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Feeding habitat utilization and preference by guanaco male groups in the Chilean Patagonia

Utilización y preferencia del hábitat de alimentación de grupos de machos del guanaco en la Patagonia chilena

ISAAC M. ORTEGA* and WILLIAM L. FRANKLIN

Departament of Animal Ecology, 124 Science II, Iowa State University, Ames, Iowa 50011, USA

ABSTRACT

Feeding habitat utilization and preference by guanaco (*Lama guanicoe*) male groups were studied at Torres del Paine National Park in southern Chile. They were observed 326 hours from January to December 1980 to assess feeding habitat. The number of animals feeding on identified habitat types was recorded at half hour intervals. Plant species composition of habitat types was determined by 4,374 step-points during the growing season. Vegetation maps were made of 64 randomly located 4 ha plots to determine relative availability. Six types of habitat were found: Mata Barrosa (41% of relative abundance), Coiron (29%), Hierbas (24%), Vega (4%), Ñirre (2%), and Calafate (0.4%). Vega was highly preferred and was fed upon by guanaco male groups significantly more than other habitat type, except in winter when it was covered by snow. Calafate was heavily used during the winter and was highly preferred throughout the year. We concluded that in this xeric environment, guanaco male groups are generalists, shifting from being grazers to browsers depending upon the socioecological season.

Key words: Utilization, preference, guanaco, Patagonia, Chile.

RESUMEN

En el Parque Nacional Torres del Paine se procedió a estudiar la utilización y preferencia de hábitat de alimentación de los grupos de machos del guanaco (*Lama guanicoe*). Estos grupos fueron observados 326 horas entre los meses de enero a diciembre de 1980 con la finalidad de determinar sus hábitat de alimentación. Cada media hora se anotó el número de animales que se encontraban alimentándose en determinados tipos de hábitat. La composición vegetacional del hábitat se determinó con un total de 4.374 puntos durante la época de crecimiento vegetal. Para determinar la disponibilidad relativa de los diferentes tipos de hábitat se elaboraron 64 mapas de vegetación con una superficie de 4 ha, los que fueron localizados al azar en el área de estudio. Los seis tipos de hábitat encontrados fueron: Mata Barrosa (41% de abundancia relativa), Coirón (29%), Hierbas (24%), Vega (4%), Ñirre (2%) y Calafate (0,4%). Los grupos de machos tuvieron una mayor preferencia y utilización por Vega con respecto a los demás tipos de hábitat, excepto durante el invierno cuando este hábitat se encontraba cubierto por la nieve. El Calafate fue preferido a través de todo el año, acentuándose considerablemente esta preferencia durante el invierno. En base a la información obtenida se puede concluir que en este ambiente xerófito los grupos de machos son generalistas, capaces de cambiar de pastoreo a ramoneo dependiendo de la estación socioecológica.

Palabras claves: Utilización, preferencia, guanaco, Patagonia, Chile.

INTRODUCTION

Knowledge of food selection and habitat utilization are fundamental for understanding the ecology of ungulates, including a population's social structure and how it functions within a given ecosystem (Hobbs *et al.* 1983). Four socioecological periods have been recognized in migratory guanaco (*Lama guanicoe*) of the southern Patagonia: Summer Territorial (mid-October to end of March), Fall Transitional (April to May), Winter Aggregational (June to third week of August), and Spring Transitional (end of August to mid-October) periods (Ortega 1985). These periods approximate the climatic seasons and are referred to as summer, fall, winter, and spring in the following text. Family Groups, Male Groups, Solo Males, Mixed Groups and

* Present address: Department of Range and Wildlife Management, Texas Tech University, Lubbock, Texas 79409, USA.

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Female Groups were the major social units. Family Groups, Male Groups, and Solo Male were the more important social units in the summer and Mixed Groups in winter (Franklin 1983, Ortega 1985).

Guanaco Male Groups have been recognized as the key social unit from which animals can be economically exploited (Cunnaza 1980, Franklin 1982 and 1983, Fritz 1985). From a management point of view, it is important to understand feeding habits in order to both preserve and potentially improve habitat. This study was part of a long-term research project on the guanaco of the Patagonia (see Franklin 1983), and our main objective was to determine the feeding habitat utilization and preference of guanaco male groups at Torres del Paine National Park, Magallanes, Chile.

STUDY AREA

Torres del Paine National Park is located in the eastern foothills of the Andean Mountains on the western edge of the Patagonia (51°03'S, 72°55'W). The 25.5 km^2 study area in the center of the park was bordered by Lake Nordenskjold to the north and west, Lakes Sarmiento and Pehoé to the south and Lagoons Larga and Cisnes to the east. The area ranged from 130 m to 535 m in elevation and small lagoons and seasonal ponds were common. To enable a better understanding of guanaco distribution and habitat availability the study area was divided into three similar sized regions: West (8.53 km^2), Central (8.46 km^2), and East (8.47 km^2).

The climatological seasons at the park are described as: spring (Sept.-Oct.) is characterized by high-velocity westerly winds creating cold but dry conditions; summer (Dec.-Feb.) is windy with occasional rain; fall (Mar.-May) is often foggy and cold; and winter (Jun.-Aug.) is cold to freezing, calm, and with or without snow. Average annual precipitation at Guardería Pudeto located in the West Region has been recorded as 546 mm, of which 60% fell between January and May (Pisano 1974). In 1980, there was a moderate to heavy snow cover (30-70 cm) from mid-June to the end of August. Mean annual minimum and maximum temperatures at Laguna Amarga (4 km east of the study area) between 1968 and 1972 were 5.7°C and 10.2°C respectively (Pisano 1974). The vegetation at Torres del Paine is characterized by shrubs and grasses. Pisano (1974) described it as a xeric pre-Andean shrub association ("asociación matorral xerófito preandino").

METHODS

Field work was conducted from January 1980 to January 1981. Guanaco Male Groups were observed for 326 hours from January to December 1980 to assess their feeding habits. An average of 9 days per month (range: 5-13) was spent observing. The length of an observation period varied with the season, but averaged 4.25 hrs/day (range: 1.3-9.3). Group size, location, number of individual feeding on defined vegetation types, and general group activity were recorded every 30 minutes.

Habitat types were initially defined based upon visual distinctiveness, dominant plant species and substrate differences. Plant species composition was later determined by the step-point method (Evans & Love 1957) at 5 m stops along 100 m transects through each vegetation type. A total of 4,374 points were made at the begining of January 1981.

Surface area (availability) of habitat types was determined from 64 randomly located plots of 4 ha each, covering a total of 10% of the study area. Each plot was visited and the vegetation types were mapped from adjacent high points and peaks. Mapped-surface area was measured in the laboratory with a planimeter.

In this study, food accessibility and abundance were considered as one term: availability (Johnson 1980). Winter accessibility to some habitat types (vega and hierbas) was limited by snow cover.

A feeding Preference Index (PI) (modified after Cain & Sheppard, see Cock 1978) was calculated by:

$$PI = \ln [(Nx/Nx')(Ax/Ax')^{-1}]$$

where Nx = number of animals feeding in "x" habitat type; Nx' = number of animals feeding in the remainder of the vegetation types; Ax = availability of habitat type "x"; Ax' = availability of the remainder of the habitat types; ln = natural logarithm, provides symmetry from

negative infinity to positive infinity. This index was used except when all animals were feeding in only one habitat type; then the preference index used was:

$$PI = \ln [(Nx)\ (Ax/Ax')^{-1}]$$

To show gradation from avoidance, no response, to attraction, preference index values between −0.50 and 0.50 were considered as a neutral response, while values above 0.51 as preference, and values below −0.51 as avoidance. Availability and utilization data are presented in percentages. It was not statistically possible, however, to compare these collective results with preference indices, because the index for each habitat type was calculated for each utilization observation and averaged for that season.

Data were analyzed by analysis of variance in which significant differences between means were determined by the protected Least Significant Difference (LSD) multiple comparison procedure (Snedecor & Cochran 1967). All significance levels are reported from two-tailed statistical analyses.

RESULTS AND DISCUSSION

An integral part of animal ecology and socioecology is the usage an animal makes of its environment, specifically the kinds of foods it consumes and the varieties of habitat it occupies.

Habitat Types: Description and Availability

The dominant plant species of this Patagonia steppe plant associations is *Mulinum spinosum* (Mata Barrosa), a spiny, 10-50 cm high dome shaped shrub. Valleys and depressions usually contain the shrubs *Senecio patagonicus* (Senecio) and *Adesmia boronoides* (Paramela). High exposure areas are characterized by *Acaena* sp. (Cadillo), *Calceolaria* sp (Capachito), and *Azorella caespitosa* (Llaretilla). *Rumex acetocella* (Vinagrillo) is very common in disturbed sites such as roadsides. Successional meadows and pond littoral zones (locally called vegas) are dominated by the grasses *Holcus lanatus* (Pasto Miel), and *Hordeum comosum* (Cola de Zorro), with the shrub *Berberis buxifolia* (Calafate) typically found on the periphery. The only tree present is *Nothofagus antarctica* (Ñirre). Six general habitat types were recognized, foliar cover of these types is given in Table 1.

1. The shrub community Mata Barrosa was the most common habitat type and covered 41% of the study area (Table 2). It was significantly more abundant in the West (54%) and East (46%) compared to the Central Region ($P < 0.05$; Table 2). Mata Barrosa was dominated by *M. spinosum,* accounting for 61% of the relative plant cover within this type (Table 1).

2. The bunchgrass community Coiron covered 29% of the study area, but there was no difference between the three regions ($P > 0.05$; Table 2). It was dominated by grasses, of which *Deschampsia* sp covered 49% (Table 1).

3. The Forb community Hierbas (24% of the study area) was more abundant in the Central (29%) and East (25%) than in the West Region ($P < 0.05$; Table 2). Forbs were the dominant plants, especially *Luzula alopercus* (Siete venas, 51%) and *R. acetocella* (17%) were the dominant species (Table 1).

4. The grass community Vega covered only 4% of the study area and was more abundant in the Central (4%) and East (6%) compared to the West Region ($P < 0.05$; Table 2). Vega was dominated by the grasses (32% relative cover) *H. lanatus* and *H. comosum* (Cola de Zorro) and the forbs (24% relative cover) *Acaena magallanica* (Cadillo) and *Potentilla anserina* (Hierba de la Plata, Table 1).

5. The beech tree community Ñirre covered 2% of the area and was found mainly in the West Region (7%). *N. antarctica* was the dominant tree (37%) with some forbs present, such as *Acaena pinnatifida* (Cadillo) and *R. acetocella* (Table 1).

6. The Calafate shrub community was the least represented habitat type and covered only 0.4% of the area with no significant differences among the regions ($P > 0.05$, Table 2). It was dominated by the shrub *Berberis buxifolia* (44% relative cover, Table 1).

Habitat Types: Feeding Utilization and Preference

On a year-round basis, Vega was highly preferred (PI = 4.0) and was fed upon by guanaco Male Groups significantly more

TABLE 1

Percent plant cover for habitat types and classes found in Torres del Paine National Park. (Other = species that contributed ⩽ 2%, N = number of step-point samples).

Porcentaje de cobertura vegetal de los tipos de hábitat y clases encontrados en el Parque Nacional Torres del Paine (Other = especies que contribuyen ⩽ 2%, N = número de puntos).

CLASSES Plant Species (N)	Habitat Types Mata Barrosa (1,000)	 Calafate (224)	 Coiron (1,000)	 Hierbas (1,000)	 Vega (1,000)	 Ñirre (150)
GRASSES						
Agrostis capillaris					5.7	
Agrostis sp.			3.2	7.0	3.9	
Arrhenatherum eliatus	2.0		4.9			
Carex gayana					2.9	
Carex sp.					3.4	
Deschampia sp.	5.6		48.3	4.7		4.0
Eleocharis albibracteata					9.7	
Holcus lanatus			16.1		16.7	
Hordeum comosum					15.1	
Rhytidosperma virescens	3.9	12.1				3.4
Total	11.5	12.1	72.5	11.7	57.4	7.4
SHRUBS						
Berberis buxifolia	6.0	44.2	4.8	3.2		5.8
Mulinum spinosum	60.6	15.2		2.3		
Senecio patagonicus	11.8	6.7	7.8	8.8		2.1
Azorella caespitosa		4.5	3.0			
Total	78.4	70.6	15.6	14.3	–	7.4
FORBS						
Acaena magallanica					13.2	6.9
Acaena pinnatifida	2.5		2.1			8.2
Acaena platyacantha					2.2	
Geranium patagonicum					2.1	
Luzula alopercus	2.9	7.6	2.0	51.1	2.1	
Potentilla anserina					10.6	
Rumex acetocella				17.3		10.1
Trifolium repens	4.0				5.9	6.1
Total	9.4	7.6	4.1	68.4	36.1	31.3
TREES						
Nothofagus antarctica						36.8
Total	–	–	–	–	–	36.8
OTHER	0.7	9.7	7.8	5.6	6.5	16.6

TABLE 2

Relative abundance (mean number of hectares and percent cover) of habitat types within the 25.5 km² study area (N = number of 4 ha sample plots).

Abundancia relativa (número promedio de hectáreas y porcentaje de cobertura) de los tipos de hábitat en los 25,5 km² del área de estudio (N = número de cuadrantes de 4 há de tamaño).

Regions	Habitat Types					
	Mata Barrosa	Calafate	Coiron	Hierbas	Vega	Ñirre
West (N = 17)						
mean ± S.D.	2.12 ± 1.25	0.0 ± 0.0	1.05 ± 1.08	0.49 ± 0.39	0.02 ± 0.05	0.26 ± 0.34
%	53.9	0.0	26.6	12.5	0.4	6.6
Central (N = 36)						
mean ± S.D.	1.14 ± 1.07	0.02 ± 0.05	1.42 ± 1.27	1.15 ± 0.70	0.16 ± 0.27	0.06 ± 0.16
%	28.8	0.6	35.9	29.1	4.1	1.5
East (N = 21)						
mean ± S.D.	1.80 ± 1.05	0.02 ± 0.05	0.87 ± 1.02	0.97 ± 0.54	0.23 ± 0.34	0.005 ± 0.02
%	46.1	0.5	22.4	24.9	5.9	0.1
Total (N = 64)						
mean ± S.D.	1.60 ± 1.16	0.02 ± 0.05	1.14 ± 1.15	0.94 ± 0.64	0.15 ± 0.28	0.09 ± 0.21
%	40.6	0.4	29.1	23.8	3.9	2.2

than other habitat types ($P < 0.0001$; Fig. 1). Mata Barrosa and Coiron were also used (Fig. 1), but there was a neutral response to Mata Barrosa (PI = 0.34) and a moderate preference for Coiron (PI = 0.87). Calafate was utilized less than the preceding types ($P < 0.0001$; Fig. 1), but was highly preferred (PI = 4.14). Hierbas and Ñirre habitat types were the least utilized and were avoided by guanaco Male Groups (PI = −1.18 and PI = −3.18 respectively).

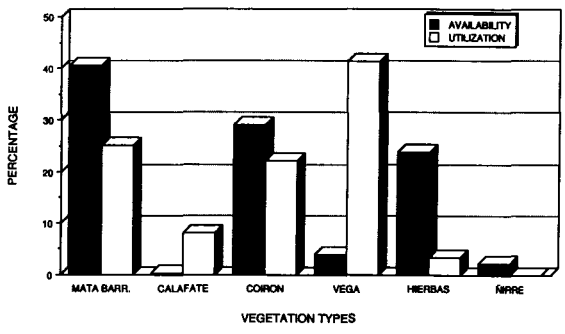

Fig. 1: Annual feeding utilization of available habitat types by guanaco Male Groups.

Disponibilidad anual de hábitat y su utilización alimentaria por los guanacos de los Grupos de Machos.

Seasonally, the shrub community Mata Barrosa was utilized similarly for the summer, fall and spring when animals showed a neutral response to it, but was used significantly less during the winter ($P < 0.0005$; Fig. 2), when it was avoided (PI = −1.31; Fig. 3).

Coiron was an important forage during fall (47%), winter (39%), and spring (38%) while less was consumed during summer (15%; Fig. 2). However, the only significant difference in use occurred between fall and summer ($P < 0.0001$). It was preferred during all periods, but summer (PI = 0.12; Fig. 3). Feeding use of Hierbas was very low, with no difference between periods ($P > 0.05$; Fig. 2) and was avoided throughout the year (Fig. 3).

Vega was highly utilized and preferred during the summer ($P < 0.0001$), but received no use in winter when it was covered by snow. Ñirre was used very little with no difference between periods ($P > 0.05$; Fig. 2) and was avoided in summer and in fall (Fig. 3).

Calafate was used little during the summer and fall (Fig. 2), but was an important feeding habitat in winter (44% of all feed-

ing observations). Its use declined during spring, though remained significantly higher compared to the other periods ($P < 0.0001$). It was highly preferred throughout the year, but especially during winter (Fig. 3).

To illustrate trends in the feeding habitat of guanaco Male Groups (both grazers and browsers) the habitat types were combined into four vegetation classes: Shrubs (Mata Barrosa and Calafate), Grasses (Vega and Coiron), Forbs (Hierbas) and Trees (Ñirre, Table 2).

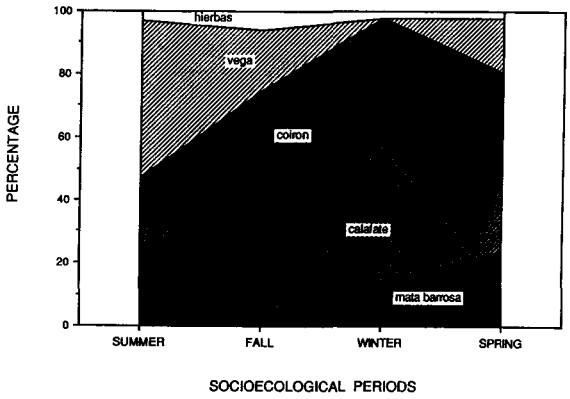

Fig. 2: Seasonal feeding utilization of habitat types by guanaco Male Groups.

Utilización alimentaria estacional de los tipos de hábitat por los guanacos de los Grupos de Machos.

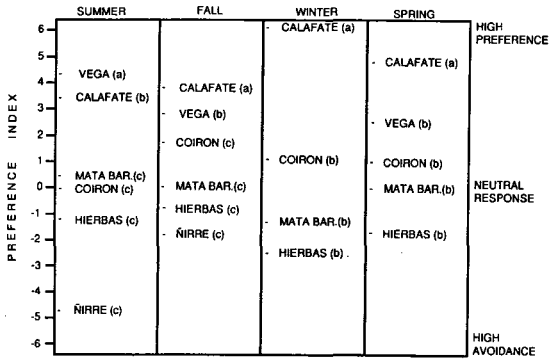

Fig. 3: Seasonal preference index for habitat types by guanaco Male Groups. Preference indices with the same letter are not significantly different.

Indice de preferencia estacional por los tipos de hábitat de los guanacos de los Grupos de Machos. Indices de preferencia con la misma letra no son significativamente diferentes.

Vegetation Classes: Feeding Utilization and Preference

Shrubs, Grasses, Forbs, and Trees were significantly different in availability ($P < 0.0001$, Fig. 4). Grasses were utilized ($P < 0.0001$; Fig. 4) and preferred more (PI = 2.12) than Shrubs (PI = 0.86). Forbs were avoided (PI = −1.18) and Trees were highly avoided (PI = −3.12). Together, Grasses and Shrubs were significantly more utilized than Forbs and Trees ($P < 0.0001$).

The Shrub vegetation class was utilized similarly during summer, fall and spring, with a peak of utilization during the winter (59%; Fig. 5). Shrubs were preferred during summer (PI = 0.89), winter (PI = 1.28) and spring (PI = 1.19), but male guanacos were neutral to them during the fall (PI = 0.44).

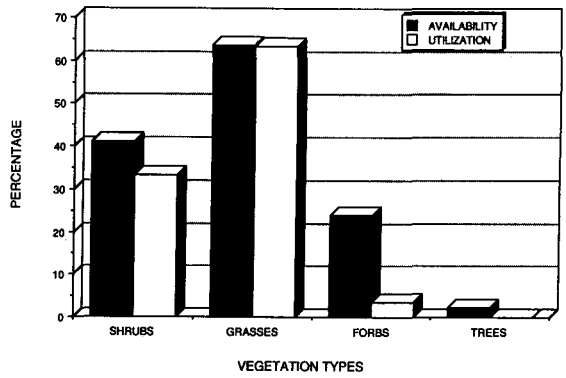

Fig. 4: Annual feeding utilization of available vegetation classes by guanaco Male Groups.

Disponibilidad anual de las clases de vegetación y utilización alimentaria por los guanacos de los Grupos de Machos.

Grasses were utilized similarly during summer, fall and spring with less use during the winter (Fig. 5). They were preferred throughout the year (summer PI = 2.25, fall PI = 1.99, spring PI = 1.19, and winter PI = 1.03).

Forbs were used little throughout all periods (Fig. 5). This class was avoided throughout the year (summer PI = −1.27, fall PI = −0.77, spring PI = −1.73), but especially in winter (PI = −2.41).

Finally Trees were rarely used during summer and fall, with no use during winter and spring (Fig. 5). This class was highly avoided in summer (PI = −4.67) and fall (PI = −1.79).

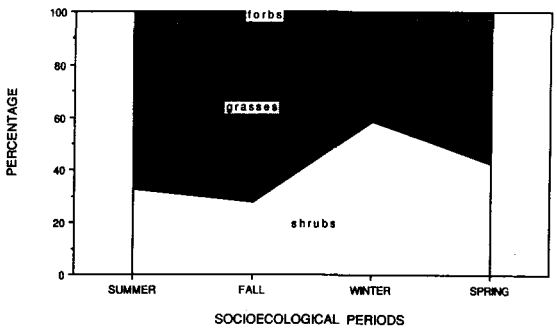

Fig. 5: Seasonal feeding utilization of vegetation classes by guanaco Male Groups. Socioecological Periods explained in text.

Utilización alimentaria estacional de las clases de vegetación por los guanacos de los Grupos de Machos. La explicación de los Períodos Socioecológicos se encuentra en el texto.

Jefferson (1980) and Raedeke (1979, 1980) studied feeding habits of guanaco on the Island of Tierra del Fuego. Raedeke's work parallels this study since he divided up the habitat types into Trees, Shrubs, Grasses, Forbs, and Other vegetation classes. Unfortunately, no further comparison could be made since a different preference index was used. He concluded that the guanaco is a "generalist herbivore, adapted to utilize a broad range of forage types".

In the xeric environment of Torres del Paine, guanaco Male Groups highly preferred grasses. Vega, which is a moist and high producing forage, was utilized and preferred during all periods, but winter. The grass Coiron received more use and was preferred most when Vega was covered by snow or when animals were moving to or from their winter range. Although guanacos males had a neutral response to the most common habitat type, Mata Barrosa, Calafate was highly preferred, especially during the winter when it was readily available above the snow covered ground. Ñirre was of little value in the winter since it is a deciduous tree.

In conclusion, guanaco Male Groups at Torres del Paine National Park were generalists. Raedeke (1980) suggested that this lack of dietary specialization might have evolved due to the lack of competitive pressure from other large herbivores on the Patagonia. In the park, guanacos were primarily grazers during summer and shifted to browse during winter when grass was not available, a feeding strategy well-adapted to a winter snow covered environment.

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