

# Guanacos' winter diet in ecotone of "Tierra del Fuego" (Argentina)

## Abstract

In the fuegian ecotone coexist native (guanaco) and introduced (cow, horse, sheep) herbivores, which is why they are conducting different studies on the behavior of the guanaco in this area, in order to establish a balance between development of livestock and forestry activity and the conservation of native species and their environment. Our aim was to evaluate and compare the diet of the guanaco and the cow during the winter (unfavorable season) to contribute to the ingestive behavior of the herbivores and to provide information on the use of the vegetal communities of the fuegian ecotone. The diet was analyzed by identifying botanical remains present in the pretreated feces. The relative frequencies of ingested taxa were obtained and analyzed according to their functional groups, being the grasses, herbaceous dicotyledons and graminoid the most consumed. There were few species consumed during the winter compared to other times and only significant differences were found in the intake of the *Gunnera magellanica*, with greater consumption by the guanaco. These results complement the studies on trophic overlap made in the area, broadening the knowledge of the ingestive behavior of the different herbivores and thus be able to elaborate a sustainable management on the area.

**Keywords:** ecotone fuegian, herbivory, *lama guanicoe*, vegetal remains, diet overlap

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## Introduction

The grazing of domestic livestock causes changes in the structure and functioning of natural pastures, affecting fundamental processes such as primary productivity, secondary productivity, changes in vegetation and nutrient cycling.<sup>1-3</sup> One of the most notable changes, it is observed, in the vegetal composition of the pastures with the replacement of species.<sup>4-9</sup> In Tierra del Fuego, the use of the habitat by the guanaco (*Lama guanicoe*) is added. This is the only ungulate that characterizes the native wildlife of this area. The guanaco is an opportunistic herbivorous, that survives in different habitats by making anatomic and physiologic adaptations,<sup>10</sup> and has a great ability to digest low quality plants, what allows the guanaco to feed on a wide diversity of vegetation.<sup>11</sup> Although the variations that were observed in the principal food items consumed by the wild populations of guanaco are dependent on the area's features and on the vegetal species that are present in the different locations where the study.<sup>12-17</sup>

Until the nineteenth century, the guanacos were present in almost all regions of Argentina, occupying different zones, from open habitats to scrublands and forests<sup>18</sup> and from regions located on sea level to regions up to 4500 above mean sea level. Nowadays, guanacos are more numerous in the Patagonian steppe and in the borders of the Andes mountain range.<sup>18</sup> This habitat shift has occurred as a consequence to the agricultural frontier expansion, that has taken over the original habitat of the guanaco. However, the population dynamics and the habitat use of the guanacos is yet scarcely known. It is therefore important to know the diet of grazing animals, determine which species are highly consumed, the variability in composition according to availability, the season of use of different plant species, the degree of overlap of diets of different kinds of animals.<sup>17</sup> Knowledge of nutritional habits in ecosystems is important for the study and interpretation of the flow of energy through them, and also allows to establish the influence of each herbivore on the composition and physiology of the community.<sup>19</sup>

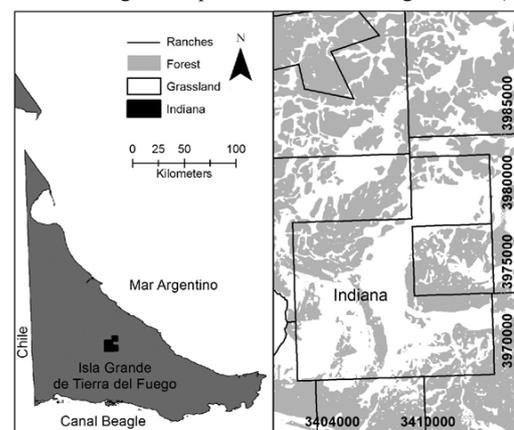
The technique of describing diets from vegetable microrests in feces is a technique used in previous studies in the area of the fuegian

ecotone, and has allowed to establish a certain degree of overlap of diets between native and domestic herbivores.<sup>8,20-23</sup> Our aim was to quantify the diet of the guanaco and of cow, during winter season, so as to provide a tool to evaluate the use of vegetal communities in the fuegian ecotone under unfavorable conditions and sustainable management and environmental conservation projects

## Materials and methods

### Study area

The study was conducted in the ecotone area of the province of Tierra del Fuego (Argentina). This region corresponds to the Subantarctic Domain, Subantarctic Province, Magellanic District,<sup>24,25</sup> which is an ecotonal zone between the vegetation of Central Patagonia and the Magellanic Forest Province of the Subantarctic Subregion.<sup>26</sup> The ranch "Estancia Indiana" (EaI, 54°21'47" S - 67°27'05" W) was selected according to the presence of cow and guanacos (Figure 1).



**Figure 1** Geographic location of the study area. Indiana ranch is located in the center of Isla Grande de Tierra del Fuego, Argentina (left). The typical cover vegetation is composed by forest and grasslands patches (right).

## Vegetation sampling and analysis

To determine the floral and diets composition, plants of the present communities, and feces belonging to guanacos and cows were collected during the winter of 2014. A list of the vegetal species present in the area according to was determined *sensu*.<sup>27–29</sup> These species were then classified according to their functional group, following the criteria applied by other authors, according to life's form,<sup>17,21,30</sup> Cushion (Cu), Creeping bushes (CrBush), Erect bushes (ErBush), Grasses (G), Herbaceous dicotyledons (HD), Tree species (Tr), Graminoids (Gr), Moss/Lichen and Bracken (MLB) The collected samples were used as reference material (*sensu*).<sup>31</sup> The identification of the plants was made at the species level, when possible or not being possible we use the gender or other taxonomic category

## Herbivore feces sampling and analysis

Food habits of herbivores were studied during winter 2014 by randomly collecting 1–5 to dung units of every dropping at each feeding area. 14 total samples were collected (7 from each herbivore). Faeces samples were spread over paper and dried at ambient temperature (24°C) for 10 days and then put into paper bags. Later on, the grounded samples were boiled with 5% NaOH for 1–2 minutes and then rinsed with sodium hypochlorite (NaClO), bleached for a few minutes, and thoroughly rinsed in water again. For each sample, 9 preparations were made and 20 optical fields were quantified for each, a total of 180 optical fields quantified per sample. For counts we use optical microscope Hokenn WP-5-02096.

## Diet analysis

The diet was analyzed by identifying the presence of botanical remains in the feces, that were previously handled according to the method proposed by Arriaga.<sup>31</sup> The species' relative frequencies were obtained and analyzed according to their life form by using the nonparametric Kruskal-Wallis test.

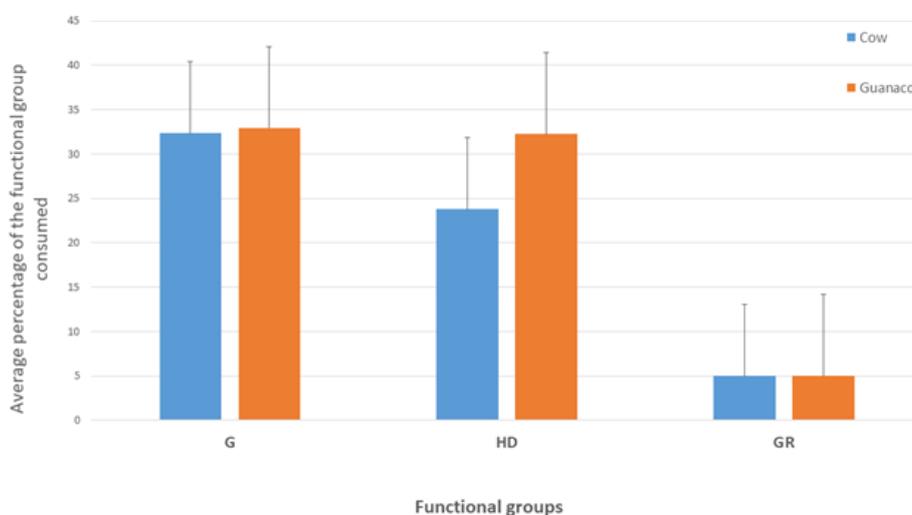
## Results and discussion

The most consumed life forms by both herbivores were, in decreasing order, G, HD and Gr (Figure 2), the same trend that was observed in previous diet studies in the area<sup>17,20,21</sup> since they are the

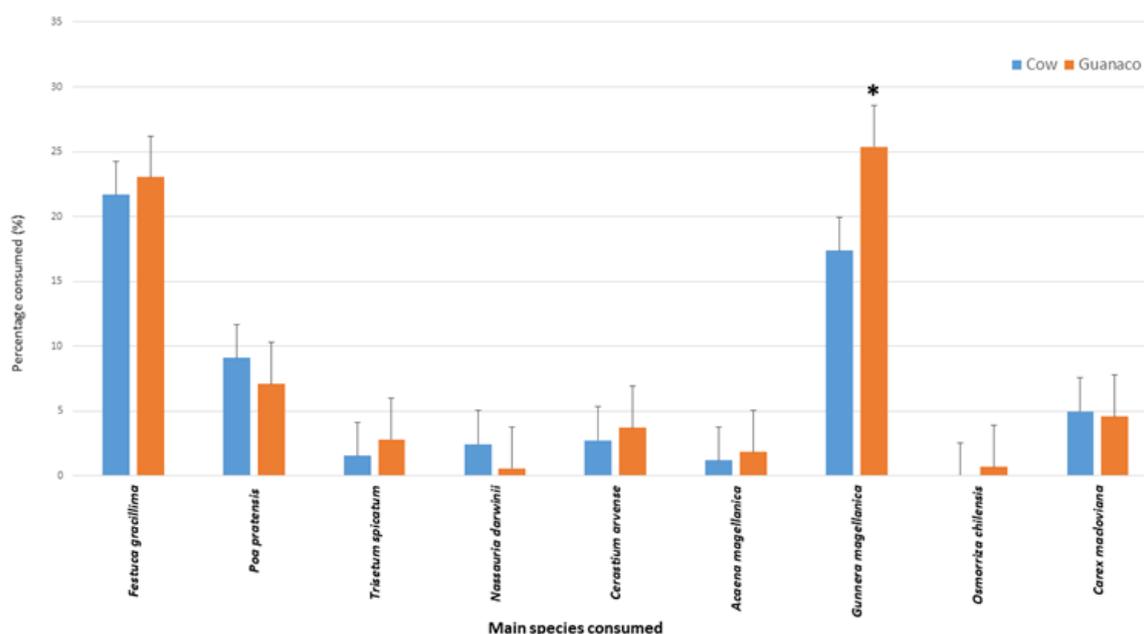
most available and palatable ways of life.<sup>9</sup> The intake frequency of the cow presented no significant differences compared to the guanaco's ( $p < 0.05$ ) (Figure 2). Although the differences were not significant between G and HD in both herbivores, in the case of the cow the difference was greater, while in the guanaco the values are not perceived (Figure 2), this may be due to the fact that the guanaco consumes more HD species present on the edges or inside the forest, a place that domestic livestock do not access.<sup>21</sup> Indirect evidence suggests that prairies are the preferred habitat for guanacos in Tierra del Fuego, but that they use forest patches due to displacement by sheep.<sup>32</sup> Regarding the diversity of species consumed, the diets of both herbivores is less varied than those described in previous works in the area, carried out during spring and summer.<sup>17,21</sup> This may be because winter affects the availability and accessibility of plants for food. The main species consumed by all the herbivores studied were *Festuca gracillima*, *Poa pratensis*, *Carex macloviana* and *Gunnera magellanica*, presenting only significant difference in the percentage of ingestion of the latter, being higher in guanaco ( $p < 0.05$ ) (Figure 3).

Previous studies have provided information about the trophic overlap that occurs between guanacos and other domestic herbivorous animals, mainly cows and sheep,<sup>21,33–36</sup> and about the change in selected items by the native herbivore before the different situations. The guanaco, as a generalist herbivore of intermediate selection, is capable of consuming most available species of plants, from grasses to ligneous species, but mainly bushes.<sup>21,34, 35,37</sup> The effect of the presence of the on the guanaco density and habitat use and selection have not been studied quantitatively in the grassland-forest mosaic of Tierra del Fuego.<sup>38</sup> The trophic overlap degree between the guanaco and cow, regarding consumed species and intake frequency, is similar to the results found in the studies previously carried out by Puig et al.,<sup>39</sup> Fernández Pepi et al.,<sup>17,21</sup> and Linares et al.<sup>40</sup>

Since guanacos migrate seasonally between forests and meadows,<sup>41</sup> as a combined effect of habitat requirements and overlap with domestic animals. The results presented complement the knowledge of guanaco feeding behavior in the presence of domestic livestock, thus being able to respond to the producers of the area and be able to propose sustainable management on these plant communities, as they are stated in previous works, such as those of Martínez Pasteur et al.,<sup>41</sup> and Flores et al.<sup>42</sup>



**Figure 2** Intake percentage, according to the life-form of each herbivore, in Eal. G: grass; HD: herbaceous dicotyledons; GR: graminoids. Blue: Cow; Orange: Guanaco.



**Figure 3** Average percentages of the main species consumed by each herbivore in Eal. Blue: Cow; Orange: Guanaco.

## Conclusion

This study contributes to improve the knowledge about the diet of the guanaco in the presence of the sheep in climate-unfavorable times (winter). This updates the information on the diet and the use of the resources by herbivorous in the fuegian ecotone. The study of plant remains is a technique that allowed us to obtain information on trophic overlap, thus constituting a tool to be taken into account in studies of this type. The data obtained in this study together with those already presented above, will allow us to evaluate the use of the environment by herbivores in this area and interpret changes in the biodiversity of plant communities, and thus be able to propose ways of managing allow to adjust the use of resources without exhausting them.

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## Conflicts of interest

The author declares there is no conflict of interest.

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