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Diurnal movements, family groups and alertness of vicuña (*Vicugna vicugna*) during the late dry season in the Laguna Blanca Reserve (Catamarca, Argentina)

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ABSTRACT

Vilá, B.L. and Roig, V.G. 1992. Diurnal movements, family groups and alertness of vicuña (Vicugna vicugna), during the late dry season in Laguna Blanca Reserve (Catamarca, Argentina). *Small Rumin Res.*, 7: 289–297.

A study of daily movements and aspects of social behavior of vicuñas (*Vicugna vicugna*) in Laguna Blanca Reserve (Catamarca, Argentina) was carried out during the last month of the dry season (November). Mean composition of a vicuña family group was one male, 3.6 females and 1.9 offspring. There was a significant interaction between behavior and zone (defined by distance from river). Early in the morning the vicuñas grazed in a location close to their apparent night-time resting area, near the slopes, distant from the river. As the morning went by, walking behaviour increased towards the river and grazing decreased. Activities according to group size were also tested and a positive correlation was observed between frequency of alert behavior per adult and the number of offspring in the family group. Frequency of grazing and walking were related to time of day and zone and not to number of animals in the group, and alert behavior was related to number of offspring.

INTRODUCTION

The vicuña is a South American wild camelid that inhabits the Puna zones (arid and high) of Peru, Bolivia, Chile and Argentina. In Argentina there are approximately 13 000 vicuñas (Cajal, 1985) distributed in the north-western provinces of Jujuy, Salta, Catamarca, La Rioja and San Juan (Cajal, 1979). In spite of being adapted to arid zones, this wild camelid is an "obligatory drinker" (Franklin, 1974, 1983) that needs water daily, especially in the dry season. The social organization includes a family group (which is very stable

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in time and space), bachelor groups (more variable), and solo animals (Koford, 1957; Franklin, 1974).

Behavioral studies of mammals in general and particularly of ungulates show that they use some areas of their environment more intensively than others, and individuals exhibit different behavior in different areas (Barret, 1980; Duncan, 1983; Franklin, 1983; Miller, 1970; Senft et al., 1983). Apart from these spatial behavior patterns, animals may show daily rhythms in their activities, occupying different areas at different time of the day and changing their activities throughout the day (Bergerund, 1974; Klinger, 1974; Senft et al., 1983).

These patterns potentially affect food selection and intake and efficiency of foraging, and conversely can be affected by food availability. The study of activities in terms of space, time and environment use is essential for working out plans for management and preservation of animals (Geist and Walther, 1974). Social behavior is another important factor to be taken into account in camelid management (Rabinovich et al., 1985). The time an animal in a group devotes to various activities depends, among other things, on group size (Caraco, 1979).

The objective of this study was to assess the daily movements and use of the environment by vicuñas at the Laguna Blanca Reserve during the dry season, and to analyse some parameters of social behavior in relation to group size.

METHODS

Study area

The Provincial Reserve of Laguna Blanca, is located in the NW region of Catamarca Province. Maximum elevation is at the Nevado de Laguna Blanca (5500 m) and minimum elevation is at Laguna Blanca itself (3200 m). Soils are stony, sandy or saline. There is almost no humic horizon. The climate is Andean: severe, with great daily thermal amplitudes (about 20°C) and frequent frosts (in winter, temperatures below −20°C). Rain is scarce (annually 100–250 mm.; Knoche and Borzakov, 1947) and seasonal (December to March). West winds are frequent, dry and strong, and they generally start blowing at noon (Turner, 1973).

Phytogeographically, the reserve is located in the high Andean and Puna region. Vegetation is xerophilous with isolated shrubs forming an average ground cover of 22%, except in swamps where coverage is approximately 100%. (Diaz and Paredes 1981).

The observation zone chosen was part of an open valley, in the NW of the Reserve, near Rio-Rio river, with a mean elevation of 3500 m. The soil is sandy and the area has no swamps. The prevailing vegetation consists of aña

gua (*Adesmia hurriuscula*), rica-rica (*Acantolippia salsoloides*), and jaboncillo (*Panicum chloroleucum*), and is homogenously distributed (Diaz and Paredes, 1981). The study area has a high point for observations (Lomita Colorada) from which scans of the studied zone were made. The scanned area covered 2.79 km^2, from Pabellón Hill to a small hill, in a triangle 2.63 km wide and 3.3 km deep.

Observations

Observations were carried out from October 20 to November 20, 1986. This period was part of the late dry season and no precipitation occurred during the observation period. Observations lasted 7 h beginning at sunrise (approximately 06.30), except on the day with strong west winds that created sand storms, when observations lasted 4 h/d. 8×30 binoculars and a 20×40 Bushnell telescope were used. A group of vicuñas was defined as that with the animals being less than 10 vicuña length from one another.

Scan sampling (Altmann, 1974) was used: every 15 min the zone was scanned from left to right and the following information was recorded on a map: group composition, group location, and the individuals' activities—grazing, walking, running, alert and lying.

RESULTS

Aspects of social organization

A total of 200 scans were carried out. An average of 15.3 (SD=13.0) animals/scan were recorded equivalent to a mean density of 5.50 animals/km^2. Two to six groups were usually under observation at the same time. About 91% of the vicuñas recorded were in groups, whereas the other 9% were solo animals. Groups were divided into:

(a) Family groups, consisting of adults with pregnant females or females with offspring. They represented 59% of the groups. The abbreviated formula (Franklin 1983) was used for the composition of family groups: Total (male–females–yearlings–offspring). Yearlings could not be distinguished because of the distance, so they were included with females. Maximum family numbers were 13 in two different families with composition 1–8–4 and 1–7–5 respectively. The minimum was 2(1–1–0). The mean family group was 6–7 (1–3.6–1.9).

(b) Bachelor groups, composed of adults with or without yearlings; they never had offspring. They represented 41% of the groups and varied in number from 2 to 22 animals, mean number being 5.44 (SD=2.1).

Daily pattern of activities

Animal movement (number of animals walking/total animals in the scan) increased significantly throughout the morning (logarithmic curve $r^2=0.88$, $P<0.005$) (Fig. 1). On the other hand, an inverse relation existed between grazing behavior (measured as the number of animals grazing/total animals in the scan) and time of the morning (exponential curve $r^2=0.949$,

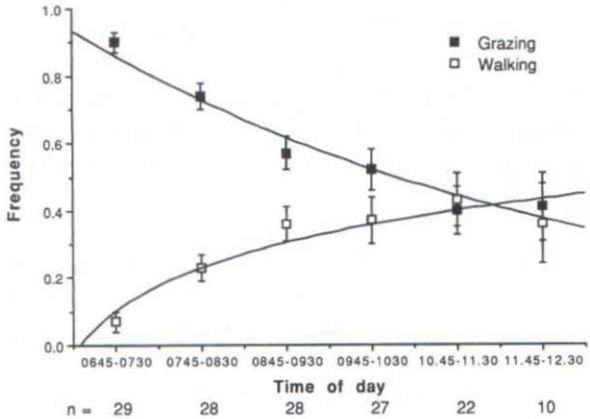

Fig. 1. Mean walking (□) and grazing (■) frequency (+standard errors) in relation to hour of day. Grazing: exponential curve $y=-1.015\times10\ (-7.282\ e^{-2x})$; $r^2=0.949$. Walking: logarithmic curve $y=0.099+0.43\times\log(x)$; $r^2=0.88$.

$P<0.0005$). At 06.45 h, the probability of finding an animal grazing was 0.90 (the animals started the day grazing) and of finding an animal walking was 0.07. Then, as the morning went by, walking increased in frequency and at 11.00 h the probabilities of grazing and walking were approximately the same. An increase in walking frequency and a decrease in eating frequency persisted till noon, when the animals moved with a 0.83 probability.

In spite of frequent wind storms, which made it difficult to obtain quantitative data (only 56 scans), asystematic observations in the afternoon showed that frequency of foraging seemed to increase whereas frequency of walking decreased during afternoon.

Lying behavior was observed at a low frequency (0.045) and had no relation to time of day. These data could be underestimated because it was very difficult to observe animals lying when they put their neck to the ground. Animals running were registered in only 8 scans, but again it was difficult to find animals running exactly at the moment the scan was made.

Spatial pattern of activity

Daily use of environment. Before sunrise (approximately 06.30 h) animals were on the slopes or at the foot of hills. As the day went by, they followed a SW–NE movement (i.e. from the hills to the river). To verify this observation statistically, those groups ($n=126$) identified in two successive observations were analyzed with respect to their closer or farther position from the river in the second record. This analysis showed a probability of movements towards the river of 0.87, and towards the hills of 0.13. A Kolmogorov–Smirnov non-parametric test showed that these proportions were highly signifi-

cant compared with what would be expected if the movements were random ($P<0.001$).

The same analysis was carried out with afternoon results, and a 0.03 probability of movement to the river and 0.87 probability in the inverse direction were obtained. The Kolmogorov–Smirnov test indicated that in the afternoon vicuñas moved from the river to the hills ($P<0.05$).

Assignment of activities to different areas. The observation zone was divided into three zones of equal area and these were classified according to distance from the river into close, intermediate and distant. The number of animals in any activity in each area was related to the total number of animals in that area (i.e. animals eating close to the river/total animals in the scan in the zone close to the river). Activities in the different areas were compared and the interaction area×activity was highly significant (two-factor ANOVA, $F=17.5$, $P<0.005$). Animals grazed and rested (lying) significantly more in the distant and intermediate zones than in the zone close to the river (Scheffe test, $P<0.005$). On the other hand, animals walked significantly more in the zone close to the river than in the distant and intermediate zones (Scheffe test, $P<0.005$).

Activity according to group size

The occurrence of grazing and walking behavior showed no correlation with the number of adults or the number of offspring in the family groups (linear regression Student's test: grazing–offspring $t(3)=0.95$, $P>0.10$; grazing–adults $t(7)=0.07$ $P>0.25$; movements–offspring $t(3)=1.3$ $P>0.10$; movements–adults $t(7)=0.51$ $P>0.25$).

The probability of occurrence of alert behavior (adult vicuña looking with

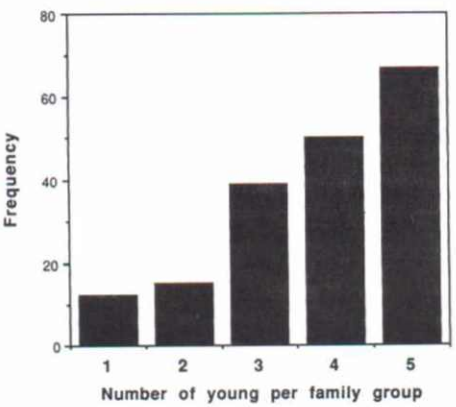

Fig. 2. Frequency of alert behavior per adult animal in relation to number of offpring in their family group. Alert behavior increased with the number of offspring in the group. Linear regression $a=1.14$; $b=1.55$; $r=0.96$; $t(3)=5.04$; $P<0.005$.

the head raised high and ears erect) was 0.19 in groups with offspring, 0.11 in groups without offspring and 0.07 in solitary animals.

In family groups, the frequency of alert behavior per adult (i.e. alert in group with two offspring/mean number of adults in groups with two offspring) was positively correlated with the number of offspring (Student's test on linear regression: $t=5.04$, $P<0.005$) (Fig. 2). The occurrence of alert behavior was also related to the activity of adult members of the group; high values were found when most of the animals in the group were eating or resting, and low values when the group was walking ($P<0.005$).

DISCUSSION

The mean vicuña family composition found in Laguna Blanca (1–3.6–1.9) was similar to that found by other authors in different places 1–3.1–1.6 from Ulla-Ulla Reserve, Bolivia (Cardozo, 1981), 1–3.1–1.6 from Las Cuevas Lauca National Park, Chile (Glade and Cattan, 1987), 1–3.0–2.0 from Pampa Galeras, Peru (Franklin, 1983) and 1–3.5–1.8 from INTA-Abrapampa Jujuy, Argentina (Vilá, 1990). Though there are variations in relation to climate and topography, we can conclude that the mean vicuña family in natural populations is one male, three to four females and approximately two offspring.

Vicuñas followed a well defined daily pattern of habitat use. An important factor affecting this pattern was distance to water. Animals grazed mainly in the most distant area from the river in the early hours of the morning and probably at sunset. In the morning, the animals were near their resting zone on the upper slopes; although not all vicuña populations rest on higher slopes. Koford (1957) considered that these zones are chosen by the animals because they are free from disturbance by livestock, men and carnivores, which usually travel the lower slopes. Disturbance by any of these could have occurred in the Reserve. A similar movement pattern (from the hills to the lower flat) was described by Franklin (1974) in Pampa Galeras (Peru), however, not all vicuña populations have this pattern especially if they live in undisturbed plain areas (Koford, 1957).

As the morning went by, the frequency of movements increased towards the river and in the afternoon the direction of movement was reversed, moving away from the water source. Vicuñas must drink daily in the dry season (Franklin, 1983), which is one of the factors that could explain why their daily pattern of activities was determined by the distance to the river. Water affects the pattern of environmental use of water-dependent ungulates more than pasture, as is shown in a comparative study made in semi-desert African species (Western, 1975). Wild horses show seasonal movements affected by the use of water (Miller, 1983). Water is an important parameter in the degree of environmental use by cattle (Roath and Krueger, 1982), zebras

(Ginsberg, 1989), and sheep inhabiting semi-arid regions (Stafford-Smith et al., 1985). The peak of grazing behavior found in the morning is similar to that noted in other ungulates, e.g. Bergerund (1974) found that reindeer had two periods of high frequency of grazing, one in the morning (08.30 h) and one in the afternoon (18.00 h).

In Pampa Galera (Peru), the vicuña is territorial all year round (Franklin, 1974, 1983). Evidence of territorial behavior (exclusive or defended zones) could not be found in this study. As the region has a pastoral, extensive nomadic economy and large numbers of donkeys (food intake of one donkey is equivalent to that of six vicuñas; Hoffman et al., 1983), to defend a zone that can be invaded and exhausted by donkeys or other domestic animals might not be an adaptive strategy for vicuñas. Koford (1957) found that domestic animals (llamas and sheep) competed with vicuñas and could displace them from their feeding grounds.

At the time of this research, the offspring were approximately 7–8 months old and they still seemed to be closely associated with their parents. This prolonged association between parents and offspring would be correlated with family stability of this species (Koford, 1957; Franklin, 1974). The direct relationship between number of offspring and frequency of alert behavior could be accounted for by this social context. As the number of offspring in the group increased, the parental care increased in direct proportion, which is evidenced, among other things, by an increase in the alert behavior

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RESUMEN

Vilá, B.L. y Roig, V.G. 1992. Desplazamiento diario, grupos familiares y comportamiento de alerta en las vicuñas (*Vicugna vicugna*), durante el fin de la temporada seca en la Reserva de Laguna Blanca (Catamarca, Argentina). *Small Rumin. Res.* 7: 289–297.

Este trabajo describe los desplazamientos diarios y algunos aspectos del comportamiento social de la vicuña (*Vicugna vicugna*) en la Reserva de Laguna Blanca (Catamarca, Argentina). Fue realizado durante los últimos meses de la estación seca (noviembre). La familia media de vicuñas encontrada fue de un macho, 3.6 hembras y 1.9 crías. Se encontró interacción significativa entre los comportamientos y las zonas estudiadas (definidas por su cercanía al río). En las primeras horas del día las vicuñas forrajeaban cerca de las zonas de dormidero, en el área mas distante del río. A medida que avanzaba la mañana la frecuencia de desplazamiento en dirección del río aumentaba y disminuía la frecuencia de forrajeo, encontrándose a los animales cerca del río caminando. Las actividades en relación al tamaño de grupo fueron también estudiadas, no hubo correlación de actividades con el número de miembros del grupo excepto para el comportamiento de alerta que estuvo directamente relacionado con el número de crías de los grupos.