

A method to weigh free-ranging ungulates without handling

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and Giacomo Gobbi*

Abstract The number of studies that have documented individual body-mass changes in free-ranging ungulates is limited, due to difficulties and risks associated with repeated captures of wild animals. We tested a remotely controlled platform scale on Alpine ibex (*Capra ibex*) and bighorn sheep (*Ovis canadensis*). Animals were baited onto the platform scale with salt, and weights were recorded by observers with binoculars and spotting scopes. We found this method was both accurate and effective and suggest that it has application for other studies on ecology and management of wild ungulates.

Key words bighorn, body mass, *Capra ibex*, *Ovis canadensis*, scale, ungulates, weight

Individual body mass plays an important role in the life history and population dynamics of ungulates (Festa-Bianchet et al. 1997, Réale and Festa-Bianchet 2000). Low body mass has been associated with decreased survival (Festa-Bianchet et al. 1997, Loison et al. 1999) and decreased fertility (Albon et al. 1983). Consequently, many fundamental and applied studies of ungulates would benefit from accurate, multiple measurements of individual weights over one season and in different years. Repeated measurement of body mass of wild ungulates is difficult, however, normally requiring repeated capture and handling. Capture operations are expensive, time-consuming, and often involve some risks to animals. Capture-related mortality rates can be high. For example, in white-tailed deer (*Odocoileus virginianus*) mortality ranged from 2.0–20.7% (Haulton et al. 2001). Repeated handling of individuals can result in acute mortality from injury or long-term mortality from stress-related disease including capture myopathy (Chalmer and Barrett 1982, Fowler 1986, Beringer et al. 1996).

Because wild ungulates are difficult to capture, few studies document seasonal and long-term

trends in body mass for a population. One exception was the long-term study of bighorn sheep (*Ovis canadensis*) at Ram Mountain, Alberta, Canada, where animals were repeatedly captured in a corral trap (Festa-Bianchet et al. 1998). A method to repeatedly weigh wild ungulates without handling would be of great interest to researchers and managers. Here we present our experience using a remotely controlled electronic platform scale baited with salt.

Study areas

We developed the method in Gran Paradiso National Park (GPNP) in northwestern Italy (45°26' N, 7°08' E) and tested it on Alpine ibex (*Capra ibex*) in GPNP and on bighorn sheep in the Sheep River Provincial Park, southwestern Alberta (50°40' N, 114°35' W).

Elevation in the GPNP Alpine ibex study area (Levionaz) ranged from 2,300–3,820 m and included alpine meadows, rock cliffs, and glaciers. During the ibex census of September 2001, 94 males and 119 females were counted. Males aged 3–16 years

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were ear-tagged and radiocollared (23 in 2000 and 47 in 2001) as part of a long-term study of ibex in GPNP. Ibex were weighed in Levionaz from June–mid-September.

Elevation in Sheep River Provincial park ranged from 1,450–1,700 m, and the land was characterized by grassy slopes, cliffs, and aspen (*Populus tremuloides*) forest. A long-term study has monitored the bighorn population there since 1981 (Festa-Bianchet 1986, Jorgenson et al. 1997, Loison et al. 1999). Over 20 years more than 600 individuals were marked with ear tags, but little information on body mass was available (Festa-Bianchet et al. 1997) until 2000, when we began using the platform scale.

Materials and methods

At GPNP we used a Weigh-Tronix model “Diamond series” electronic scale (Weigh-Tronix, Fairmont, Minn., USA), with an advertised precision of 0.1 kg. We modified the scale, substituting a wooden platform (60 × 120 cm) fixed on a metal frame for the original metal platform (61 × 61 cm). Modification was necessary because initial trials suggested ibex were frightened by the metallic sound when they stepped on the original platform. The scale was connected by a 30-m cable to an electronic display suitable for outdoor use. A sealed, rechargeable lead battery connected to the display powered the system (Figure 1). We positioned the scale against rock walls in traditional saltlicks so that individual ibex had to step on the scale with all 4 legs to access salt. Access to salt was limited to one individual at a time by stones and logs (Figure 1). We placed a log on one side of the scale so the observer could clearly see whether ibex stepped on the platform with all 4 legs (Figure 2). Observers used either binoculars or spotting scopes from 50–60 m to avoid interference with animal activities.

At Sheep River we used a Weigh-Tronix model “AlloyWeigh” scale (50 × 120 cm, maximum load 455 kg, accuracy 0.5 kg), with an extra 70 m of cable for the display, allowing us to run the cable to the monitor, which was usually kept in a vehicle. Cost of the entire apparatus was about \$ 1,400 in 2000. Because bighorns could be found at a number of sites along a road, we used a mobile rather than a fixed platform. Unlike ibex, bighorns were tolerant of each other and readily licked salt while

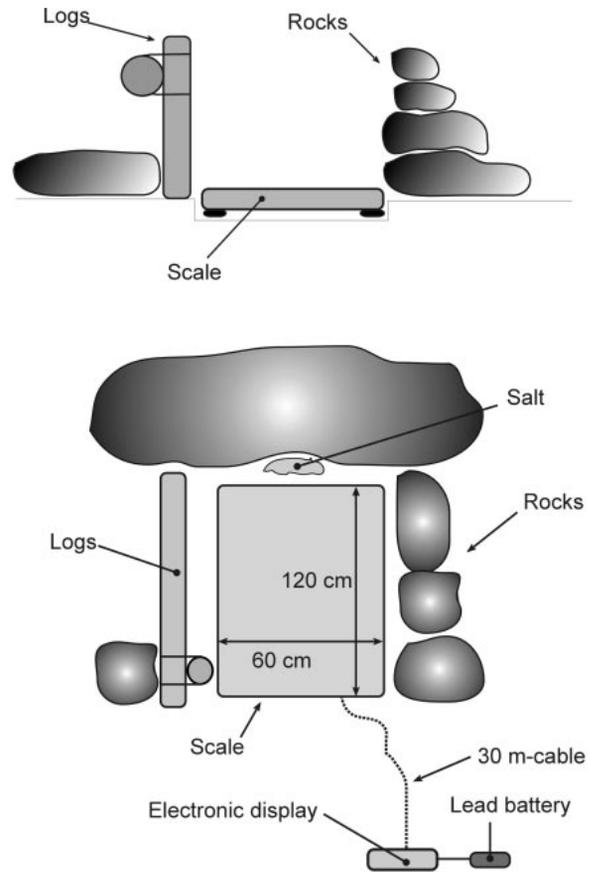


Figure 1. Schematic diagram illustrating the remotely controlled electronic scale used in Levionaz (GPNP, IT). Art by B. Bassano.

in contact with other bighorns. Consequently, we required a system to allow only one bighorn at a time on the scale. Using plywood and wood boards 5 cm deep and 10 cm wide (2 × 4), we built side panels 60 cm high and 120 cm long and placed large rocks on the base of the side panels so bighorns could not push them out of the way (Figure 3). The entire apparatus could be loaded in a truck and set up at a new location in less than 5 minutes. We placed small pieces of 2 × 4 under each corner of the scale to level it. Bighorns were not afraid to step on the metal platform; therefore, we did not modify the scale, using it as provided by the manufacturer. We installed the scale close to a group of bighorns and placed a salt block in front of it. In most cases we installed the scale along the road. When a bighorn stepped on the scale, an observer in a vehicle or on the ground read its tag number with binoculars, verified that all 4 legs were on the platform, and read the weight on the remote display. Side panels limited scale access to

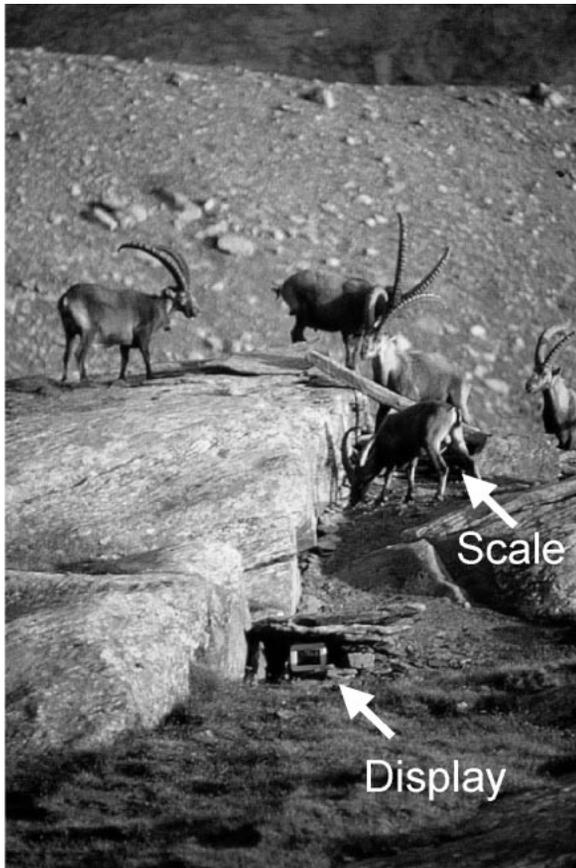


Figure 2. Adult Alpine ibex males are weighed at the scale in Leivonaz (GPNP, IT). Note the log on one side of the platform that prevents more than one ibex at a time from reaching the salt. A log was preferred to a rock wall because it permitted observers to see whether the subject had stepped on the platform with all 4 legs. Photo by A. von Hardenberg.

only one bighorn at a time and forced the animal to put all 4 feet on the scale. Because bighorns are highly gregarious, we did not place salt against an obstacle or several bighorns would have climbed on the platform together despite the side panels. Consequently, several bighorns could lick the salt with only one standing on the scale.

During summer 2000 some marked ibex were weighed ≤ 4 times in less than an hour. We used those repeated measures to assess the repeatability of weight estimations following the formula by Lessels and Boag (1987).

Results

The method provided accurate, repeated weight measurements of free-ranging ungulates without handling. During summer 2000, 181 ibex weight

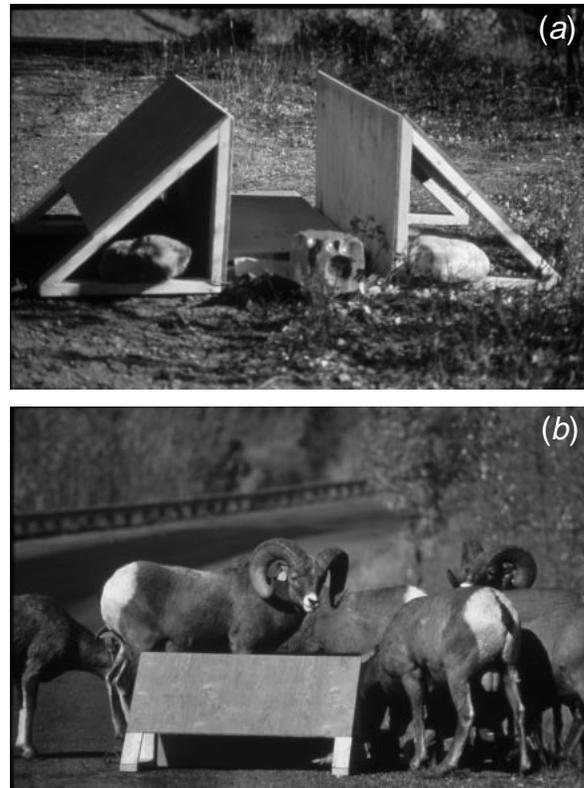


Figure 3. (a) The scale used in Sheep River Provincial Park, Alberta, and (b) weighing bighorn sheep at Sheep River Provincial Park, Alberta. Photos by F. Pelletier.

measurements were collected at GPNP. Of these, 140 were of unmarked individuals and 41 were of 14 different marked individuals weighed ≤ 6 times each (Figure 4). Of the marked ibex present in the study area during summer 2000, 78% were weighed at least once. During summer 2001 we collected only 97 weight measurements because the ibex spent much of their time at higher elevations (up to 3,200 m), away from the saltlick. Of 97 measurements taken in 2001, 76 were of 36 marked ibex representing 88% of all marked individuals present. Nineteen marked ibex were weighed at least twice (Figure 4).

Repeatability, estimated for ibex weighed repeatedly within less than an hour (2 times: 23 cases; 3 times: 7 cases; 4 times: 1 case), was extremely high ($F_{30,40} = 12\ 748$; $r = 0.999$). Measurement error was 0.01% of total within-individual variance ($MS_w/MS_a \times 100$).

At Sheep River success of the weighing system increased substantially over the years of study. In the first year, we obtained 24 weights from 18 marked bighorns representing 20% of the total

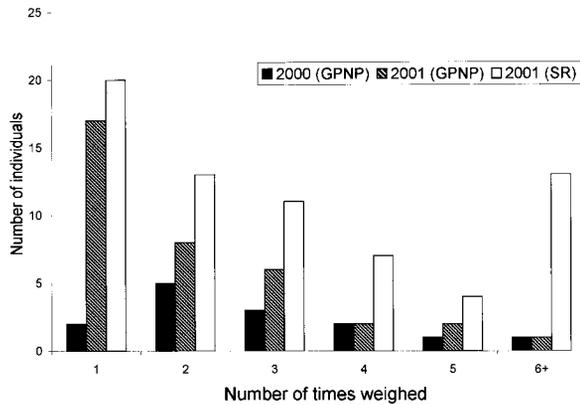


Figure 4. Number of times individual animals were weighed during summers 2000 and 2001 for marked Alpine ibex in Levionaz (GPNP, IT) and for bighorn sheep during 2001 in Sheep River (SR) Provincial Park, Alberta. "6+" indicates animals weighed more than 6 times.

number of marked animals. In 2001 we weighed 72% of the marked bighorns, obtaining 227 weights from 68 individuals (Table 1). In 2001 we collected at least 2 weights for 71% of weighed bighorns ($n = 68$), and we weighed some bighorns up to 9 times (Figure 4). We weighed up to 30 individual bighorns in one session.

At GPNP ibex came to the scale mostly in the evening from approximately 17:30 until darkness (around 21:30). Therefore, we intensively monitored the scale for about 4 hours every evening from the beginning of June until mid-September. We also collected weights at other times of the day whenever we saw animals near the scale, which was visible and within <1-hour walk from most of the study area. At Sheep River we started weighing sessions only when we found animals near the road. We spent about 4 hours a day from mid-September to mid-December attempting to weigh bighorn sheep.

Discussion

Scales on which animals step voluntarily have been developed for wild birds. For example, king penguins (*Aptenodytes patagonicus*; Lemaho et al. 1993) and dark-eyed juncos (*Junco hyemalis*; Vézina et al. 2001) have been successfully weighed this way. Dittus (1998) enticed toque macaques (*Macaca sinica*) to sit in a baited weighing pan hung in a jungle tree. Platform scales are commonly used to weigh domestic cattle and sheep. Wild ungulates kept in captivity are sometimes trained to step on scales in research enclosures. For example,

Table 1. Percentage of marked bighorn sheep weighed in Sheep River Provincial Park, Alberta, Canada 2000–2001. Total number of marked bighorns was 89 in 2000 and 95 in 2001.

Age-class	2000	2001
Ewes	29.4	74.3
Rams	0.0	70.8
Yearling females	0.0	100.0
Yearling males	100.0	100.0
Lambs	28.6	54.2

captive moose (*Alces alces*) have been weighed in this way in Alaska (Schwartz and Hundertmark 1993). To the best of our knowledge, however, this is the first time this approach has been used to weigh free-ranging wild ungulates. Our field tests indicate the method is both accurate and effective. Cost of the apparatus was reasonable for the data obtained, and instruments used were strong and should last many years. We feel the time and effort involved are justified by the quality and quantity of data obtainable.

This method is potentially applicable to many other species that could be attracted with baits. Besides Alpine ibex and bighorns, this method is currently being used to weigh mountain goats (*Oreamnos americanus*) at Caw Ridge, Alberta, Canada, and preliminary results are encouraging: 69% of 96 marked goats were weighed this way in 2001 (Y. Gendreau, Département de biologie, Université de Sherbrooke, personal communication).

We suggest this method has potential to provide useful information for a wide range of studies of wild ungulate populations. The technique, however, would be of limited use in the absence of marked or otherwise recognizable individuals, and we advise against using it to determine mean weights of different sex-age classes in unmarked populations because of the risks of pseudo-replication (Machlis et al. 1985). We found that some individuals were repeatedly weighed and appeared "salt-happy." Had they not been marked, this would have biased our results. Our experience is limited to gregarious species. Applicability of this method to territorial ungulates such as male Alpine chamois (*Rupicapra rupicapra*; von Hardenberg et al. 2000) is still to be investigated.

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