wolf and into two distinct lineages between 6000 and 117,000 years ago. Other researchers had previously dated this event to 1 million years ago using the fossil record. The recent date for the wolf-coyote split “is phenomenal,” VonHoldt says. “They are very close relatives.” Even western wolves that do not breed with coyotes still share some coyote genes.

But the team found even more coyote genes, of more recent origin, in red wolves and eastern wolves, including those from Algonquin Provincial Park in Canada where pure eastern wolves were thought to exist. The paper estimates that Algonquin wolves have about 32% coyote ancestry, and Que-}

A continent of canids

Opinions vary on wolf ranges and identities, but most researchers agree that the gray wolf once roamed across much of North America (including into Mexico, not shown) and that the coyote ranged across the west. A new genetic study finds that the red wolf and the eastern wolf (one from Quebec in Canada, bottom) arose later by mixing with coyotes as they expanded eastward.

ary biologist at the University of California, Los Angeles.

Rutledge and others, including conservation geneticist Paul Wilson, who studies the eastern wolf at Trent University in Peterborough, Canada, argue that researchers need to sequence more samples of C. lycaon before dumping that taxon. But others who have long questioned the status of eastern and red wolves welcome the work. “Wolf biologists and others have been waiting for this sort of definitive analysis for years,” says Susan Haig, a wildlife ecologist at the United States Geological Survey in Corvallis, Oregon.

The loss of species status for the red and eastern wolves doesn’t mean they should lose protection, Wayne and others say. Hybridization is “a natural and commonly occurring evolutionary event,” Wayne says, noting that the ESA has successfully been used to protect hybrid species such as the Florida puma and western spotted owl. He thinks eastern and red wolves should be protected because they likely still carry genes from wolves that once inhabited these regions, and because they are evolving into animals better adapted to today’s human-dominated landscapes. The team also argues that the agency’s arguments for delisting the gray wolf are no longer valid.

It’s possible that eastern and red wolves—if regarded as grays—would still be protected, but FWS declined to comment on the details of the paper.

Other scientists say the messy natural biology revealed by the study clashes with society’s need for clear legal definitions. “It’s beautiful work and topflight science,” says Mike Phillips, a restoration ecologist with the Turner Endangered Species Fund in Bozeman, Montana. “But from a practical standpoint, to do what they’re asking [and consider the ecological benefits of hybrids], you’d have to amend the ESA.”

He and others lament the possibility that red wolves might lose ESA protection because of the findings. That, they say, would be a sad irony for canids that likely evolved because of human disturbance in the first place.
Rethinking the North American wolf
Virginia Morell (July 28, 2016)

Editor's Summary

This copy is for your personal, non-commercial use only.

**Article Tools**
Visit the online version of this article to access the personalization and article tools:
http://science.sciencemag.org/content/353/6298/434

**Permissions**
Obtain information about reproducing this article:
http://www.sciencemag.org/about/permissions.dtl