

Characteristics of grazed and restored Mediterranean landscapes of Northern Greece

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Abstract

Rangelands are a dominant land use type in the Mediterranean basin countries occupying more than 50% of the Mediterranean zone and forming pastoral landscapes of various types. These landscapes usually include severely degraded lands due to overgrazing. The most common restoration actions for such lands are grazing management regulation and pine reforestation. In the Lagadas county of northern Greece five (5) different grazed and restored landscapes were identified: a moderately grazed shrubland, an overgrazed shrubland, an abandoned shrubland, a rangeland partially reforested with pines and a rangeland fully reforested with pines. All these landscapes were evaluated for two main characteristics, namely the landscape structure and value. Landscape structure was evaluated with the use of landscape metrics (size, edge and shape metrics), while landscape value was based on analysis of specific qualitative criteria. Results showed that the moderately grazed shrubland and the overgrazed shrubland sustained the most fragmented - heterogenic and geometric structure compared with the other landscapes. For the landscape value, the moderately grazed and the abandoned rangeland sustained high-valued landscapes that require retention while the partially and fully reforested rangelands as well as the overgrazed ones sustained low-valued landscapes that need modification. It was concluded that moderate grazing had the best influence on the structure and value of Mediterranean pastoral landscapes.

Key words: Pastoral landscapes, landscape metrics, landscape value analysis.

Introduction

Rangelands are a dominant land use in the Mediterranean basin countries, occupying more than 50% of the Mediterranean zone (Le Houerou 1981). These rangelands are part of Mediterranean landscapes that have been shaped during the human history mainly by pastoral activities (Papanastasis and Chouvardas 2005). In northern Greece, three types of pastoral landscapes can be found, namely grasslands, shrublands and forest ranges (<40 tree canopy cover). One of the main threats of the Mediterranean pastoral landscape is land degradation due to overgrazing. The most common restoration actions against land degradation are regulation of grazing management, reforestation followed by prohibition of livestock grazing (Papanastasis 2009) and suspension of grazing without reforestation. The aim of this study was to evaluate two main landscape

characteristics, namely landscape structure and value, of grazed and restored rangelands, in order to investigate the role of the different restoration practices on the formation and value of pastoral landscapes.

Materials and methods

Five different pastoral landscapes were chosen, located within the Lagadas county in central Macedonia of northern Greece. These landscapes were: a moderately grazed shrubland, an overgrazed shrubland, an abandoned shrubland, a rangeland partially reforested with pines and a rangeland fully reforested with pines. The area covered by each type was 12.14, 10.61, 3.69, 7.08 and 28.04 ha respectively. All these landscapes are related to restoration actions taken against land degradation in the study area.

The first step in the process of analyzing landscape characteristics (landscape structure) was to create tree / shrub cover maps for each landscape, based on Google Earth remote sensing images (access year 2011). In order to update or confirm the results, these maps were corrected in ArcGIS v9.3 using Greek orthophotos of 2008 (source: Ktimatologio S.A.) The program Patch Analyst v 3.1 (Elkie et al. 1999) was used to quantify tree / shrub structure for the five landscapes. The digital tree / shrub cover maps were the main source for the structural analyses. Four indices were included in the study: number of patches (NP) and mean patch size (MPS) as an overall measure of landscape fragmentation and heterogeneity, edge density (ED) as a measure of the amount of ecotones (Farina 2000), and mean shape index (MSI) as a measure of landscape geometry (tree-shrub shape irregularity). The mathematical formulas of the chosen indices are included in the Patch Analyst and Arc Fragstats user manuals (McGarigal and Marks 1995, Elkie et al. 1999).

For the landscape value analysis, 20 landscape criteria were applied (Penning-Rowsell 1981, Ispikoudis et. al. 2001): scale, enclosure, variety, harmony, movement, texture, colouring, rarity, security, stimulus, impression, type of view, fragility, naturalness, typicalness, size, importance, authenticity, symbolic and potential values. These criteria were used by six independent experts who visited the five landscapes and graded each one based on a scale from value 1 to 4. The average of the total scores obtained by each expert resulted in the total grade of each landscape. Based on the final grades (total landscape grades from 20 to 80), three management classes were set up, namely modification (20-50), retention (51-65) or preservation (66-80) (Bacon 1979, Ispikoudis et. al. 2001).

Results and Discussion

The analysis of the data for the five digital maps showed that 36.83 ha or 59.83% of the whole area was covered by shrubs or trees. The moderately grazed and the overgrazed landscapes were below average with 23.06% and 43.17% of shrub cover, respectively. On the contrary, the abandoned as well as the partially and fully reforested landscapes had much higher tree / shrub cover, namely 71.27%, 96.05% and 71.40% respectively. The relatively lower tree / shrub cover of the fully reforested in comparison to the partially reforested landscape was attributed to the fact that the pine plantation of the former landscape was younger (about 10 years) and suffered more damages from natural hazards such as strong winds and diseases than the latter landscape. The graphical representation of tree / shrub cover of the five landscapes is shown in figure 1.

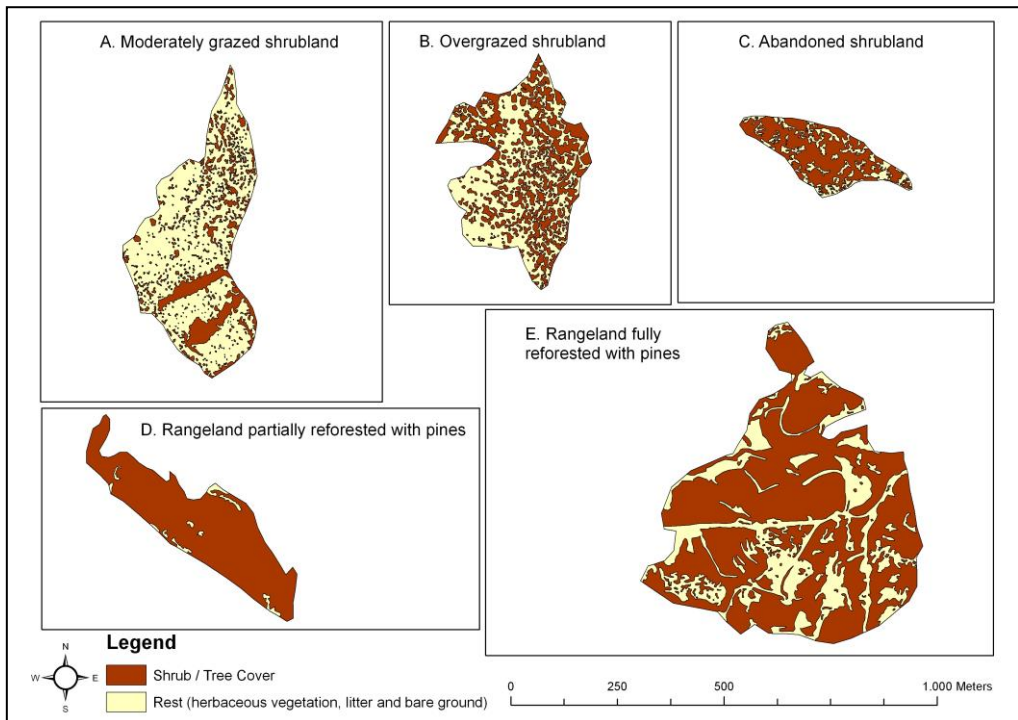


Figure 1. Shrub / Tree cover maps of five Mediterranean pastoral landscapes

The calculation of landscape metrics for the five landscapes revealed that the moderately grazed and overgrazed landscapes had the most

fragmented - heterogenic cover structure (NumP and MPS) (Table 1). On the contrary, the partially reforested and the abandoned landscapes were the most homogenous because their tree / shrub cover structure was arranged to only a few relatively large patches (NumP). The fully reforested landscape had an average amount of fragmentation probably due to the openings that were created from the pine tree damages. The two grazed landscapes presented the most geometrical structure of shrubs (MSI, Table 1), which displayed a more irregular shape of tree / shrub cover, indicating the geometric effect that grazing activity has on landscapes. Finally, based on the edge metric (ED), it is clear that the overgrazed, the abandoned and the moderately grazed landscapes created a significant amount of edges between the tree / shrub cover and the other cover types (herbs, litter and bare ground) compared to the other two reforested landscapes.

Table 1. Landscape metric values for the tree / shrub class of the five grazed and restored Mediterranean landscapes

| Landscape | NumP ¹ | MPS ² (Ha) | ED ³ (m/Ha) | MSI ⁴ |
|---|-------------------|--------------------------|---------------------------|------------------|
| 1 Moderately grazed shrubland | 431 | 0,0065 | 1143,92 | 1,3757 |
| 2 Overgrazed shrubland | 189 | 0,0242 | 1526,38 | 1,5577 |
| 3 Abandoned shrubland | 7 | 0,3758 | 1365,14 | 2,6444 |
| 4 A rangeland partially reforested with pines | 1 | 6,7967 | 329,90 | 2,5289 |
| 5 A rangeland fully reforested with pines | 56 | 0,3575 | 587,82 | 1,6907 |

¹ Number of Patches, ²Mean Patch Size, ³Edge Density, ⁴Mean Shape Index

The results of the landscape value analysis can be seen in table 2. From this table it is apparent that the moderately grazed and the abandoned landscapes received higher grades (value) than the others suggesting their need for retention (visually attractive). On the contrary, the partially and fully reforested landscapes, as well as the overgrazed one received lower grades suggesting their need for modification (visually less attractive).

Based on the final outcome on landscape structure and value, it seems that the action of moderately grazing results in landscapes with the most positive characteristics.

Table 2. Value analysis of the five grazed and restored Mediterranean landscapes

| | Moderately grazed shrublands | Overgrazed shrublands | Abandoned shrublands | Rangeland partially reforested with pines | Rangeland fully reforested with pines |
|--------|------------------------------------|--------------------------|-------------------------|--|--|
| Grades | 61 | 44 | 52 | 49 | 38 |

Conclusions

Restoration actions taken against land degradation seem to have a direct effect on landscapes characteristics (structure and value). The moderately grazed landscape is the most fragmented - heterogenic, geometrically shaped and with the highest landscape value. Also, the abandoned landscape was the most irregularly shaped and with high landscape value. On the contrary, the overgrazed landscape had the lowest landscape value but the largest amount of edges. The partially reforested landscape was less fragmented, more irregularly shaped and with a higher value than the fully reforested one. In general, moderately grazing seems to have a positive impact on landscape structure and value.

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