Applied Animal Behaviour Science 165 (2015) 81–87

Contents lists available at ScienceDirect

Applied Animal Behaviour Science

journal homepage: www.elsevier.com/locate/applanim

Comparative study of trophic behaviour and herd structure in wild and feral goats living in a Mediterranean island: Management implications

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ARTICLE INFO

Article history:
Accepted 18 January 2015
Available online 7 February 2015

Keywords:
Majorcan wild goat
Feral goat
Behaviour
Feeding
Insularity
Hunting

ABSTRACT

The aim of this study was to compare the trophic behaviour and the social structure of Majorcan wild goats and feral goats present in the island of Majorca. The former are descendants of an ancestral goat ecotype introduced in the island in the late Neolithic, whereas feral goats come from domestic forms introduced recently from the Iberian Peninsula. The study was conducted in four localities of the Serra de Tramuntana, a mountain range located in the northwest of the island of Majorca. Behavioural data were collected in three seasons, summer, winter and spring of 2011–2013, and when goat activity is at its peak, i.e., 3 h after dawn and before dusk. The following variables were recorded: group composition (males, females, and kids) and activity (feeding, walking, resting, and watching). The proportion of time spent on each activity and their frequency were obtained from focal samples. Multivariate analyses of variance (MANOVA) were used to simultaneously analyse the activity variables. A total of 155 observations of 85 herds were registered throughout the study. A similar behaviour pattern has been observed in this study for the two goat ecotypes, feral and wild, apart from some seasonal variations in feeding and resting activities. In summer, feral goats showed higher feeding efforts (duration and frequency) than wild goats; this might be related to a lower efficiency obtaining feeding resources by the former, whereas wild goats, that have inhabited the island for millennia, coexisting with vegetation in periods of lower forage abundance and quality, would be more efficient herbivores during restrictive periods. Average herd size for both ecotypes is smaller than that recorded for domestic goat herds, suggesting a relatively low browsing damage compared to the latter. Also, feral goats apparently have a higher gregarious behaviour than wild ones, which might relate to their domestic origin. Currently, the management of goats on the island is based on maintaining the wild ecotype and eradicate the feral one, whose impact on vegetation is supposedly worse. However, our results show a similar trophic behaviour by both ecotypes, so that their impact on vegetation should also be expected to be similar, indicating that this argument has not enough scientific basis.

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http://dx.doi.org/10.1016/j.applanim.2015.01.015
0168-1591/

1. Introduction

The arrival of goats (*Capra* sp.) to the island of Majorca is very ancient, and has documented between 2300 and 2050 BC during the Pre-Talaiotic culture (Seguí et al., 2005). It has been postulated that the first goats introduced to the island gave rise to a local breed that remained in the wild until present, the so-called Majorcan wild goat (*Capra aegagrus [hircus]* ssp.). Currently, it is an important source of income through hunting activities in the island (Seguí et al., 2005), being in the hunting grounds where the purest populations are conserved. The introduction of domestic breeds (*C. hircus*) in more recent times and their subsequent abandonment has led to the establishment of a large population of feral goats phenotypically clearly differentiated (Vives and Baraza, 2010). This abandonment took place in the 1960s, when tourism began to develop intensively. Goats may form feral populations in localities where they are abandoned, as keeping them as domestic stock is no longer valuable, and particularly where predators are absent or scarce, as it occurs in Majorca.

Herds of feral goats have a marked effect on the ecosystems they inhabit (Coblentz, 1978) and can be an economic and hunting resource (Forsyth et al., 2009). In many places the feral goat is considered an invasive species (Parkes, 1993; Parkes et al., 2002), foreign to the natural ecosystem and therefore its eradication is recommended in order to reduce the negative impact on the agricultural and natural ecosystems.

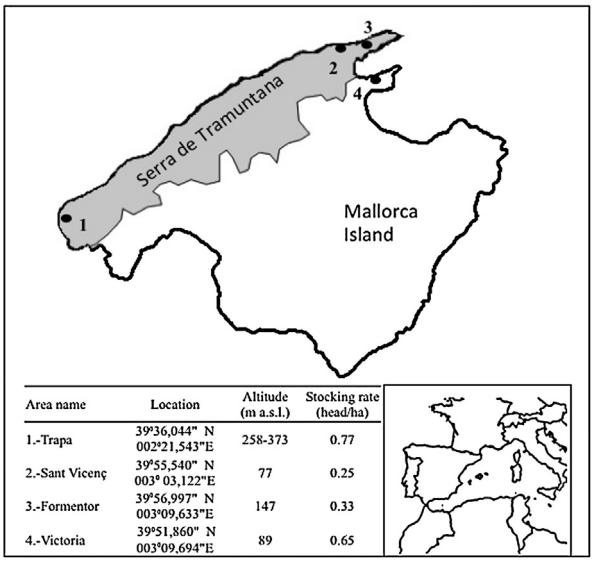
In the Serra de Tramuntana of Majorca, feral goats have been present for at least 50 years, according to farmers' accounts. In the past, both wild and feral goats were hunted alike on the island using an ancient technique called "cans i llaç" (dogs and loop), which consisted of a round up the goats with the help of dogs in cliffs and then catching them with a loop (Seguí, 2008). Nowadays, the way that goats are managed in the island differs according to their ecotype. Wild goats are only hunted using firearms it hunting areas, whereas feral goats are captured throughout the highlands using both techniques, dog and loop for kids, and firearms, in eradication campaigns.

The available literature on the behaviour of goats describes a very similar social behaviour between wild and feral populations (Shackleton and Shank, 1984). Therefore, we would not expect much difference between the behaviour of feral goats and the Majorcan wild goats, but due to different handling both ecotypes receive, their behaviour could be different. The main objective of this study was to compare the trophic behaviour and the social structure of Majorcan wild goat and feral goat herds present in the island of Majorca. The identification of food habits and routines, as well as the social structure of both ecotypes, might allow us to establish proper management scenarios for both goat ecotypes.

2. Methodology

2.1. Study area

The study was conducted in four localities of the Serra de Tramuntana, a mountain range located in the northwest of the island of Majorca. It ranges 90 km and stretches in a southwest-northeast direction, with a surface of 800 km^2. The highest peak is Puig Major, 1445 m above sea level (a.s.l.) (39° 48′27″ N, 2° 47′36″ E). The entire mountain range was listed as a World Heritage Site by UNESCO in 2011.



Area name	Location	Altitude (m a.s.l.)	Stocking rate (head/ha)
1.-Trapa	39º36,044" N 002º21,543"E	258-373	0.77
2.-Sant Vicenç	39º55,540" N 003º 03,122"E	77	0.25
3.-Formentor	39º56,997" N 003º09,633"E	147	0.33
4.-Victoria	39º51,860" N 003º09,694"E	89	0.65

Fig. 1. Sample location.

The climate is typically Mediterranean, with two rainy seasons (spring and autumn), a hot dry summer and a warm dry winter. Spatial variation of rainfall is significant, with a maximum of 1400–1600 mm per year located in the central sector of the mountain, with drier points not exceeding 300–350 mm in coastal areas. The annual average temperature ranges from 16 to 18 °C in the lower parts of the mountain. The four areas considered in this study are located in the lower part of the mountain range between 77 m and 439 m a.s.l. The perennial tussock grass *Ampelodesmos mauritanica* dominates the vegetation community. Several shrub species, such as *Chamaerops humilis*, *Olea europaea* var. *sylvestris*, or *Pistacia lentiscus* are scattered over the territory, mainly close to caves and rock shelters. This plant community is characteristic of the giant reed thicket succession (*Smilaco balearicae–Ampelodesmetum mauritanicae*), according to Rivas-Martínez et al. (1992).

Two study areas, Formentor and Victoria (Fig. 1), are hunting estates where animals are selected according the breed traits of the Majorcan wild goat (Decree 91/2006 of the Council of Majorca). The animals survive year round with the resources of the estates, without any food supplementation, but subject to disease control. The stocking rate of these areas was calculated from data provided by the managers (Fig. 1). These goats are considered as *Capra aegagrus* by some authors, because of their wild status (Seguí and Payeras, 2002; Masseti, 2009), but some others argue that they are feral populations of ancient domestic stocks, and should be included in the domestic species *Capra hircus* (Giannatos et al., 2006).