From the Field

Foot snares: an effective method for capturing African lions

Laurence Frank, Dairen Simpson, and Rosie Woodroffe

Most ecological and behavioral research on large African carnivores has been conducted on protected populations in national parks, where individual animals are habituated to vehicles and readily approached. Habituated lions (*Panthera leo*) can be individually recognized through natural markings such as whisker spot patterns (Pennycuick and Rudnai 1970), scars, and ear damage. If they must be handled for marking, radiocollaring, and biomedical sampling, they can usually be darted from a vehicle (e.g. Mills 1996). However, due to the rapid decline of predators outside protected areas (Woodroffe 2001), there is urgent need for management and conservation research on nonprotected populations. Persecuted carnivores become wary of vehicles, and capturing these animals with traditional methods is difficult at best, requiring a major investment in time and effort. Obtaining a meaningful and unbiased sample of animals may be impossible using such techniques. Further, traditional methods have significant drawbacks:

1. Cage traps (de Wet 1993) require a large team to transport, lions are reluctant to enter them unless the cages are baited with the lion's own kill, and captured animals sometimes destroy their claws attempting to get out. Leopards (*P. pardus*) enter them readily, but often destroy their canines and claws;
2. In some countries, steel leghold traps are considered inhumane and are illegal;
3. Mass capture by darting at baits (Smuts et al. 1977, Mills 1996) is best used in areas where lions are accustomed to vehicles and where it is possible to shoot wild ungulates for bait; those variables are often mutually exclusive.

Foot snares (Proulx 1999) have long been used to capture bears (*Ursus* spp.) and have been adapted for mountain lions (*Puma concolor*; Logan et al. 1999); tigers (*Panthera tigris*; Goodrich et al. 2001), lynx (*Lynx canadensis*; Mowat et al. 1994), foxes (*Vulpes vulpes*), and coyotes (*Canis latrans*; Shivik et al. 2000). In this paper we describe the use of foot snares to capture nonhabituated lions and other large African carnivores.

Study area

This work was conducted in Laikipia District, Kenya, a 10,000-km^2 semi-arid equatorial rangeland comprised both of commercial cattle ranches and communal grazing lands occupied by traditional Laikipiak-Masai pastoralists (Frank 1998). Although not formally protected, all native wildlife still occur in good numbers, and livestock depredation by large carnivores, particularly lions, is a major form of wildlife–human conflict. Although tolerance for predators in this area is remarkably high, many are killed following livestock depredation, and as a result survivors are largely nocturnal and wary of vehicles.

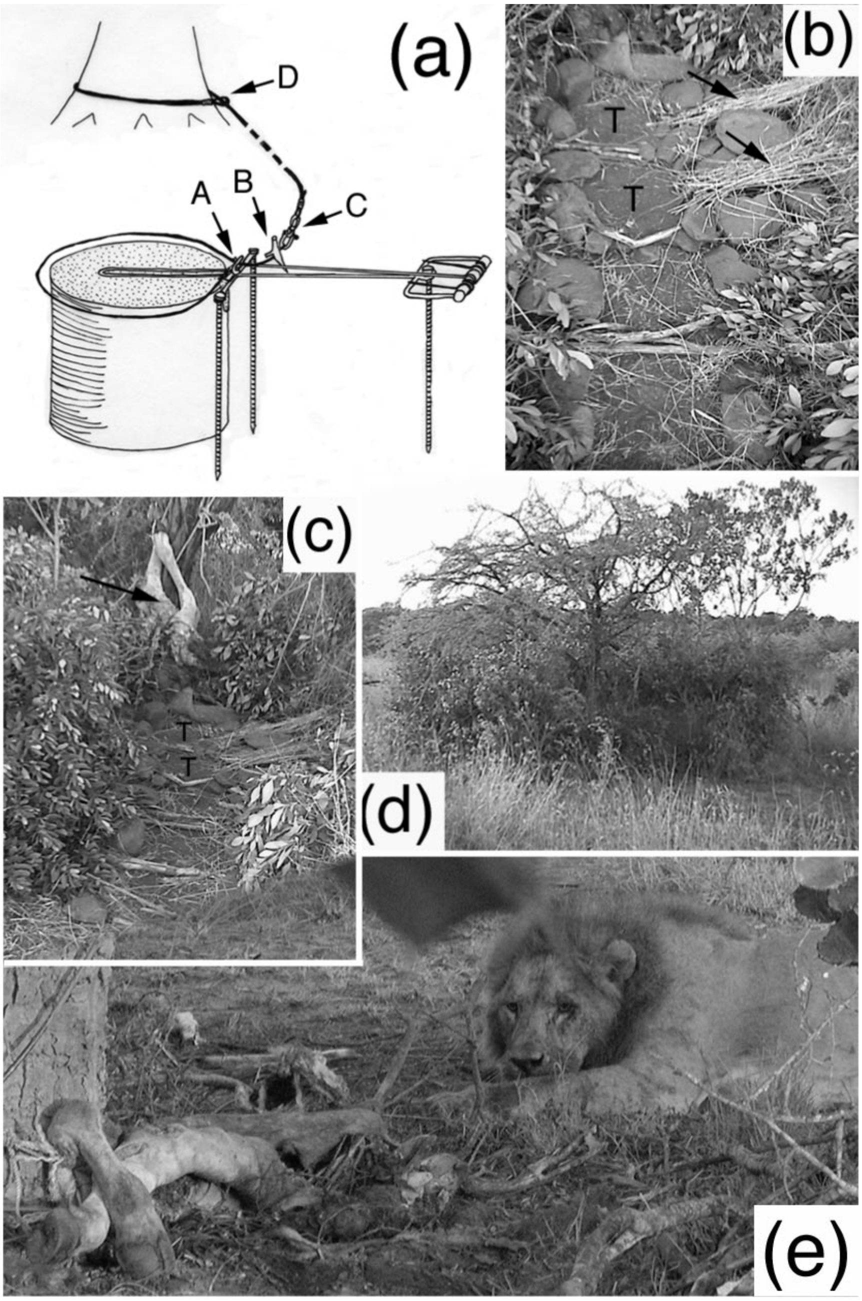

Figure 1. Foot snare set for lions: (a) placement of the trap in the ground, with the snare cable passing through the hook of the throw arm at A, pegged to the ground at B, connecting to an anchor via a heavy swivel at C, which was looped around the anchor tree at D; (b) the set concealed: traps were set along the path to the bait at points marked T; arrows indicate throw arms hidden by grass; (c) the path to the bait (legs of a lion-killed eland, indicated by an arrow); traps are set at points marked T; (d) bush enclosure around the bait tree permits access only along the path; (e) male lion captured in foot snare.

Materials and methods

The foot snare consisted of a 1-m-long, 5-mm-diameter wire cable with 5-cm loops at either end, made with cable clamps or swaged aluminum ferrules. A simple slide stop made of 19-mm angle iron keeps the sprung snare tight on the foot. Stainless-steel aircraft cable is preferable to galvanized cable due to its strength and flexibility; in much of Africa, however, it may not be widely available. The snare was fired by a spring-powered throw arm (Aldrich grizzly snare, available from North American trapping supply houses or an improved variant available from the United States Department of Agriculture [USDA], Idaho Wildlife Services State Director, 9134 Blackeagle Dr., Boise, ID 83709, USA). A 6–7-mm anchor cable was wrapped around a stout tree, and a heavy swivel between the snare and the anchor prevented the cable from kinking and "locking up" when an animal twisted it (Figure 1*a*).

With any trap, there is a possibility of an animal freeing itself, especially when approached by a person on foot. For safety, we placed sets where captured lions could be darted from a vehicle.

We secured a whole or partial ungulate carcass and the snare anchor cables to a stout tree that lacked low branches that a snared lion could climb. We then sited 2 to 5 snares next to the bait, placed where an approaching lion was directed to step. We anchored the throw arms to the ground (the USDA version requires 3 30–40-cm steel spikes) and dug a 20-cm-wide plastic bucket filled with foam rubber into the ground under the trigger pan, flush with the trigger. The snare was placed flat around the bucket; a peg secured the cable to the ground near the swivel, holding it in place when the trap was sprung. We then lightly covered the snare, trigger, and bucket with fine soil, and the throw arm with grass (Figure 1*b*).

We built a dense thornbush enclosure around the tree and bait, leaving 1 or 2 1-m-wide corridors leading over the traps. We placed sticks, pebbles, or elephant (*Loxodonta africana*) dung to guide the lion's foot placement onto the triggers, and large stones were placed on either side of the throw arms to prevent the animal from standing on them. Care was taken to ensure that the twigs and branches of the enclosure walls did not impede the action of the throw arms. A large carcass accommodates 4–5 snares, or can be cut in half for 2 sets, with 2 snares set at each, placed 50–100 m apart. Three people could build a pair of these in 2 hours. We set snares late in the afternoon to avoid attracting vultures to the sets.

We set snares at 3 kinds of sites. On 14 occasions we set at lions' own kills where sufficient meat remained that lions could be expected to return to feed. On 10 occasions we set at or near sites where lions were known to be in the vicinity, either because they had been sighted that morning or because radiocollared animals had been detected. On 5 occasions we set snares at "likely locations" where lions had been sighted regularly in the past or where recent tracks were found.

Where lions' own kills were not available, we used dead livestock or wildlife (usually zebra, *Equus burchelli*) carcasses as bait. On those occasions we dragged the baits for 200–500 m in one or more directions to create scent trails leading to the sets. At sunset, we parked the vehicle 200–300 m from the set, and used a 12-volt sound system to play sounds known to attract lions. The sound system consisted of tape recorder or CD player, 12-volt amplifier, and two 12-volt cone-type speakers, but a "boom box" portable stereo system could also be used if lions were known to be nearby. Most effective was a recording of a distressed buffalo (*Syncerus caffer*) calf, which we often followed with a female lion roaring; the latter may help discourage hyenas from coming in. Sounds of spotted hyenas (*Crocuta crocuta*) squabbling over a kill, often used to attract lions and hyenas (Mills 1996), might be less successful for attracting lions in areas of low lion density. We played the recordings for 10 minutes, at intervals of 15 minutes, turning the speakers 90° between playbacks.

Lions frequently appeared and were caught within minutes of starting the calf playback. If they were not captured immediately, traps were checked early in the evening. On occasion, however, we caught several cubs, with angry adults pacing the surrounding bush in the darkness. In those circumstances, the animals were left until dawn, as adults are less aggressive in daylight.

Handling

We immobilized carnivores with medetomidine (0.03–0.04 mg/kg; available at 10 mg/ml as Zalopine, Orion Pharmaceuticals, Finland) and ketamine (2–3 mg/kg, concentrated to 200 mg/ml), delivered with a Daninject rifle (Daninject, Børkop, Denmark). Each animal was routinely injected with amoxicillin prior to release. We reversed medetomidine anesthesia with atipamezole (Antisedan, Pharmacia Animal Health, Kalamazoo, Mich.) about an hour after darting.

We assessed injuries visually and by palpation; all trapping personnel were highly experienced, and had each captured hundreds or thousands of North American, European, or African carnivores.

We measured capture success as the proportion of attempts on which one or more lions were caught; we also report the number of animals caught on each attempt.

Cost

Cost per snare varied between US$33–50, depending upon whether we used Aldrich or USDA throw arms, and galvanized or stainless steel cable; throw arms are reusable, but cables required replacement after catching an animal. A swaging tool for aluminum ferrules cost about $100. The sound system cost several hundred dollars.

Results

Capture Success

We set foot snares on 32 occasions, leading to the capture of 27 lions on 18 occasions (0.84 lions per set-night). The mean number of lions caught on each successful attempt was 1.5 (SD=0.62, range 1–3).

Foot snares set at known locations of lions had the highest capture rate, with 13 attempts leading to the capture of 15 lions on 10 occasions (1.15 per set-night). Capture success was slightly lower when snares were set at lions' own kills (14 attempts, 10 lions caught on 7 occasions; 0.71 lions per set-night), and lowest when snares were set at "likely locations" (5 attempts, 2 lions caught on 1 occasion; 0.4 lions per set-night). Differences in trapping success (capture of one or more lions) between the types of sites did not attain statistical significance ($\chi^2=5.2$, df=2, $P=0.076$).

When foot snares were set at lions' own kills, there was no difference in capture success at wildlife ($n=6$) and livestock ($n=8$) kills, with one or more lions being captured on 50% of attempts. There was also no difference (Fisher's Exact Test, $P>0.999$) in capture success between sets constructed at known lion locations using wildlife bait ($n=4$ attempts, 75% successful) rather than livestock bait ($n=7$ attempts, 86% successful).

Lions escaped from foot snares on 4 occasions. Three of these (an adult female, a subadult male, and a small cub) escaped by pulling the captured foot out of the snare. A fourth lion (an adult male) broke the snare by pulling the end of the cable through the last cable clamp securing the lock, leaving all of the capture equipment still anchored to the tree. This last escape occurred when we approached the lion to dart it and was due to an inadequately tightened cable clamp.

By-catch of nontarget animals

Only 5 of the 32 attempts to capture lions failed to catch anything; other wild carnivores were usually captured when lions were not. By-catch comprised 5 striped hyenas (*Hyaena hyaena*), 5 spotted hyenas, 2 black-backed jackals (*Canis mesomelas*), and 1 cheetah (*Acinonyx jubatus*). On 2 occasions we captured hyenas (one spotted, one striped) at the same sets as lions (one adult female, one large male cub); none of these animals were injured through their proximity to one another or by other pride members. We captured 4 leopards in snares set specifically for them. We captured no ungulates, presumably because snares were set under trees, surrounded by cut bush, and in immediate proximity to a carcass.

With the exception of one leopard caught by a hind foot, all lions and nontarget animals were captured by a foreleg, usually at the wrist. We captured a few animals around the metacarpals; these "shallow catches" were thought to be responsible for the escapes, and can be largely avoided by setting a light trigger. Lions that responded immediately to the call-in tape were removed from traps within 15 minutes of capture, while those caught later at night may have spent up to 10 hours in the snares.

Trap injuries

No lions showed any injuries that could be seen or palpated, and no teeth were chipped or broken after capture in foot snares. Lions struggle little once caught; after a brief fight, they simply lie down. When traps were checked in the morning, most adults showed edema of the restrained foot, but in no case did the cable break the skin or even cause hair abrasion. In all cases, the animals put full weight on the foot upon recovering from anesthesia. Most were subsequently observed in the days and weeks following capture, and none were ever observed limping. One spotted hyena and the leopard caught by a hind foot had minor (1–1.5-cm-long) skin lacerations. Hyenas struggled more than lions and were more likely to experience hair abrasion, but we observed no serious injuries from foot snares. Nine brown hyenas (*Hyaena brunnea*) captured in foot snares as part of a separate study in Namibia showed no detectable injuries.

By comparison, one 8-month-old spotted hyena caught in an offset leghold trap had broken most of its milk teeth out of the jaw from chewing on the trap and had to be euthanized. Offset leghold traps also caused minor foot lacerations in 3 other hyenas (spotted and striped). Seven out of 18 leopards captured by ranchers in cage traps damaged their canines, ranging from chipped tips to 3 teeth broken off at the base.

The medetomidine-ketamine combination provided much smoother induction and recovery than the commonly used ketamine-xylazine or tiletamine-zolezepam (Telazol [Animal Health Group, AH Robins Co., Richmond, Va., USA] or Zoletil [Virbac SA, Carros, France]). It also allowed use of a standard 3-ml syringe. We encountered no drug-related complications during the immobilization of 79 lions, 24 leopards, 53 spotted hyenas, and 37 striped hyenas.

Discussion and Recommendations

Foot snares efficiently capture wary lions where traditional methods, cage traps, and free darting may be ineffective. Capture success compared favorably with other reported approaches to trapping felids (e.g., 5% success cage-trapping leopards in Kruger National Park, Mills 1996; 0.2–2% success foot-snaring tigers in Russia, Goodrich et al. 2001; 1 capture per 193 snare-days for mountain lions in New Mexico, Logan et al. 1999).

Importantly, foot snares produced no significant detectable injuries in lions other than transient edema. As with any leghold system, however, the snares must be checked frequently, and trees with low branches must be avoided so that a trapped animal does not end up hanging from the foot. By setting at night, possible problems of hyperthermia associated with drug immobilization during high daytime temperatures are avoided. By comparison, the wire-mesh cage traps typically used for predators in Africa (de Wet 1993) and commonly considered humane often result in serious damage: lions and especially leopards frequently break off canines and tear out some or all claws, even if only left in traps overnight. Obviously, an animal released with badly damaged teeth and claws is likely to have difficulty capturing prey and may be more likely to turn to hunting livestock (e.g., Rabinowitz 1986).

Foot snares are cheap, easily transported, and can be set by a single person if necessary. A large cage trap, on the other hand, costs several hundred dollars to construct, needs frequent repair, and requires a large team and a truck to move it. Foot snares suffer two main disadvantages: 1) As with any foot-capture system, they are nonselective: compared to drive-up darting or mass capture, one cannot easily choose which lion gets caught; and 2) large animals must be chemically immobilized for release. Thus, the capture team must be experienced and equipped with appropriate drugs and darting equipment. Nontargets up to the size of a striped hyena, however, can be released by restraining them with a catch pole.

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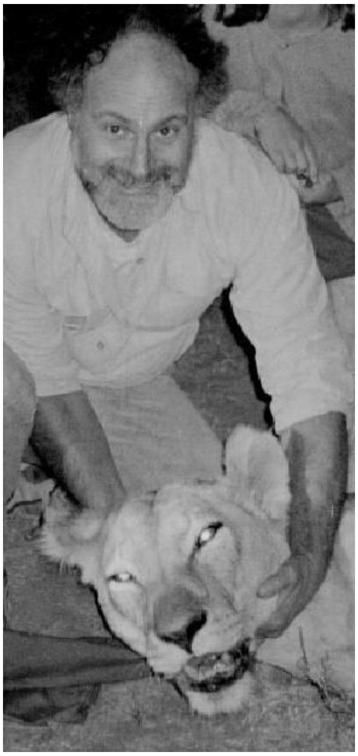

biology and management of large African predators outside protected areas. ***Dairen Simpson*** (right) is a professional trapper who has spent most of his career working for government agencies and research projects in California. Since 1998 he has been adapting North American trapping techniques for use in research on African carnivores in Kenya and Namibia. ***Rosie Woodroffe*** (far right) obtained her B.A. and D.Phil. from the University of Oxford, where she studied behavioral ecology of the European badger. She then spent four years at Cambridge University as a research fellow, first studying the banded mongoose in Uganda, then writing the International Union for the Conservation of Nature Action Plan for African wild dogs. Rosie was then a lecturer at the University of Warwick, and is currently assistant professor in the Department of Wildlife, Fish and Conservation Biology at the

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