Landscape composition of rangelands within the "Natura 2000" habitat network in Greece

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Abstract

Rangelands constitute an important part of the habitat type ecological network "Natura 2000" of protected areas in Greece. In this paper, the five rangeland types present in this network, namely grasslands, phrygana, shrublands, forest ranges and wet grasslands, were identified and analysed some aspects of their landscape composition along four altitudinal zones. According to these results, 57 rangeland habitat types can be found in Greece, covering an area of 1,169,403 ha or 47% of the total mapped area. The most common rangeland types are those where woody plants are dominant, covering about 65% of rangelands. Diverse mosaic pattern is evident in all altitudinal zones but it prevails in the middle altitudes, while rangelands above 1200 m seem to be more homogenous composed of extensive shrublands. Forest ranges make the most fragmented landscapes in all altitudinal zones except above 1200 m where their presence is relatively limited.

Key words: Edge density, cover, mean patch size, pastoral landscapes, patch density

Introduction

Lands used for extensive livestock grazing, i.e. rangelands, are part of the habitat types network "Natura 2000" in Greece. They constitute important areas for nature conservation because they have been shaped by grazing activities for thousands of years (Papanastasis and Chouvardas 2005), resulting in pastoral landscapes of various types. Their conservation largely depends on the continuation of livestock husbandry and other agricultural activities (Caballero et al. 2009). For their sustainable management, however, their types and conservation status need to be investigated so that the necessary measures are accordingly implemented. The aim of this study was to identify the rangeland types present in the habitat types network of "Natura 2000" and evaluate their landscape composition.

Materials and methods

In order to draw a picture of the landscape composition of rangelands, data from the habitat type mapping (MINENV 2001) were used. This mapping covers 19% of the terrestrial part of the country and it is

distributed in 237 areas, most of them belonging to "Natura 2000" network. Initially a single layer with all polygons of the 237 areas was created and polygons with null values or with area less than 1 ha were removed. Then, according to the description of the habitat types (Dafis et al. 2001) polygons corresponding to the four types of rangelands found in Greece, namely grasslands, phrygana, shrublands and forest ranges (Papanastasis and Noitsakis 1992) were selected plus wet grasslands (Table 1).

Table 1. Rangeland habitat types from the mapping of 2001.

Rangeland type	Habitat types
Grasslands	6110 Karstic calcareous grasslands, 6170 Alpine calcareous grasslands, 6173 Stepped and garland grasslands, 6210 Semi-natural dry grasslands on calcareous substrates, 6211 Sub-continental steppic grasslands, 6220 Pseudo-steppe with grasses and annuals, 6230 Nardus grasslands on siliceous substrates, 6420 Mediterranean tall-herb and rush meadows, 6430 Eutrophic tall herbs, 6432 Subalpine and alpine tall herb, 6510 Lowland hay meadows, **6270* *Spartium junceum* steppes, 6280 Mediterraneo-montane grasslands, 6290 Mediterranean subnitrophilous grasslands, 6450 Helleno-Moesian riverine and humid clover meadows, 651A Mesophile pastures**
Shrublands	4060 Alpine and subalpine heaths, 4090 Endemic oro-Mediterranean heaths with gorse, 5110 Stable *Buxus sempervirens* formations on calcareous rock slopes, 5130 *Juniperus communis* formations on calcareous heaths or grasslands, 5210 Mediterranean matorral: Juniper formations, 5211 *Juniperus oxycedrus* matorral, 5212 *Juniperus phoenicea* matorral, 5213 *Juniperus excelsa* and *J. foetidissima* matorrals, 5310 Laurel thickets, **5340 Garrigues, 5350 Pseudomaquis, 5160 Subcontinental and continental deciduous thickets (Prunion fruticosae)**
Phrygana	5320 Low formations of *Euphorbia*, 5330 Thermo-Mediterranean and pre-steppe brush, 5331 Tree-spurge formations, 5420 Aegean phrygana, 5430 Phrygana formations
Wet grasslands	1410 Mediterranean salt meadows, 1420 Mediterranean halophilous scrubs, 1430 Iberia halo-nitrophilous scrubs, 1510 Salt steppes, 3170 Mediterranean temporary ponds, **1260 Halophytic grass and fhryganic meadows, 72A0 Reed beds, 72B0 Rush meadows**
Forest ranges	2270 Wooded dunes with *Pinus pinea* and/or P. pinaster, 9170 Eastern oak-hornbeam forests, 9250 *Quercus trojana* woods, 9290 Cypress forests, 9310 Cretan *Quercus brachyphylla* forests, 9320 Olea and Ceratonia forests, 9340 *Quercus ilex* forests, 9350 *Quercus macrolepis* forests, 9410 Acidophilous forests, 9540 Mediterranean pine forests with endemic pines, 9562 Grecian juniper woods, 9563 Stinking juniper woods, **925A Mixed thermophilous forests with *Ostrya carpinifolia* and *Carpinus orientalis*, 925B *Celtis australis* forests, 934A Greek kermes oak forests, 934B Sclerophyllous forests of *Crataegus monogyna***

* Habitat types in bold are not included in Annex I of the Habitats Directive (92/43/EC).

For these five types a new layer was created where the rangeland type was added as another attribute. Spatial data were processed with the GIS Software ArcGIS v9.3, while landscape metrics were calculated with Patch Analyst v5.0 (Rempel et.al. 2012), an extension of the ArcGIS. Four indices were used: class cover for an overview of the rangelands' cover distribution and fragmentation, mean patch size and patch density as overall measures of fragmentation and landscape pattern and edge density (ED) as a measure of fragmentation (Leitao et. al. 2006). The mathematical formulas of the chosen indices are those described by McGarigal και Marks (1995). In order to explore the diversity of these indices with elevation, the altitude to the centroid of each polygon (based on the ASTER GDEM Version2 for Greece - www.jspacesystems.or.jp/ /ersdac/GDEM/E/4.html) was attributed and each polygon was classified according to the altitudinal zones used by Papanastasis et al. (1986). Then a separate layer of all rangeland types for each altitude class was produced and Patch Analyst was employed for each layer.

Results and Discussion

From the 237 habitat types, 57 were characterised as rangelands, covering an area of 1,169,403 ha or 47% of the total mapped area.The distribution of rangelands in the mapped areas is presented in figure 1. Cover of each rangeland type with altitude is presented in figure 5. Cover of grasslands and phrygana is increasing and decreasing respectively with altitude, as expected from the ecology of the dominant species of each type. The decreased cover of wet grassland type with altitude is also expected since the relevant habitat types are bound to water bodies mainly found in low elevation and coastal areas. Very high cover by shrublands in the zone over 1200 m is a sign of abandonment from pastoral activities (Sitzia et.al. 2010). Abandonment due to the limitation of transhumance activity can also explain the sharp fall of forest ranges in the zone over 1200 m, but other reasons should also be considered, such as the grazing exclusion policy from such landscapes considered as degraded forests. Diverse mosaic structure appears in all altitudinal zones but the relatively higher values of patch (Figure 3) and edge density (Figure 4) in the middle altitudes indicate that pastoral landscapes of diverse mosaic prevail between 600 and 1200 m.

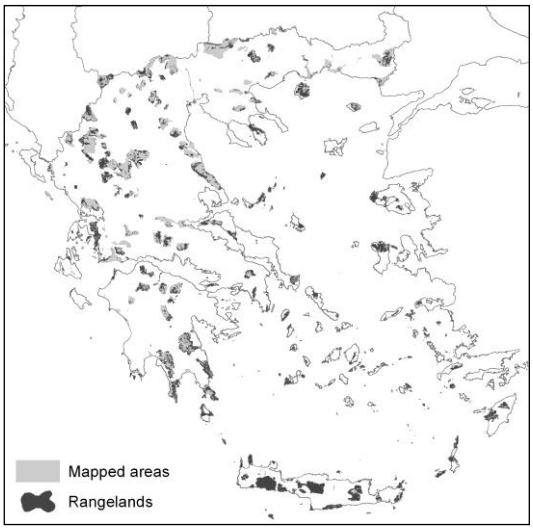

Figure 1. Rangelands distributed within the mapped area of the habitat type network "Natura 2000".

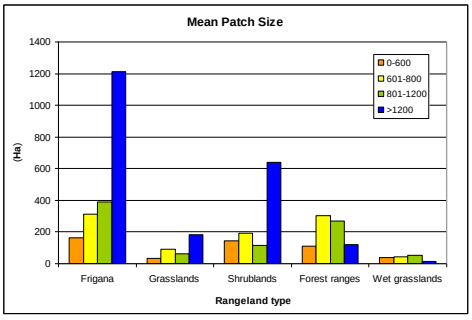

Figure 2. Mean patch size of rangelend types in each altitudinal zone.

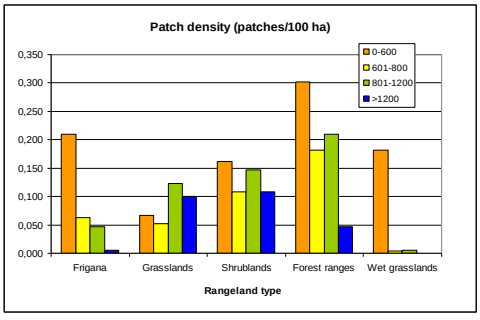

Figure 3. Patch density of rangelend types in each altitudinal zone

Above 1200 m, the high cover percentage of shrublands indicates a less heterogeneous landscape. Relatively high values of patch and edge density of forest ranges in combination with relatively low values of mean patch size and high cover values indicate that this is the most fragmented rangeland type. Grasslands and shrublands show lower fragmentation, especially in the high altitudes where both types present high values of cover (Figure 5) and mean patch size (Figure 2).

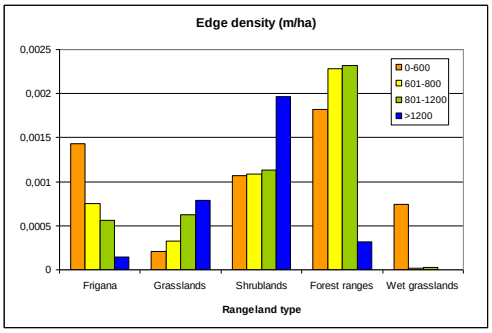

Figure 4. Edge density of rangelend types in each altitudinal zone

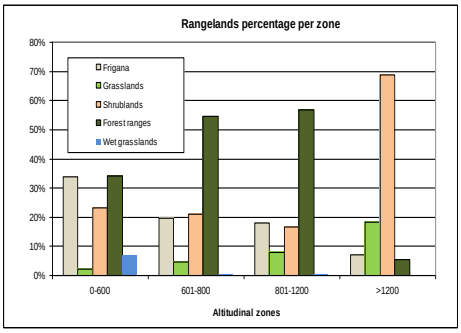

Figure 5. Rangelands cover in each altitudinal zone

Conclusions

Rangelands of Greece are important areas for conservation of nature presenting different composition with altitude, originating from both the ecology of specific rangeland types and the pastoral activities.Diverse mosaic pattern is evident in all altitudinal zones but it prevails in the middle altitudes, while rangelands above 1200 m seem to be more homogenous. Forest ranges have the most fragmented landscapes in all altitudinal zones except above 1200 m where their presence is relatively limited.

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