Heritage of Iraq, where Saadullah works, asked the Smithsonian offer help at Nimrud first, says Brian Lione, who specializes in cultural heritage management at the Museum Conservation Institute. With $300,000 from the Department of State and $100,000 from the Smithsonian, the yearlong project began in April. The Iraqi Institute for the Conservation of Antiquities and Heritage, located a couple hours from Nimrud in Erbil, serves as headquarters for the rescue effort.

Time is of the essence because the artifacts urgently need protection. Building new roofing structures was ruled out as too complex. Instead, the team will identify and inventory objects and rubble, trying to work out how pieces of smashed structures, statues, and friezes once fit together. They must also separate original materials from pieces of roofing structure and from parts of the site that were reconstructed in recent decades. Items will then be moved to storage facilities at the edge of Nimrud.

The emergency rescue effort follows a strategy developed largely by Aparna Tandon of the International Centre for the Study of the Preservation and Restoration of Cultural Property in Rome. Archaeologists, members of the military, and other first responders all get special training. They learn how to document, photograph, and protect different types of materials; crate damaged objects; guard against looting; and more. In July, Kent Severson, a conservator at the Shangri La Museum of Islamic Art, Culture, and Design in Honolulu, visited Erbil to offer Iraqi team members a crash course in how to move massive chunks of stone. "We packed off to a big field in Erbil that is filled with destruction debris, demolition from houses including great chunks of concrete, all mixed up in dirt and very rough," Severson says. "This approximates the site at Nimrud."

In sweltering summer heat, the team practiced tying concrete with nylon straps to lift it, pretending it was Nimrud's vulnerable gypsum. They experimented with using a chain hoist to maneuver the slabs onto wooden rollers and dollies, designed to mimic the stone cart they'd later use to traverse spaces too tight for a truck.

Now, the team is waiting for the all-clear to enter Nimrud—a first step, Saadullah hopes, toward ultimately rebuilding it. "My love for my heritage and for my country encourages me to start thinking where to start, how to start, to try to rescue this site," he says. The team hopes to learn how realistic that goal is, Johnson says. "We're trying to get to the point where later on those decisions can be made." ■

PHOTO: GNAGEL/ISTOCKPHOTO

Just over 100 Mexican wolves roam the remote mountains along the Arizona–New Mexico border.

CONSERVATION

Critics pan wolf plan

Recovery plan for Mexican wolf promises no new U.S. habitat. States are pleased; some biologists are dismayed

By **Cally Carswell**

On 26 January 1998, federal wildlife officials drove three Mexican wolves to a remote corner of southeastern Arizona, where they soon became the first wild wolves to roam the U.S. Southwest in nearly 30 years. Mike Phillips, a biologist who had helped reintroduce wolves to the southeastern United States and Yellowstone National Park, said that day that reestablishing the Mexican wolf was going to be "the biggest wolf conservation challenge" yet. The captive-bred wolves would have to survive in a landscape grazed heavily by livestock, increasing the potential for deadly conflicts with ranchers.

Still, Phillips never thought it would be this hard.

Nineteen years after the U.S. Fish and Wildlife Service (FWS) released those animals, the agency has announced its draft plan for reestablishing a viable population. The recovery plan, released this June, will guide the agency's actions as it tries to boost the Mexican wolf population enough to justify removing it from Endangered Species Act (ESA) protection.

Southwestern states believe the plan appropriately balances the concerns of ranchers and local communities with conservation goals. But Phillips and some other wildlife scientists say it will leave the Mexican wolf in peril, despite decades of effort to save it. They charge that FWS designed the plan primarily to appease the states, putting politics before science-based conservation.

"The plan is an absolute waste of time," says Phillips, director of the Turner Endangered Species Fund in Bozeman, Montana, a private organization that has long contributed to Mexican wolf conservation. "They've given the states everything they wanted." FWS officials acknowledge that the plan was developed with state input in a series of closed-door workshops that Phillips also participated in, an approach they say is consistent with the ESA's mandate that the agency partner with states.

The Mexican wolf is a subspecies of gray wolf, a smaller cousin of the wolves that were reintroduced to Yellowstone in 1996. Those wolves have gone on to flourish throughout the northern Rocky Mountains and are gaining a foothold in the Pacific Northwest, with the total population estimated at nearly 2000 animals. Mexican wolves, meanwhile, have limped along. Their numbers surpassed 100 only recently, and the population is highly inbred.

At the heart of the current controversy is a debate over where federal biologists should release more wolves, outside their current range in southeastern Arizona and southwestern New Mexico, to create a larger and more resilient population.

In 2011, Phillips was one of nine scientists recruited by FWS to come up with a science-based definition of "recovery" for Mexican wolves. The team eventually recommended

establishing two additional populations, one around the Grand Canyon in northern Arizona, and another in southern Colorado and northern New Mexico. Recovery would be achieved, they suggested, when the wolves in the three areas totaled 750, with at least 200 animals in each population and movement between them. The team also supported restoration in Mexico, but concluded the habitat there was too marginal to support a sizable population.

In 2012, FWS incorporated the science team's recommendations into a rough draft of a recovery plan. A copy of the draft obtained by *Science* said the Mexican wolf was "not recoverable" unless its range included the northern sites. But the agency never finished the draft or released it to the public. Sherry Barrett, FWS's Mexican wolf recovery coordinator in Albuquerque, New Mexico, says the process was put on hold for administrative reasons, including an environmental lawsuit that forced the agency to prioritize revising its regulations for the release and management of wild wolves. Phillips and others, however, believe the agency buried the plan because of pressure from Arizona, New Mexico, Colorado, and Utah, which objected to expanding wolf territory.

The draft recovery plan released this summer departs dramatically from the science team's earlier recommendations. It concludes that expanding the current Arizona–New Mexico population to just over 300 wolves and establishing a population of 170 wolves in Mexico will be enough to ensure recovery. "Our focus," Barrett says, "was to see if there was enough habitat in Mexico and south of Interstate 40 [I-40]," the east-west highway that bisects both states.

Barrett explains that Mexican wolves historically occupied these areas, whereas the states argue that the northern sites fall outside the historic range. After running models on habitat potential and population viability, FWS concluded that populations south of I-40 and in Mexico could have at least a 90% chance of persisting for 100 years, the threshold it set for recovery. "That's what the science showed us," Barrett says.

Carlos Carroll, a biologist with the Klamath Center for Conservation Research in Orleans, California, questions the FWS population modeling. He argues that it included an incomplete "sensitivity analysis"—an examination of how small changes in, say, mortality or reproduction affect the outcome. Such analyses can tell managers how much confidence to invest in a model's results. One factor missing from the analysis, Carroll says, was potential variation in the proportion of female wolves that breed every year. Small fecundity changes can lead to significantly worse outcomes, he notes, suggesting the populations FWS envisions may be much more vulnerable to extinction than the agency estimates.

Phillips is also skeptical about the plan to build a wolf population in Mexico, where most habitat is on private land, cattle are plentiful, and data on natural prey are unreliable. "Wolf recovery has gone forward because of large tracts of public land," where the animals are less likely to be shot for threatening livestock, he says. "It's also critical that those public lands support large numbers of native prey." But Barrett says FWS has good partners in the Mexican government, which is not voicing concern that private lands are a barrier to recovery. "Our intent is to see if it's possible down there," she says.

Jim Heffelfinger, wildlife science coordinator at the Arizona Game and Fish Department in Phoenix, thinks that's the right course. The 2011 science team, he says, put "too much focus on what would be the gold standard if we didn't need to consider stakeholders." He believes the new plan can get enough buy-in to work on the ground.

FWS is reviewing more than 100,000 public comments on the draft plan. A final version is due in November.

Phillips concedes that focusing on Mexico and the existing U.S. wolf population is the path of least political resistance. But biologically, he says, it's a dead end. "I think the world of the U.S. Fish and Wildlife Service. But in this case, they let the Mexican wolf down." ■

Cally Carswell is a science and environment journalist in Santa Fe.

Not in my backyard

In 2012, the government considered introducing Mexican wolves at two new U.S. sites. The latest plan relies instead on establishing new populations in Mexico.

SPACE TECHNOLOGY

Minisatellite surge spurs downlink infrastructure

Budding ground station networks capture deluge of CubeSat data

By **Joshua Sokol**

Joshua Semeter needed a data plan. Not for his smartphone, but for his satellite. Semeter, an engineering professor at Boston University, is the principal investigator for ANDESITE, a toaster-sized satellite destined for low-Earth orbit. After it launches in November, the satellite will eject a cloud of eight even smaller sensors that will track how the electrical currents that feed Earth's aurorae vary and how they respond to solar activity. Semeter hopes the mission will run for at least 2 weeks and send home a gigabyte of magnetic readings.

If, that is, he can figure out how to get all those data back to Earth. ANDESITE and hundreds of other recently launched CubeSats—minisatellites pieced together like Lego blocks—have created a data bottleneck. "It's all well and good to build cheap satellites," Semeter says. "But as soon as you put a data geyser on one, like a camera, you need a high data rate and substantial infrastructure to retrieve the information." Now, traditional and startup companies as well as the military and government agencies are jumping into the fledgling market. They are building out or buying into global antenna networks and testing more capable downlink technologies and architectures.

When the first generation of CubeSats launched in the early 2000s, they transmitted a trickle of largely perfunctory bookkeeping data with standard low-power radios. "We were basically doing the same thing, using the same thing, as the ham radio guys," says engineer Bob Twiggs of Morehead State University in Kentucky, who co-developed the CubeSat standard—10-centimeter cubes that serve as building blocks for many small satellites. Twiggs and his students were able to pull down their data with amateur-grade antennas—

CREDITS: (GRAPHIC) J. YOU/*SCIENCE*; (DATA) C. CARROLL

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