



**Buzz cut.** As feral goats turned Isabela's brush and cloud forests into patchy grassland, tortoises suffered.

## INVASIVE SPECIES

# The Galápagos Islands Kiss Their Goat Problem Goodbye

The world's largest eradication campaign has virtually rid an ecological wonderland of feral goats, a devastating invader. Next in the crosshairs: cats and rats

**SANTA CRUZ, GALÁPAGOS ISLANDS**—Rachel Atkinson hops like a Darwin finch from one volcanic outcropping to the next, then plunges into ankle-deep mud. Squishing as she walks, the botanist with the Charles Darwin Research Station homes in on the ailing invaders: blackberry, passion fruit, and quinine bushes clustered near Santa Cruz Island's last shrubby stands of *Scalesia* trees. Atkinson smiles in approval. One more blast of herbicide ought to prevent the aliens from regrowing and give the *Scalesia* a shot at survival after all.

Atkinson's search-and-destroy mission is part of an ambitious 6-year, \$18 million Global Environment Facility (GEF) effort by the station and Galápagos National Park to turn the tide against invasive species in the Galápagos Islands, the fragile crucible of life that inspired Charles Darwin to formulate his theory of evolution 150 years ago. The GEF grant runs until next year, but the results so far are stunning. A survey here last month has confirmed that enemy number one—the feral goat—has been virtually wiped off Isabela, Santiago, and Pinta islands. All told, some 140,000 feral goats were slain in 5 years of the GEF-funded Project Isabela, the largest eradication project ever undertaken. "A great battle has been won here," says Victor Carrion, sub-director of the park.

Although one bane has been eliminated, others are at large. In northern Isabela, rats have ravaged the last two nesting sites of mangrove finches, estimated at fewer than 100. And both rats and feral cats have deci-

mated a subspecies of marine iguana (*Amblyrhynchus cristatus albemarlensis*) endemic to Isabela, prompting the World Conservation Union to add it to its vulnerable list in 2004. Rangers have set out traps and poison for Isabela's rats and are plotting eradication campaigns on Floreana and Santiago islands. An effort to poison feral cats will commence next year.

The Galápagos have been under siege ever since pirates and whalers began visiting the archipelago in the 1700s and leaving behind goats, pigs, and other animals as a living larder for future visits. But it wasn't until the late 1980s that the goat population suddenly started booming, possibly due to El Niño-driven changes in vegetation patterns. Godfrey Merlen, a Galápagos native and director of WildAid, says he saw "two or three" goats on the upper flanks of Isabela's Alcedo volcano in 1992. When he returned 3 years later, he saw hundreds. "It was total chaos," Merlen says. The goats had denuded the once-lush terrain, transforming brush and cloud forests into patchy grassland.

Ecological shock waves rippled across Isabela. The highlands had served as a safe haven for species such as the giant tortoise. "We saw many more tortoises falling into the volcanic craters," trying to reach feeding grounds or because of erosion, says Carrion. "Being a baby tortoise is hard enough," adds Thomas Fritts, past president of the Charles Darwin Foundation. "Competing with voracious herbivores is an extra challenge."

Park rangers quickly cottoned on and started slaying the goats in 1995. They had eradicated a much smaller population from Española Island in the 1970s. But with tens of thousands of goats on northern Isabela alone, officials knew they needed a novel approach. In 2000, GEF agreed to bankroll an antagoat operation as long as it was part of an effort to tackle invasive species across the board (*Science*, 27 July 2001, p. 590).

Goats were still top priority. The park imported hunting dogs from New Zealand and trained them to track and kill goats. Helicopters were pressed into service for sharpshooters to reach rugged highlands. To flush out the last feral holdouts, the park released "Judas" goats, including sterilized females plied with hormones to keep them in heat and attract males. The last feral goat in northern Isabela was shot in March. Hunters have also purged pigs from Santiago and donkeys from both islands.

Local scientists say native plants are already bouncing back. Seedlings of *Scalesia* and soldierbush are sprouting on Alcedo. And on Santiago, cat's claw and Galápagos guava are thriving, providing nesting grounds for the secretive Galápagos rail.

One looming threat is microbial invaders. "What can cause far greater and permanent damage are the small introduced species [such as] West Nile virus, now in Colombia, a stone's throw away from Galápagos," says Merlen. In a paper in the August issue of *Conservation Biology*, Marm Kilpatrick of the Consortium for Conservation Medicine in New York City and colleagues concluded that West Nile virus-ridden mosquitoes could easily hitch a ride on a commercial jet from mainland Ecuador. "The Galápagos has been very lucky so far, but it's just a matter of time," says Simon Goodman of the University of Leeds in the U.K., an author of the paper. He says that West Nile virus could inflict the sort of damage in the Galápagos that avian malaria did in Hawaii in 2004, when it drove a honeycreeper (*Melanerpes formicivorus*) to extinction. Galápagos officials pledge to remain vigilant and point to the establishment in 2003 of a molecular pathology lab on Santa Cruz funded by the U.K.'s Darwin Initiative.

To avoid ceding hard-won breathing room for native species, the park and research station plan to set up a \$15 million fund for ongoing eradication efforts. In the meantime, they are stepping up efforts against invasive plants and gearing up for the cat-and-rat blitzkrieg. Unless these and other unwelcome visitors go the way of the goats, warns Carrion, "the worst may be yet to come."

—JERRY GUO

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