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Evaluation of animal production systems on species rich Mediterranean islands: A case study on the Island of Rhodes

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Abstract. Islands present an interesting model for biodiversity evaluation studies. The study area is the Rhodes Island in the Eastern Aegean Sea. The land area covers some 140,000 ha and officially holds a considerable population of sheep and goats (15,000 and 31,000 respectively) as well as 1800 cattle. Vegetation includes some 1300 species of which 12 are endemic and 186 are important, therefore two Natura 2000 areas are designated: GR4210005 and GR4210006 covering 34,346 ha in total. For the purposes of setting grazing management rules in the areas, the production systems applied in this island were investigated and a combination of National Statistics, CORINE and field data was used to define system dependence on local grazing resources. Subsequently grazing capacities were determined and advised to the local authorities together with management guidelines with the aim of maintaining the preserved areas under moderate grazing activity.

Key words. Production systems – Rangeland management – Biodiversity – Islands – Greece.

Évaluation des systèmes de production animale sur les espèces riches îles de la Méditerranée : Une étude de cas sur l'île de Rhodes

Résumé. Les îles présentent un modèle intéressant pour des études d'évaluation de la biodiversité. La zone d'étude est l'île de Rhodes en mer Egée orientale. La superficie couvre environ 140 000 ha et possède officiellement une population considérable d'ovins et de caprins (15 000 et 31 000 respectivement) ainsi que 1800 bovins. La végétation comprend environ 1300 espèces dont 12 sont endémiques et 186 sont importants, donc deux zones Natura 2000 sont désignées : GR4210005 et GR4210006 couvrant 34 346 ha au total. Afin de proposer des règles de bonne gestion des pâturages pour ces zones, les systèmes de production ont été étudiés, par une combinaison de données des Statistiques nationales, de CORINE et des études de terrain, afin d'évaluer la dépendance des systèmes des ressources pâturables. Des indices de capacité de charge ont pu être ainsi déterminés et proposés aux autorités locales, accompagnés de lignes directrices pour leur gestion dans le but de préserver ces zones par un pâturage modéré.

Mots-clés. Systèmes de production – Gestion des pâturages – Biodiversité – Îles – Grèce.

I – Introduction

Multifunctionality of grazing systems is widely recognized today, where along with production and economic objectives, cultural, social and environmental dimensions cannot be neglected. In this sense, pastoral livestock systems can be considered as cost-effective instruments to modulate the strong inclination of vegetation development towards shrub invasion (Sternberg *et al.*, 2000; Casasús *et al.*, 2005) and the accumulation of plant biomass. If adequately implemented, grazing management can be a suitable tool to maintain traditional complex landscapes and sustain biodiversity (Rook *et al.*, 2004). The dependence of biodiversity preservation on proper use of land has been documented in many studies (Sternberg *et al.*, 2000; Casasús *et al.*, 2005).

Greece has a long history of breeding sheep and goats utilizing the indigenous vegetation, under a system of free ranging or shepherded grazing, which in combination to some shepherds' practices, formed the present land cover and biodiversity (Hadjigeorgiou *et al.*, 2005). Islands present an interesting model for land biodiversity evaluation studies, since transferring of terrestrial organisms is minimal and management effects on biota more prominent.

A systemic way of thinking is necessary to reach a holistic understanding of the phenomena, which determine sustainability of livestock grazing systems (Gibon *et al.*, 1999). Multidisciplinary approaches combining spatial, temporal and bio-technical skills (Flamant *et al.*, 1999) are required when addressing these issues.

II – Materials and methods

The objective of this field study was to depict the systems of pastoral livestock farming in the study area of Rhodes island and define management rules aiming to maintain current situation. Livestock farming systems were investigated at the farm scale and farms were classified according to their structure and management, with special focus on the utilization of grazing areas, but also considering socio-economic factors. Since the majority of the farmed animals in the area consist of sheep and goats, the survey was focused in them. Subsequently, an appropriate structured questionnaire was completed by 26 animal farmers interested in collaborating, always with the assistance of an expert. The survey principally recorded basic farm data, i.e. number of animals per category, production output, available grazing areas, available arable areas, as well as fencing, housing and machinery infrastructure. Moreover, the survey included questions designed to collect information on farm management practices, feeding programmes for the different classes of animals, rations used, rangeland management (calendars, animal types, areas and location), stock hygiene, preventive treatments, farm economics (values of inputs and outputs), commercialization of products, social characteristics of farmers, etc.

At the regional scale, existing data (CORINE land cover, on farm statistics and animal census, etc.) were combined with vegetation sampling to determine the areas available for grazing and their potential. Exclusion cages were erected in autumn to study vegetation dynamics, where for herbaceous vegetation available biomass at the start of summer, species composition and chemical composition were recorded. Shrub vegetation was clipped at the same time to estimate the biomass available for grazing and chemical composition was analyzed. Finally nutritional value of the vegetation was defined according to existing equations (Van Es, 1978). The above data were co-investigated in order to facilitate management decisions. The study area was divided on a Municipality territory level, since most of the available census data are available at this level, and boundaries of the study area were described on the map at the same level.

III – Results and discussion

The study area of the Rhodes island (36° N, 28° E) as part of the Eastern Aegean complex of islands is covering some 140,000 ha of land. The island shows a large variety of ground relief and ecological niches and hosts two "Natura 2000" sites (GR4210005 and GR4210006), with a total surface area of 34,346 ha. These sites are hosting 26 important plant species, 5 mammal species, 4 reptiles and 2 invertebrates declared "endangered" and put under protection status, through EU Directives 79/409 and 92/43. Furthermore, a wealth of endemic and rare species, grows on the island, where 1,300 plant species have been recorded (Carlström, 1987) of which 186 have been declared important (endemic, endangered or under protection).

The island holds a population of 117,000 people, who by majority (57.6%) are occupied in the

"services" sector and in fact tourism. However, a total of about ten thousand agricultural holdings are officially registered on this island (NSSG, 2004). Moreover, a total of 15,000 sheep, 31,000 goats, 1800 cattle and 500 equines are farmed on the island, at an average flock size of 61 sheep, 59 goats, 15 cattle and 2 equines per farm (NSSG, 2004). On average, annual productivity of livestock in this area according to official census is 37 kg milk and 10.7 kg meat per ewe; 33 kg milk and 10.3 kg meat per goat; 1500 kg milk and 215 kg meat per cow (NSSG, 2004). However, field data produced in this study demonstrated these figures might be even lower (Table 1).

Table 1. Basic production parameters of the sheep and goat farms investigated in Rhodes island (n=26) and estimates of the gross farmer's income (in Euros) per reproductive female animal

Ewes	Goats	Lambs/ewe	Kids/goat	Milk/ewe	Milk/goat	Gross income
95	240	0.89	0.92	10	8	33

Since the majority of the farmed animals in the area consist of sheep and goats, and they utilize the available grazing resources, the study focused on the calculation of their nutritional requirements (NRC, 1985). Therefore sheep and goats requirements were calculated at 2868 Mj NEL/head/year and 38 kg protein/head/year for maintenance and production. Moreover, the supply of nutrients through imported feedstuffs (roughages and concentrates) was calculated at 30% for "energy" and 65% for "protein". Therefore it was concluded that sheep and goats obtain 2000 Mj NEL/head/year (or 70%) of their "energy" requirements through grazing.

According to CORINE land cover data study area had a total of 22 different land cover classes. Assuming that areas under CORINE codes 211, 212, 221, 223, 242 and 243 correspond to cultivated land, areas under codes 231, 321, 322, 323 and 324 correspond to the potential grazing land and areas under codes 311, 312 and 313 include all forestry land, it was estimated that cultivated land of the island amounted 34,045.4 ha (24.3%), rough grazing land 57,626.3 ha (41.1%) and forestry land 36,702.9 ha (26.2%).

The representative samples collected, according to geographical location and the land cover types provided data on vegetation productivity. Therefore, by combining the vegetation biomass available for grazing, its nutritional value and the nutritional requirements of the breeding animals in the study area, the grazing capacity of the rough grazing lands was assessed and defined at 0.22 LU/ha. Although this figure was comparable to the calculated grazing load of the area, an appreciable deviation from the mean was observed among the different municipalities, indicating the uneven distribution of the animals within the island, which should be rectified. However, abandonment of agricultural activity and in particular animal farming in the island poses a threat in these marginal areas and risks the stability of the whole ecosystem (de Rancourt *et al.*, 2006; Volanis *et al.*, 2007). Therefore, efforts should be made to secure the continuation of these activities possibly through correct marketing of local products.

IV – Conclusions

This study dealt with the important interrelationship of small ruminants with the islands vegetation. It was concluded that current grazing load would maintain land cover in its present form, therefore supporting biodiversity. Proper management directions should be applied and farmers should be actively encouraged to follow them, towards a global benefit.

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