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## **THE CHANGES OF THE NATURAL RESOURCES ACCESS IN THE SMALL FORESTRY MEDITERRANEAN ISLANDS: THE CASE STUDY OF SKIATHOS, GREECE**

### **Abstract:**

It is known that island forests constitute rare and, at the same time, vulnerable ecosystems that express the complexity and the ecologic interactions of our planet. Ecosystems of island regions change at great speed and, in most cases, they are environmentally degraded. The right management of the natural assets of island forest regions and, at the same time, the socio-economic growth of human resources constitutes the only solution for the achievement of sustainable development. Sustainable management of forest resources can only be achieved through a well-organized road network based on spatial planning. The aim of this paper is to present the progress of the existing forest road network at the Island of Skiathos for the last decades. With the contribution of Geographic Information Systems (GIS) and orthophotomaps, spatial planning of the forest road network can be evaluated for all these years and Road Density can also be calculated. Thematic maps of the forest roads, for each year separately, will also be presented. The current study explores the application of spatial planning in forest roads in order to achieve sustainable development with respect to nature assets and the landscape, in combination with viable forest exploitation.

### **Keywords:**

Island, Forest Roads, GIS, Road Density

**JEL Classification:** Q01

## Introduction

Forest roads are conspicuous components of landscapes and play a substantial role in defining the landscape pattern. The forest landscapes and ecosystems are defined by the interaction among anthropogenic and natural interferences, land ownership, land use-cover and landforms (Forman and Godron, 1986; Forman and Alexander 1998; Forman et al, 2003). One of the most important anthropogenic interferences to the natural environment is the construction of forest roads. Also, physical and ecological characteristics of landscapes constrain the land use and landscape pattern. Land-use changes are influenced by political, social, and economic parameters.

Forest roads provide access and allow the exploitation of natural assets, but also change the land use and create new transportation needs (Dale et al, 1993; Ewing and Cervero, 2001; Hess et al, 2001; Noland, 2001; Tampekis et al, 2009; Turner et al, 1996).

The evolution of the existing forest road network at the Island of Skiathos, in the last decades, and the variation in forest road density are important factors affecting forest landscapes. The heterogeneous landscape of Skiathos Island allows the examination of a wide range of factors that affect road density.

Our results are important for understanding the impacts of roads on ecosystems in the frame of sustainable development. In the past there wasn't other research about the road density of Skiathos Island and also is the first digitization of the area.

## Methodology

### *a) Study area*

The study area is the island of Skiathos. It is a small Greek island in the northwest Aegean Sea. It is the most western island in the Northern Sporades group, east of the Pelion peninsula in Magnesia on the mainland, and west of the island of Skopelos. Specifically, the study area is situated at 23° 37' 33'' until 23° 51' 41'' Western Longitude and 39° 11' 92'' and 39° 21' 45'' Northern Latitude from the base of the National Observatory of Athens. The study area constitutes of 4989.8 ha.

In Skiathos there is one area identified as Area of Community Interest (Sites of Community Interest) and was included in the European ecological network Natura 2000 (Directive 92/43/EEC). That area is the island of Skiathos (code: GR1430003, 32 ha).

Skiathos' vegetation consists mainly of *Quercus Coccifera*, *Quercus Ilex*, *Arbutus Unedo*, *Juniperus Phoenicea*, Aleppo Pine forests and brushwood (*Sarcopoterium Spinosum*). Previously dominated forests of oak were gradually replaced by pine forests. The prevalence of pine trees was helped by this replacement, as the wood was used in the construction of ships' skeletons. Also, the vegetation of Skiathos, is characterized by gross pine (14.5 ha) pine (*Pinus Pinea*) and Aleppo pine (*Pinus Halepensis*).

Mediterranean climate prevails in Skiathos with cold winters and pleasant summers. There is almost complete absence of rainfall during the summer months. The temperature during July and August often exceed 30 degrees Celsius, while in June the weather is somewhat cooler. As in most islands, from July to mid-August we encounter the phenomenon of Meltemi, quite throwing the night temperature.

The population of the island, in 2011, was 6.088 and the density was 122people/km<sup>2</sup>. The Town of Skiathos (pop. 4,883 in 2011) and the airport are located to the northeast next to a lagoon. Other settlements along the coastline are Xanemos (143), Kalyvia (312), Troulos (158), and Koukounaries (119).

### **b) Method**

For the needs of the research digital orthophotomaps of the area were used. We also used the forest management plan of Skiathos Island for the last decades and we utilized factors such as forest, urban, rural road network length etc. Thus, the road networks were digitized and finally, we extracted measurements that regard the length of the road networks. We digitized the roads, visible in digital orthophotos and in the map of the management plan. The digital orthophotos and the management plan's map regard the period between the years of 1996 and 2010.

The density of forest roads (DF) is expressed by the ratio of the length of main forest roads (in meters) to the area (in hectares).

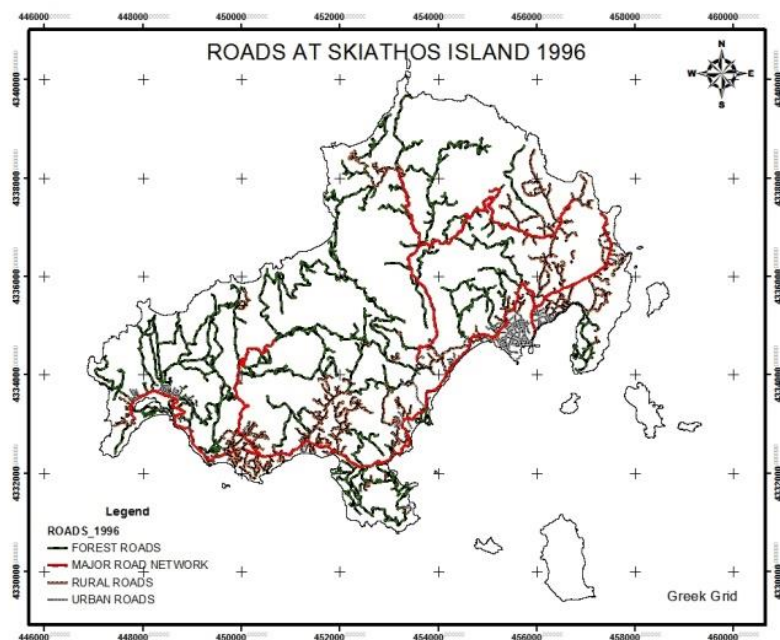
$$DF = \frac{L}{F}$$

DF: Forest road density (m/ha), L: Length of forest roads (m), F: Surface (ha).

### **Results and discussion**

For the year 1996 we calculated approximately 129707,1739 (m) of forest roads. In figure 1 the road network is presented.

**Figure 1. Roads at Skiathos Island for the year 1996.**



Source: Samara, 2014

In the above figure we could see the digitization and the categorization of the road density for the year 1996. Also, the length of the road network is presented in the next table.

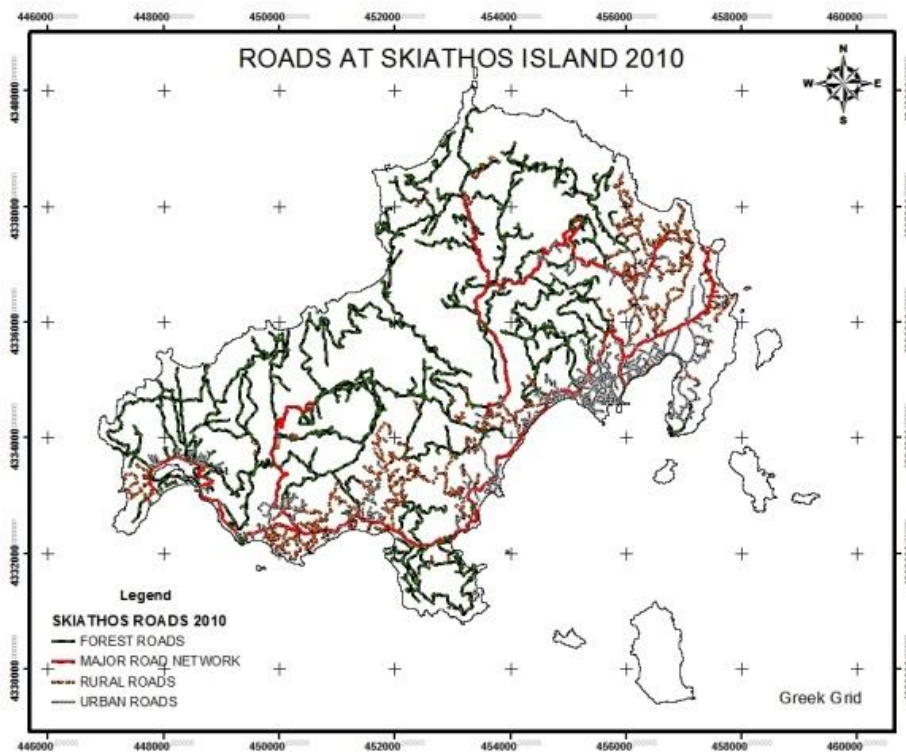
**Table 1. Road network length (m) for the year 1996.**

a/a	Name	Sum Length (m)
0	Forest Roads	129707,1739
1	Major Road Network	31258,6287
2	Rural Roads	72439,7685
3	Urban Roads	25309,2003
<b>Sum</b>		<b>258714,7714</b>

The forest road density is calculated by the equation  $DF = \frac{L}{F} = \frac{129707,1739}{4925,7866} = 26,3323\text{m/ha}$ .

For the year 2010 we calculated approximately 146904,1085 (m) of forest roads. In figure 2, the road network is presented.

**Figure 2. Roads at Skiathos Island for the year 2010.**



Source: Samara, 2014

In the figure 2 we could see the categorization of the road density accordance to the figure 1. Also, the length of road network is presented in table 2.

**Table 2. Road network length (m) for the year 2010.**

a/a	Name	Sum Length (m)
0	Forest Roads	146904,1085
1	Major Road Network	31258,4435
2	Rural Roads	59814,5813
3	Urban Roads	59181,6312
<b>Sum</b>		<b>297158,7645</b>

The forest road density is calculated by the equation  $DF = \frac{L}{F} = \frac{146904,1085}{4925,7866} = 29,8235\text{m/ha}$ .

## Conclusions

Roads are prevalent features of landscapes and have a wide range of ecological effects. A greater understanding of factors affecting road networks is needed. Moreover, this is the aim of this research to forecast how the road density would be change in the future. This provision is necessary for the rural planning and the institutionalization of the land uses.

Between the years 1996 and 2010, an increase of the forest road density has been noted. In the year 1996 the length of the forest road network was 129707,1739 m (total road network length 258.714,7714 m) and in the year 2010 the length was 146.904,1085 m (total road network length 297.158,7645 m). This happened due to an increase of the population in the island and, also, to a diversification of land uses which appeared in recent years.

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