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SHORT COMMUNICATION

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Effects of radio-collars on behaviour of alpine chamois *Rupicapra rupicapra rupicapra*

Beatrice Nussberger & Paul Ingold

Nussberger, B. & Ingold, P. 2006: Effects of radio-collars on behaviour of alpine chamois *Rupicapra rupicapra rupicapra*. - Wildl. Biol. 12: 339-343.

Wildlife research often uses radio-telemetry to track habitat use and movement of individual animals. This method may cause suffering or changes in the behaviour of radio-collared animals. The behavioural data collected may not be representative of the wild population, if the transmitter affects the behaviour of the animals. We therefore assessed the effect of radio-collars on some aspects of behaviour of alpine chamois *Rupicapra rupicapra rupicapra* in the Swiss Alps. We also determined if collared animals were isolated from non-collared animals. We observed in 30-minute focal animal sampling periods the behaviour of nine female alpine chamois carrying a radio-collar for > 2 years and 40 non-collared females. Analysed behaviour included grazing (head down, head up), alert, scratching and licking. Furthermore, we compared distances between a non-collared female chamois and her collared and non-collared neighbours. Multivariate analysis revealed no significant difference in the behaviour of collared and non-collared chamois. For a non-collared chamois, there was no preference to be nearer to a non-collared than to a collared neighbour. We conclude that the tested radio-collars did not affect the behaviour of the chamois and that collared animals were not isolated from non-collared animals.

Key words: behaviour, effect, radio-collar, Rupicapra rupicapra, telemetry

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Wildlife research often uses radio-telemetry to track animal movement and behaviour. This method offers many advantages, as it is possible to 'observe' animals without having to actually see them. On the other hand, radio-

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telemetry implies capturing and manipulating animals, and the manipulated animals then carry the transmitter over an extended period of time (Gavin & Haas 1989). We can not exclude short- or long-term negative effects of radio-collars. If such effects exist, it would bring up some ethical and scientific problems: the animal could suffer, and, if the transmitter affects the behaviour of the animal, the animal would no longer be a representative sample of the non-collared population. To avoid such problems, guidelines about weight and form of the collars have been devised (Brander & Cochran 1969). It is generally assumed that, as long as these guidelines are applied, the effect of radio-collars on animals is insignificant. But is this assumption correct? Only a few publications on the effect of transmitters on behaviour are available, and most of them concern birds (Caizergues & Ellison 1998). Cousse & Janeau (1991) have summarised some studies dealing with the impact of capturing and manipulating ungulates immediately after releasing. There are very few studies about long-term effects of transmitters on ungulates. Generally, survival and reproduction rather than behaviour have been tested (Bank et al. 2000). Côté et al. (1998) have shown that collars do not affect female mountain goat *Oreamnos americanus* foraging, alert behaviour or social status. To our knowledge, no controlled studies about the effects of collars on the behaviour of chamois exist.

Since 1997, we have radio-collared chamois for the 'Tourismus und Wild'-project (Ingold et al. 2002). We wanted to know if the behaviour of the chamois was affected by the collar. In this paper, we consider whether the radio-collar affected the behaviour of female chamois by comparing grazing, alert, scratching and licking behaviour of collared and non-collared females. We chose these types of behaviour because they could be influenced by the radio-collar in many different ways. The weight of the radio-collar could incite the chamois to keep the head down. We therefore would expect grazing with head up and alert behaviour to be less pronounced by collared than by non-collared chamois. The collar itself could cause irritation of the neck, because of humidity accumulating between the skin and the plastic collar. This would increase scratching und licking behaviour by collared animals. On the other hand, the shape of the collar could decrease the mobility of the neck, and therefore decrease the rate of licking, which is a behaviour implying neck mobility.

We also determined if collared animals were isolated from non-collared animals. Non-collared animals may avoid collared animals because of their modified aspect.

Study area and animals

Observations took place in the region of Männlichen (2,343 m a.s.l.), near Wengen in the Bernese Oberland, Switzerland, during the winter of 2002. The study area, which is about 0.4 km^2 is composed of steep subalpine and alpine meadows situated above the timberline (at 2,000 m a.s.l.).

In 2001, > 150 alpine chamois lived in this region. Between 1997 and 2000, 30 chamois (14 females, 16 males) were captured using foot-snares, fitted with individually marked radio-transmitters and released. No narcotic drugs were used. The radio-collar, weighing 300 g (about 1% of a chamois' body mass) has a breaking point so that it will fall off after 4-5 years. In 2002, nine females were still carrying the collar; they had been wearing it for two years by this time (one female even carried it for four years). These females were 5-12 years old, and seven of them had a kid (Table 1).

Methods

To assess the impact of the radio-collars on the behaviour of chamois, we observed collared and non-collared females from the ridge of the Männlichen at distances of 40-600 m from the animals during 28 January - 28 April, 2002. Each of the nine collared females was observed repeatedly during 30-minute periods (see Table 1). We made 40 30-minute observations on collared and 40 on non-collared animals. Data were collected for five types of behaviour: grazing with head down, grazing with head up, alert, scratching and licking (Table 2).

The daily activity pattern of our collared chamois in winter was studied by Boldt (2003). Our collared females started their activity at about 08:00. After 12:00 they were moving downwards, towards the forest where we

Table 1. Age (in years), maternal status and number of observations for the nine collared chamois that were observed from 28 January to 28 April, 2002, in the Männlichen region, Switzerland.

Female	Age	With kid	Number of observations
Ardena	6	Yes	8
Aurora	7	Yes	5
Ciria	9	Yes	4
Falbala	5	Yes	6
Moja	12	Yes	4
Naomi	7	Yes	4
Samba	10	No	4
Solara	8	No	4
Ultima	9	Yes	1

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Table 2. Definitions of the behaviour observed among all female chamois that were observed from 28 January to 28 April, 2002, in the Männlichen region, Switzerland.

Behaviour	Definition
Grazing head down	Standing or slowly moving with head under the horizontal axis of the body. Head in contact with vegetation and showing jerky movements.
Grazing head up	Standing or slowly moving with head over the horizontal axis of the body. Head in contact with vegetation and showing jerky movements.
Alert	Standing with head upright over the horizontal axis of the body.
Scratching	Standing on three legs with one hind leg moving jerkily up and down along the neck.
Licking	Nibbling on the body with the muzzle.

lost sight of them. Their activity decreased from 18:00 (Boldt 2003). We therefore observed the animals between 07:00 and 12:00, when they were active and visible to the observer. To avoid biases caused by external factors, all animals were observed when the snow cover was not exceeding 75% of the area surrounding the chamois and under similar weather conditions (i.e. no precipitation). Observations of non-collared chamois took place either before or after observations of collared chamois, whenever possible within the same hour.

To determine if collared chamois were isolated from non-collared conspecifics, we estimated if the distance between a collared female and the nearest non-collared female was greater than the distance between this non-collared female and her nearest non-collared neighbour. This estimation took place whenever a collared female was seen for the first time during the day.

For each of the 40 observations of the collared and the non-collared chamois, we calculated the frequency and the mean bout duration of the different behaviours and the proportion of time spent on each behaviour. Non-collared animals could not be individually recognised. Therefore, we could not intentionally repeat measures on the same non-collared animals. We assume that we observed 40 different individuals. Because the collared individuals were observed repeatedly, we used the average for each individual in statistical and descriptive analyses.

Our null hypothesis was that collared individuals do not differ from non-collared animals concerning the recorded variables, i.e that each of them belongs to the group of non-collared individuals. We used identification analysis (Flury & Riedwyl 1988) as a special case of discriminant analysis. The resulting discriminant function, the identification function, is different for each collared individual and was calculated using GLM (Generalized Linear Models, logit link). The decision on whether or not the individual belonged to the group of non-collared individuals was based on a global test, i.e. Pillai's Trace (MANOVA with presence/absence of collar as independent variable), which is the most robust test in our case (Zar 1999). In the event of rejection of the null hypothesis, the responsible variables can then be identified using e.g. backward elimination in stepwise regression. Variables were the frequency and proportion of grazing with head down, grazing with head up, alert, scratching and licking. We transformed (square root and arcsin transformations) the data in order to achieve a normal distribution for each variable, so we could assume multivariate normality, which is required for significance testing.

To analyse neighbourhood relations, we applied a two-tailed binomial test.

For all statistical calculations, we used SPSS 10.0 (Chicago Illinois: SPSS Inc. 1999).

Results

Behaviour

None of the collared chamois were significantly different from the non-collared chamois, relating to the behaviours grazing with head down, grazing with head up, alert, scratching and licking (multivariate test: $P > 0.2$ for each female; Table 3).

Table 3. Comparison of each of the nine collared female chamois with non-collared individuals using identification analysis and Pillai's trace multivariate test (hypothesis df = 10, error df = 30). For nine collared female chamois, the behaviour did not differ significantly from the behaviour of non-collared chamois.

Female	Pillai's trace	P
Ardena	0.174	0.773
Aurora	0.103	0.961
Ciria	0.111	0.947
Falbala	0.328	0.202
Moja	0.045	0.999
Naomi	0.178	0.761
Samba	0.088	0.979
Solara	0.060	0.996
Ultima	0.164	0.811

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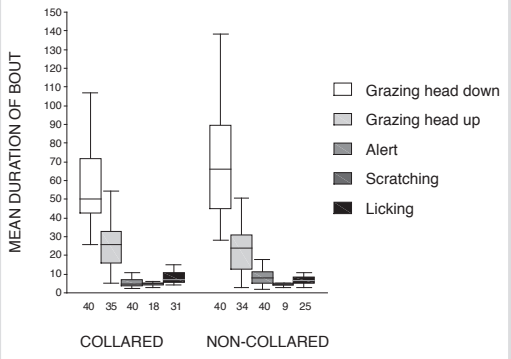


Figure 1. Mean duration of bout (in seconds) for each of the five observed behaviours for collared and non-collared female chamois. Medians, first and third quartile, minima and maxima are indicated. Figures below the x-axis give the number of observations.

The descriptive analyses showed the same result. The mean duration of bouts of each behaviour (i.e. grazing head down, grazing head up, alert, scratching and licking) within a 30-minute observation period was similar for collared and non-collared individuals (Fig. 1), and the number of bouts per observation period was also nearly the same for both categories (Fig. 2).

The chamois spent most of the observation time grazing head down (i.e. 80% of observation time by collared chamois and 79% by non-collared chamois). Grazing with head up represented 10 and 8% of the time budget of collared and non-collared animals, respectively. Alert behaviour represented 6 and 9% for collared and non-collared chamois, respectively. Licking represented 1% of observation time in both categories and scratching 0.17% in collared and 0.09% in non-collared chamois.

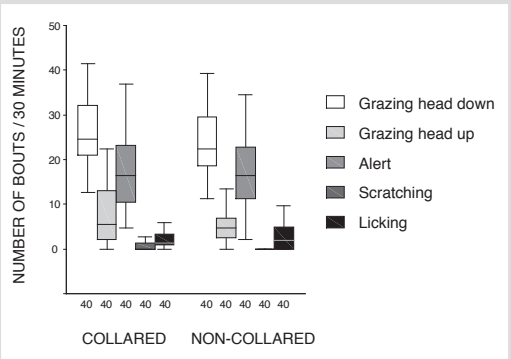


Figure 2. Number of bouts per 30 minutes for each of the five observed behaviours. Median, first and third quartile, minima and maxima are indicated. Figures below the x-axis give the number of observations.

During the rest of the observation time chamois were engaged in other types of behaviour (e.g. walking, urinating, marking and shaking).

Neighbourhood relationship

Non-collared individuals did not associate more closely with non-collared than with collared individuals (two-tailed binomial test: N = 150, P = 0.462).

Discussion

We found no significant difference between collared and non-collared chamois concerning the behaviours grazing with head down, grazing with head up, alert, scratching and licking. In addition, the radio-collars do not seem to have a repelling effect (at least not if the collar has been worn for an extended period of time), since non-collared chamois did not avoid the proximity of collared animals. Therefore the radio-collars used in our study did not affect, at least not detectably, the behaviour of female alpine chamois. Nevertheless, some trends appeared. Mean bout duration of the alert behaviour was slightly shorter for collared individuals than for non-collared individuals (see Fig. 1). The proportion of time spent on alert behaviour was slightly smaller for collared than for non-collared animals (6 vs 9% of observation time). This latter trend, although not significant, was previously found in mountain goats (Côté et al. 1998). The weight of the collar may incite the chamois to put the head down, which would result in a shorter alert bout. The number of observations containing the behaviour 'scratching' was twice as high in collared as in non-collared animals (N = 18 vs N = 9; see Fig. 1). So, it is possible that the collar irritated the skin on the neck, either because moisture accumulated under the plastic collar or because of the rubbing of the collar against the neck. Time spent scratching is of minor importance, since it represents < 1% of the time-budget. One female (Ardena) showed a tendency to graze with her head up. Her neck was emaciated and her fur was flat and even partially torn off. The collar could move all along the neck. When Ardena was grazing with her head down, her collar hit her lower jaw at each head movement. She may have tried to prevent this by grazing with her head up. This behaviour emphasises the importance of fixing the collar tightly around the neck. But it is not possible to prevent the neck from getting slimmer at the end of the winter due to emaciation caused by food shortage during winter and loss of winter fur. Minimising the possibility for a collar to move is therefore an issue that needs to be taken into account when attaching radio-collars.

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We are not aware of any previous studies on the long-term effect of radio-collars on chamois. The literature only mentions some observed but untested short-term effects. Capture and manipulation may have great consequences. Chamois can die because of the capturing method (Catusse et al. 1994). Pépin et al. (1989) observed a female chamois immediately after her marking and releasing. She showed an abnormal behaviour for at least 24 hours. There are also some findings about the impact of collars on the mother-infant bond just after the marking. Chamois kids can be separated from their mothers for a long time during and after capture. When they find each other again, the mother does not accept her kid right away (Richard, 1990, Bächler 1996). Furthermore, Bächler (1996) and Bamberg (1987) describe problems with reintegrating fallow deer *Dama dama* into the group. It seems that, after a certain delay, the behaviour of captured individuals reverts to normal, but this has yet to be studied.

Many aspects should be considered when assessing the impact of radio-telemetry on animals. They include type of trap, period of captivity and manipulation, weight and form of the transmitter in relation to the weight of the animal, and tightness of the collar around the neck. If we take these aspects into account when applying telemetry, it is possible to minimise the effects of radio-collars on chamois. In our study, there were no injuries or deaths, and the possible remaining effects of the collars were not serious. Thus, with the necessary precautions, radio-telemetry with all its advantages can be applied in chamois.

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