



# **Grasslands and Woody Plants in Europe**

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# Effects of pastoral activities on woody-plant community distribution and landscape diversity in western Crete

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## Summary

The role of pastoral activities involving grazing, pastoral burning and corralling was studied in a representative village community of western Crete. Land cover types within a range of 300 m around 16 animal sheds of the study area were mapped from air photos taken in 1989 and digitised with GIS. Also, the number and kind of animals belonging to each shed was recorded. It was found that open-shrub communities such as phrygana and garrigues, which are favoured by grazing and burning, were proportionally covering a larger area near the sheds while denser and taller woody communities such as maquis and woodlands tended to increase their area away from them. The implications of pastoral activities for woody-plant community distribution and consequently for landscape structure and diversity are discussed.

*Keywords:* animal sheds, landscape diversity, pastoral burning, woody plant community distribution.

## Introduction

Up until a few decades ago, livestock husbandry in western Crete was practised extensively. Animals were communally grazed but their numbers were kept in equilibrium with the grazing capacity of Mediterranean vegetation, which was rotationally burned by shepherds every 5-10 years in order to control the density and spread of the unpalatable woody plants, thus creating a patchy vegetation pattern. In recent years, mainly since Greece joined the European Union (EU) in 1981, the situation has changed. Although the communal system of grazing is still practised, the number of sheep and goats has been increased by 50% and permanent sheds have been built due to EU subsidies (Ispikoudis *et al.*, 1993; Ouled Belgacem, 1993). In addition, livestock husbandry became more intensive by improving the local animal breeds, by feeding the animals with hay and concentrates and by shortening the burning cycle of woody vegetation to ensure high quality feed. These changes have led to a more sedentary system of production in which animals are roaming around the permanent sheds instead of spreading more uniformly over a larger area. As a result, the pattern of woody community distribution over the landscape has changed.

It seems therefore that intensification of animal husbandry in western Crete is creating new landscape patterns. In this paper, the role of pastoral activities on woody plant community distribution and landscape diversity is investigated and discussed.

## Study area

The research was carried out in the village community of Epanochori, located in the northern part of the Sougia Basin in western Crete (latitude: 35° 19', longitude: 23° 50'). The whole village territory has an area of 2232 ha of which 536 ha are covered by phryganic ecosystems, 720 ha by garrigues, 252 ha by maquis and 172 ha by coniferous forests (*Pinus brutia* and *Cupressus sempervirens*) while the remaining 380 ha are occupied by agricultural lands (e.g. olive groves and cereals), settlements, riverine vegetation and bare ground (Papanastasis & Kazaklis, 1998). Altitude ranges from about 300 to 1600 m and soils are derived from metamorphic rocks and hard limestone (Ouled Belgacem, 1992).

The whole area is grazed by 3630 sheep and 3880 goats, which are distributed in 16 range units, each one centred by a shed (Ouled Belgacem, 1992). The total grazed area amounts to 768 ha; while the stocking rate was different in the 16 units due to the different number of animals allocated to each one of them but high thus indicating overgrazing (Table 1).

Table 1. Stocking rates in 16 stables of the Epanochori village community.

Stable No	Number of animals	Range unit (ha)	Stocking rate (animals ha <sup>-1</sup> )
1	150	58	2.58
2	235	75	3.13
3	200	61	3.27
4	90	38	2.36
5	50	18	2.77
6	10	4	2.50
7	1000	288	3.47
8	45	17	2.64
9	80	26	3.07
10	120	38	3.15
11	35	14.5	2.41
12	130	38	3.42
13	25	12	2.08
14	35	15.5	2.25
15	200	54	3.70
16	20	11	1.81

Source: Ouled Belgacem (1992)

## Materials and methods

Land use/cover types of Epanochori were mapped from air photos (with a scale of 1:30,000) taken in 1989 by using a Bausch and Lomb Stereo-Interpretation Systems SIS-95 instrument (Kazaklis & Karteris, 1993). The land cover maps produced were subsequently introduced into a GIS (Arc-Info) basis. A digital terrain map was also produced from the topographic map of the region. The points in which the 16 sheds were located were indicated on the maps. Land cover types around the 16 sheds were recorded every 50 m away from each shed and at four cross directions (N, E, W and S) up to a 300 m distance. Land cover types were grouped into five categories (arable land and settlements, phrygana, garrigues, maquis and woodland (forest)). These categories were checked in the field and the dominant plant species were recorded. The relation between the relative percentage land cover of each category and its distance from the shed was graphically expressed.

## Results

Figure 1 shows the mean distribution of the 5 land cover types 300 m away from the 16 sheds. It is evident that phryganic ecosystems were the vegetation cover type occupying more than 30% of the area around the sheds. They were dominated by *Sarcopoterium spinosum*, *Cistus creticus*, *Genista acanthoclada* and *Euphorbia acanthothamnus*, all of them seasonally dimorphic dwarf shrubs which are favoured by the combination of pastoral fires and overgrazing (Papanastasis, 1977). The second-largest cover type was garrigues, which are also open, dwarf-shrub communities, dominated by a mixture of phryganic species and evergreen shrubs such as *Erica manipuliflora* and *Quercus coccifera*. Maquis vegetation, characterized by tall and densely arranged shrubs such as *Arbutus unedo*, *Erica arborea*, *E. manipuliflora* and *Olea oleaster*, occupied a relatively small area and so did the woodlands (forests), which were dominated by *P. brutia*, particularly near the sheds. This open landscape around the sheds was further enhanced by the presence of arable land and settlements.

A better picture of the woody-plant community distribution was derived when individual sheds were examined according to the kind of animals they house and graze in their territory. Figure 2 shows that the structure of vegetation was more diverse around sheds where livestock were mixed (c and d) as well as around the shed where there were only goats (a) than around the shed where only sheep were grazing (b). On the other hand, a clear change in the arrangement of cover types at the 150-200 m distance from the sheds was found with a more diverse structure beyond 200 m compared with the one close to the sheds (less than 200 m distance from them).

## Discussion and conclusions

If we consider that plant cover and height increases as we move from phrygana to garrigues and from there to maquis and woodlands (Kazaklis & Karteris, 1993), the arrangement of these woody plant communities in space may affect landscape structure and

Figure 1. Distribution of land cover types in relation to distance from the shed (mean of 16 sheds).

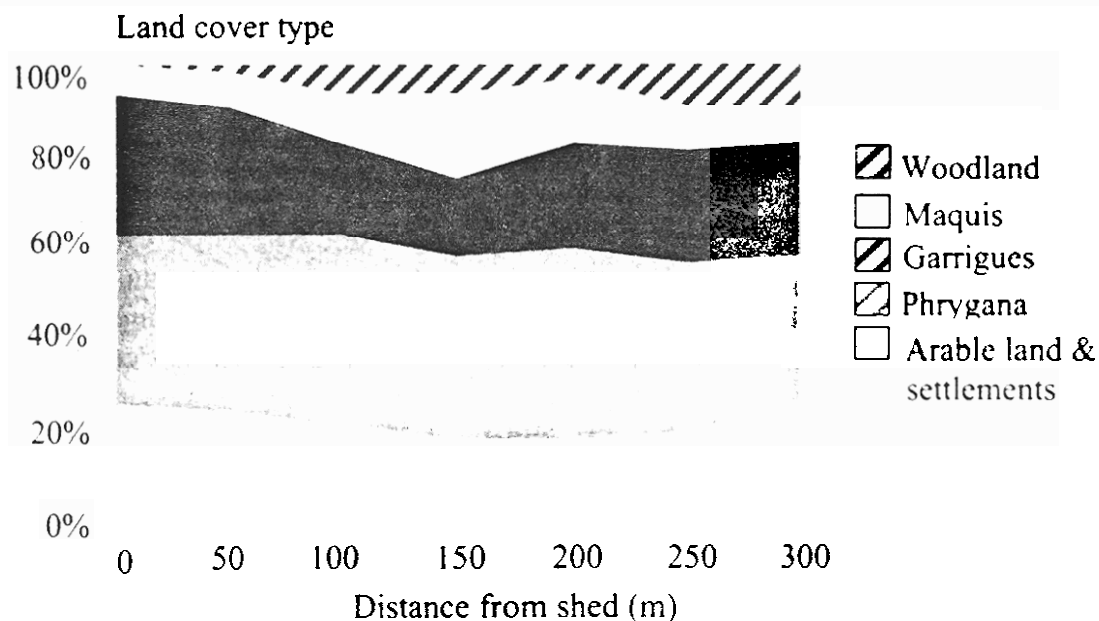
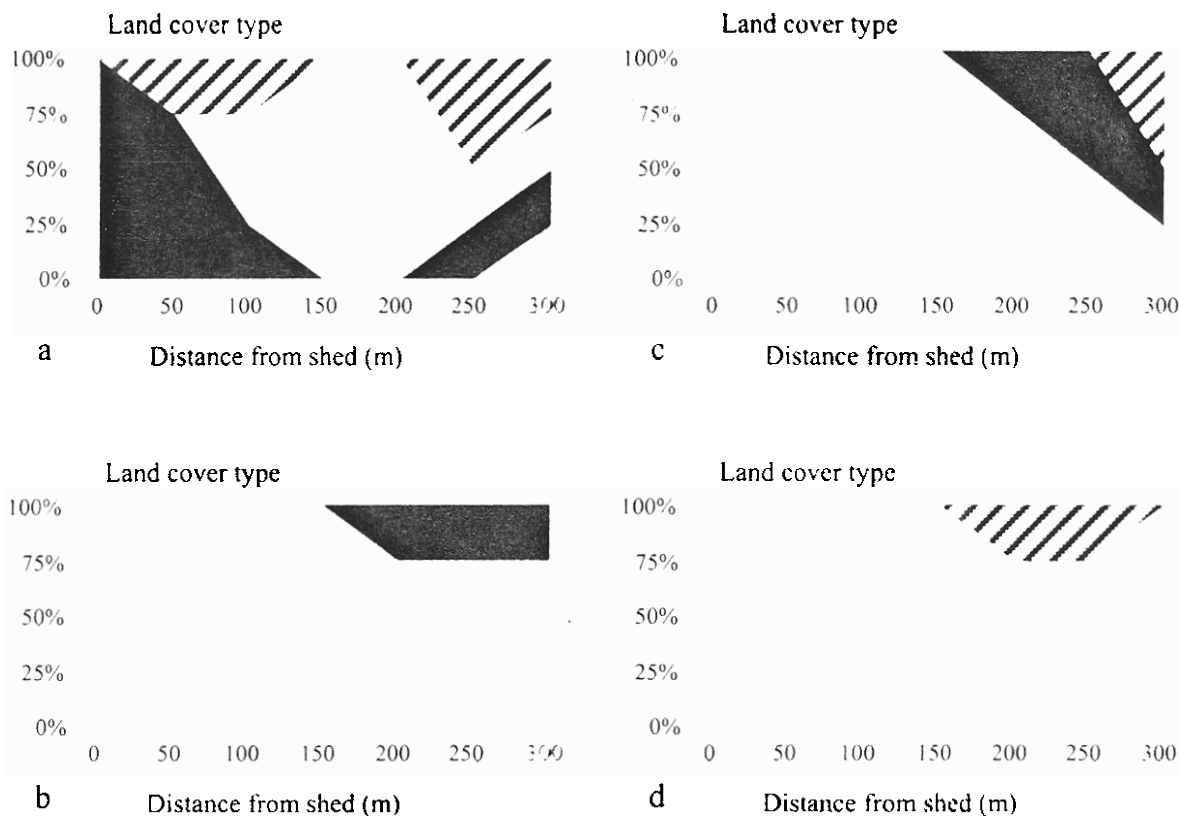


Figure 2. Distribution of land cover types in relation to the distance from the shed in various livestock farms: (a: only goats, b: only sheep, c and d: sheep and goats)



Phrygana Garrigues Maquis Woodland Arable land & settlements

diversity. The more orderly they are arranged the more uniform the landscape becomes while their random distribution may result in a more heterogeneous landscape.

On the other hand, the boundaries of these woody-plant communities are not fixed. Maquis can be converted to garrigues, and garrigues and coniferous forests to phrygana with pastoral fires and overgrazing. Also, the opposite way may be followed if these two factors are removed (Papanastasis *et al.*, 1999).

The fact that open, dwarf-shrub communities such as phrygana and garrigues were covering proportionally larger area near the sheds than away from them suggests that pastoral activities, as practised in Epanochori, may lead to a homogeneous landscape. Such a development may be prevented if sheep are combined with goats instead of having only sheep in the Mediterranean rangelands of western Crete.

## References

- Ispikoudis, I., G. Lyrantzis & S. Kyriakakis, 1993. Impact of human activities on Mediterranean landscapes of western Crete. *Landscape and Urban Planning*, 24: 259-271
- Kazaklis, A. & M. Karteris, 1993. Land use type: patterns and relationships with abiotic landscape factors in western Crete. *Landscape and Urban Planning*, 24: 249-257.
- Ouled Belgacem, A., 1992. Grazing practices in western Crete and their impact on rangeland vegetation. Ms Thesis, Mediterranean Agronomic Institute of Chania, Crete.
- Papanastasis, V.P., 1977. Fire ecology and management of phrygana communities in Greece. Proceedings of the Symposium on Environmental Consequences of Fire and Fuel Management. In: *Mediterranean Ecosystems* H.A. Mooney & C.E. Conrad (coors). USDA Forest Service, General Technical Report WO-3, pp. 476-482. Washington D.C.
- Papanastasis, V.P. & A. Kazaklis, 1998. Land use changes and conflicts in the Mediterranean-type ecosystems of western Crete. In: *Landscape Degradation and Biodiversity in Mediterranean-Type Ecosystems*. Rundel *et al.* (eds). Ecological Studies, Vol. 136, pp. 141-153. Springer-Verlag Berlin-Heidelberg.
- Papanastasis, V.P., I. Ispikoudis, M. Arianoutsou, P. Kakouros & A. Kazaklis, 1999. Land use changes and landscape dynamics in western Crete. In: *Dynamics in Mediterranean Vegetation Landscape*, S. Mazzoleni *et al.*, (eds). Gordon and Breach Publ, UK (under publication).