



ORIGINAL INVESTIGATION

**Diet of the mara (*Dolichotis patagonum*), food availability and effects of an extended drought in Northern Patagonia (Mendoza, Argentina)**

Silvia Puig<sup>a,\*</sup>, Mónica I. Cona<sup>a</sup>, Fernando Videla<sup>a</sup>, Eduardo Mendez<sup>b</sup>

<sup>a</sup>Grupo Ecología y Manejo de Vertebrados Silvestres (GEMAVR), Instituto Argentino de Investigaciones de Zonas Áridas (IADIZA), CONICET, CC. 507, 5500 Mendoza, Argentina

<sup>b</sup>Grupo Botánica y Fitosociología, Instituto Argentino de Investigaciones de Zonas Áridas, Mendoza, Argentina

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**Abstract**

The mara is a near threatened Caviomorph, endemic to Argentina. Studies on feeding ecology allow assessment of the dietary adaptability of maras to habitat changes. The mara diet and food availability on two sampling sites, belonging to distinct landscapes of Northern Patagonia, were estimated using microhistological analysis and point-quadrat transects, over four seasons, and besides during an extended drought. Significant differences were detected by Kruskal-Wallis ANOVA, feeding selection by the  $\chi^2$  test, and dietary preferences by Bailey's confidence interval. Grasses dominated food availability, with *Panicum* and *Poa* as major species, followed by shrubs and scarce forbs. Plant cover and forbs increased in spring and summer. The drought caused a strong decrease in plant cover and proportion of grasses. Maras ate all grass species, most forbs and several shrubs. Grasses dominated the diet, with *Poa* and *Panicum* being the major species, supplemented by the shrubs *Lycium* and *Prosopis*. Maras ate more grasses and forbs in spring and summer, and shrubs in autumn and winter. More shrubs and forbs, and less grasses, were eaten during the drought. Plant categories were used selectively only in autumn and winter, and in the drought period, with preference for shrubs and avoidance of grasses. *Bromus*, *Poa*, *Plantago* and *Prosopis* were preferred, and *Panicum* avoided. The mara qualified as a grazer but shifted to a mixed feeder during the drought. *Dolichotis patagonum* shared habitats with several big and medium-sized herbivores and showed the highest dietary similarities with plain vizcachas, brown hares and horses. Protective measures for natural habitats are needed, given that increasing impacts on food resources and habitat quality could be threats to the survival of maras and other wild vertebrates in Northern Patagonia.

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**Keywords:** Caviidae; Feeding ecology; Arid environments; Drought; Diet selection

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**Introduction**

The mara (*Dolichotis patagonum*) is a medium-sized herbivore (8.0 kg in body weight, Taber, 1987), that belongs to the Caviidae family. This cursorial rodent, endemic to Argentina, lives in environments of Monte and Patagonia from 28°S to 50°S (Cabrera, 1953;

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\*Corresponding author. Tel.: +0054 261 5244115; fax: +0054 261 5244001.

E-mail addresses: spuig@mendoza-conicet.gov.ar, geecs@lanet.com.ar (S. Puig)

Redford and Eisenberg, 1992; Campos et al., 2001a). Human impacts on the habitat, introduction of exotic herbivores, and poaching were detected as threats to the mara (Baldi, 2004); the species qualified as near threatened (Ojeda and Pardiñas, 2008). This diurnal herbivore prefers open grass-dominated habitats to construct its breeding warrens and avoids closed habitats dominated by tall shrubs (Kufner and Chambouleyron, 1991; Baldi, 2007; Rodriguez, 2009). Studies on the mara feeding strategy can enrich explanations of habitat selection, which until now only focused on vigilance strategy (Dubost and Genest, 1974; Taber, 1987; Taber and MacDonald, 1992).

The mara was described as a generalist herbivore in Central Monte, based on the high dietary diversity of this rodent, compared to other herbivores present in that environment (Kufner et al., 1992). An opportunistic behavior was noted due to the inclusion of the most stable and predictable food resources, grasses and shrubs, in the mara diet throughout the year, and from the appearance of forbs as main dietary items after the spring rains (Kufner and Sbriller, 1987). Monocots comprised most of the mara diet in Central Monte during the wet season (Campos et al., 2001b), whereas dicots (shrubs) were detected as the main nutritional source for maras in Southern Monte during winter and summer (Bonino et al., 1997). Studies on feeding ecology allow assessment of the dietary adaptability of maras to habitat changes. Dietary proportions of plant species reflecting their respective proportions in the vegetation will be expected from an opportunistic behavior (Jaksic, 1989).

Environmental variables such as food availability, climate and human impacts, only occasionally considered in dietary studies of this caviomorph, can be important factors to explain dietary variations among mara populations. Studies on differences among seasons and regions in the quantity and quality of the food available for maras can be essential to understand the mentioned changes in dietary prevalence from monocots to dicots. Plant structure, cover and diversity, and therefore food availability for herbivores, are expected to show differences among environments according to topographic, edaphic, hydric and phytogeographic characteristics, among others (Fernández and Busso, 1999). A lower plant cover, a faster loss of moisture content in plants, and a predominance of unpalatable, spiny and even aphyllous species are to be expected as the climate grows more arid (Cabido et al. 1993). Especially during drought periods, plant cover will decrease, and sprouting and vulnerable plant species will disappear. Human impacts such as logging, fires and livestock overgrazing usually generate a reduction of plant cover and diversity, and a predominance of species non-consumed or avoided by herbivores (Fiori and Zalba, 2003; Abraham et al., 2009).

Arid environments are characterized by strong climate variations, with frequent drought periods (Stafford Smith, 1996), and herbivores need to develop responses to face food shortage, such as flexible and opportunistic foraging strategies, migratory movements, creation of food-storing sites, and reduction of energy demands (Scoones, 1995; Van Horne et al., 1998; Rosi et al., 2003; Gutman et al., 2006, among others). The Northern Patagonia environment has a special interest due to its dry and cold climate and high rainfall variability, which adds temporal uncertainty to the spatial heterogeneity of food availability (Puig et al., 1996). Outstanding spatial differences in vegetation and soil in that environment are strongly related to the irregular distribution of volcanic stone outcrops (González Díaz, 1972; Martínez Carretero and Dalmaso, 1993).

The objectives of this study are to analyze the mara diet and food availability at two sampling sites, belonging to distinct landscapes of Northern Patagonia, in order to detect: a) whether the mara exhibits dietary opportunism, and this feeding behavior persists despite seasonal and spatial changes in food availability, and b) whether food availability and the diet of maras are affected by an extended drought.

## Material and methods

### Study area and habitat characteristics

The study area (36°30'S 69°00'W, 1,200 to 2,000 m in altitude) is representative of La Payunia, the northernmost biogeographic unit of the Patagonian province (Cabrera and Willink, 1980), which has been recently proposed as a new phytogeographic province (Martínez Carretero, 2004). The climate is continental desert (Consejo Federal de Inversiones, 1977). Mean temperature ranges from 6 °C in winter to 20 °C in summer, and annual precipitation averages 255 mm. The Payún volcanic complex (3680 m a.s.l) stands out in La Payunia. The relief presents gentle slopes and large plains, interrupted by basaltic steps and hills originated from volcanic activity (González Díaz, 1972, 1979). The xerophyllous vegetation belongs to the Patagonian shrub steppe. Almost all shrubs are represented by evergreen species.

La Payunia has been divided into landscapes characterized by recurrent patterns of relief, soil and vegetation, based on 1:50,000 aerial photography, geological cartography (González Díaz, 1972, 1979) and plant cartography (Martínez Carretero and Dalmaso, 1993; Roig et al., 1996). Two of those landscapes were selected with different geomorphology and vegetation characteristics (Table 1), and one study

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