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Impact of Settlements on the Landscapes of Slavyanka Mountain (South-Western Bulgaria)

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ABSTRACT

The research area covers the northern slope of Slavyanka Mountain in South-western Bulgaria. The settlement network includes the villages of Petrovo, Yanovo, Goleshovo, Lehovo, Paril, and Nova Lovcha. The villages have a long history and since their establishment they have influenced the nature of the mountain. The presence of caves in the area shows evidences of ancient mining. East of Paril village, traces of the early Iron Age period have been found. Archaeological data indicate that Petrovo, Paril, and other villages were formed during the Roman Empire. The agricultural activities have changed depending on the social conditions. Studies show that in the period of 14th – 17th century, pottery and agriculture were highly developed along with intense livestock breeding. More intensive development occurred in the 19th century and at the beginning of the 20th century and these activities continue nowadays, even though in decreased intensity. Particularly serious damages of mountain environment were caused in the mid-twentieth century. Among the most important anthropogenic disturbances we mention the extraction of marble, carried out in quarries of different size. Another aspect of human activity is connected to the forest roads in the mountain. They are numerous man-made byways and they significantly impact the landscapes. The border line between Bulgaria and Greece is also subject to linear transformation of landscape. The anthropogenic activities have had significant impact on landscapes in the Slavyanka Mountain. The mountain itself has several protected areas out of which the "Alibotush" Biosphere Reserve is the most notable one.

1. INTRODUCTION

Anthropization is the process of modifying the natural complexes due to human impact. It leads to changes in vegetation, wildlife, soils, relief, water, etc. In the science of landscape natural territorial complexes that are affected by any kind of economic activity are called *anthropogenic landscapes*. These types of landscapes keep the main features of the natural landscape – geological foundation and climate, based on zonal and azonal laws. Landscapes and their functioning lie on physical, chemical, and biological processes. It is most precisely to be considered as a basic unit of natural complexes' functional mechanism. They represent the different levels of organization of matter in the geosystems. This includes: mechanical removal of solids; human intervention in the water cycle; impact and change of the natural biological processes and disturbance of the biological equilibrium; anthropogenic interference with the migration of chemical elements and compounds, as well as violations of the heat balance in geosystems. These effects are intertwined and need to carefully consider their interrelationships and relationships [2]. As a typical example for the research area may indicate that might be given even by the water (sheet and gully) and the wind erosion – processes of natural origin, in many cases triggered by human activity. It results as imbalance of the natural geosystems. In some of these geosystems the balance is quite unstable. An important stimulating factor to stabilize the landscape conditions is the vegetation. That is why its violation coupled with

irrational agrotechnics can cause significant changes in the current state of natural complexes. Numerous authors have studied the processes occuring in the landscape as a result of human impact (Isachenko. 1976, 1983; Yordanova, Velev, 1985; Kostrovitskiy and others, 1987; Velchev, 1997; O' Neill et.al., 1989; Wood, R., J.Handley, 2001; Penin, 2004, etc.). In addition, there are personal field studies made by the author as a part of his ongoing PhD program.

Up to the stage of transformation many authors outline three main categories of anthropogenic landscapes: low modified, modified and highly modified. Nowadays, these landscapes occupy more than 50% of the land on the planet. Their state and development is directly dependent on human activity.

The lower parts of Slavyanka Mountain have modified and heavy modified landscapes. On the other hand a significant part of the deciduous, mixed and coniferous forest belts (might be considered with a degree of low modification and even as a contingent natural, but their rate is insignificant if compared to transformed by people natural territorial complexes. This in turn is essential for the present study that aims to investigate both relatively well preserved in natural terms territories, and anthropogenic areas, especially the rural areas of the foothills of this mountain in Southwestern Bulgaria.

2. STUDY AREA

The reasons for choosing this particular area and the formulation of the object of study have been determined by the intensifying objectively existing environmental problems in this part of the country. The state of contemporary landscapes is directly related to the anthropization nowadays, i.e. human impact over natural complexes. Several reasons make the research area scientifically attractive. From natural perspective, it is a combination of different geographical units characterized by morpho-hydrological, petrographic, climatic, biological and soil diversity (i.e. there are factors for significant landscape diversity). From the anthropogenic point of view, the territory is subject to certain, mainly agricultural influence and transformation since ancient times.

The region combines a kind of landscape diversity to anthropogenic activities, resulting in the dynamics in the course of various geochemical and geophysical processes in different hypsometric zones of the mountain. The studied area covers the northern slope of Slavyanka Mountain which is located in Southwestern Bulgaria. It is a border mountain between Bulgaria and Greece, and the southern part of it is outside the country. The settlement network includes the villages of Petrovo, Yanovo, Goleshovo, Lehovo, Paril, and Nova Lovcha. The study area covers an area of 84.14 km² (fig. 1).

Fig. 1. Study area – Northern slope of Slavyanka mountain *(source: Astrium 2014).*

3. DATA AND METHODS

Different approaches have been used to indicate the current state of landscapes influenced by economic activities in the region. And the historical aspects of the utilization of the natural environment in the mountain Slavyanka have been taken, as well.

The methodology of landscape studies combines a set of methods. Some of these methods – geochemical, geophysical, cartographic, field studies, etc. – are used in previous examinations of the studied territory. The data used include digital topographic and thematic maps, satellite images, and in-situ data from field observations.

The methodology for land cover and land use data development is presented in the manuals of the CORINE Land Cover (CLC) project [16], [15]. The land use/cover data for the study area is obtained by computer aided visual interpretation of ortho-rectified multispectral satellite images from IRS-P6 and SPOT 4 for 2006 on third level of the CLC nomenclature [9], [10], [11], [12]. The extraction and analysis of land cover and land use data is performed in GIS environment (ArcGIS 10.0).

4. RESULTS AND DISCUSSION

The villages have a long history and since their establishment they have been impacting the nature of the mountain. The presence of caves in the area shows evidences of ancient mining. East of Paril village, traces of the early Iron Age period have been found. Archaeological data indicates that Petrovo, Paril, and other villages were formed at the time of Roman Empire. The agricultural activities have been changing depending on the social conditions. Studies show that pottery and agriculture were highly developed in the period of the 14th – 17th century.

Livestock breeding was intensively developed, too. More intensive development occurred in the 19th century and at the beginning of the 20th century and nowadays these activities continue, even though in

decreased intensity. Mainly, sheep, goat, and cattle herds have been bred. And today this activity continues, but on a reduced scale, because of the changes in the social and economic conditions. The attenuation of livestock farming began in the early '90s of the 20th century. Reducing the number of animals leads to reduced grazing in the open grassland that gradually reduce the area and began succession of restoration of natural landscapes around them. This is related to the emergence of new pioneer mostly grass and shrub species, such as Jerusalem Thorn (*Palliurus spina christi*), juniper (*Juniperus pygmaea*), thyme (*Thymus* spp.), germander (*Teucrium montanum*), fern (*Pteridium aquilinum*), crownvetches (*Coronilla emerus*), etc. Livestock breeding and, especially, logging in the mountain in the past caused a network of holed roads and trails, and the trails are numerous and in the higher parts of the mountain. Our field observations show that the length of the trails and roads on the northern slope of the mountain are more then tens of kilometers, and their density increases in areas with old pastures and meadows. This in turn has led to a change in the natural vegetation along roads and paths, and the appearance of ruderal species, such as coltsfoot (*Tussilago farfara*) cotton thistle (*Onopordum acanthium*), plantains (*Plantago sp.*), patience dock (*Rumex patientia*), elder (*Sambucus sp.*), etc. Similar ruderal species are typical of local landfills, which are few in each village and are also a major polluter of the environment in the area. In the past combustion of landfills and incineration of waste used to be practiced, which is harmful to the surrounding areas with pollutants such as heavy metals, cyanide, oil, polycyclic aromatic hydrocarbons, etc. In the lower part of the mountain, where these settlements are located, the air and soil pollutions have been indicated in a result of the use of different agricultural vehicles and machines. Currently this impact has decreased as a result of the depopulation of the area. Traces of mining activity have been found in some of the caves. For example, 5 km east of the village of Petrovo there is the cave of "Rupata". It has two galleries; one is narrow and almost vertical and 45 m deep. It is likely to have been used for the extraction of ore, especially iron. This activity was carried out in the foothills of Slavyanka Mountain until 1960.

Particularly serious damages of mountain environment were caused in the mid-twentieth century. Among the most important anthropogenic disturbances is the extraction of marble, carried out in quarries of different size. The quarries are very big near the village of Petrovo and in the eastern part of Slavyanka Mountain. There are large abandoned quarries and a cluster of marble blocks and "dunes" of marble dust. Around these sites the dust pollution continues on a relatively large area, leading to the alkalization of the soils. This has in turn led to the emergence of some calcareous species of plants that are permanently settled in the areas of production of marble.

Increased human activity is observed near the hut of Izvora, near the village of Petrovo, where several outbuildings of a different nature and purpose are located. In the past they were used along with the border checkpoint and they were related to the security of the Bulgarian-Greek border. At some places in the mountain still showing signs of border guard band called wire enclosure along which also occur predominantly linear anthropogenic disturbances.

The border fence between Bulgaria and Greece falls into the category of linear disturbance of landscape. It passes along the mountain ridge length approximately for 33 km. During the summer season, people practice activities of collecting berries and herbs; particularly endangered is the natural habitat of Balkan endemic ironwort tea (*Sideritis scardica*), locally called *alibotushki tea*. As a consequence, administrative measures have been taken to prevent access to its habitats, as well as the access to protected areas in the mountain.

The extinction of species as a result of anthropogenic activities does not only mean the loss of these species for the nature of the territory, but also for science, and disturbs the food chain and natural balance of the bioecocenosis.

The most famous karst spring near the village of Petrovo is captured and water is used for irrigation and water supply at the foot of the mountain. This way the natural water exchange and the natural flow of water from the mountain are also altered, in this case by Petrovska River.

Typical agricultural landscapes are developed in the area of rural settlements at the foot of Slavyanka Mountain. The main crops are of rye, oats, wheat, corn, vegetables, vines and some fruit trees such as plums, pears, apples, pomegranates, figs and others.

A study on the land use/cover was made using remote sensing – CORINE Land Cover. The produced map at scale of 1:100,000 shows the structure and spatial distribution of land use/cover for 2006 (fig. 2). We observed 12 classes of land cover on the territory of the Slavyanka Mountain. Data on areas overlapped by them and their share in the total studied area are presented in table 1. The distribution of classes by CORINE nomenclature is shown in figure 2.

The land cover of the northern slope of Slavyanka Mountain is dominated by forests and semi-natural areas. In 2006 they covered 6746.126 ha (80.2%) from the study area. Land use/cover data shows the following:

a). Forests – broad leaved forest (311); coniferous forest (312) and mixed forest (313) – occupy a total area of 5080.6794 ha (60.39%).

b). Natural grasslands (321) and transitional woodland scrub (324) occupy a total area of 1659.3512 ha (19,74%).

c). The total area of sparsely vegetated areas (333) is of 6.0949 ha (0.07%).

Secondary is the area of agricultural areas – second class of CLC. The cover an area of 1523.773 ha (18.09%) from the study area:

a). The total area of land mainly occupied by agriculture with significant areas of natural vegetation (243) and complex cultivation patterns (242) is 1018.731 ha (12.1%);

b). Permanent crops – vineyards (221) covers 310.939 ha (3.69%);

c). Non-irrigated arable land (211) covers 193.0292 ha (2.29%);

d). Pastures (231) covers 1.0739 ha (0.01%).

Third in territorial range are the anthropogenic objects. Their total area in 2006 is of 144.1237 ha (1.71% from the studied area). Just one CLC class is included here.

e). Discontinuous urban fabric (112) covers the area of 144.1237 ha (1.71%).

Table 1. Distribution of land cover for 2006 in Slavyanka mountain.

CLC Class	CLC code	Area (ha)	Percentage (%)
1. Artificial surfaces	112	144,1237	1,71
	Total	**144,1237**	**1,71**
2.Agricultural areas	211	193,0292	2,29
	221	310,939	3,69
	231	1,0739	0,01
	242	198,1215	2,35
	243	820,6095	9,75
	Total	**1523,773**	**18,09**
3. Forest and semi-natural areas	311	2708,157	32,19
	312	1883,0031	22,38
	313	489,5193	5,82
	321	906,9964	10,79
	324	752,3548	8,95
	333	6,0949	0,07
	Total	**6746,126**	**80,2**
	TOTAL	**8414,023**	**100**

These anthropogenic activities have had a significant impact on the landscapes in the peripheral parts of the area, mainly in the western, eastern and northern periphery of the region, both in the past and at present time. This is the reason for a few protected areas to be established, among which the most significant is the biosphere reserve "Alibotush". Alibotush was acknowledged as a reserve with a total area of 1185.8 ha in 1951, in order to preserve the largest habitat of Bosnian pine *(Pinus heldreichii)*, Balkan endemic species, and some trees in the higher parts, which are over 400 years. In the higher parts other characteristic species are the Austrian black pine *(Pinus nigra)*, Scots pine *(Pinus sylvestris)*, Macedonian pine *(Pinus peuce)*, Norway spruce *(Picea abies)*, Silver fir *(Abies alba)*.

The lower parts are dominated by beech *(Fagus silvatica)*, Hop-hornbeam *(Ostrya carpinifolia)*, chestnut *(Castanea sativa)*. Of the rarer species we mention the yew *(Taxus baccata)*, Daphne *(Daphne kosanini)*, mezereon *(Daphne mezereum)*, etc. Here also grows the endemic Bulgarian fir *(Abies borisii–regis)*. Particularly, interesting is the grass plants whose range is determined by the favorable soil and climatic conditions and, especially, by karst terrain, occurring as a kind of "oasis" for many Mediterranean and thermophilic species. In the reserve the fauna is very diverse. There have been over 1200 species of insects. Along with the typical country species - deer *(Capreolus capreolus)*, wild boar *(Sus scrofa)*, hare *(Lepus europaeus)*, fox *(Vulpes Vulpes)*, badger *(Meles meles)*, etc. There are also many Mediterranean species like jackal *(Canis aureus)*, two types of tortoises *(Testudo graeca, T. eversmanii)*, the Macedonian lizard *(Lacerta erchardi)*, an extremely rare cat snake *(Telescopus fallax)*, and others.

The Mediterranean representatives of invertebrates particularly vary– over 55-60% of all invertebrates in the reserve. Nowadays the biosphere reserve "Alibotush" is strictly guarded in order to preserve the unique landscapes and rare protected plant and animal species.

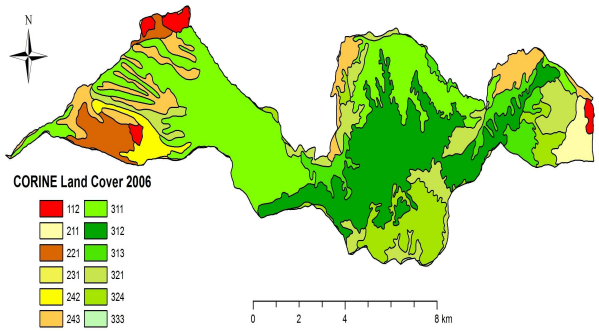

Fig. 2. Land cover and land use in Slavyanka Mountain in 2006.

5. CONCLUSION

The area of study is one of the relatively less affected by the contemporary manifestations of anthropogenic interference. In the recent years the quarrying has been stopped and the access to the mountain is limited to tourists and collectors of various herbs and berries. A moderate mountain hiking is developing on marked trails. From the studies conducted it can be concluded that the study area is insignificantly affected by anthropogenic activity. Also the state of the high mountain landscape could be defined as natural.

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