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Biodiversity and ecological conditions of rangelands for the local livestock system of Lemnos (Greece)

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Abstract. In contrast to most Aegean islands, Lemnos (482 km², Northeast-Aegean) is characterized by non-calcareous sandstones, marls and alluvial deposits. Prevailing land use is agriculture, chiefly for fodder production for sheep and goat husbandry. Apart from local cereal crop production, the animals depend on the island's rough grazing lands. In the project Terra Lemnia, we attempt to relate land-use systems, vegetation types and biodiversity patterns. In a first step, we collected a sample of 19 plot-based vegetation records of 100 m² each. We found chiefly three main land-cover types: (1) Low-shrub formation (phrygana) dominated by *Sarcopoterium spinosum*; (2) Low-growing dense-sward formation of perennial and annual grasses and herbs; (3) Heavily trampled and overgrazed patches dominated by unpalatable ruderal plants. *Sarcopoterium phrygana* (12 plots studied) comprise on average 62.3 vascular plant species per plot, low-growing dense swards (5 plots) 57.3 species. With up to 10 % (and sometimes more) of the island's known species pool represented in a single 100 m² plot, the phrygana and the low-sward rangelands of Lemnos have an extremely high alpha and moderate beta and gamma diversities. Patches of ruderal plants are rich in large flowers and inflorescences and have often long flowering periods (April-July). They thus attract numerous pollinators and other arthropods, and contribute quite essentially to the biodiversity richness of the island.

Keywords. Aegean islands – Grazing – Land-cover types – Phrygana – Rangeland diversity.

Biodiversité et conditions écologiques des parcours pour le système d'élevage local de Lemnos (Grèce)

Résumé. Contrairement à la plupart des îles de la mer Égée, Lemnos (482 km², nord-est de la mer Égée) est caractérisée par des grès, des marnes et des alluvions non calcaires. L'agriculture est l'utilisation prédominante des terres, principalement pour la production de fourrage destiné à l'élevage des ovins et des caprins. Outre la production céréalière locale, les animaux dépendent des pâturages de l'île. Dans le projet Terra Lemnia, nous essayons de relier les systèmes d'utilisation des terres, les types de végétation et les schémas de biodiversité. Dans un premier temps, nous avons collecté un échantillon sur 19 enregistrements de végétation basés sur des parcelles de 100 m² chacun. Nous avons principalement trouvé trois types de couverture terrestre: (1) La formation d'arbustes bas (phrygana) dominée par *Sarcopoterium spinosum*; (2) La formation à croissance lente et dense de graminées et de plantes herbacées vivaces et annuelles; (3) Des parcelles fortement piétinées et surpâturées dominées par des plantes rudérales désagréables. *Sarcopoterium phrygana* (12 parcelles étudiées) comprend en moyenne 62,3 espèces de plantes vasculaires par parcelle, des prairies denses à croissance faible (5 parcelles) de 57,3 espèces. Avec un maximum de 10% (et parfois plus) du pool d'espèces connues de l'île représentées dans une seule parcelle de 100 m², les prairies de phrygana et de pâturages à faible altitude de Lemnos présentent une diversité extrêmement élevée en alpha et des niveaux en bêta et gamma modérés. Les parcelles de plantes rudérales sont riches en grandes fleurs et inflorescences et ont souvent de longues périodes de floraison (avril à juillet). Elles attirent ainsi de nombreux pollinisateurs et autres arthropodes et contribuent de manière essentielle à la richesse de la biodiversité de l'île.

Mots-clés. Îles de la mer Égée – Pâturage – Types de couverture végétale – Phrygana – Diversité des pâturages.

I – Introduction

Lemnos (Greece) is a North Aegean island, which shows a distinctive cultural, biogeographical and ecological character. It is the southernmost of the larger islands in the North Aegean and is well isolated from the neighbouring islands of Lesbos, Samothraki and Imbros. In contrast to most typical Aegean islands, Lemnos is characterized by gentle slopes, wetlands and a long coastline contributing to the formation of an extensive net of freshwater and brackish marsh formations especially in the eastern part. Unlike other large Aegean islands, Lemnos is hilly rather than mountainous (maximum 429 m a.s.l.). This gentle topography is mainly due to the absence of calcareous rocky landscapes and to the prevalence of volcanic, molasse (sandstones, marls) and psammitic rock formations on most of the island (Davis, 1959). The climate of the area is subhumid or almost semi-arid, with a mean annual precipitation of c. 500 mm. Frequent winds, blowing mainly from N or NE, contribute to the dry climate of the island.

The island of Lemnos conserves a high-level ecological value, based on a variety of natural vegetation formations but chiefly on human-made habitat types such as of arable and pastoral farmland. Cultivated crops include wheat, barley, grapes, cotton and sesame. The cereals are chiefly for fodder production. In Lemnos the main domestic grazing animals are sheep and goats. There are approximately 80,000 sheep and 12,000 goats that depend on the island's cereal crop production and on its rough pasturelands and low shrublands (phrygana). The type of grazer, its numbers and plant selectivity are important factors for floristic composition and patterns. Local breeds of sheep and goats, still extant in small populations on Lemnos and better adapted to the local climate and rough grazing conditions, range long distances and exert lower grazing pressure than imported breeds.

In the framework of the “Terra Lemnia” project supported by the “MAVA Foundation for Nature”, our objective was to examine the status of biodiversity, in particular plant species composition and richness, and to assess the impacts of different land use, as a basis for establishing a system of effectively monitoring the impact (success) of all activities on biodiversity using bio-indicator species.

II – Methods

During April-May 2018, field work and collection of baseline data on the current status of biodiversity has been conducted on agro-pastoral land of selected rangeland areas of the island, including rangelands of the Natura 2000 site GR4110006 (Chortarolimni, wider area of Lake Alyki and Fakos Peninsula).

In the four broader study areas of Vigla, Fakos, Ifaisteia, Poliochni-Fisini, plus a fifth one in the communal farm ‘Metropolis’, 19 plots were studied in greater detail. Work was carried out in the selected sites by a team of experts and comprised plot sampling in rangelands of mainly phryganic and herbaceous plant communities. We collected plant specimens and completed floristic and vegetation sampling, using the method of Braun-Blanquet (1928), in similar rectangular plots of 10x10 m² as the other project collaborators were recording crop landraces, forage and fodder crops, birds and beneficial insects.

The 19 plots were delineated within semi-natural vegetation (rangeland). For these plots information concerning: (i) grazing intensity (high / medium / low / no grazing – abandoned) and (ii) grazing animal type (sheep, goats, both / local breeds or not), has been added.

III – Results and discussion

Preliminary results of this first fieldwork in 2018 included records of 285 species (including four on genera level) (Table 1). Some of the plants like *Elytrigia obtusiflora*, *Lotus hispidus*, *Medicago coro-*

nata, *Trifolium nigrescens*, *Trifolium tenuifolium* and *Vicia parviflora* were discovered for the first time on Lemnos Island. A taxonomic analysis shows that the recorded plant taxa belong to 32 plant families and 180 genera. The ten most common plant families are: Fabaceae (22%), Asteraceae (19%), Poaceae (14%), Caryophyllaceae (7%), Brassicaceae (5%), Lamiaceae (4%), Apiaceae (3%), Boraginaceae (2%), Euphorbiaceae (2%), Geraniaceae (2%) and Orchidaceae (2%). It is noteworthy that (i) the three first families, Fabaceae, Asteraceae and Poaceae represent 55% of the total flora registered and (ii) about 62% of the plant taxa are plants with annual or biennial life cycle (annuals, therophytes) and 38% perennials.

We found basically two types of rangeland on Lemnos: (i) Phrygana (low shrubland) dominated by *Sarcopoterium spinosum* of the phytosociological alliance *Hyperico olympici-Cistion cretici* was found widespread and chiefly on soils derived from weathered molasse; in places it occurs as successional stage on abandoned agricultural land; and (ii) more or less dense swards of herb-rich grasslands of the phytosociological order *Poetalia bulbosae*, that are common mainly on shallow soils over old volcanic (andesite) rocks. Both phrygana and herb-grasslands are very species-rich (62.3 and 57.3 species per 100 m² respectively) and especially rich in annual plants (thereophytes) (Table 1).

The very high percentage of therophytes is typical of Mediterranean phryganic and herbaceous vegetation (Panitsa *et al.*, 2003). Rauh (1949) and Browicz (1991) pointed out that the inhabitants 'brought lowlands and moderate slopes under cultivation and allowed steeper slopes to be overgrazed by sheep and goats'. High percentages of therophytes and especially of annual leguminous species are indicators of long-term but moderate human interference in many Mediterranean rangeland ecosystems (Arianoutsou and Margaris 1981, Barbero *et al.*, 1990, Panitsa *et al.*, 2003). In Lemnos island, leguminous species contribute 17% on all recorded plant taxa and 21% of the therophytes.

Table 1. The ten most common plant species on the plots (n=19) including information to plant family and life form

Scientific name	Plant Family	Life form	Plot records
<i>Sherardia arvensis</i>	Rubiaceae	Therophyte	17
<i>Trifolium campestre</i> *	Fabaceae	Therophyte	16
<i>Cerastium glomeratum</i>	Caryophylloceae	Therophyte	14
<i>Tordylium apulum</i> *	Apiaceae	Therophyte	13
<i>Leontodon tuberosus</i> *	Asteraceae	Hemicryptophyte	13
<i>Eryngium campestre</i> *	Apiaceae	Hemicryptophyte	13
<i>Dactylis glomerata</i>	Poaceae	Hemicryptophyte	13
<i>Hymenocarpus circinnatus</i> *	Fabaceae	Therophyte	12
<i>Galium aparine</i> *	Rubiaceae	Therophyte	12
<i>Carlina corymbosa</i> *	Asteraceae	Hemicryptophyte	12

*Insect-pollinated species.

A third land-cover type of rangelands comprises ruderalized patches of heavily trampled and overgrazed sites dominated by unpalatable plants such as *Asphodelus ramosus*, *Ballota acetabulosa*, *Euphorbia characias* along with various thistles. Patches of these ruderal plants have usually lower species diversity than the other formations but are rich in large flowers and inflorescences and have often longer flowering periods (April-July). In this long time interval, they thus attract numerous pollinators and other arthropods and contribute quite essentially to the richness of the island's faunal and floral diversity.

Such enormous variation in rangeland appearance and diversity reflected abiotic effects as well as differences in grazing intensity in different rangeland sample plots and areas, sometimes current land use intensity, sometimes the heritage of former locally overly high stocking densities. Our preliminary results revealed that such intensity-dependent patterns may be found within a single

sample area or even farming unit, where overgrazed rangelands next to former or extant farmsteads and lairs being dominated by unpalatable plants such as *Asphodelus ramosus*, and *Sarcopoterium spinosum* rangelands ('phrygana') widespread in the surroundings. Long-term abandonment of rangelands appears to lead to a denser subshrub (and shrub) canopy and to a lower proportion of annual plants, a process resulting in a net loss of species density.

IV – Conclusions

The Terra Lemnia project seeks to develop scientifically solid, yet practical, guidelines for biodiversity friendly, low input, farming methods in Lemnos, building on good practices already found in the island today. Fieldwork in 2018 has shown that such methods may also be economically viable – and farmers can acknowledge this, a fact that leaves room for optimism that the diversity of Lemnian pastoral and agroecosystems can indeed be maintained and even enhanced.

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