

What determines grazing preference for Mediterranean woody species?

Perevolotsky A.

Systèmes sylvopastoraux. Pour un environnement, une agriculture et une économie durables

Zaragoza : CIHEAM
Cahiers Options Méditerranéennes; n. 12

1995
pages 221-224

Article available on line / Article disponible en ligne à l'adresse :

<http://om.ciheam.org/article.php?IDPDF=96605524>

To cite this article / Pour citer cet article

Perevolotsky A. **What determines grazing preference for Mediterranean woody species?**. *Systèmes sylvopastoraux. Pour un environnement, une agriculture et une économie durables*. Zaragoza : CIHEAM, 1995. p. 221-224 (Cahiers Options Méditerranéennes; n. 12)



<http://www.ciheam.org/>
<http://om.ciheam.org/>

What determines grazing preference for Mediterranean woody species ?

Perevolotsky Avi

Department of Natural Resources, ARO, The Volcani Center, PO Box 6
Bet Dagan 50250 - ISRAEL

Summary: This paper compares the importance of the nutritional value vs. the role of secondary compounds in determining goats' dietary preferences. It is demonstrated quantitatively that minimizing tannin ingestion is perhaps more important for goats than maximizing nutritional content of the diet. However, since goats must gather 1.5-2.0 kg DM/day for maintaining productivity, their diet is a compromised result of forage abundance, high nutritional value and low content of anti-nutritional compounds.

Key-words: Tannins, Nutritional value, Goats, Grazing preference

INTRODUCTION

Goats are notorious for their ability to select feed, either among plant species or between vegetative parts (Harrington, 1982). Goats have been traditionally considered as efficient browsers but many field studies have questioned the 'browsing' conclusion (e.g., Lu, 1988). The current view considers the goat as well-adapted to utilize leaves, buds and fruits of woody plants but not as an obligate browser, and as being extremely flexible and mixed-feeding 'opportunists' in its feeding behavior (Lu, 1988; Stuth and Kamau, 1990). This grazing behavior emphasizes the capability of selecting preferred food items among a variety of nutritional sources. On the other hand, the role of secondary compounds, mainly tannins, in determining grazing behavior, has been recognized recently (Bryant et al., 1991). Diet selectivity is obviously affected, to a certain level, by the plant antiherbivory defense system whether 'physical' - thorns, prickles (Cooper and Owen-Smith 1986, Perevolotsky and Haimov 1992); nutritional (high fiber content-low nutritional value - Provenza, 1994) or 'chemical' (secondary compounds that cause physiological malaise and deter animals from continuing grazing).

The objective of this study was to evaluate the relative role of the nutritional value and secondary compounds in determining the feeding behavior of goats in the Mediterranean woodland in Israel.

MATERIALS AND METHODS

The study took place in a dense stand of Mediterranean woodland near the foothills of the Judean Mountains in central Israel (latitude 31°40'N, longitude 34°55'E, elevation - 350 m, mean annual rainfall - 400 mm). The woody vegetation in the area forms a dense thicket dominated by dwarf shrubs (mainly *Cistus* sp.), moderate-sized shrubs (*Pistacia lentiscus* and *Rhamnus lycioides*) and low trees, dominated by *Quercus calliprinos* and *Phillyrea latifolia*.

Actual feeding time (time devoted solely to feeding); species-specific feeding time, and the number of individual plants of each species grazed or passed by were recorded by direct

observations. Feeding time per plant and species and the number of eaten plants, were used to determine the diet composition and selectivity. All by all, there were 99 observation intervals with an average length of 8.25 minutes, and an overall observation time of 4269 minutes (71 h) (for more details on the experimental setting see Perevolotsky and Haimov, 1991).

The abundance of different plant species in the goat diet (equivalent of r in Ivlev's index - Ivlev, 1961) was derived from species-specific grazing time. The abundance of different plant species in the field was determined from the data on species distribution along the goat's route. Ivlev's forage ratio (FR - Ivlev, 1961) - the ratio between the proportion of a given food item in the consumer diet (r) to the proportion of the same food item in the environment (p) - was used for quantifying plant selectivity.

An assessment of the nutritional value of the 4 most common species in the goats' diet: herbaceous vegetation, *Cistus* sp., *Quercus calliprinos*, *Phillyrea latifolia*, and of *Pistacia lentiscus* which is very abundant in the field but not in the diet, was conducted. In vitro digestibility of organic matter (IVOMD) of foliage samples was determined by the Tilley and Terry method. Crude protein content of the foliage was determined by the micro-Kjeldahl method. Water content was calculated by subtracting dry weight of plant samples from the fresh weight. Tannin concentration was determined in foliage samples of the dominant species by the Hagerman and Butler protein precipitation (astringency) method (1978).

RESULTS AND DISCUSSION

Figure 1 presents the average grazing time for each of the common species in the study area. Clearly, there are considerable differences in the time devoted to graze each species, but the question is whether these differences represent any selectivity based on plant properties. The preference or avoidance of the various species is expressed in figure 2 by different location and distance from a 'neutral' line ($r=p$) that represents a situation of random choice: selection is in linear relations with abundance. Herbaceous vegetation and *Quercus calliprinos* are preferred species, *Cistus* and *Pistacia* are avoided and *Phillyrea* is chosen in random.

The nutritional parameters of the foliage of each of the common species is presented in Table 1. When a nutritional index is calculated (combining digestibility, protein and water content), and compared to the tannin effect on Forage Ratio, it becomes clear that secondary compounds are more important in determining selectivity than is the nutritional content (fig.3). In other words, the goats select against tanniferous material more than for nutritious forage.

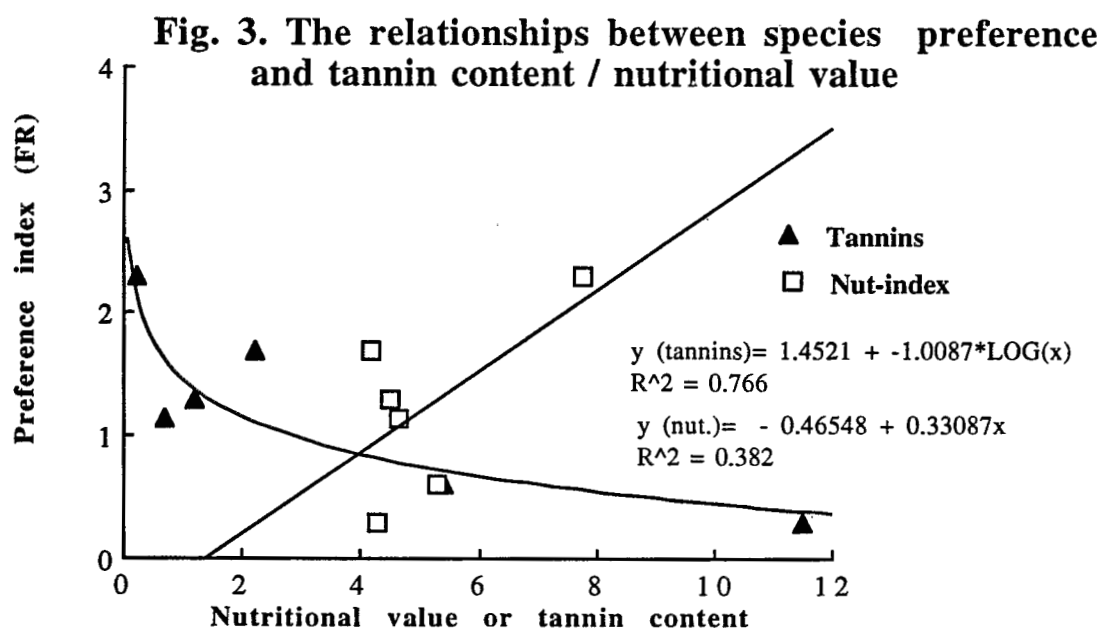
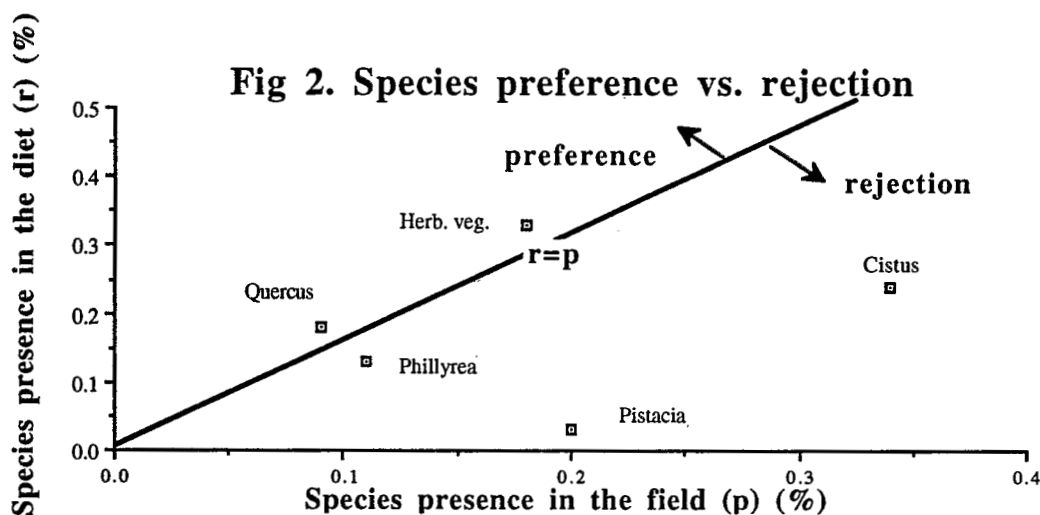
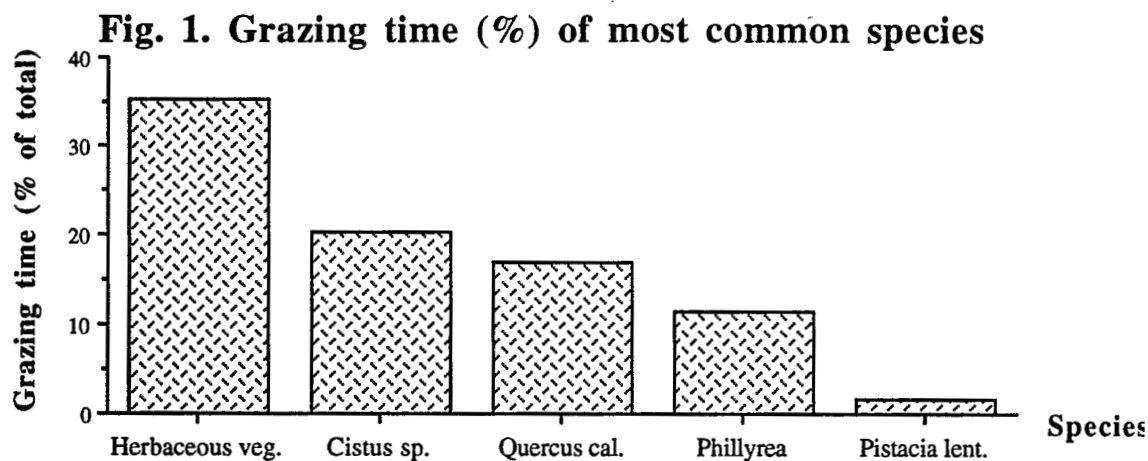
Table 1. The nutritional and tannin content in foliage of dominant species

SPECIES	TANNIN* (%)	DIGESTIBILITY (%)	PROTEIN (%)	WATER* (%)
<i>Herbaceous vegetation</i> **	0.20	70.00	15.00	70.00
<i>Cistus spp.</i>	5.40	44.40	9.50	52.00
<i>Quercus calliprinos</i>	2.20	35.60	7.50	40.00
<i>Phillyrea latifolia</i>	0.70	45.00	8.00	40.00
<i>Pistacia lentiscus</i>	11.50	30.30	8.00	47.00

* - Expressed in percentage of dry weight.

** - In the green season (3 months)

This study suggests that the goat dietary preferences are a combination of attempting to increase nutritional value intake while minimizing the digestion of secondary compounds, a "maxi-mini" strategy. The fact that the tannin concentration was more significant in determining Forage Ratio (higher R^2) than is the nutritional value, may indicate that aversion, rather than preference, characterizes the goat digestive behavior.



What, then, determines dietary behavior and preferences of goats in the Mediterranean environment? Goats are forced to gather about 1.5-2.0 kg of dry matter forage during a regular grazing day (Perevolotsky et al., in press) from a relatively unpalatable 'menu.' Because most plants encountered in the scrubland are of moderate to low nutritional value, it is efficient to consume them on an availability basis and thus obtaining the majority of the diet bulk. However, in order to improve the diet quality, goats also practiced a selective grazing. While doing so, the level of ingested tannins (as well as other chemicals) may induce a diet switch once aversive effects occur. Such grazing strategy, combined with the continuous need to sample the vegetative community and the limited information on actual forage values, provides most of the reasoning behind the goat diet selectivity in the Mediterranean scrubland. The goats under these environmental conditions are not generalist herbivores as much as selective mixed feeders (grazers-browsers). They operate under the constraint of gathering a minimum amount of digestive organic matter for maintenance within a limited period of time, while avoiding the ingestion of too much secondary compounds.

REFERENCES

Bryant J.P., Provenza F.D., Pastor J., Reichardt P.B., Clausen T.P., du Toit J.T., 1991. Interactions between woody plants and browsing mammals mediated by secondary metabolites. *Annual Review of Ecology and Systematics* 22:431-446.

Cooper S.M., Owen-Smith N., 1986. Effects of plant spinescence on large mammalian herbivores. *Oecologia* 68:446-455.

Hagerman A.E., Butler L.G., 1978. Protein precipitation method for quantitative determination of tannins. *Journal of Agricultural Food Chemistry* 26:809-812.

Harrington G.N., 1982. Grazing behavior of the goat. Pages 398-403 *In XXX, editor. Proceedings 3rd Int. Conf. on Goat Prod. and Disease. Tucson, Arizona. pp. 398-403*

Ivelv V.S., 1961. *Experimental Ecology of the Feeding of Fishes*. New Haven, Conn., Yale University Press.

Lu C.D., 1988. Grazing behavior and diet selection of goats. *Small Ruminant Research* 1:205-216.

Perevolotsky A., Haimov Y., 1991. The effect of thinning and goat browsing on the structure and development of Mediterranean woodland in Israel. *Forest Ecology and Management* 49:61-74.

Perevolotsky A., Haimov Y., 1992. Structural response of Mediterranean woodland species to disturbance: evidence of different defense strategies *Israel Journal of Botany* 40:305-313.

Stuth J.W., Kamau P.N., 1990. Influence of woody plant cover on dietary selection by goats in an Acacia senegal savanna of East Africa. *Small Ruminant Research* 3:211-225.