

# AUTOMATIC MONITORING SYSTEM FOR BROWN BEAR IN TRENTO, ITALY

GIANNI NICOLINI, Centro di Ecologia Alpina, 38040 Viote Monte Bondone (Trento), Italy, email: nicolini@cea.itc.it  
GIAMPAOLO AVANCINI, Istituto per la Ricerca Scientifica e Tecnologica, 38050 Povo (Trento), Italy, email: avancini@itc.it  
FLORIANO ZAMBELLI, Istituto per la Ricerca Scientifica e Tecnologica, 38050 Povo (Trento), Italy, email: zambelli@irst.itc.it  
CLAUDIO CHEMINI, Centro di Ecologia Alpina, 38040 Viote Monte Bondone (Trento), Italy, email: chemini@cea.itc.it

**Abstract:** In this century, the brown bear (*Ursus arctos*) population in the Alps has declined; a few individuals survive in the Adamello-Brenta Natural Park in Trentino, Italy. This population is at high risk because it lives in one of the most highly populated and rapidly changing bear ranges in the world. Management of the bear and its environment presupposes a wide knowledge of the structure and dynamics of its population. We tested a monitoring technique using automatic stations installed near 2 feeding sites, subjecting the bears to minimal disturbance. These stations use infrared cameras, scales, and systems to record or transmit images and data. Results of our 4 years of experimentation include 21 hours of film, and show the method to be effective. Using these stations, we demonstrate the lack of bears in sites previously thought more frequented by bears.

*Int. Conf. Bear Res. and Manage. 9(2):139-143*

**Key words:** automatic monitoring, brown bear, Italian Alps, population management, *Ursus arctos*.

In the last century brown bears occurred widely throughout the Alps. A remnant population survives in Trentino, in northern Italy (Fig. 1). Bears are also penetrating the Eastern Alps (Austrian and Italian) from Slovenia (Adamic 1987). In the past few decades, the once widespread Trentino bear population has been reduced to a 250 km<sup>2</sup> area in the northeast portion of the Dolomites of Brenta (Osti 1991). Most of this area is part of the Adamello-Brenta Natural Park. Irregular bear sightings, sometimes difficult to interpret, have been reported in less studied areas, away from the Park. It is very difficult to evaluate the local bear population and its increase or decrease over time. The historical bear hunting data shows a continuously shrinking area that was regularly frequented by bears, and even that area probably never had a high population density; about 2.2 bears were removed per year from 1870 to 1933 (Castelli 1935). The bear has been protected by national law since 1939, but poaching continued for about 30 years (Pedrotti 1972, Roth 1976). Population estimates made in the last 20 years suggested a population of 10 individuals, ranging from 6–8 (Daldoss 1981) to 14–16 (Osti 1987) or 15 (Roth 1987). Osti (1991) gave an average birth rate of 1.34 cubs/year for the period 1967–89.

The bear population in Trentino is considered at high risk of extinction for 2 main reasons: (1) their small number could render the bear subject to genetic drift, although there is no proof of this, and the population could be subject to negative stochastic events; and (2) Trentino has a relatively high human density (70 inhabitants/km<sup>2</sup>), and the area frequented by the bear is under pressure from tourism. About 137,000 summer visitors were recorded in 1991 on the roads leading into the Dolomites of Brenta. In the valley (Val di Tovel) leading to the area with the highest number of bear sightings, about 50,000 summer

visitors were recorded in the valley bottom (S. Flaim, Adamello-Brenta park, pers. commun., 1992). The bear area is also subject to forestry management for wood cutting and cattle grazing (693 head in 1992 in 9 reserved areas).

The bear in Trentino has biogeographical importance, but it is also an important symbol of environmental integrity for protection movements and for the tourism industry. Bear presence has been opposed by some segments of the population and their political representatives because it could restrict the use of natural resources. The protection of the bear has mainly focused on trying to conserve its habitat, with considerable eco-



**Fig. 1.** Location of the 2 monitoring stations near Spormaggiore (S) and Tuenno (T) in Trentino, Italy. The area with constant or recurrent presence of bears is given (dashed line) following Osti (1991).

nomic efforts by the Adamello-Brenta Natural Park (about \$350,000 in 1992). However, this alone will not avoid the local extinction of the bear in the presence of negative stochastic events.

Because of these threats to the bear population, the possibility of more intense management was evaluated. Traditional methods of monitoring bear density appeared to be affected by the extreme smallness of the population, and we avoided all techniques that would have disturbed the bear. We began a research project based on electronic technologies (Nicolini et al. 1991). Herein we present the results of this electronic monitoring on 2 feeding sites from 1989 to 1992 and discuss the possibility of using this method for population monitoring.

The research project was financed by the Servizio Parchi e Foreste Demaniali of the Autonomous Province of Trento, with the contribution of the Istituto per la Ricerca Scientifica e Tecnologica (ITC/IRST) of Trento.

## STUDY AREA AND METHODS

We installed control instruments in 2 pre-existing feeding sites known to be visited by bears. The first station was installed on 1 July 1989 near Spormaggiore; the second station, on 10 May 1992 near Tuenno. Both stations functioned until 31 August 1992. From 1 December to 31 March of every year the stations were inactive.

The site near Spormaggiore is a historical feeding site for bear monitoring that was activated in 1976. Each week, from March to November, it is supplied with bovine entrails. The feeding site is a small clearing near a trail in a relatively thermophilous and thick mixed-wood of Scotch pine (*Pinus sylvestris*), beech (*Fagus sylvatica*), hop hornbeam (*Ostrya carpinifolia*), and flowering ash (*Fraxinus ornus*), at about 500 m above sea level.

The site near Tuenno was a conifer forest of spruce (*Picea abies*) and fir (*Abies alba*), at 1,150 m above sea level. The station was installed at a feeding site known to be frequented by bears that had been irregularly supplied with bovine entrails for 2 years.

The automatic stations collected precise information on the timing of bear visits (date and hour), recorded images and sounds of the animals, determined biometric data, and gathered information about other species visiting the feeding sites. Images were collected locally by solid state video-cameras with a local video cassette recorder (VCR) or remotely by transmission to a recording center. The station was activated by pas-

sive infrared sensors and microwave motion detectors. As the bears were most active at night, both the video camera and recording systems were in black and white. The scene was illuminated by a panel of luminous diodes (LED) that emitted almost monochromatic light in the infrared range. A directional microphone was installed near the camera for sound recording. Near the Spormaggiore recording station, a 2 x 1.5 m weighing scale was buried. The weighing platform used a steel blade mechanism that eliminated oscillation and was completely hidden from the animal. The scale was located on the path that led to the food. The measured weight was superimposed on the images together with date and hour of the sighting. Energy for the instruments was provided by photovoltaic cells and storage packs. Tested accuracy for weight was  $\pm 5\%$ .

The video cameras, lights, and sensors were mounted on trees and camouflaged. The other instruments were housed in a buried cement container at the Spormaggiore site and in a fiberglass container installed on a platform among tree branches at the Tuenno site. The entire system was hidden from the bear. Data processing and storage was done through a personal computer and video recorders. This system allowed some frames of the animal image to be acquired and digitized to measure linear dimensions of the bear. The distance of the subject from the camera was assessed from reference markers on the ground.

Managing these stations required 1–2 monthly visits from April to November. The approximate cost of the complete station in Spormaggiore was about \$12,000 (1992 U.S.), while the station in Tuenno cost about \$7,000.

## RESULTS AND DISCUSSION

The station near Tuenno, although installed in an area thought to be frequented by bears, gave no results as of 31 August 1992.

At the feeding site near Spormaggiore we recorded about 21 hours of bear images from summer 1989 to summer 1992. Activations from bear visits were 11.3% of the total activations and 34% of the identified visits (Fig. 2). Other animals identified by video camera (mainly stone-marten *Martes foina*, badger *Meles meles*, red fox *Vulpes vulpes*, and dogs) were responsible for 17.8% of the total activations. Most activations (66.8%) did not result in animal images recorded by the video system. This was due to the high sensitivity set for the system, to avoid any loss of information. Human presence, including the visits to attend to the instruments

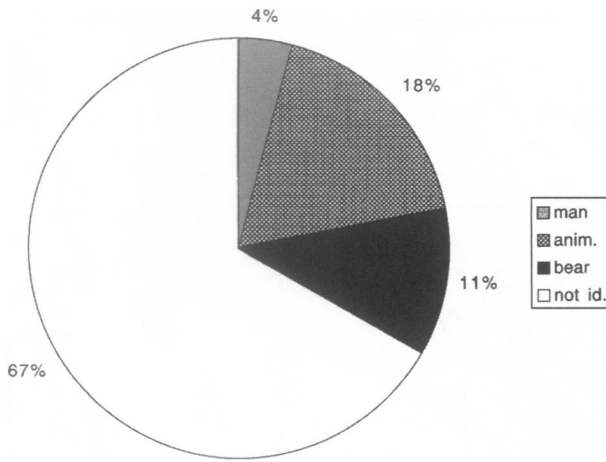


Fig. 2. Activations of the automatic station at the feeding site near Spormaggiore in Trentino, Italy, during 1991 and 1992: relative abundance of activations due to bear, other animals (anim.), man, and unidentified (not id.) causes.

and resupply food, and the bear presence are not significantly correlated on a daily basis (1990,  $r = -0.08$ ; 1991,  $r = -0.10$ ; 1992,  $r = -0.07$ ). During the first 2 years, it was necessary to repair many problems caused by climatic conditions (freezing, humidity, lightning) and by insects entering the instruments, but eventually the system was made more reliable and the resulting images were sufficiently clear.

The occurrence of bears on the feeding site was recorded from 19 July to 4 November in 1989, from 3 April to 27 October in 1990, from 4 May to 13 October in 1991, and from 4 May to 31 August in 1992. During the entire monitoring period (703 days), bear presence at the feeding site was recorded on 273 days. Maximum visits occurred in August and September (22 days with bear activity in both months). A decrease in the number of visits during June is evident in 1990 and 1991; the data of 1992 are affected by the lack of 1 bear (Fig. 3).

The images and the weight measurements allowed the identification of 2 bears, a male (OM1) and a female (OF1); their co-occurrence on the site was recorded twice. Brief images recorded twice suggest the presence of a third individual, but this was inconclusive. No other bear used the feeding site. OF1 was identified as the female captured and radiotagged in 1976 (Roth and Osti 1979) by an ear tag and by a characteristic rigidity in the left hind leg. This old bear, in bad general appearance and weighing about 30 kg after hibernation, did not appear in the recordings for 1992.

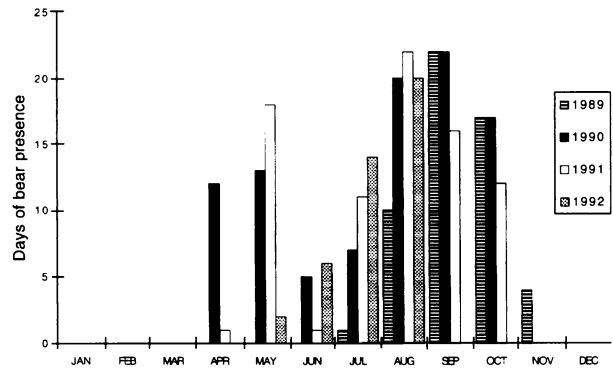


Fig. 3. Monthly days with bear occurrence at the feeding site near Spormaggiore in Trentino, Italy, recorded by the automatic station during the 4 monitoring seasons from 19 July 1989, to 31 August 1992.

The daily visits of the 2 bears were concentrated in a band from 1800 to 0600 hours. Visits to the site in full daylight were sporadic. Both bears showed a preference for the hours around midnight (Fig. 4). The microphone system recorded the voice of a bear (OF1) only once.

The weights of the bears were recorded by the buried scale. The 2 individuals showed a striking difference in body size (Fig. 5). The seasonal variation of weight for OM1 recorded during the monitoring period ranged from 130 kg (3 Sep) to 149 kg (3 Nov) in 1989, from 114 kg (26 Apr) to 160 kg (26 Oct) in 1990 (+40%), from 125 kg (12 May) to 156 kg (9 Oct) in

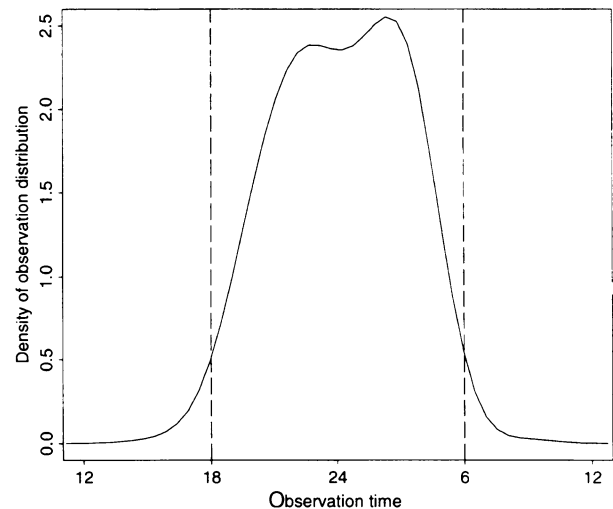
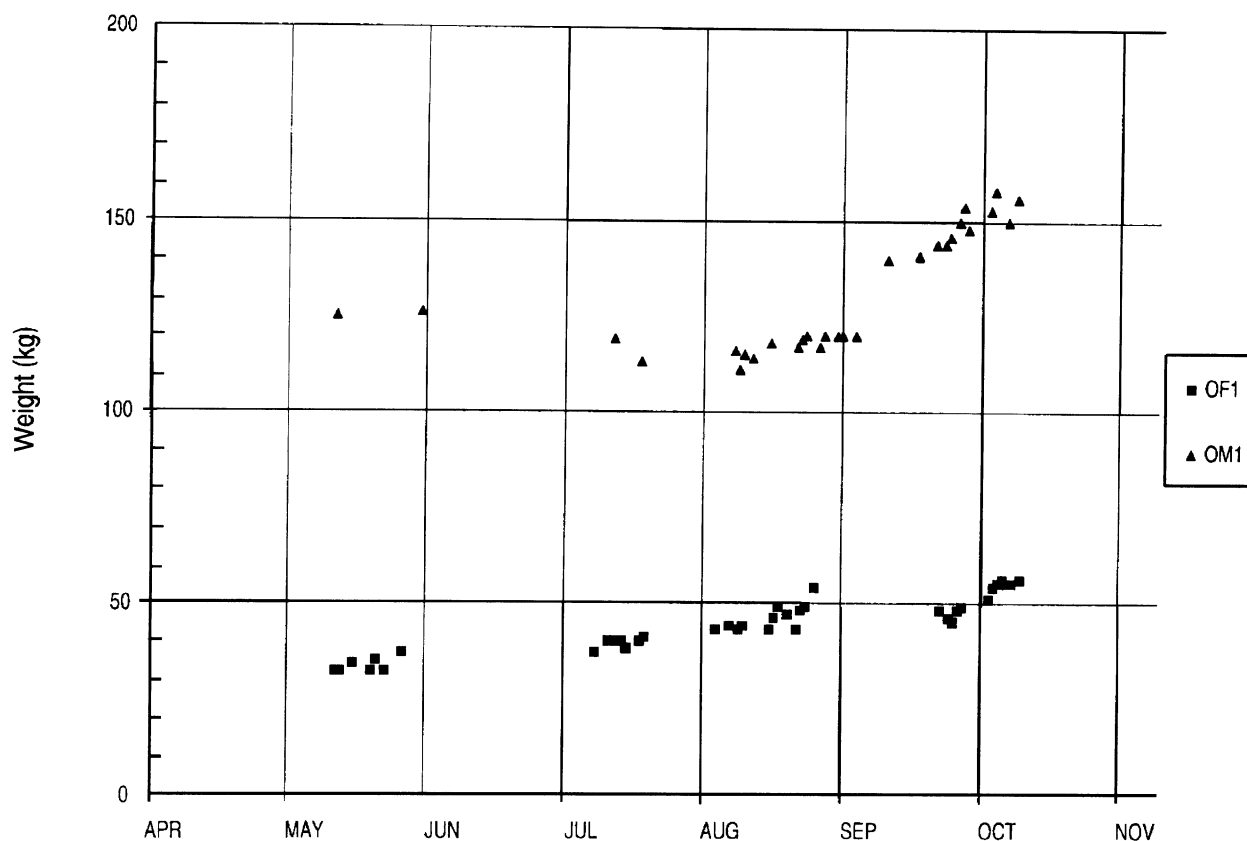


Fig. 4. Density of bear visit time distributions at the feeding site near Spormaggiore in Trentino, Italy, 1990-92: interquartile distance used for the density smoother bandwidth.



**Fig. 5.** Weights of bears OF1 and OM1 measured by the automatic station at the feeding site near Spormaggiore in Trentino, Italy, during 1991.

1991 (+25%), and from 110 kg (10 Jun) to 140 kg (31 Aug) in 1992 (+27%). The increase in body weight started around mid-August, while in spring and early summer the weight was constant or even decreased (Fig. 5). The difference between the last weight measured in fall and the first one the following spring indicated the weight decrease during hibernation. The recorded percent decrease for OM1 was 23% during the winter 1989–90, 22% in 1990–91 and 29% in 1991–92. The old female OF1 showed a higher range of weight variation (from 31 kg on 29 Apr to 60 kg on 12 Oct in 1990 and from 32 kg on 12 May to 56 kg on 10 Oct in 1991), with a dramatic loss of weight during hibernation. When captured, on 13 August 1976, OF1 weighed 51 kg. This specimen is thought to have not survived the 1991–92 winter.

## CONCLUSION

This monitoring method gave a sound assessment of bear presence, and precise biometric information on

individuals. It was limited in that it required finding a site regularly frequented by bears such as a feeding site.

Extension of the method to a population monitoring technique will require finding further sites visited by bears and equipping them with monitoring stations. Such sites are currently unknown. Placing stations randomly to survey the study area would require a high density of stations, and given the sparsity and shyness of bears, would present insuperable problems of cost, surveillance and management.

The bear population of Trentino, although very reduced, cannot be effectively monitored using just 2 stations. However, we think that the monitoring of bears at the 2 study sites was an effective tool for gathering information on the status of the bear population of Trentino. One of the sites was a long-term feeding site, traditionally and intensely used by bears (Osti 1987), and both sites were in the core of the occupied range of bears. A far higher number of bears was previously believed to frequent the feeding site near Spormaggiore, including females with cubs. In fact, this site had been

the main source of information on cubs in Trentino since 1972 (Cattani 1987). As for the bear population, no increase in density and birth rate has been recorded in recent years (Osti 1991), and no cub presence has been observed on the entire range after the activation of our stations.

Our results suggest that the current estimates of density and birth-rate for the bear population of Trentino are lower than previously estimated, and the sparsity of bears currently using the feeding site is a serious cause of concern for the survival of bear in Trentino.

## LITERATURE CITED

- ADAMIC, M. 1987. L'orso bruno in Slovenia: problemi e prospettive per la conservazione della specie. Pages 94–96 in *L'Orso nelle Alpi*. Università di Camerino, Camerino, Italy. (In Italian.)
- CASTELLI, G. 1935. L'orso bruno nella Venezia Tridentina. Assoc. Provinciale Cacciatori, Trento, Italy. 193pp. (In Italian.)
- CATTANI, V. 1987. L'orso bruno delle Alpi nel Trentino: situazione e prospettive. Pages 68–75 in *L'Orso nelle Alpi*. Università di Camerino, Camerino, Italy. (In Italian.)
- DALDOSS, G. 1981. Sulle orme dell'orso. Temi, Trento, Italy. 250pp. (In Italian.)
- NICOLINI, G., G.P. AVANCINI, AND F. ZAMBELLI. 1991. Sistema di monitoraggio automatico della popolazione di orso bruno del Trentino (*Ursus arctos* L.). Società Italiana Ecologia Atti 12:403–409. (In Italian with English summary.)
- OSTI, F. 1987. L'orso bruno (*Ursus arctos* L.) in Trentino: presenza e distribuzione nel quinquennio 1981–1985. Pages 75–83 in *L'Orso nelle Alpi*. Università di Camerino, Camerino, Italy. (In Italian.)
- . 1991. L'orso bruno nel Trentino. Collana Naturalistica 3. Edizioni Arca, Trento, Italy. 209pp. (In Italian.)
- PEDROTTI, F. 1972. Elenco di orsi bruni (*Ursus arctos* L.) uccisi in Trentino dal 1935 al 1971. Pages 225–240 in *Una vita per la natura*. Savini-Mercuri, Camerino, Italy. (In Italian.)
- ROTH, H.U. 1976. Status of the last brown bears of the Alps in the Trentino, Italy. *Int. Conf. Bear Res. and Manage.* 3:307–308.
- . 1987. La situazione dell'orso nell'Europa meridionale: evoluzione recente e prospettive. Pages 55–60 in *L'Orso nelle Alpi*. Università di Camerino, Camerino, Italy. (In Italian.)
- , AND F. OSTI. 1979. Prime esperienze di radiolocalizzazione di due orsi del Trentino. *Natura Alpina* 17:27–38. (In Italian with English summary.)