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Restoring semi-arid rangelands on a Greek Aegean island

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SUMMARY – Sheep farming is an important activity on the Aegean island of Lesvos, where sheep are grazing on the available areas year-round. Since most of the grazed areas are invaded by the xerothermic, undesirable, thorny bush *Sarcopoterium spinosum*, a rehabilitation trial was designed. Data were collected on the area usage, edapho-climatic conditions and the area vegetation and were used in formulating the rehabilitation strategy targeting a 5-ha area under rainfed conditions. The strategy included: removal of plant cover by mechanical means, soil conditioning (liming and fertilization), reseeding with a mixture of *Dactylis glomerata*, *Medicago sativa* and *Trifolium subterraneum*, and protection from grazing. Grazing was allowed to cattle at the end of the first growth period and to sheep thereafter. Results after fifteen years show that *Sarcopoterium spinosum* plants are near extinction and an average production of herbaceous vegetation of 2,000 kg dry matter/ha is achieved. It is concluded that rangeland rehabilitation in semi-arid islands presents an interesting option for supporting livestock farming and upgrading the landscape.

Keywords: Rangeland management, land rehabilitation, grazing sheep, Greece.

RESUME – "Restauration de parcours semi-arides dans une île de la mer Egée, Grèce". L'élevage ovin est une activité importante dans l'île de Lesbos (Egée Nord) où les animaux sont sur parcours et pâturage toute l'année. Depuis que la plupart des pâturages sont envahis par le *Sarcopoterium spinosum*, plante épineuse, xérophile et indésirable, un essai de réhabilitation a été réalisé. Des données ont été collectées sur l'utilisation de la zone, sur sa végétation et sur les conditions édapho-climatiques, et utilisées pour formuler une stratégie de reconquête sur une surface de 5 ha en conditions pluviales. Le protocole a inclus le défonçage de la couverture végétale avec des moyens mécaniques, la préparation du sol (amendement, fertilisation), le sursemis avec un mélange de *Dactylis glomerata*, *Medicago sativa* et de *Trifolium subterraneum* et la mise en défens. Le pâturage par des vaches a été permis après la première période de croissance, puis par des ovins. Après 15 années les résultats montrent que le *Sarcopoterium spinosum* est proche de l'extinction et qu'une production moyenne de végétation herbacée de 2000 kg de matière sèche est atteinte. On en conclut que la réhabilitation des pâturages dans les îles semi-arides est une option intéressante pour soutenir l'élevage et améliorer le paysage.

Mots-clés : Gestion des parcours, réhabilitation des pâturages, ovins, Grèce.

Introduction

The extensive pastoral lands have traditionally played an important role in the evolution of livestock production systems in the Mediterranean areas (Le Houerou, 1981; Hadjigeorgiou *et al.*, 2005), where they still function mainly towards the production of a range of quality products (Boyazoglu and Morand-Fehr, 2001; Hadjigeorgiou *et al.*, 2002). Moreover, these marginal areas have shaped the local animal species and breeds capable of surviving and utilizing these lands (Bertaglia *et al.*, 2007).

Multifunctionality of grazing systems is widely recognized today, where along with production and economic objectives, cultural, social and environmental dimensions need not to be neglected (Steinfeld, 2006). In this sense, pastoral livestock systems can be considered as cost-effective instruments to modulate the strong inclination of vegetation development towards shrub invasion (Valderrabano and Torrano, 2000). If adequately implemented, grazing management can be a suitable tool to upgrade and maintain traditional landscapes and sustain biodiversity (Rook *et al.*, 2004). The Aegean islands of Greece are characterized by large areas of xerothermic vegetation, where a long history of uncontrolled grazing by mixed sheep and goat flocks and burning has been recorded, with a subsequent result of now being occupied by non-edible plants. Sheep farming is an important activity on the island of Lesvos (Hadjigeorgiou *et al.*, 1997), where sheep are ranging the available areas year round. However, most of the grazed areas are invaded by the undesirable thorny

bush *Sarcopoterium spinosum*, thus largely reducing vegetation productivity. Subsequently a rehabilitation trial was designed with the aim to reverse this situation.

General information on land and farming

Lesvos island extends over 163280 ha of land, where the official census (NSSG, 1995) reports 37% as the cultivated land, 38% as grazing land, 18.9% as forests and the remaining 6.1% goes to various land uses (water bodies, built areas, bare land etc). However, by analyzing remote sensing data (Marathanou *et al.*, 2000) reached a new categorization of land uses (presented in Fig. 1) and measuring 41% of olive groves, 23% of pine forests, 22.6% of rough grazing lands, 7.1% of oak forests, 5.3% of arable land and the remaining 1% for all other uses. On this island some 60000 livestock units (LU) are farmed of which sheep of the local Lesvos breed form the largest part (70.6%), followed by goats (9.8%), cattle (7.3%), equines (4.5%) and the remaining 7.8% covers other species such as poultry and pigs.

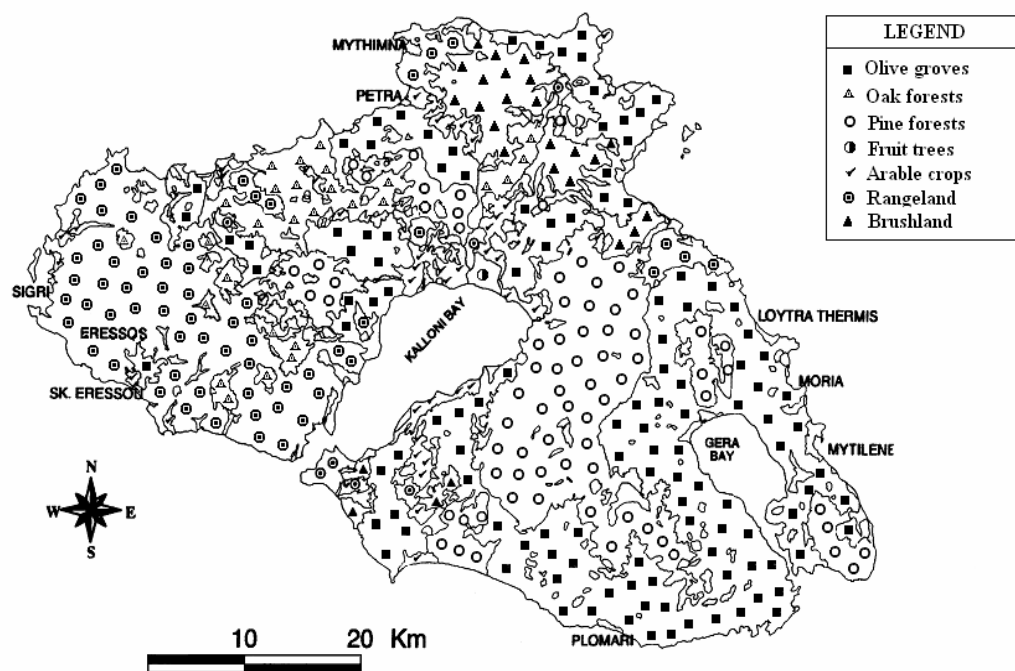


Fig. 1. Map of Lesvos Island depicting location of the island's major towns and the areas of the various types of vegetation coverage (from Marathanou *et al.*, 2000).

Materials and methods

A municipal district with a strong tradition to animal farming was selected in the center of the island where some 10000 sheep and 1000 goats were kept along with 250 cattle. Total ranging land amounted to 3200 ha, whereas an additional 50 ha were used for fodder production (alfalfa hay). Data were collected on edapho-climatic conditions and the area's vegetation and used in formulating the rehabilitation strategy targeting a 5 ha area under rainfed conditions. The selected area was flat with a shallow soil layer ranging from 20 to 60 cm in depth. The analysis of soil samples revealed a moderately acid (pH: 5.6) Sandy Clay Loam (SCL) soil, poor in organic matter content (1.5%), very poor in calcium (>0.5% CaCO₃), nitrogen (0.2%) and phosphorus (9.5 mgP/kg). Annual precipitation in the broader area reaches 700 mm, while annual average temperature measures 17.7°C. Floristically, the selected rangeland, comprised mainly (85%) of the following ligneous plants: *Sarcopoterium spinosum*, *Cistus* sp., *Pistacia lentiscus* and *Pyrus* sp., while herbaceous plants such as: *Hordeum* spp., *Bromus* spp., *Phalaris* spp. and *Cynodon dactylon* were contributing about 15% to the total plant biomass.

The rehabilitation strategy, which was effected in autumn 1992, included: removal of plant cover by mechanical means and soil conditioning (liming with 3 tones of CaCO₃ per ha and fertilization with 200 kg/ha of a 20-10-0), followed by reseeding with a mixture of *Dactylis glomerata* (cultivar Dorise), *Medicago sativa* (cultivar Iliki) and *Trifolium subterraneum* (cultivar Trikkala) at a rate of 15, 15 and 30 kg/ha respectively. Subsequently the area was protected from grazing and was allowed to grazing cattle, at the end of the first growth period (early summer 1993), and to sheep thereafter.

Measurements were made, on five years intervals, on grass herbage mass production by protecting, at the beginning of the growth period, 5 or 6 quadrats (1x1 m) from grazing and cutting them at the end of the period (early summer). Herbage samples were shadow-dried for a week before weighing. Ground cover of floristic groups (herbaceous or ligneous plants) was determined as a proportion of the total by measuring number of ligneous plants and their diameter and estimating bare ground surface in 5 or 6 quadrats (2x2 m).

Results and discussion

Results after fifteen years show that *Sarcopoterium spinosum* and other ligneous plants in the rehabilitated area are near extinction contributing less than 10% to the total plant biomass. Herbaceous vegetation averaged the production of 2000 kg dry matter/ha over the length of the observation period. In fact, grass herbage produced averaged 2350, 2100, 2050 and 1800 kg dry matter/ha for the years 1, 5, 10 and 15 after treatment. Ground cover comprised of 0, 3, 8 and 12% ligneous plants (almost solely *Sarcopoterium spinosum*), 94, 90, 85 and 83 % herbaceous plants (mainly *Bromus* spp., *Hordeum* spp. and *Dactylis* sp.) and 6, 7, 7 and 5% bare ground respectively for the years 1, 5, 10 and 15 after treatment. The process of degradation of grazing resources in Europe as a whole (Roeder, 2007) and in the European Mediterranean areas in particular, has been widely described (Zervas, 1998; Bartolomé *et al.*, 2000).

Conservation of grazing resources appears as a key issue to support sustainable local development but a strong tendency towards shrub infestation and forest invasion can be observed in many mountain grazing areas (Ispicoudis and Chouvardas, 2005). The implications for landscape degradation and risk of fire hazards have been already mentioned. Although adequate stocking densities can control shrub vegetation (Valderrabano and Torrano, 2000), there are doubts on the capacity of domestic animals to efficiently control the dynamics of ligneous plant cover (Bartolomé *et al.*, 2000). In any case, differences among animal species in their capacity of utilizing the range of pastoral resources (Gordon, 2003) need to be taken into account.

Conclusions

It is concluded that rangeland rehabilitation in semi-arid islands, towards removal of undesirable plants, is feasible through a combination of mechanical treatment, reseeding and animal grazing. This intervention presents an interesting option for supporting livestock farming through usage of indigenous resources and upgrading the landscape in marginal areas.

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