Electric Fence Enclosure Fails to Confine Feral Goats

By Dan Taylor

Feral goats *(Capra hircus)* were introduced to Hawaiian and most other Pacific islands by mariners during the late 18th and early 19th centuries. They severely degraded the integrity of native ecosystems. During the 1970s and '80s goats were eradicated from most of Hawaii Volcanoes NP (92,676 ha). Installation of wire mesh boundary fences were the cornerstone of the park's goat removal strategy. Within the fences goats nearly were eliminated by systematic drives, hunting, and aerial shooting. Remaining animals were eliminated using radio-collared Judas goats (Taylor and Katahira, 1988). However, 30 to 50 goats still frequent an unfenced area of approximately 2,400 ha in the park. Our considerable success with wire mesh fences notwithstanding, a cheaper and more aesthetic alternative to wire mesh fencing was desired to control these animals.

Electric wire fences are commonly used to enclose livestock, including cattle, horses, goats, sheep, and other animals (Smith, et al., 1986). However, the literature is silent regarding the efficacy of using electric wire fences to control movements of feral goats. A neighboring rancher has successfully enclosed domesticated goats using a simple 2-strand electric wire fence. He and some of his associates convinced us to test electric fence wires on feral goats.

Our ultimate objective is to eradicate feral goats from a remote, sparsely vegetated, and rugged section of the park at elevations 2,000 to 3,500 m on the south

slope of Mauna Loa. The animals here are seldom hunted or harrassed, nor constrained by fences. Workers constructed a spacious experimental electric fence enclosure, then captured 4 goats from a feral Mauna Loa group and put them into the enclosure. We evaluated the effectiveness of the fence and construction costs.

Methods

Park resource management workers enclosed 7 ha using a high quality, 12 V DC, electric fencing package obtainable in the U.S. market (Common Sense Fence, Inc., Chatfield, MN). A 12 V, 55 amp-hr marine battery energized the circuit, which was recharged by a 28 cm x 36 cm solar collector. Workers installed 6 strands of #12.5 gauge galvanized wire, under 150 pounds tension, supported by 25 mm-dia fibreglass posts. The bottom, third, and fifth wires were charged with 5,500 V, delivered for 1/10,000 sec at 45-55 pulses per minute. Alternate wires were grounded. The system was grounded with a buried 2 cm dia, 2 m long solid copper rod. The bottom wire was 5 to 20 cm above ground level and succeeding intervals were 15, 20, 20, 25, and 25 cm. The top wire was therefore 110 to 125 cm above ground level.

The rectangular enclosure was 1375 linear meters circumference. Thus there were 8,250 m of wire, 4 braced corner posts, and one gate. We made the enclosure as spacious as we could configure it, between a secondary road and a 12-16 m high escarpment, yet entirely visible from atop the escarpment. Distances from escarpment viewpoints to the fence ranged from 18-328 m. It was not feasible to construct an enclosure the size of a theoretical home range.

Vegetation within the enclosure covered approximately 15 percent of the area. The dominant grass was non-native *Andropogon glomeratus;* dominant shrubs were native *Styphelia tamaemae* (pukiawe), *Dodonaea sp* (a'ali'i), *Dubautia sp;* dominant trees were native *Metrosideros polymorpha* (ohi'a) and non-native *Myrica faya* (firetree). Fifty-five clumps of the rare native shrub, *Scaevola kilaueae*, were protected from goats with special wire canopies. *Myrica faya* individuals which obscured views of the fences were cut down. Vegetation clumps and several rock outcrops and earth cracks provided numerous refugia for goats.

Technicians captured 1 juvenile (female) and 3 mature (2 male, 1 female) goats from one of the remote Mauna Loa groups and then sedated them with injections of Rompun and Ketamine. They immediately fitted each animal with a color-coded collar bearing a radio transmitter to facilitate observation during the test and to locate escapees. Then they delivered the goats, still under sedation, by helicopter to the enclosure, which was 19 km from the capture site and 821 m lower in elevation. The animals awoke and began walking about the enclosure 1:51 to 3:46 hours after they arrived. Observers discreetly monitored the goats from the escarpment and recorded behavior before and during encounters with the fence wires.

Results and Discussion

Within 24 hours, all 4 goats penetrated the electric wires and escaped. The 2 adult males escaped together, at mid-day, 57 and 20 min., respectively, after arousal from sedation. One of the males was recaptured and returned to the enclosure 72 min. after his

Billy hits the wires *and gets hung up by his horns (proving it doesn't take two to tangle).*

escape. He escaped again 75 min. later. The 2 females escaped together shortly after dawn on the second day, after spending the night in the enclosure. They had been active for 22:01 and 23:05 hours, respectively. The electric wires were fully charged throughout the test, as indicated by a signal strobe and by a clip-on volt meter that indicated a charge of 5,500 V on the fence before and after the test. Three of the goats were in contact with wires long enough during their passage through the fence to have received 3 to 5 shocks during their passage through the wires.

Continued on page 20

Solar charge unit *is attended to by Phillipa Lin, a VIP (volunteer in the Park).*

The test fence enclosed subject animals in new territory, and therefore it could be argued this created an immeasurably different circumstance than a barrier across accustomed travel routes. Critics credibly insist a *bonafide* electric fence barrier in the Mauna Loa control unit still hasn't been tested. My curiosity about this question remains unsatisfied. However, if the enclosed goats hadn't escaped so easily we could justifiably have repeated the test or even installed a test fence on Mauna Loa.

All of the escapees dispersed less than 2 km from the enclosure. The females stayed together, and the males dispersed separately. They were monitored for 4 to 6 weeks, using the radio transmitters. Finally they were shot.

Materials cost $5,085 (U.S.), including solar electricity panel and fence chargers, and excluding shipping costs. Crews of 4 to 8 workers took 293 hours to construct the enclosure. Because most of the posts had to be set in drilled holes, and because the workers were not accustomed to installing electric fences, I estimate the time required to complete this project was about 30 percent longer than normal. Costs for comparable Type III galvanized, 130 cm-high wire mesh fence with tee-type steel galvanized posts would be $6,200. Experienced park crews could install such a wire mesh enclosure in 240 hours. Therefore material and construction costs of electric fencing do not offer outstanding advantages in our circumstances.

In National Parks, however, aesthetic qualities of fences must be considered. The required fence would be located along a distant but highly visible park boundary, which crosses open lava fields in a frequently viewed and photographed section of the Mauna Loa volcano. A wire mesh fence would present an obvious linear and textural intrusion on an otherwise pristine vista, unless the gray galvanized wires were tinted brown or black. An electric fence would be invisible at a distance greater than 1 km if the white posts could be colored.

Park managers have a low tolerance for goats, because of the detrimental impact they have on the fragile subalpine ecosystem of the Mauna Loa section of the park. We intend to eradicate them. Since we still are not certain the free-roaming goats of Mauna Loa will accept electric wires as barriers, we will install traditional wire mesh fences, despite cost and aesthetic disadvantages. Wire mesh fences are certain to be effective and will continue to be used until a better alternative is available.

Acknowledgements. I thank A. Kikuta, H. Hoshide, L. Katahira, and other wildlife management staff of Hawaii Volcanoes National Park for fence construction and animal handling support. I also thank C. Stone, D. Okita, B. Marlin, and T. Gavin for their support.

Taylor is a Resource Management Specialist at Hawaii Volcanoes NP.

Literature Cited

Smith, B., P.S. Leung, and G. Love. 1986. Electric fencing design pages 169-198, in *Intensive grazing management: forage, animals, men, profits. The Graziers Hiu, Haw. 169-198.*

Taylor, D. and L. Katahira. 1988. Radio telemetry as an aid in eradicating feral goats. Wildl. Soc. Bull. 16:297-299.