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Spring food preferences of rabbits (*Oryctolagus cuniculus* L., 1758) on the Islet of Alegranza (Canarian Archipelago)

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Rabbits have frequently been introduced into several oceanic islands throughout the world (Monnerot et al. 1994; Callou et al. 1996) and currently it is one of the most widely distributed animal species. They were brought to the Canary Islands during the conquest of the archipelago in the 15th century AD (De Abreu Galindo 1977) and today they are present on all the main islands and islets of the archipelago. This lagomorph species has shown a high capacity of adaptation to insular environments (Cheylan 1984), causing serious conservation problems for the composition and structure of vegetation (Thompson 1994). Despite its wide distribution the diet has been poorly studied on islands, and for the Canarian Archipelago only one specific contribution on this subject matter has been published (Martín and Marrero 1999). However, Nogales et al. (1995) gave some information on the frugivorous role performed by this species in some xeric habitats from the Island of Tenerife.

Two main objectives are pursued in this study: 1) to investigate the spring diet of rabbits and the between-year variation pattern, and 2) to determine whether they show diet selection on an islet of minor dimension and of low plant diversity.

Alegranza is the most northern Islet of the Canarian Archipelago, 17 km from the Island of Lanzarote. It has a surface of 11.7 km^2, a maximum altitude of 289 m a.s.l. and the climate can be characterized as semi-arid (annual precipitation lower than 250 mm and average annual temperature of about 20 °C). It has a xeric, sparse and low vegetation, some of the most common species being, *Chenoleoides tomentosa*, *Salsola vermiculata*, *Salsola divaricata*, *Salsola tetrandra*, *Suaeda vera*, *Euphorbia regis-jubae*, *Lycium intricatum*, *Launaea arborescens*, *Aizoon canariense*, among others.

The present study was carried out in three different areas during April 1996 and 1997. One area was located inside La Caldera volcano while the other two were in Llano del Cortijo (hereafter Llano I and Llano II). Every study area had a size of 4 063 m^2 in which both vegetational coverage and biovolume were measured to estimate plant availability. We collected 280 fresh faeces per areas/spring at random from different latrines. The faeces samples were frozen until they were analysed by use of a microhistological method, based on the plant epidermal resistance to chewing and herbivore digestion (Chapuis 1979). This analysis has been widely used to determine the diet of herbivores (Martínez 1988; Quintana et al. 1994) and although its efficacy has sometimes been discussed (Klein and Bay 1995), Rosati and Bucher (1992) suggested that the impact on the estimated botanical composition will rarely cause significant alterations in diet estimates. A faeces sample (2 g) was homogenized and two drops of this mixture were taken and observed with an optic microscope at 100 to 400 magnification. This process was repeated several times for each study

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area with the aim of obtaining a representative sample of the rabbits' diet. Five fields on each slide were examined for a total of 100 slides per study area, including a total of 3 000 examined fields. Epidermal tissues were identified by comparison with a reference collection of both right and back side of leaves and stems of the vegetation of the islet. Data taken from readings of optic fields (N = 3 000) are expressed as a percentage of frequency of occurrence of each plant species. We used Chi-square and G tests to analyse the variation in rabbits' diet and plant availability in the three study areas and during both springs.

More than twenty plant species were identified in the *Oryctolagus cuniculus* faeces (Tab. 1), representing over 18 % of the total species present on the Alegranza Islet. The clearly dominant species were *Salsola vermiculata* in La Caldera (> 73 %) and *Chenoleoides tomentosa* in Llano I (> 73 %) and Llano II (> 88 %) during both collection years. In general, a similar between-year pattern consumption of plant species can be observed. Other plants found at high frequency were, in La Caldera, *Aizoon canariense* and *Mesembryanthemum nodiflorum*, and in Llano I and II, *Heliotropium ramosissimum*, *Aizoon canariense*, and some *Poaceae* species. The consumption of plant species was significantly different in the three study areas ($p < 0.05$), except for *Mercurialis annua* ($G = 2.29$; d. f. = 2; $p = 0.31$) and *Nicotiana glauca* ($\chi 2 = 1.34$; d. f. = 2; $p = 0.50$) in 1996, and for *Nicotiana glauca* ($G = 4.03$; d. f. = 2; $p = 0.13$), *Salsola divaricata* ($G = 2.92$; d. f. = 2; $p = 0.23$), and *Spergularia fallax* ($G = 1.81$; d. f. = 2; $p = 0.40$) in 1997, whose frequency of occurrence did not vary significantly between the three areas.

Comparing diet vs. availability (Fig. 1), it can be observed that no direct relationship exists between plant species abundance and their consumption from all study areas ($p < 0.001$). Therefore, rabbits clearly selected plants for consumption, and abundant species such as *Euphorbia regis-jubae*, *Lycium intricatum*, *Nicotiana glauca*, and *Suaeda vera* showing low consumption levels.

Table 1. Plant species composition identified in rabbit faecal pellets from Alegranza Islet (Canaries). Values are expressed in % of frequency of occurrence (presence/absence).

Species	La Caldera		Llano I		Llano II	
	1996	1997	1996	1997	1996	1997
Aizoon canariense	8.4	4.8	20.6	23.0	8.4	27.6
Ajuga iva	–	0.6	–	–	–	–
Anagallis arvensis	–	–	1.4	–	1.2	–
Chenoleoides tomentosa	–	–	73.6	76.0	94.0	88.8
Echium lancerottense	–	–	0.2	0.2	–	–
Eurphorbia regis-jubae	1.2	0.2	–	–	–	0.4
Heliotropium ramosissimum	–	1.2	32.0	19.6	5.4	27.6
Ifloga spicata	–	–	–	4.4	–	1.8
Launaea aborescens	–	–	1.8	–	1.6	–
Lycium intricatum	–	1.0	–	–	–	–
Mercurialis annua	0.6	0.2	0.4	–	1.2	–
Mesembryanthemum nodiflorum	0.2	17.8	–	–	–	–
Mesembryanthemum sp.	–	–	0.2	–	–	–
Nicotiana glauca	0.8	0.8	1.6	1.2	1.2	0.2
Patellifolia patellaris	–	1.2	0.4	3.2	–	0.4
Policarpaea nivea	–	–	8.0	–	2.0	–
Salsola divaricata	–	0.2	–	0.6	–	1.0
Salsola vermiculata	83.8	77.8	–	–	–	–
Spergularia fallax	2.6	0.6	1.0	1.4	3.6	0.8
Suaeda vera	–	–	2.6	–	1.6	–
Gramineae	5.8	2.0	2.6	20.2	5.8	15.4
Indeterminate	6.6	5.2	9.8	14.0	3.8	9.0

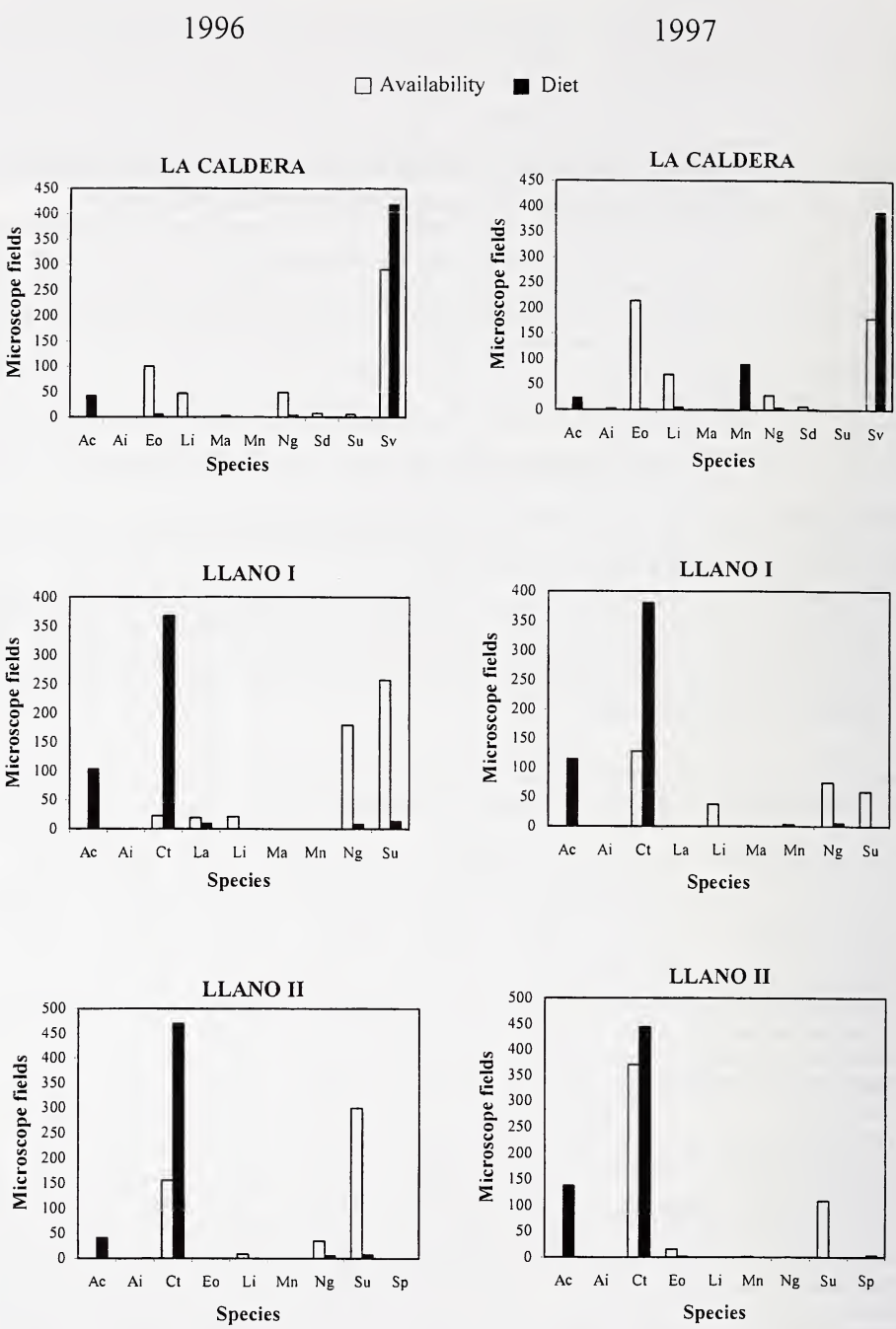

Fig. 1. Comparison between plant availability and diet in the spring of 1996 and 1997 on the Alegranza Islet (Canaries). Data from plant availability were transformed to the same units of optic fields with the aim of relating them to the diet. Ac: *Aizoon canariense*, Ai: *Ajuga iva*, Ct: *Chenoleoides tomentosa*, Eo: *Euphorbia regis-jubae*, La: *Launaea arborescens*, Li: *Lycium intricatum*, Ma: *Mercurialis annua*, Mn: *Mesembryanthemum nodiflorum*, Ng: *Nicotiana glauca*, Sd: *Salsola divaricata*, Sp: *Spergularia fallax*, Su: *Suaeda vera*, Sv: *Salsola vermiculata.* Only the species present in the study areas were included.

Alegranza has an impoverished vegetation because of the continued use of land for agriculture and livestock until 1968, when the island was declared uninhabited (A. Pallarés pers. comm.). Despite this low flora diversity, rabbits consumed at least twenty plant species during the springs of 1996 and 1997. The largest consumption belonged to species included in the Chenopodiaceae family, mainly *Salsola vermiculata* in La Caldera and *Chenoleoides tomentosa* in Llano I and Llano II. These two species do not share the same area, so the rabbits' preference for one of them cannot be estimated. It is interesting to note that Myers et al. (1994) recorded that rabbits avoid Chenopodiaceae species due to the fact that these plants contain a high concentration of salt in arid regions. However, Dawson and Ellis (1979) also reported that this lagomorph consumed these species after a drought period since they have high levels of protein. Furthermore, the low consumption level of some abundant plants in the environrnent, such as *Nicotiana glauca* or *Euphorbia regis-jubae*, may be explained by their content of toxins.

The fact that rabbits select their food could be attributable to the plant features, since other vertebrate herbivores do not compete for this resource on the islet. Despite the fact that rabbits clearly selected two plant species (*Chenoleoides tomentosa* and *Salsola vermiculata*), they consumed vegetables, whose frequency of occurrence varied considerably from one year to the other, e. g., gramineous, *Aizoon canariense*, *Heliotropium ramosissimum*, and *Mesembryanthemum nodiflorum*. Finally, although in general rabbits showed a similar between-year consumption pattern for the main plants in the springs of both years, their diet probably changes during the different seasons of the year according to the state of the vegetation, as indicated by several authors for other areas in the world (Bhadresa 1977; Soriguer 1988; Duffy et al. 1996).

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