# IDENTIFICATION AND ANALYSIS OF DEFORESTED AREAS IN THE MARAMURES MOUNTAINS NATURAL PARK USING SATELLITE IMAGES

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***Abstract.*** *Protected areas are terrestrial or aquatic surfaces specially designed to protect and maintain the biodiversity, natural resources and related cultural resources. In Romania there are 16 natural parks: Apuseni (Alba County, Bihor and Cluj), Porțile De Fier (Caraș-Severin County and Mehedinți), Grădiștea Muncelului-Cioclovina (Hunedoara county), Bucegi (Argeș county, Brașov, Dâmbovița and Prahova), Balta Mică a Brăilei (Brăila County), Vânători Neamț (Neamț County), Lunca Mureșului (Arad County and Timiș), Lunca Joasă a Prutului Inferior (Galați County), Comana (Giurgiu County), Dinosaur Geopark Țara Hațegului (Hunedoara county), Maramureș Mountains (Maramureș County), Plateau Mehedinți Geopark (Mehedinți County), Putna-Vrancea (Vrancea County), The Superior Mureș Gorge (Mureș County), Cefa (Bihor County), Văcărești (Bucharest). Maramures Mountains Natural Park is a protected area of national interest, which corresponds to the 5th category of IUCN (terrestrial landscape herbal park), being a protected area in which the interaction between humans and nature over time has produced an area with a distinctive character, with ecological, biological, cultural and aesthetic value. The massive deforestation in Maramureș Mountains Natural Park led us to analyze the evolution of the park using satellite images, so we chose the reference data from the past 20 years. The satellite images clearly show how the forest has been exploited. The EU set the goal to halt the loss of biodiversity in Natura 2000 protected areas by 2020, but a few months before the deadline, the images show the total destruction a vast surface near the park and its protected area.*

***Keywords****: Protected areas, biodiversity, natural resources, International Union for Conservation of Nature, deforestation, satellite images.*

## INTRODUCTION

According to the Romanian legislation, the protected natural areas represent: "terrestrial and / or marine areas where wild animals live, or biogeographical, landscape, geological, paleontological or other elements with special ecological, scientific or cultural value can be found. They have a special regime of protection and conservation, established according to the legal provisions "(http://legislatie.just.ro/Public/DetaliiDocument/83289).

The Maramureș Mountains Natural Park is located in the northern part of Maramureș County, near Borsa, Moisei, Vișeu de Sus, Vișeu de Jos, Leordina, Ruscova, Repedea, Poienile de sub Munte, Petrova, and Bistra, and includes the Maramureș Mountains massif up to the Romanian-Ukrainian border. The Maramures Mountains Natural Park is a protected natural area with the goal of preserving the local scenery and traditions, protecting the area's natural, spiritual, and cultural heritage, and encouraging tourism based on these values (APPLETON, 2001).

In 2005, the Maramureș Mountains were designated as a national interest protected area under the category of natural parks. Stable ecosystems, the presence of large-scale natural habitats, and a traditional way of life that is directly dependent on natural resources that has been conserved to a substantial extent were the key factors for the classification (https://www.muntiimaramuresului.ro).

The Maramureș Mountains are a natural environment with a great deal of floristic and faunal richness, which can be seen in both species and terrestrial ecosystems (BERES, 2000).

The Maramureș Mountains Natural Park has ten settlements: seven along the Vișeu River and three along the Ruscova Valley, the park's main affluent. With an area of 133,418 ha, it is Romania's largest natural park, accounting for almost 10% of the country's total protected areas, with the forest fund covering around 85,000 hectares. The population is estimated to be around 90,000 people, with mining, extensive agriculture, logging, and lumber processing being the mainstays of the local economy. The other two spheres of activity took up some of the employees as a result of the mining sector's bankruptcy, but this had negative repercussions for the environment as the strain on remaining natural resources, particularly forests, continued to rise (http://ananp.gov.ro/parcul-natural-muntii-maramuresului/).

Until 2011, the forest in the Maramureș region had been logged in a proportion of around 20%, making it one of Romania's most severely deforested districts. Non-forested places are those where deforestation and forest degradation have been so severe that trees have lost their dominance, and where there are very few of the basic traits and elements of a natural forest in the soil and on the surface. Extensive and frequent exploitation, grazing, firewood collecting, hunting, wildfires, erosion, and mining are all common causes of such high degradation (DANCI, 2011).

In the last 30 years, a true "Wood Mafia" has emerged in Maramureș, and the once-proud forests of Romania are on the point of extinction. According to a recent research by the National Institute of Statistics, Maramureș is the county with the greatest loss of forested areas due to logging. According to a survey by Greenpeace Romania, the value of stolen wood from ancient forests is also enormous: 4 million euros in 2016, representing 45.59 percent of the total harm caused by illegally obtained timber trades at the national level. Maramureș County has lost almost 5,000 hectares due to severe deforestation, making it the second county in the country to lose such a large area due to theft, after Gorj (https://romaniasalbatica.ro/ro/parc-natural/muntii-maramuresului).

Despite warnings that Romania's forests are being destroyed by mafia groups and perishing under the chainsaw (as many political leaders, businessmen, prosecutors, police officers, and secret service agents are involved in these structures), the Senate passed a bill allowing deforestation in protected areas with virgin and quasi-virgin forests (BAVARU et al., 2007). Illegal tree felling occurs on a daily basis in the Maramureș Mountains Natural Park, with the Repedea-Ruscova-Vișeu Valley being the most impacted. These deforested areas can also be seen on the satellite pictures used in the research. The evolution of this anthropic phenomenon may be seen on the forested sections of the Maramureș Mountains Natural Park, according to satellite photographs (BĂRBOS, 2007).

## MATERIAL AND METHODS

We used ArcGIS, the Copernicus site's databases, Europe's eyes on Earth, Google Earth Pro, and Natura 2000 Network Viewer to locate the cleared areas using GIS technologies.

ArcGIS is a geographic information system (GIS) program that lets you manage and analyze geographic data by displaying it as layered maps, such as climate data, environmental data, and trade movements. It is used to produce and illustrate groundbreaking research by a wide spectrum of academic institutions and departments, including in the humanities and sciences. It is also used by a large number of governments and private/commercial organisations all around the world.

ArcGIS, like many other GIS tools, creates maps by category, which are then arranged as layers. Each layer is georeferenced, so that when they're placed on top of one another, the computer aligns them properly to form a complicated data map. Depending on the needed display, the

foundation layer is nearly always a geographical map, derived from a variety of sources (satellite, road map, etc.). Users can access a large number of them through this program, which also includes live stream layers with traffic information.

The photos are high-resolution and come from both contemporary and historical sources around the world, enabling for the creation of historical maps as well as current demographic data and observations. Surface phenomena like height, temperature, precipitation, and so on may be fully integrated into such maps and visual models thanks to incredible surface analysis tools (https://www.esri.com/en-us/arcgis).

Natura 2000 is a network of natural conservation areas across the European Union's territory. It is made up of Habitats Directive Special Areas of Conservation and Birds Directive Special Protection Areas. There are both terrestrial and marine protected areas in the network (https://natura2000.eea.europa.eu/#).

Copernicus The European Union's Earth observation program, Europe's eyes on Earth, examines our planet and its environment for the benefit of all European citizens. Satellite Earth observation and in-situ (non-spatial) data are used to provide information services (https://www.copernicus.eu/en).

Large amounts of global data from satellites, ground, aerial, and maritime measuring systems give information to enable service providers, governments, and other international organizations improve the quality of life for Europeans and others. The information services provided are free and open to the public.

Copernicus demonstrated an endless cosmos to humans, which had previously been limited by the rotation of the planets and the sun around the Earth, and produced a knowledge of a world without bounds (https://land.copernicus.eu/).

We also utilized Google Earth Pro to conduct an analysis of deforested areas during the last 30 years, creating a perimeter that was monitored to monitor deforestation.

Google Earth is a piece of software that combines a virtual globe, a map, and geographic data. It was initially known as EarthViewer 3D and was developed by Keyhole, Inc., a CIA-based firm that Google acquired in 2004. The Earth map is made by superimposing satellite photos, aerial photography, and geographic data on top of a globe (https://www.google.com/earth).

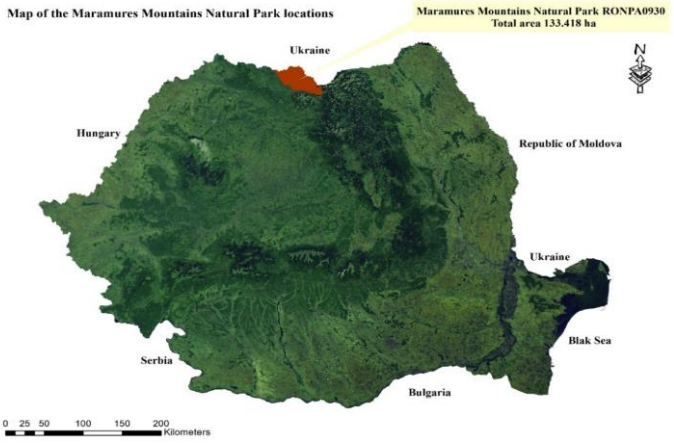


Fig. 1. Location of the studied area

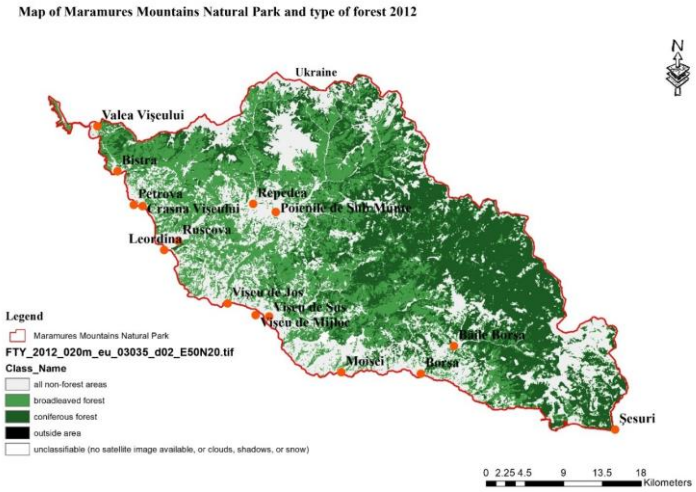


Fig. 2. The predominant type of forest at the level of the Maramureș Mountains Natural Park in 2012

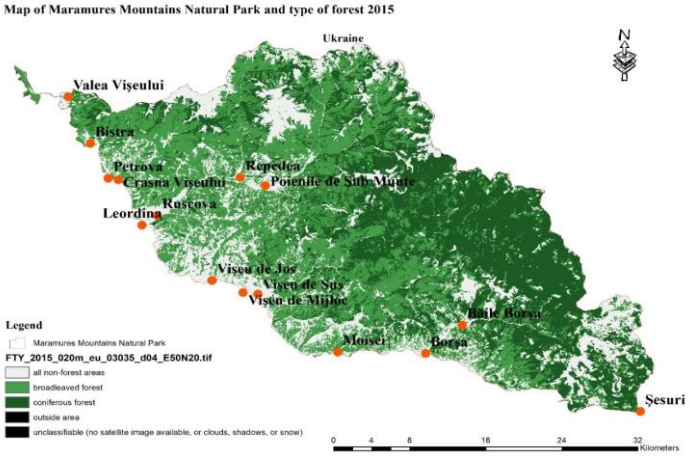


Fig. 3. The predominant type of forest at the level of the Maramureș Mountains Natural Park in 2015

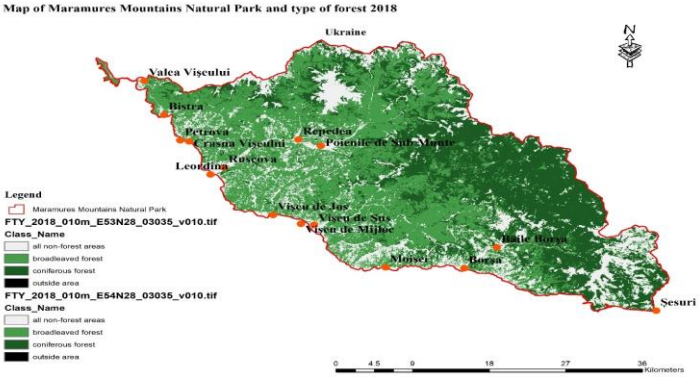


Fig. 4.The predominant type of forest at the level of the Maramureș Mountains Natural Park in 2018

The total assessed wooded area is 71,366 ha, of which 5,663 ha were deforested prior to 2012, and 1,836 hectares were deforested between 2012 and 2014. According to statistics provided by Romsilva, an area of 7,499 ha was cleared in the Maramureș Mountains Natural Park over the last 30 years, accounting for 27 percent of the entire examined area and resulting in a volume of wood of roughly 1.69 million cubic meters, with a damage of 90 million euros. Poienile de sub Munte, Repedea, and Ruscova are the places most devastated by illegal logging (CERONI, 2007).

**RESULTS AND DISCUSSIONS**

The analysis of the deforested areas in the Maramureș Mountains Natural Park was done using Google Earth Pro program, so you can see the massive deforestation in the last 10 years.


Fig. 5. The evolution of the deforested areas in the Maramureș Mountains Natural Park 2011

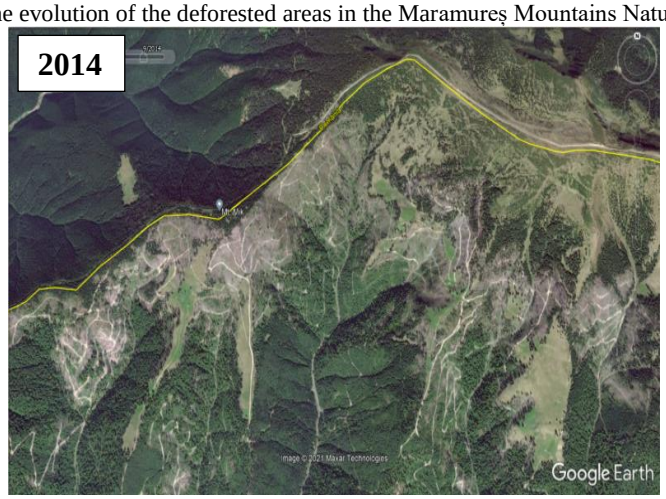


Fig. 6. The evolution of the deforested areas in the Maramureș Mountains Natural Park 2014

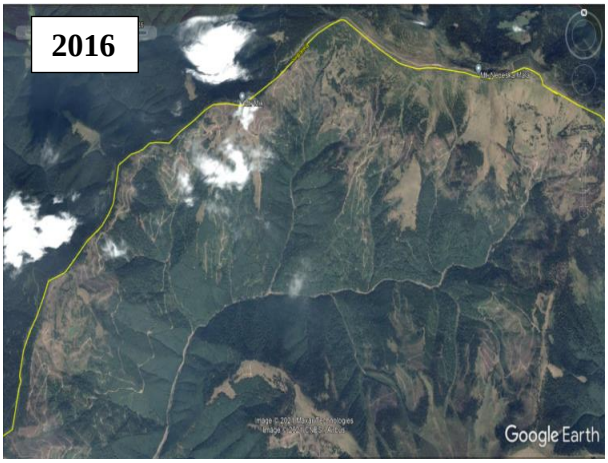


Fig. 7. The evolution of the deforested areas in the Maramureș Mountains Natural Park 2016


Fig. 8. The evolution of the deforested areas in the Maramureș Mountains Natural 2017

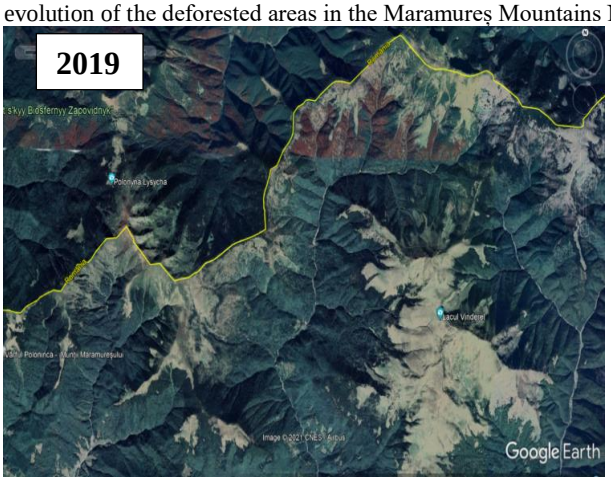


Fig.9 . The evolution of the deforested areas in the Maramureș Mountains Natural Park 2019

Following the examination of satellite pictures over the last ten years, the progression of human effect on the Maramureș Mountains Natural Park has been noticed, including forest clearing, with many of these deforestation activities being illegal or at the legal limit. The study's satellite photographs properly depict the calamity, including the network of exploitation routes that have expanded slopes, damaging even the network of mountain valleys in the logging area. This timber is being hauled over the valleys' courses and the roads built with the equipment, routes that give testament to the devastation that has occurred. If we examine photographs from subsequent years (2014, 2016, 2017, 2019), we can observe the ecological disaster that occurred in the protected natural area of the Maramureș Mountains in 2011.

When we talk about the locations Poienile de sub Munte, Repedea, Ruscova, and others, thousands of hectares of forest area have vanished in the previous ten years. We're talking about Romania's and possibly Europe's greatest deforestation, often known as "A visible satellite calamity."

## CONCLUSIONS

There are 1574 protected areas on Romanian territory, with terrestrial protected areas occupying 24.52 percent of the country's surface and marine protected areas accounting for 23.1 percent.

To summarize, GIS-based protected area management is a trustworthy and modern option for ensuring not only a modern and helpful graphic support, but also some models for spatial analysis in order to safeguard and manage protected areas in the most efficient manner.

The phenomenon of deforestation in natural parks is widespread in Romania, and the only authorities that report these issues are non-profit organizations. Worse, in most cases, those in charge of protecting these sites are complicit with illegal loggers, and those who aren't part of this group have a difficult time performing their duties.

In the last few years, illegal loggers have killed five rangers in Romania, three of them in the Maramures County, and many others have been beaten up and assaulted.

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