Sistema per la cattura di animali selvatici, particolarmente per la cattura di ungulati

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Radio-controlled up-net enclosure to capture free-ranging Alpine chamois *Rupicapra rupicapra*

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Abstract We used an enclosure trap with a lifting net to capture Alpine chamois (*Rupicapra rupicapra*). The trap was activated by remote radio-controlled electromagnets powered by photovoltaic modules. The up-net trap had considerable advantages over mechanical methods described in the literature for the capture of chamois. During 36 capture sessions, we captured 50 chamois, or 1.39 animals per session. Capture success was 96.2% of the average of 1.4 animals that entered the trap during a capture session. Mortality was 2%, and another 2% of the captured chamois was injured. There were no known postrelease capture-induced pathologies, and the capture effort was 1.7 man-days per chamois. The trap allowed to select specific target animals and to capture sex–age classes (particularly kids and their mothers) that are normally difficult or impossible to capture. It could be set off from a distance; it only required about 4 h to assemble and could be operated by as few as two people.

Keywords Mechanical capture · Mountain ungulates · Alpine chamois · Radio-controlled up-net · *Rupicapra rupicapra*

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Introduction

Live captures of Alpine chamois (*Rupicapra rupicapra*) are challenging because of its steep habitat and the long flight distance, which rarely allow use of dart guns, especially in hunted populations (Hamr 1988). Consequently, many capture programs rely on mechanical methods, including box traps (Berducou 1993; Delmas 1993), foot snares (Struch and Baumann 2000), drop nets (Jullien et al. 2001), descending nets (Hansen et al. 1993), and drive nets (Berducou 1993; Meneguz et al. 1997). Most of these methods, however, have severe limitations in efficacy, selectivity, risk of injury for captured chamois, capture of nontarget species, and substantial manpower needs (Schemnitz 1994). None of these methods allow the regular capture of kids, which has relied on hand-capture of newborns with the aid of dogs (Jullien et al. 1994). To our knowledge, no study has been able to capture a substantial number of mother–kid pairs.

Here, we present a new mechanical capture technique called “up-net” that allows capture of all chamois sex–age classes. We also compare the new method with other methods used to capture this species.

Materials and methods

Study area

We captured chamois in two locations on the Italian Western Alps, the Pellice valley (44°82′N, 7°23′E), and the Varaita valley (44°58′N, 7°19′E), at elevations ranging from 2,205 to 2,420 m above sea level. Both sites had open habitats with interspersed alpine pastures and rockslides, with slopes of 15 to 25° and a predominant south and southwest aspect. During summer, they were frequently visited by chamois, mainly groups of females, kids and yearlings, and occasionally males. Based on block counts carried out on a yearly basis, the estimated density of chamois was 8–9/km^2 in Pellice valley and 7–8/km^2 in Varaita valley. Both traps were also visited by roe deer (*Capreolus capreolus*), and the one in the Pellice valley by Alpine ibex (*Capra ibex*) and European mouflon (*Ovis aries*).

Methods

Captures were conducted between July and September 2006 and 2007. The up-net enclosure is a square (perimeter of 100–150 m; Fig. 1) made of aluminum/iron poles (3.5 m high) connected together by a steel cable (2.8–3 m high), an electrical circuit, and nets (3×50 m; 10-cm mesh, 4-mm-diameter nylon rope; Ziboni Ornitecnica, Bergamo, Italy). Nets were folded in a small trench along the perimeter of the frame. The bottom of the nets was pegged down so that animals could not escape after the nets were raised. The top side was connected with a nylon rope to a counterweight that was tied to an electromagnet on the top of each pole. When the electromagnet was activated, the counterweight raised the net using a pulley mechanism (Fig. 1). The separation of electromagnets required a 24-V voltage pulse supplied by a battery powered by two photovoltaic modules (12 V/10 W). Due to the limited power of the solar panels, we used electromagnets that required no electricity while on stand-by (Compact electromagnetic release unit®—Cooper Csa Srl, Corsico (MI), Italy). A remote control supplied by alkaline cells (type AAA LR03/1.5 V) was used to activate the electric impulse generated by the battery. The working range of the remote control was reported up to 1 km.

Salt blocks in the enclosures were used as baits (Mattfeld et al. 1972; Pedersen and Adams 1977). Traps were operated from inside a cabin about 500 m from the up-net. Observations and captures were limited to two 4-h periods, at dusk and dawn. The capture team included two to four operators.

Captured chamois were blindfolded and hog-tied. Each animal was measured, weighed, and marked with plastic ear tags. Lactating females and their kids were fitted with a radio collar with mortality sensor (Televilt-TVP Positioning, Lindesberg, Sweden). Finally, animals were released.

Each day when we attempted to capture chamois was considered as "capture session." We defined "exposure time" as the number of days from when the up-net was installed to when chamois first visited it; "efficacy" as the number of animals captured per capture session; "relative efficacy" as the ratio between efficacy and chamois density in the study area; "success" as the number of animals captured of those that entered the trap; "effort" as the number of man-days taken to capture an animal; "handling time" as the interval between physical restraint and release of a single animal; and "trapping time" as the interval between trap activation and the release of a single animal. We monitored released animals for a month to check for possible capture-related pathologies or mortality (Peterson et al. 2003).

Results

The up-net enclosure can be assembled in about 4 h by three experienced operators. During 36 capture sessions, 52 chamois (20 lactating females, 5 unlactating females, 15 kids, 8 yearlings, and 4 males) entered the trap: 50 were caught and 2 kids (3.8% of entered chamois) escaped. With the exception of kids, chamois usually entangled their hooked horns in the net and were then easily restrained. Kids were chased into the net. We captured eight mother–kid pairs. Exposure time averaged 8.3±3.3 days and ranged from 4 to 12 days. We caught on average 1.39 chamois per capture session (range 1–6), or 96.2% of those that entered the trap. The effort required was 1.7 man-days per animal; handling time averaged 7.2±2.6 min (range 5–9 min) while trapping time was 28±5.3 min (range 9–62 min). One adult female (2% of captured chamois) asphyxiated after becoming entangled into the net, and a male suffered a cutaneous wound after hitting a pole; this animal was treated with a single dose of long-acting antibiotic and released. No capture-related pathologies were observed.

One female was captured twice in the same year, and two chamois were recaptured the following year. In addition, 28 mouflon, 7 roe deer, and 72 ibex entered the traps, but they were not activated. No handlers were injured. The total cost of materials for a single trap, net excluded, is approximately 3,500.00 € (VAT included).

Discussion

Our trap differs from drop nets (Jullien et al. 2001) and from the descending-net trap described by Hansen et al. (1993) and Montané (1999) because up-nets are laid down

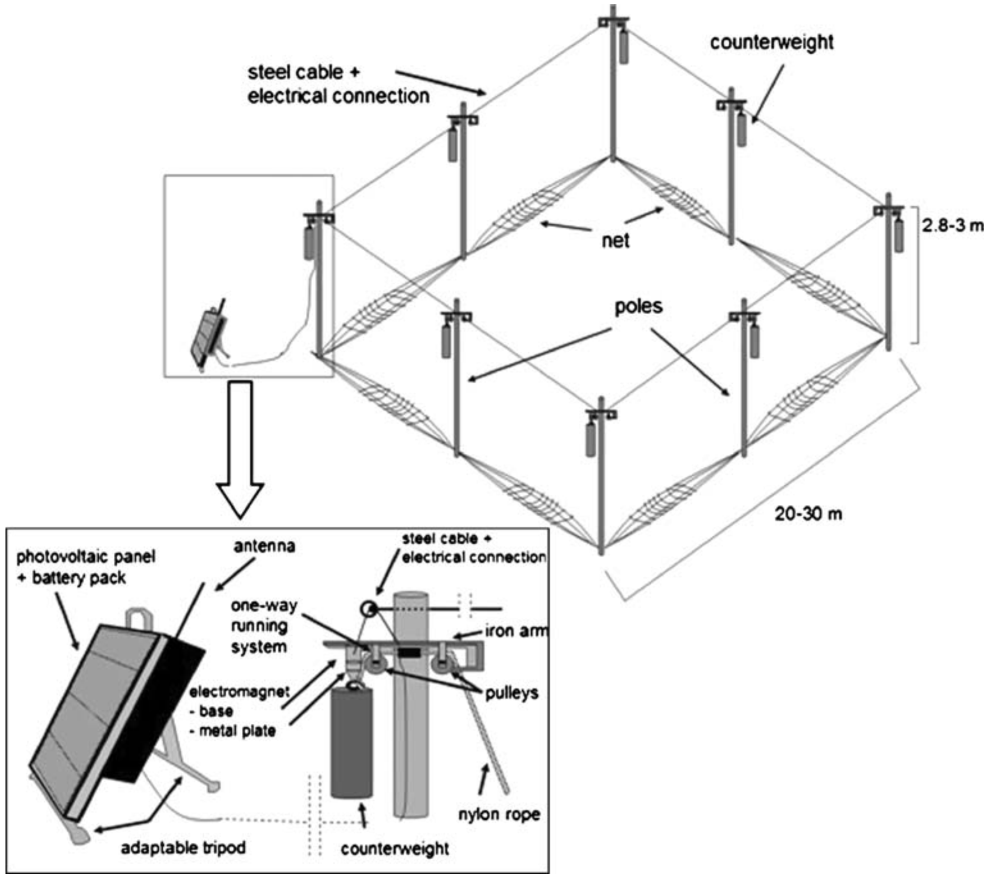

Fig. 1 Radio-controlled up-net enclosure. On standby: nets are folded on the ground; the two parts of the electromagnets are in attractive position; the counterweights are hanged on the top of the pole. At the electromagnets activation (power supplied by the photovoltaic panels): nets are raised by ropes connected to the counterweights through a pulley mechanism. In the enlarged box: the self-sufficient device for supplying energy (*on the left*); the electromechanical system to activate the raising of the net (*on the right*)

and then lifted, with the bottom preanchored to the ground. Two of 15 kids escaped by squeezing under the net where we had forgotten to anchor it. None of the captured chamois could jump over the 2.5-m net.

The radio control allowed us to trigger the trap from more than 500 m, which minimizes disturbance to the animals as they approach the trap. The self-sufficient method for supplying energy means that the enclosure can be used in remote areas.

Table 1 Efficacy and safety of selected methods used to capture free-ranging chamois, *Rupicapra* spp

Method	N. chamois captured	Chamois density (N/km^2)	Capture session	Efficacy	Relative efficacy	Success	% chamois injured	Mortality	Reference
Drop-net	99/101[a]		86	1.15		98%		0%	Jullien et al. 2001
Box-trap	164/188[a]		486	0.34		87.2%		4%	Jullien et al. 2001
Box-trap	1,043		3,066	0.34					Berducou 1993
Box-trap	45		770	0.06			4.4%	6%	Delmas 1993
Box-trap	355		570	0.62					Boillot 1993
Box-trap	268		2,154	0.12				4%	Houssin 1993
Drive-net	237	12–13	159	1.49	0.11				Berducou 1993
Drive-net	57		21	2.71				3.5%	Meneguz et al. 1997
Drive-net	10		4	2.5					Boillot 1993
Drive-net	114		171	0.67					Geraud and Nebel 1993
Descending-net trap	41/103[a]	30	14	2.93	0.10	39.8%		4.9%	Hansen et al. 1993
Up-net	50/52[a]	7–9	36	1.39	0.17	96.2%	2%	2%	Current study

Capture session, each day dedicated to capture; efficacy, number of animals captured per capture session; relative efficacy, ratio efficacy/chamois density in the study area; success, number of animals captured of those that entered the trap;

[a] Chamois that entered in the traps (captured, escaped, or released without handling)

Very few animals were killed or injured during captures. We observed no clinical signs of capture myopathy (Peterson et al. 2003), and no mortality was recorded in the first month postcapture.

Roe deer, ibex, and mouflon regularly entered the traps. Therefore, considering the high capture success for chamois, we suggest that the up-net holds promise to capture other species of small to medium-sized wild ungulates.

In addition to the mechanical methods listed in Table 1, free-ranging chamois have been captured with foot snares (Berducou 1993; Delmas 1993), dog-assisted hand capture of newborns (Jullien et al. 1994), and chemical immobilization (Gauthier 1993; Peracino and Bassano 1993; Bassano et al. 2004; Dematteis et al. 2008). Because few of these studies reported complete data on the efficacy, success, effort required, mortality, and injuries, direct comparisons of methods are difficult.

Capture efficacy varies according to the employed method, but it may also depend on the chamois abundance in the study area (Berducou 1993). Comparing therefore the relative efficacy in the situations where chamois density is known (Berducou 1993; Hansen et al. 1993), we note that the up-net presents the higher index (Table 1).

The capture success of the up-net (96.2%) is clearly more favorable than the one (39.8%) obtained by Hansen et al. (1993) using a descending-net trap. It could depend on the way the bottom of the net lies on the ground, respectively pegged down and flitting.

Drive-nets require substantially more manpower than the up-net and often lead to higher capture-related pathology and mortality (Meneguz et al. 1997; Kock et al. 1987). Drive nets are not selective, and their use is generally not indicated above the tree line (Cressonier 1981; Kattel and Allgredge 1991; Meneguz et al. 1997).

Although newborn chamois have previously been captured by hand (Jullien et al. 1994), the up-net trap allows the capture of mother–kid pairs. Knowledge of mother–kid links has several potential applications in fundamental and management studies (Powell and Proulx 2003).

A mortality of 2% was recorded using the radio-controlled up-net trap, on the low end of the range reported for other chamois capture methods (0–6%; Table 1). The short handling time of trapped chamois minimized the risk of injury (Schemnitz 1994; Powell and Proulx 2003). The use of chemical immobilization was not deemed necessary, limiting costs, permit requirements, and the need for veterinary assistance (Plumb 1999; Kreeger et al. 2002).

Management implications

Information gathered from wild animals is required for wildlife research, conservation, and management. Although much can be learned by indirect techniques, some information is collected only by capturing animals, for example, age determination, morphometric measurements, marking, or serum biochemistry. Capture of wild animals has potential to cause injury and to change normal behavior and physiology (Kreeger and Seal 1990; Proulx 1999). Consequently, researchers are challenged to design research and use methods that have minimal impact on study animals and remain safe for field personnel. Procedures that affect study animals adversely not only raise important ethical and animal welfare issues but also are likely to influence the animals' behavior or physiology in ways that affect research results (Powell and Proulx 2003). The capture method we proposed has produced considerable advantages compared with other techniques described in literature for the capture of chamois.

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Declaration The experiments in this study comply with the current Italian laws.

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