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Impact of supplementary feeding on winter home range size and activity patterns of female red deer (*Cervus elaphus*) in alpine regions

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Summary

From 2003 to 2007 we collared and tracked six red deer hinds with GPS-GSM collars in our 4.000 hectare study area at the Nationalpark "Hohe Tauern", Salzburg (Austria). We wanted to get a better insight to the seasonal deer migration from their winter to the summer ranges. A supplementary feeding station was run close to the border of the national park core area from November to April. Former observations suggested an exchange between the feeding station in winter and some specific open, treeless areas in high altitudes in summer. The collars were additionally equipped with activity sensors and so we drew a fine scaled picture of the habitat use in this alpine area and the activity patterns of deer during day, month and year.

The results showed that there was a strong deer migration from winter (feeding station) to specific summer ranges. The individual winter home range size (Dec. – Feb.) varied from 5 to 340 hectares, the deer were strongly bonded to the feeding station (altitude 1160 m). During the summer months (especially when they are hot and dry) the deer were trekking to habitats in high altitudes up to 2500 meters. In the Austrian study area the size of the individual summer home ranges (June – August) varied from 130 to 790 hectares. In the Swiss national park (without supplementary feeding) we got a remarkable different picture of habitat range. In winter the individual Minimum Convex Polygon (MCP) varied from 150 to 8990 hectares. In summer the MCP varied from 170 to 5350 hectares.

The main activity phases of the deer during the summer months were strongly linked to sunrise and sunset. In both populations (with and without supplementary feeding) the activity increased rapidly within a few days at mid April. In the Austrian population the activity maximum was reached in mid June, minimum at the end of December. During the winter months their daily activity was at a very low level except the phases of feeding through the local hunters. In the Swiss population the maximum was reached at beginning of June, the minimum at beginning of January.

Keywords

Red deer, GPS collars, activity, spatial use, supplementary feeding

Aims and duration

Results of a former long time running management project in our Austrian research area suggested an exchange between a supplementary feeding station in winter and treeless areas in high altitudes in summer. To optimize management strategies according to IUCN Guidelines (see poster "Managing red deer populations according to the IUCN requirements in the national park Hohe Tauern, Austria") we started the telemetry project to get better insight into the seasonal deer migration from their winter to the summer ranges. Within this project we focused especially on the effects of the 4 to 6 months lasting supplementary feeding on the spatial use and the activity patterns of female red deer.

The presented results refer to the first part of the telemetry project from 2003 until 2008, the second part of the project is still running.

Area of study

The Austrian study-area is located in the eastern part of the national park Hohe Tauern near the village of Bad Gastein. All collaring was done at in the "Koetschach-Valley", which is running from southeast to northwest at an elevation from 1,280m to 1,080m above sea level. The valley is surrounded by mountains up to 3,000m. A supplementary feeding station is run by local hunters near the border to the core area of the national park.

The Swiss data were collected in Il Fuorn in the Swiss National Park. The elevation runs from 1,400m to about 3,200m above sea level.

Methods

We used GPS-GSM collars from Vectronic Aerospace, Germany. The collars were equipped with a GPS device, a GSM module, a temperature logger and an activity sensor. The GPS schedule was set every three hours and after seven positions have been recorded the data was sent via SMS to the base station. The sent text file included date, time, longitude, latitude, height, temperature of the collar and several parameters describing the accuracy of the GPS position. Inaccurate GPS positions were filtered out (ADRADOS et al. 2003).

The activity sensor consisted of a two dimensional acceleration sensor and measured the acceleration every eight seconds. So only the physical activity was measured. The mean of five minutes was recorded and stored on board. This led to 288 values per day. To send this amount of values in text file via SMS was too energy and time consuming. So the activity data had to be retrieved directly from the collar via a link manager. The GPS data were processed with ArcGis 9.3 from Esri, the activity data were processed with Microsoft Excel. All collaring in Austria was done at the supplementary feeding station in the Kötschach valley.

Results

Up to now we collared six female red deer from 2003 to 2008 in Austria. We were able to retrieve several collars and renew them. Thus three females could be collared over more than one year. From three collars we could read out activity data so far.

The results of the GPS data showed a strong deer migration from the feeding station (winter) to the high altitude summer ranges and vice versa (see figure 1). Depending on the climate conditions (especially snow cover) the feeding started in November or December and lasted until the end of April. The deer were strongly bonded to the feeding station particularly from January until March. The individual minimum area of the calculated Minimum Convex Polygon in winter (December till February) was 5 to 340 hectares (Table 1). In April red deer started to explore areas aside of the feeding station where the snow has retreated. These are especially meadows at the bottom of the valley. The main migration to the high elevated alpine meadows took place in May. From June to September the deer stayed in the high regions. In summer (June till August) the calculated Minimum Convex Polygon reached 130 to 790 hectares. The deer started to migrate to the feeding station in October again.

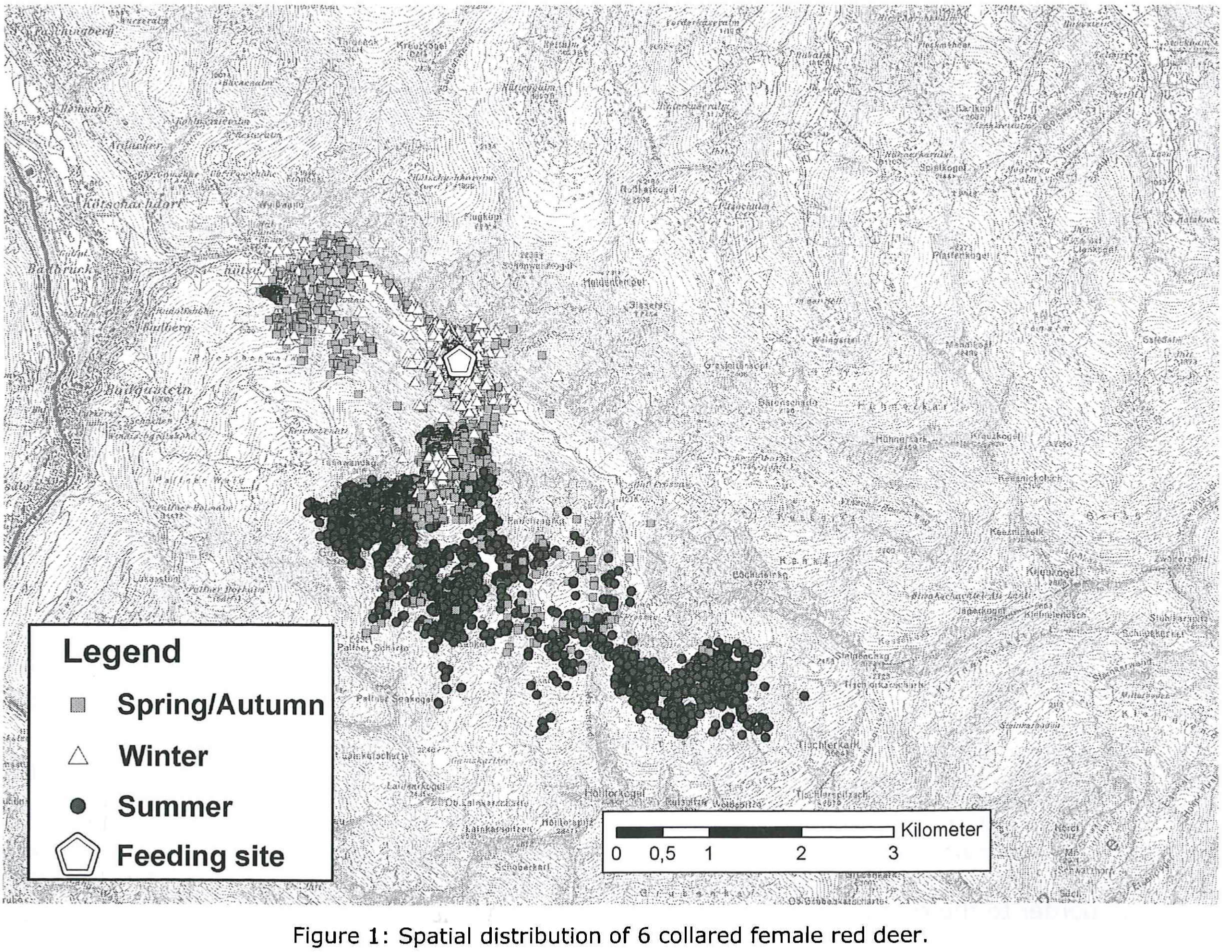

Figure 1: Spatial distribution of 6 collared female red deer.

In the Swiss national park (without supplementary winter feeding) in winter the individual Minimum Convex Polygon (MCP) varied from 150 to 8990 hectares. In summer the MCP varied from 170 to 5350 hectares. In spring and autumn, when red deer changed from summer to the winter habitat, the MCP size reached much higher amounts in the Swiss National Park compared with NP Hohe Tauern, where red deer was bonded at the supplementary feeding station (1160 m altitude).

Table 1: Seasonal range size of adult female red deer in the National Park Hohe Tauern (Austria) and the Swiss National Park (individual maximum and minimum area calculated with Minimum Convex Polygon method).

	NP Hohe Tauern (with suppl. winter feeding)		Swiss NP (without suppl. feeding)	
Number of collared female red deer	6		9	
	MCP size (ha)		MCP size (ha)	
	Min.	Max.	Min.	Max.
Winter (Dec. – Feb.)	5	336	150	8986
Spring (Mar. – May)	110	807	115	16897
Summer (June – Aug.)	128	792	172	5345
Autumn (Sept. - Nov.)	197	753	229	14576

The activity data (see Figure 2) showed differences between populations without supplementary feeding (Swiss National park) and with supplementary feeding (NP Hohe Tauern, Austria). As soon as the deer were present at the supplementary feeding station and accepted the feeding, they showed activity maxima during the late morning hours when the feeding took place. In this respective winter season the feeding started at the 2nd of November and was stopped at the 30th of April. The individual shown in Figure 2 came by at the 20th of December and stayed around the feeding site until the 12th of April. Within this timeframe the activity shifted to the morning hours, the rest of the day it stayed at a very low activity level. Within the non-fed Swiss population the collared individual showed no activity maxima during the morning hours in the respective time frame. The main activity phases took place in the early evening hours.

In both populations the activity throughout the rest of the year (spring to autumn) is similar. The main activity phases a strongly linked to the sunrise and the sunset. During daytime there is lower activity during the noon hours and constant level of activity during the night hours.

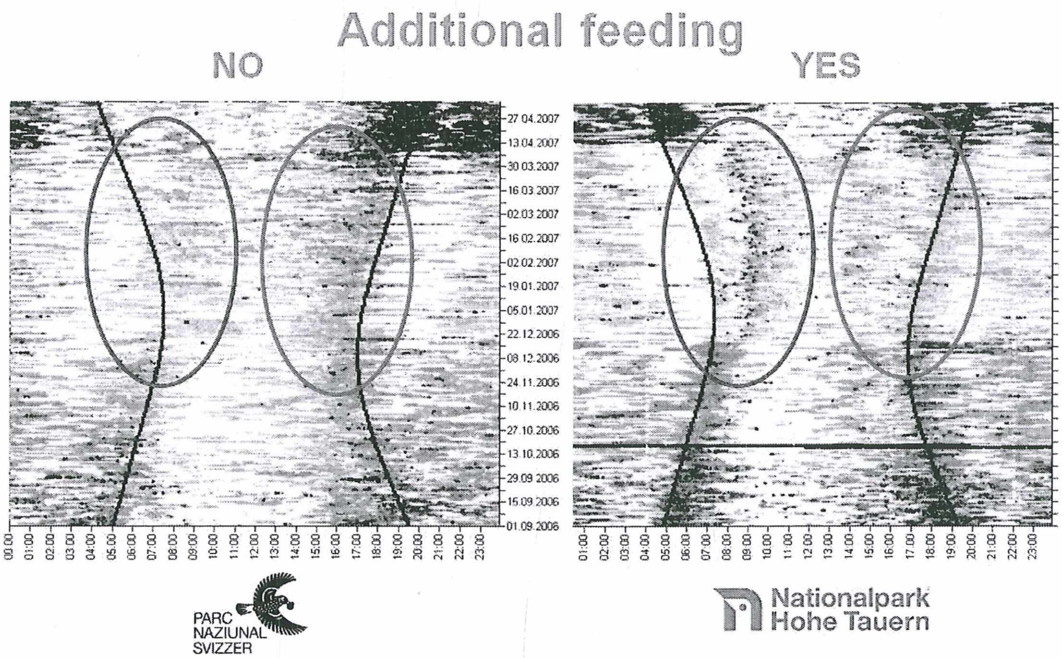

Figure 2: Actogramm of two individuals representative of each population. Left: Swiss National Park without supplementary feeding, Right: National Park Hohe Tauern with supplementary feeding in winter. Black lines: sunrise and sunset. White: no activity, the darker the colour the more active the individual.

In addition, another interesting new result showed up: Both individuals (in Switzerland and Austria) suddenly raised their activity pensum more or less at the same day around the 13th of April to a very high level. Even though the Swiss deer started to increase slightly since the end of December, it changed abruptly to a high activity level after the mentioned date. This change is stronger within the Austrian deer with supplementary feeding. Within one day the physical activity peak in the morning hours was neglected and the activity shifted to a complete new daily rhythm (peaks around sunrise and sunset, constant activity during night). It seemed that red deer "accepted" the additional feeding during a certain time frame and was strongly attracted during that period. Although the feeding was kept going until the end of April it abandoned the feeding site earlier and changed its rhythm. With additional data we might be able to evaluate the physiological consequences of this behavior and the influence of additional feeding.

References

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