A remote-controlled teleinjection system for the low-stress capture of large mammals

Andreas Ryser, Martin Scholl, Martin Zwahlen, Martin Oetliker, Marie-Pierre Ryser-Degiorgis, and Urs Breitenmoser

Abstract To recapture trap-shy Eurasian lynx (*Lynx lynx*) in Switzerland, we developed a selective and minimally invasive capture system (MICS). The device consists of a blowgun remotely controlled by means of 2 built-in cameras and a swiveling 2-way pan-tilt head. The blowgun is monitored and triggered from a distance of up to 400 m and is capable of shooting darts with high accuracy at distances of about 12 m. We darted lynx at kill sites, but the system generally can be used in any situation where a medium to large mammal stands still for a moment at a predictable distance. The MICS allows selection of specific individuals, thereby avoiding capture of nontarget animals. As there is no holding device, risk of injuries due to capture is minimized. Preliminary data on hematology and serum cortisol levels furthermore indicated that captures with the MICS induced less stress than captures with either box traps or foot-snares. We believe this new system opens new possibilities to capture cautious animals and provides considerable progress regarding animal welfare considerations.

Key words animal welfare, capture stress, capture techniques, carnivores, Eurasian lynx, *Lynx lynx*, selective capture, teleinjection system, trapping

The capture of wild animals is an essential part of many wildlife research projects. Trapping systems and procedures should be efficient, selective, and safe for animals. However, these conditions often are not fulfilled. Secretive medium-sized or large animals in dense and rugged habitat are particularly difficult to capture. Usual trapping methods typically include a holding device, which frequently leads to injuries and sometimes to the death of animals (Kenneth et al. 1999, Goodrich et al. 2001, Ryser-Degiorgis et al. 2002, Schmidt-Posthaus et al. 2002, Earle et al. 2003). Furthermore, most trapping systems are not selective, and captures of nontarget individuals or species result in casualties as well as damage to the equipment (Kenneth et al. 1999, Goodrich et al. 2001). In the case of chemical immobilization, the emotional status of the animal is an important factor to consider: injecting a drug into an animal in a state of alarm may produce effects opposite to those occurring in a quiet animal. Excitement can lead to metabolic changes and thus increase the hazards due to anesthesia (Fowler 1995). Both animal welfare considerations and cost-effective fieldwork call for a selective, low-risk, and stress-free capture method.

Address for Andreas Ryser: Coordinated research projects for the conservation and management of carnivores in Switzerland (KORA), Thunstrasse 31, CH-3074 Muri, Switzerland; e-mail: a.ryser@kora.ch. Address for Martin Scholl: Bernstrasse, 3267 Seedorf, Switzerland. Address for Martin Zwahlen and Martin Oetliker: Institute of Theodor Kocher, Freiestrasse 1, CH-3012 Berne, University of Berne, Switzerland. Address for Marie-Pierre Ryser-Degiorgis: Centre for Fish and Wildlife Health, Institute of Animal Pathology, University of Berne, Postfach, CH-3001 Berne, Switzerland. Address for Urs Breitenmoser: Institute of Veterinary Virology, University of Berne, Länggass-Strasse 122, CH-3012 Berne, Switzerland.

In the course of a 4-year study (1997–2000) of Eurasian lynx (*Lynx lynx*) in the northwestern Swiss Alps, we caught 43 individuals by means of traditional trapping techniques such as foot-snares and box traps (Haller and Breitenmoser 1986, Breitenmoser 1989, Breitenmoser-Würsten et al. 2001). Eurasian lynx are medium-sized carnivores of 17–25 kg, preying mainly upon small ungulates such as roe deer (*Capreolus capreolus*) or chamois (*Rupicapra rupicapra*), on which they usually feed for 3–5 consecutive nights. Although foot-snares set at fresh kills appeared to be relatively efficient, the capture success of 40% reached at the beginning of the study dropped to 28% at the end. According to our observations, this decline was mostly due to trap-shyness of previously caught animals, but also of young individuals having experienced a capture of the dam or of a sibling. Furthermore, foot-snares did not allow capturing a specific member of a family group. We were therefore looking for a device that would allow selective capture of lynx at kill sites. Since lynx are extremely cautious when returning to their kills, we wanted a system that would minimize human presence and alterations of the kill site. Also, the appliance needed to be safe for animals and humans. In addition, it had to be portable, weatherproof, and operative in below-freezing temperature. We describe the construction, operation techniques, and first experiences with a remote-controlled, minimally invasive capture system (MICS), and we discuss its potential.

Table 1. Main components of the minimally invasive capture system (MICS) used to capture Eurasian lynx in Switzerland. Numbers refer to text, and to Figures 1 and 2.

Number	Item	Brand or source
MICS box:		
1	Box	Phönix Mecano Komponenten AG, Stein am Rhein, Switzerland
2–3	Dart pistol (2) and 1-m × 11-mm barrel (3)	VARIO 1V, Telinject® GmbH, 67354 Roemerberg, Germany
4	Heating system	Self-made
5	Laser pointer	OLSH 503 P, Conrad, Solothurn, Switzerland
6	Spotlight with IR filter	SureFire, LLC, Fountain Valley, CA,USA
7	Daylight camera	Conrad, Solothurn, Switzerland
8	Low-light camera	Swiss Army
9	Pyroelectric infrared motion-sensor	Hygrosens instruments GmbH, Titisee-Neustadt, Germany
10	Car central locking	Magic lock, Waeco International GmbH, Emsdetten, Germany
External use:		
11	12V/27 Ah deep-cycle battery	Fortis Akkumulatoren AG, Dietlikon, Switzerland
12	950-cc CO2 tank with pressure control	MIGROS, Berne, Switzerland
13	2-way pan/tilt head	Self-made
14	Antennas with 2.3-GHz amplifier	Self-made
15	Control panel	Self-made
16	Sony video-walkman GV-D800	Sony Corporation, Tokyo, Japan
17	Trunk platform	Self-made
Additional equipment:		
	3-ml dart syringe with 1.5 × 20-mm collared needle	Telinject® GmbH, 67354 Roemerberg, Germany
	Dart transmitter	Telinject® GmbH, 67354 Roemerberg, Germany

Methods

Technical description of the system

The MICS consisted of a tele-guided blowgun, remotely controlled by means of 2 built-in cameras and a swiveling 2-way pan-tilt head. We used a commercial dart pistol (number 2 in Table 1, Figures 1 and 2), equipped with a 1-m barrel (11-mm diameter) (3) fitted into a plastic box (1) with dimensions of 2,450 × 3,950 × 120 mm. In this box we installed an adjustable laser pointer (5), an infrared lighting system (6), a standard daylight camera (7) and a low-light camera (8), a pyroelectric infrared motion sensor (PIR, Hygrosens instruments GmbH, Titisee-Neustadt, Germany) (9), and a heating system (4). Power was supplied by a deep-cycle 12V battery (11). A car central door locker (10) triggered the pistol. The dart pistol was connected to a small CO_2 tank (12) by a 2-m tube. The pressure could be tuned between 1 and 3 bar.

The entire box was mounted on a remote-controlled 2-way pan-tilt head (13), which could be fixed on either a tripod or a trunk platform (17, Figure 2). The MICS was commanded from a control panel (15, Figures 2 and 3), by either a 100-m cable or a wireless connection by a radio signal

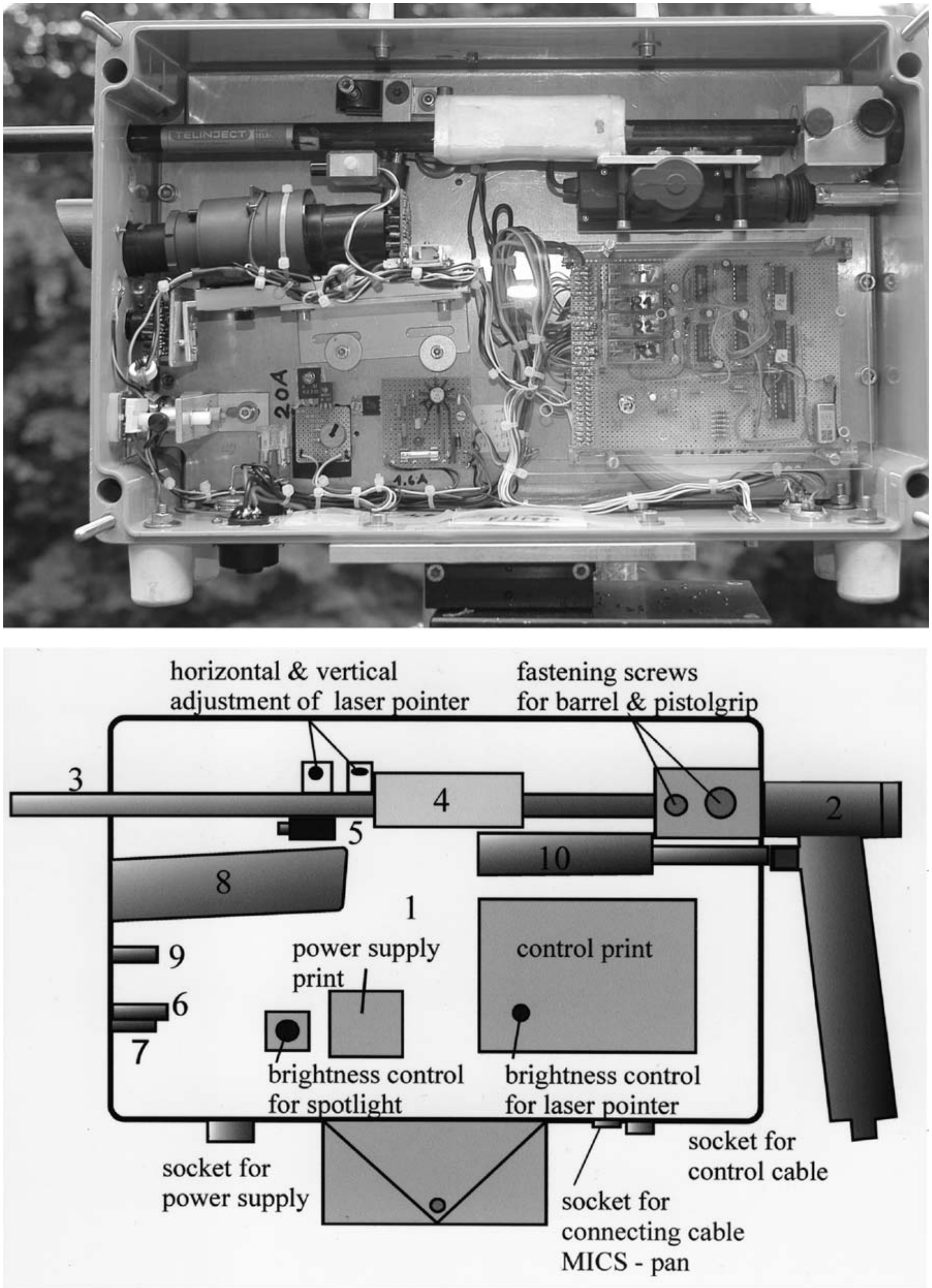

Figure 1. Details and diagram of the minimally invasive capture system (MICS) used to capture Eurasian lynx in Switzerland. Numbers refer to text and Table 1.

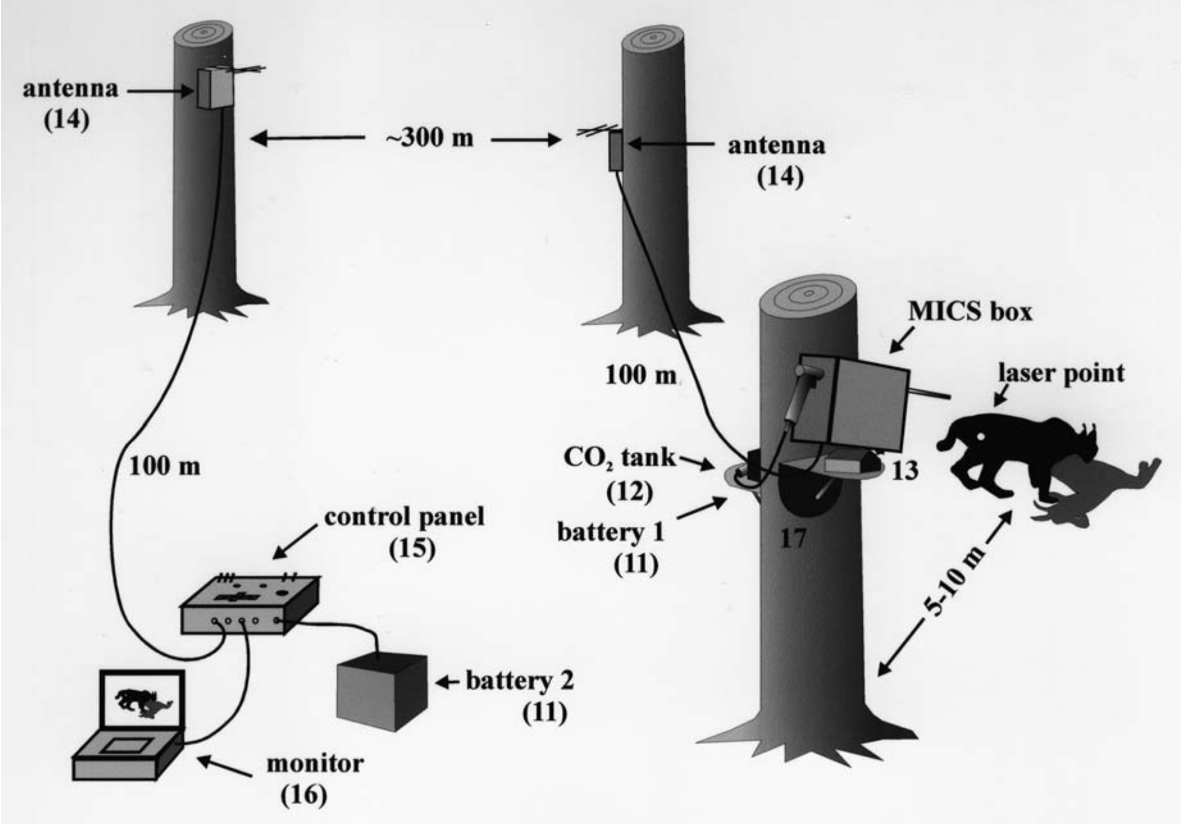

Figure 2. Schematic setup of the minimally invasive capture system (MICS). The MICS box can be connected with the control panel either by radio (as shown) or by a 100-m cable. In the latter case, the control panel was powered by battery 1. The drawing shows the MICS mounted on the trunk platform. Numbers refer to text and Table 1.

between 2 directional antennas (14) up to 300 m apart. The control panel allowed moving the pan-tilt head with the MICS in 2 axes (160° horizontal, 35° vertical), switching on and off the infrared lighting system and the laser pointer, switching between daylight and low-light cameras, and finally triggering the dart. The heating system automatically switched on when the temperature dropped below 5°C, keeping the barrel at 5–10°C to prevent freezing of the liquid drug in the dart syringe. Brightness of the lighting system (spotlight) and of the laser pointer required manual adjustment in the MICS box (Figure 1) according to the environmental conditions. As a monitor (16), we used a Sony video-walkman GV-D800 with a 4" LCD screen (Sony Corporation, Tokyo, Japan). This device also allowed digital video recording of the whole capture, allowing analysis of the animal's reaction during the test phase.

The effective price of the MICS was difficult to estimate from production of the prototype. We spent extensive time developing the electronic control, the data transmission, and the mechanical parts. The total value of the materials amounted to $4,000 (US). The most expensive parts were the low-light camera and the 2-way pan/tilt head ($400 US each), the antennas ($500 US) and the monitor ($1,200 US).

Setup of the system

Since Eurasian lynx could not be lured to a specific place, we installed the system at kill sites only. Ungulates killed by lynx were found by either radiotelemetry or snow tracking, or were reported by local people. Lynx usually return to their kills between dusk and midnight. Therefore, we set the device well before sunset. We placed the system 5–10 m away from the kill. To prevent the lynx from dragging the kill away, we attached it either with steel hooks to the ground or with a rope to a tree. Furthermore, we tried to direct the lynx to present its body in a lateral position with guiding sticks, dead trees, or stones. For security reasons, we did not use the MICS in the vicinity of cliffs, fast-

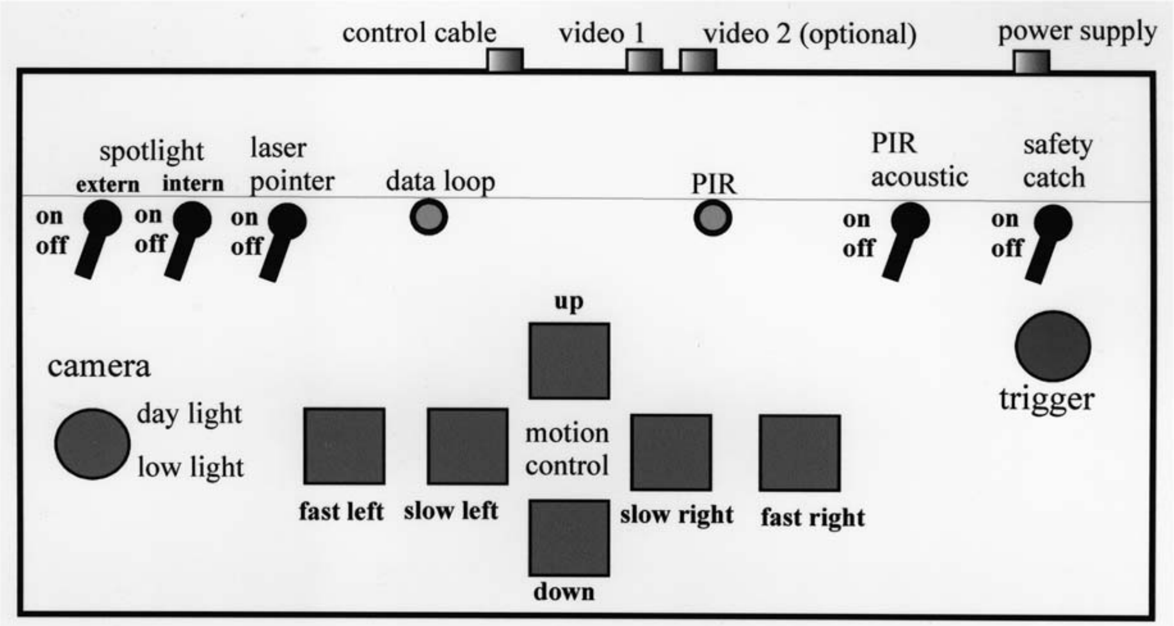

Figure 3. Diagram of the control panel. The pyroelectric infrared motion sensor (PIR) activates either a visual (PIR) or an acoustic alarm (PIR acoustic) when an animal approaches the kill site. The trigger button can only be pressed if the safety catch is off. The "data loop" lamp provides information about the data transfer quality between the MICS box and the control panel.

Figure 4. The minimally invasive capture system (MICS) mounted on a trunk platform 8 m from a dead chamois. Attached to the left side of the trunk are the battery and the antenna connecting the MICS with the control panel. The CO_2 tank is stored below the trunk platform.

running waters, or roads with heavy traffic within 200 m of the kill site. Outside forested areas, we mounted the MICS on a tripod; if trees were available, we used the trunk platform (Figure 4). We adjusted the accuracy of the dartgun for the chosen distance with a practice dart syringe loaded with the same amount of fluid as the dose foreseen. The dart had to hit the laser point in at least 3 consecutive trials to be considered accurate.

Chemical anesthesia

We anesthetized lynx with a combination of medetomidine hydrochloride (Domitor®, Orion, Corporation, Espoo, Finland) and ketamine hydrochloride (Ketasol®, E. Graeub, Berne, Switzerland), as it was used in previous studies in Switzerland (Jobin et al. 2000, Breitenmoser-Würsten et al. 2001). In our study, medetomidine (0.11–0.16 mg/kg estimated body weight) was applied with a dart syringe into the rear leg muscles. The needle had a collar to prevent it from bouncing back and falling off, and the dart was equipped with a radiotransmitter to locate the anesthetized animal if necessary. The subsequent administration of ketamine (3.2–5.5 mg/kg) injected intramuscularly by hand resulted in rapid onset of a reliable immobilization. During the anesthesia, we monitored the animals clinically and took routine blood samples. After handling, we antagonized the medetomidine with atipamezole hydrochloride (Antisedan®, Orion, Corporation, Espoo, Finland) at 0.56–0.77 mg/kg. Effects of atipamezole and the recovery phase either were observed directly from a hide or the movements of the animal were recorded by means of radiotelemetry. We left the capture site as soon as the animal walked away.

Blood analysis

An elevated count of neutrophils and a decreased number of lymphocytes are characteristic of a stress leukogramm (Latimer and Rakich 1989). To assess the stress experienced by lynx during capture, we compared the ratio of neutrophils to lymphocytes (N:L ratio) of animals caught with different systems. We drew blood with a vacutainer from the *Vena cephalica* into a sterile tube for biochemical analysis and into an ethylenediaminetetraacetic (EDTA) tube for hematology. We processed blood samples within 24 hours (Clinical Laboratory, Faculty of Veterinary Medicine, University of Zurich, Switzerland), and stored additional serum samples frozen (–20°C) for further laboratory analysis. We determined levels of serum cortisol later by chemiluminescence (Enzym-Labor Dr. H. Weber AG, St. Gallen, Switzerland). We collected blood samples in 6 captures with MICS, 5 with foot-snares and 6 in box traps. We took all blood samples approximately 1 hour (median = 60 min; range = 30–110 min) after medetomidine injection.

We compared the stress leukograms of lynx captured with MICS and 2 different trapping systems commonly used for capturing free-ranging lynx in Switzerland: 1) Foot-snares: 3 to 4 snares are set around a lynx kill (Breitenmoser 1989). To reduce stress and risk of injury for the animal, we monitored traps by means of a radiotransmitter. The lynx were anesthetized within 10–20 minutes after being caught. 2) Box traps: nonbaited 2-door box traps were placed on logging roads in steep terrain (Haller and Breitenmoser 1986, Breitenmoser-Würsten et al. 2001). Lynx following those roads would enter the trap and activate the trigger. We checked box traps at least twice within 24 hours by means of a radiotransmitter. Several hours may have passed between trapping and delivery of the anesthetic drugs.

Results

Installation and operation of the system

The MICS system weighed 38 kg and could be carried by a single person. A team of 2 or 3, however, proved to be most efficient. To set up the MICS properly, we needed approximately 1 hour. Depending on the terrain structure and distance to the potential hide, the signal was transmitted by either cable or radio. If visual contact between the 2 antennas was provided, successful data transfer over a distance of 500 m was possible. An additional 100-m cable either between MICS box and aerial or between aerial and control panel allowed us to use the MICS even in difficult terrain and dense vegetation. The precision of the pointer–pistol combination was high. We used a test syringe loaded with 3 ml water and fitted with a radiotransmitter to test the accuracy for 3 different distances (Figure 5). Mean divergence at 6, 9, and 12 m ($n = 150$) was 14.2 mm (±11.7 mm). The most extreme inaccuracy measured was 50 mm (at 9 m). Visibility of the laser point on the screen of the monitor in bright daylight was poor, and shooting during a sunny day was difficult. Therefore, as soon as the system was adjusted, we marked the spot of

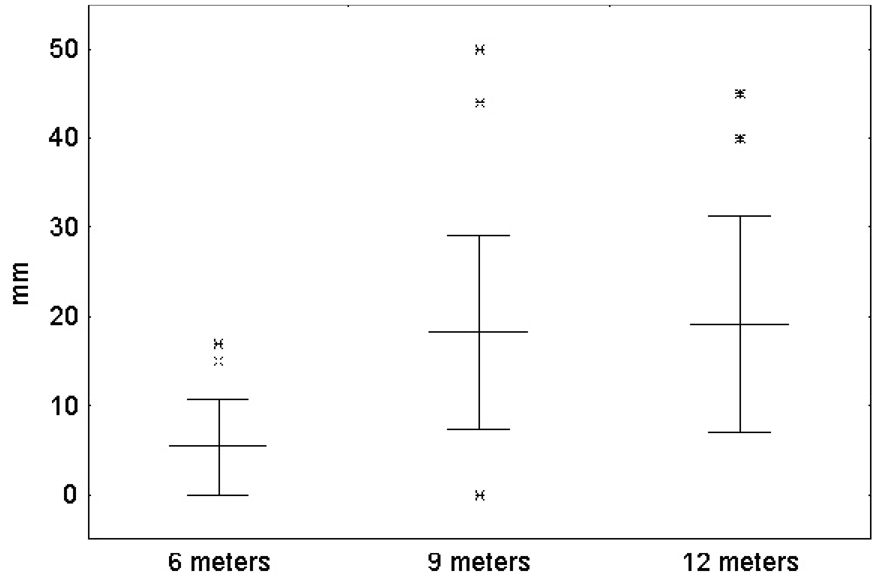

Figure 5. Mean (±SD and extremes) accuracy of shooting over 3 different distances with a thrust of 3 bar (*n* = 50 for each distance). The syringe was filled with 3 ml water and fitted with a transmitter (total weight = 16 g).

the laser point on the screen with a transparent sticker and a permanent marker. Since the camera and the pistol were placed in the same box, the spot of the screen and the barrel moved simultaneously. Marking the spot of the laser point on the screen of the monitor had the additional advantage that the laser pointer was not needed for aiming and shooting anymore, thus avoiding disturbance of the target animal. We set up the control panel in a shelter 300–400 m from the kill (e.g., in a vehicle, tent, or cabin). The motion sensor in the MICS signaled any movement at the kill site, so we did not have to constantly observe the monitor. The lynx were shot at 0.5–11 hours after the set-up of the system (*n* = 7; median = 2 hours). We followed the lynx's movements on the monitor and recorded them on tape. While the animal was feeding and presenting a flank, we directed the MICS to its caudal thigh muscles using the reticule on the monitor, and shot (Figure 6). To avoid possible injuries to the head and breast, we aimed only at the thigh muscles, although we believe that the precision of the device would allow shooting at smaller muscle areas such as the shoulder. After a hit, we waited for at least 10 minutes, then started locating the transmitter-equipped dart syringe by means of radiotelemetry.

The MICS, as a remote-controlled capture system equipped with a monitor, allowed us to shoot selected animals (e.g., a particular member of a family group [mother and kittens]) or individuals with or without radiocollar. Nontarget species visiting the kill, such as domestic cats, martens (*Martes martes* and *M. foina*), or foxes (*Vulpes vulpes*), were not disturbed and did not compromise the chance of capturing a lynx. So far we have used the MICS 7 times successfully for capture or recapture of free-ranging lynx (Figure 7).

Figure 6. A Eurasian lynx is scanning the immediate vicinity of the kill (roe deer lying in front of the lynx) while the minimally invasive capture system (MICS) was directed on its hind leg (note the laser point acting as guiding support on its left thigh and the additional infrared light source as it was used with a first prototype). Still frame of capture video in infrared.

Figure 7. Recaptured radiocollared male lynx. Note the syringe with transmitter sticking in the thigh muscle.

Behavior of target animals

Lynx approaching the kill (n = 11) showed no visible reaction toward the MICS. However, while lynx were scanning the immediate vicinity of the kill site, moving the MICS or switching on the laser pointer made them suspicious; one animal even took flight. After we marked the laser point on the monitor screen, the pointer was no longer needed for aiming, and this disturbance was avoided. While lynx were feeding, movements of the MICS caused no visible reaction. For careful aiming when the animal was broadside, we needed on average 37 seconds (range 8–59 seconds; n = 7). We did not attempt to shoot in 2 capture trials because the animals never presented themselves in a favorable position.

Analysis of the captures recorded on videotape showed that some lynx reacted to the sound of the firing dart pistol even before they were hit by the dart. As a reaction to the shot and hit, 4 lynx (1 adult female, 2 adult males, and 1 subadult male) fled from the kill site and were found in deep sedation, in 3 cases at 170 m and in 1 case at 200 m from the MICS. Three lynx (2 adult males and 1 subadult female) did not take flight and were lying immobilized at 10 m, 20 m, and 30 m from the kill site, respectively. In one early attempt to capture a lynx, the syringe bounced back twice when it hit the muscle because we at first used plain needles. After the first shot, this lynx stayed within 50 m and observed us reloading the MICS. After the second shot, it jumped up, but stopped at approximately 10 m and came immediately back to feed. All lynx caught with the MICS thus far were in deep sedation when we found them (i.e., after the administration of medetomidine alone) and could be safely handled even before the ketamine injection. None of the MICS-captured animals showed any detectable injuries, except the small puncture wounds caused by the collared needle.

Blood analysis

Lynx chemically immobilized with the MICS had a significantly lower N:L ratio (5.3 ± 2.7, n = 6) than lynx caught in box traps (26.0 ± 7.2, n = 6, P < 0.005, 2-sample t-test). This difference also was present for 2 individuals first caught in box traps (N:L ratio = 31.0 and 30.7, respectively) and recaught about 1 year later with the MICS (N:L ratio = 8.4 and 5.5, respectively). However, lynx caught with foot-snares had only a slightly higher N:L ratio (8.2 ± 2.2, n = 5) than those caught with the MICS (P = 0.079). Although less marked, the same tendency was present for serum cortisol levels: animals trapped with the MICS (n = 5) showed a lower average value (7.3 ± 2.7 mcg/dl) than those captured with foot-snares (8.7 ± 4.6 mcg/dl, n = 2) or box traps (9.7 ± 3.9 mcg/dl). These differences were not statistically significant.

Discussion and management implications

The MICS is very accurate and ensures a high rate of success in darting animals. The largely noninvasive handling at the kill sites allows capture of cautious or trap-shy animals. Although we have had no opportunity for capture trials with other species, we believe the MICS might be a valuable tool for capturing different medium-sized and large mammals. Nevertheless, some restrictions need to be taken into account when working with this capture device: 1) The target animal has to appear at a previously defined location, (e.g., baiting or feeding sites, kill sites, dens, or water holes); 2) Time is needed for accurate aiming; the focus animal has to stay motionless at a presumed distance for a certain time; 3) Besides the size of the animal, its potential reaction time must be considered when choosing the shooting distance of the MICS. Some lynx reacted so quickly that a distance of 12 m, while still close enough for accurate shots, might be too far; 4) The main advantage of the MICS—the lack of any holding device—includes potential risks, as the animal is free to move after delivery of the drug. Nearby cliffs, rivers, or roads may be dangerous to animals during the induction period of anesthesia; and 5) The lack of a holding device bears a risk to researchers searching for a potentially dangerous mammal with unknown status of anesthesia at night in dense-cover habitat. Therefore, we recommend the use of such a system to capture potentially dangerous animals only if those animals can be observed over a safe distance or approached in a vehicle.

All lynx caught with the MICS were in deep sedation when we found them. We never observed such a good response to medetomidine when we caught lynx in foot-snares or box traps. Since excited animals usually require higher drug doses (Kreeger et al. 2002), an unusually high level of immobilization for the same amount of drug can be indicator for a low-stress status. Comparison of hematological data and serum cortisol levels indicated that the MICS caused measurably less stress than box traps. The "good" values for the foot-snares were rather surprising, but they might be due to the fact that the animals remained in the snares for only short periods. Furthermore, the suitability of the considered blood parameters as an appropriate indicator for acute to peracute stress in Eurasian lynx should be assessed. Blood cortisol as a stress indicator has been controversial in other species (Kock et al. 1987, Morton et al. 1995). In addition, a larger data set would allow performing a multivariable analysis including parameters like age and sex. Nonetheless, the preliminary results indicate that the remote-controlled teleinjection system might considerably advance the stress-free capture of animals.

We believe that this new capture method substantially reduces the risk of injuries and might signal progress in animal welfare considerations. However, the system still needs improvement (e.g., regarding size and weight). Trials in different climatic regions and with species other than Eurasian lynx will bring new information concerning its suitability for other mammals and habitats. Furthermore, collection of additional data is necessary to draw conclusions concerning the stress situation induced by different capture systems.

Acknowledgments. The MICS was developed during a research project funded by the Swiss Agency of Environment, Forests and Landscape (SAEFL). Many thanks go to H. Lutz, University of Zurich, and his team for processing the blood samples. We are grateful to Ch. Breitenmoser-Würsten, A. Siegenthaler, and K. Sonderegger for logistic support, and F. Zimmermann, Ch. Angst, J. Laass, K. von Wattenwyl, and Ch. Willisch for their assistance in the field. Finally, we thank A. Moser of the Schweizer Fernsehen SF DRS for the use of his Sony video-walkman monitor, and J. Lewis for critical reading of the manuscript.

Literature cited

Breitenmoser, U. 1989. A footsnare for medium sized carnivores. Cat News 11: 20.

Breitenmoser-Würsten, Ch., F. Zimmermann, A. Ryser, S. Capt, J. Laass, A. Siegenthaler, and U. Breitenmoser. 2001. Untersuchungen zur Luchspopulation in den Nordwestalpen der Schweiz 1997–2000. KORA-Bericht Nr. 9, Muri, Switzerland.

Earle, R. D., D. M. Lunning, V. R. Tuovila, J. A. Shivik. 2003. Evaluating injury mitigation and performance of #3 Victor Soft Catch® traps to restrain bobcats. Wildlife Society Bulletin 31: 617–629.

Fowler, M. W. 1995. Restraint and handling of wild and domestic animals. Second edition. Iowa State University Press, Ames, USA.

Goodrich, J. M., L. L. Kerley, B. O. Schleyer, D. G. Miquelle, K. S. Quigley, Y. N. Smirnov, I. G. Nikolaev, H. B. Quigley, and M. G. Hornocker. 2001. Capture and chemical anesthesia of Amur (Siberian) tigers. Wildlife Society Bulletin 29: 533–542.

Haller, H., and U. Breitenmoser. 1986. Zur Raumorganisation der in den Schweizer Alpen wiederangesiedelten Population des Luchses *Lynx lynx*. Zeitschrift für Säugetierkunde 51: 289–311.

Jobin, A., P. Molinari, and U. Breitenmoser. 2000. Prey spectrum, prey preference and consumption rates of Eurasian lynx in the Swiss Jura Mountains. Acta Theriologica 45: 243–252.

Kenneth A. L., L. L. Sweanor, J. F. Smith, and M. G. Hornocker. 1999. Capturing pumas with foot-hold snares. Wildlife Society Bulletin 27: 201–208.

Kock, M. D., R. K. Clark, C. E. Franti, D. A. Jessup, and J. D. Wehausen. 1987. Effects of capture on biological parameters in free-ranging bighorn sheep (*Ovis canadensis*): evaluation of normal, stressed and mortality outcomes and documentation of postcapture survival. Journal of Wildlife Diseases 23: 652–662.

Kreeger, T. J., J. M. Arnemo, and P. R. Jacobus. 2002. Handbook of wildlife chemical immobilization. International edition. Wildlife Pharmaceuticals, Inc., Fort Collins, Colorado, USA.

Latimer, K. S., and P. M. Rakich. 1989. Clinical interpretation of leucocyte responses. Veterinary Clinics of North America: small animal practice 19: 637–668.

Morton, D. J., E. Anderson, C. M. Foggin, M. D. Kock, and E. P. Tiran. 1995. Plasma cortisol as an indicator of stress due to capture and translocation in wildlife species. Veterinary Record 136: 60–63.

Ryser-Degiorgis M.-P., H. Lutz, K. Bauer, H. Sager, A. Ryser, F. Zimmermann, Ch. Breitenmoser-Würsten, and U. Breitenmoser. 2002. Veterinary supervision of lynx translocation within the Swiss Alps. Pages 147–153 *in* Proceedings of the 4th scientific meeting of the European Association of Zoo- and Wildlife Veterinarians (EAZWV), 8–12 May 2002, Heidelberg, Germany.

Schmidt-Posthaus H., Ch. Breitenmoser-Würsten, H. Posthaus, L. Bacciarini, and U. Breitenmoser. 2002. Causes of mortality in reintroduced Eurasian lynx in Switzerland. Journal of Wildlife Diseases 38: 84–92.

Andreas Ryser (shown with an adult male lynx) is the field coordinator of the KORA's Swiss Lynx Project in eastern Switzerland and a Ph.D. candidate at the University of Berne, Switzerland. He graduated in zoology at the University of Berne and has been working with Eurasian lynx since then. His primary research interests include carnivore ecology and habitat use. ***Martin Scholl*** is a retired electronics engineer who has been working in the field of high-frequency technology for many years. As a consequence of his strong interest in wildlife conservation and technology, he became a pilot to assist the Swiss Lynx Project in radiotelemetry studies and developed most of electronic equipment needed in the framing of this project. ***Martin Zwahlen*** is an electronics technician working at the instruments and apparatus shop of the Theodor Kocher Institute, University of Berne. He has been working for the Swiss Lynx Project for many years, assisting researchers in the development of electro-technical equipment such as phototraps and capture systems. ***Martin Oetliker*** is a mechanic and the head of the instruments and apparatus shop at the Theodor Kocher Institute, University of Berne. He was involved in many tasks regarding technical requirements of the Swiss Lynx Project. ***Marie-Pierre Ryser-Degiorgis*** is the head of the Wildlife Group at the Centre for Fish and Wildlife Health, University of Berne. She graduated as a veterinarian and wrote her doctoral thesis at the University of Berne, and worked as a guest researcher at the Wildlife Department of the National Veterinary Institute in Uppsala, Sweden. Her major interests are diseases of wild carnivores and wildlife conservation. ***Urs Breitenmoser*** is the head of the KORA Group. He graduated in zoology at the University of Berne in 1983 and earned his Ph.D. in lynx ecology. He was then a guest researcher at the British Columbia University in Vancouver, Canada. Since 1993 he has been working at the Rabies Centre at the University of Berne. He is co-chair of the World Conservation Union (IUCN) Cat Specialist Group.

Associate editor: *Crête*