FINAL REPORT

Contract number: IPA ITMNEAL/TBR-MOD/SRV/03

Project Name: TO BE READY "The flood and big fire forest prediction, forecast and emergency management", Interreg IPA Italy-Albania-Montenegro 2014-2020 Program.

Contract title: "Experimental Forest Fire Technical Map AIB and Obstacle on the Fly on Sample Areas, Albania"

REPUBLIKA E SHQIPERISE
MINISTRIA E MBROJTJES

G-O PROJEKT

G-O PROJEKT
SHPK
NUIS: L 71403020 P

Client:	Ministry of Defense
Beneficiary:	Government of Albania
Project:	Experimental Forest Fire Technical Map AIB and Obstacle on the Fly on Sample Areas
Origin of Financing:	General Budget of European Union
Type of document:	Final Report
Contract number:	IPA ITMNEAL/TBR-MOD/SRV/03
Consultant:	GO Project
Date of report:	2022

Table of Contents

GO PROJEKT SHPK NUIS:L 71403020 P

List of Figures:

Introduction

The problem of forest fires takes on a very delicate connotation in protected areas, where the measures to contain the damage caused by fires must be specifically defined and related to the characteristics of natural emergencies (habitats, populations, and landscapes) object of protection and conservation. For protected areas, fire prevention planning lines must be set up and followed, which although closely integrated with those of the regional AIB plan, are inevitably more complex than those referring to the rest of the territory. This is mainly due to the fact that in protected areas, together with the differentiation of territorial realities, the problem of the complexity of naturalistic emergencies and their relationship with the structural and functional trauma caused by fire must be evaluated more carefully. In addition, forest fire planning in protected areas must be closely integrated with environmental planning (park plan, basin plans, landscape plans) and with the forest planning of conservation biology, at regional and local level (forest settlement plans), in consistency with the principles of landscape ecology, systemic silviculture and sustainable forest management. The objective to be achieved with the fire prevention plan in protected areas is to limit the damage, aiming primarily at reducing the surfaces traveled rather than decreasing the number of events. While not neglecting the determining causes that are more difficult to counter, the prevention intervention must be focused more on the control and management of the predisposing causes, that is, on those factors that contribute to condition the behavior of the fire, and therefore the destructive force and the damage that it can cause, and the degree of difficulty of control by the extinguishing service. The management of the fire element obviously provides for a preparatory environmental planning capable of interpreting the dynamic meaning of the current mosaic and therefore of preparing rules of conduct and interventions that they contribute to favoring both an evolution towards more mature forms of vegetation and one.

In this respect, the consultancy after the literature review, has also conducted a field survey that consisted on new measurements and calculations for update of different type of networks.

A final map that includes the most affected areas of forest and pasture inventory, seasonally, has been prepared. This map, along with a set of findings will be a reference in planning and evaluation of forest management local documents. This technical study can also be further used for reference and replicated for other protected areas.

G-O PROJEKT SHPK NUIS L 71403020 P

I. GENERAL OVERVIEW

A. Principles of work

Considering the context of this study, to conduct an efficient operating method, it is advisable that some general requirements are respected in the development of it, such as:

- ***The activities to be carried out*** must be organized in such a way as to be able to withstand unexpected variations. It often happens that there are variations with respect to what is expected due to the onset of difficulties that are not normally foreseeable. Sometimes the information that is gathered is not what is expected.

- The main objective ***is to create a map*** along with a technical report that presents the current situation of fire risk management and will provide an updated and homogenous information that can be used in the future to determine the seasonality, frequency, intensity, extension, danger and fire risk for the area. The technical paper can help analyze the profile of the gravity based on statistical data using for example data from Corine Land Cover.

- The Projected Coordinate System to be used for longitude and latitude will be ***ETRS Albania 2010*** and for altitude ***EGM 2008***. These are global reference coordinate systems. GNSS receivers of high accuracy will be used for this survey. The scale of the maps to be produced will be in 1:10,000 to 1:50,000 depending on the size of the area. Maps should contain all basic sings such as title, description, scale, scale bar, north direction, coordinate system, legend.

- ***Survey on the field*** will be focused on sample areas, which will be selected before and during the measurements due to the unpredictability of the terrain where previous records will be examined beforehand to ensure data accuracy. This survey will aim to present the interconnection between the elements of the area such as urban areas, roads, water bodies, forest plots, tourist areas, etc. This means pointing out which urban areas are facing higher risk of fire hazards based not only on the geographical position but also on the demographic data. Categorizing roads by their width, type, composition, accessibility which will help create strategies for escape plans. It is also possible that after the survey and more detailed analyses in the office emergency escape signs could be inserted on the field. Water bodies can be used as a source for water supply for emergencies. Dajti Mountain National Park is a very rich area containing lakes, lagoons, rivers, etc. That means identifying sources for emergency re-filling with water for air vehicles and landing areas.

- ***The areas covered by fires in the last years***, sources which will be found from old documents and will be presented on the map. After field survey data must be compared to indicate possible inconsistencies or adjustments. Fire risk mapping enables us to understand the spatial extent of the risk in the form of maps showing the levels and nature of the risk, which change for each recurrence period providing us with crucial information for fire risk identification and warning.

- ***The essential elements*** that need to be identified on this study are the areas at different levels of risk, the areas with different protection levels in relation to the zoning of the protected area, the evaluation of the impact of the planned works on the protected area and in particular on the object of protection.

- Analyzing data such as ***terrain elevation*** or ***tree height*** through different calculations will help determine flight risk and obstacles. Besides natural obstacles we can find artificial ones such as electrical poles or private property. Another interesting study will be calculating ***timing of possible air intervention*** depending on the distance from the starting point.

- The area of study is a ***protected area*** so additional information such as climate, rainfall, meteorology, soil type, biodiversity is also important to be presented on a map for future studies. Some of this data will is to be presented by season. This information has a direct impact on the preventing strategies.

B. Objectives and products

For the implementation of this study, particular emphasis was placed on the data contained in the previous forest managements part of the protected area, technical manual for fire prevention planning and Guidelines for Wildfire Risk Assessment in Albania.

A further element of analysis arose from the data relating to the fires that occurred in the DMNP territory in the last decade which showed an increase trend in the summer periods, against a medium / high risk present in the winter-spring periods, thus as in all of Albania. This could also be due to the changed climatic weather conditions that have occurred in the region in the last decade and, consequently, in the DMNP area.

The criterion on which this study is based on the defense of territory from fire through the management of the fire element (fire management) abandoning, what had been in the past, the criterion that aimed at the protection of territory by switching off, always and in any case, where possible, of all types of fire (fire control).

By combining the elements cited above, it will be possible to create a forest fire risk map, which is a combination of basic and statistical data, where after this zoning, the most dangerous areas will be recognized and have priority in prevention and later interventions.

A map of obstacles will also be built, where all possible obstacles in flight will be determined, which is the fastest intervention in cases of danger of forest fires. This map will contain all the necessary elements for determining the flight and its efficiency in terms of quantity and time.

G O PROJEKT
SHPK
NIPT: L 71403020 P

C. Overall timeline

Number	Activities (A) and Deliverables (D)	Week 1	2	3	4	5	6	7	8
A1	Data collection and documents review	■	■						
A2	Inception report								
A2.1	Preparing of Inception Report	■	■						
D	Incorporating comments and delivery of Inception Report			■					
A3	Data editing								
A3.1	Pre-definition of selected areas	■							
A3.2	Preparation of data for the project implementation	■	■						
A4	Field Survey								
A4.1	Field measurements for road networks/ water bodies		■	■	■				
A4.2	Field measurements for electrical/gas lines			■	■				
A4.3	Editing of old data based on field survey				■	■			
A5	Elevation data								
A5.1	Calculation for tree height analysis				■	■			
A5.2	Calculation for terrain elevation analysis				■	■			
A6	Forest Inventory & Fire Risk								
A6.1	Analysing data of old management plans/studies			■	■	■			
A6.2	Editing/digitalizing areas of forest and pastures			■	■	■			
A7	Urban-Forest Interface areas								
A7.1	Zoning of urban areas, cultural areas, heritage areas etc				■	■	■		
A8	Flight obstacle and risk for the area								
A8.1	Obstacles: tree height, electrical lines, private property etc					■	■		
A8.2	Flight intervention time, emergency landing					■	■		
A9	Experimental Forest Fire technical map AIB								
A9.1	Measured and edited data incorporated in one map					■	■	■	
A10	Final Report								
A10.1	Preparation of Final report							■	
D	Incorporating comments and delivery of Final Report							■	■

G-O PROJEKT SHPK NUIS: L 71403020 P

II. TERRITORY OF DAJTI MOUNTAIN NATIONAL PARK

A. General description of Dajti Mountain National Park.

Dajti Mountain National Park is one of the most beautiful natural areas of Tirana, located in the North-East of Tirana. The first national park since 16.02.1960. With DCM no. 402, dated 21.06.2006, the area of "Dajti Mountain" National Park is expanded to 29,216.9 ha, having the II category according to IUCN. Due to its recreational capacity, defines it as one of the most important nature tourism sites of Albania. It is a very rich ecosystem characterized by wonderful landscapes, specific vegetation and flora, paleo-ecological values, wildlife, caves etc. The maximum height of the Dajti Mountain NP is 1,827m, the peak of Meçeku, of Saint Mary. It is one of the most important natural environments in Albania not only because of the high values of biodiversity and landscape, but also because it constitutes the largest recreational centre of our country due to its position near the country's capital. An area of landscape, cultural, historical and traditional values. Dajti Mountain NP offers excellent opportunities for sport and educational activities, including hiking or biking, picnics and more. Land use in the Park is characterized by agricultural activity, mostly represented by fruit trees, olives, vineyards and vegetables and husbandry. The infrastructure in general is poor and developed almost in inhabited area. The numerous touristic potentials make the park part of almost all annual tourist routes organized in Albania. Until now the DMNP, has been praised for its landscape, nature, beautiful sights, which are also considered as the park's strengths. The natural and rural areas in the park provide opportunities for the development of rural tourism, mountain tourism, ecotourism, agrotourism and outdoor activities (parachuting, mountain biking, trekking, mountaineering, hiking, horseback riding, study tours, etc.). Some of these activities are the main motive for visits by foreign visitors to the natural areas. The demand for outdoor activities is growing rapidly in the park ecotourism market.

The relief is hilly-mountainous, with slopes with pronounced asymmetry, with different shapes and slopes, with strong slope processes, where landslides, landslides and erosion are very active. Bokrim near the village Mner are part of the list of natural monuments, even those that have a valuable landscape geomorphological, highly degraded and deserted by erosion sacrificial slopes, driven by man, as we will talk about later down. The terrain is very rugged, separated by valleys and valleys with sides with different contrasts, where all types of soils are present: grey, brown and forest browns; these form microenvironments which are covered by quite diverse vegetation. The eastern and south eastern wing works from the accumulation of flysch-clay hills; high rocky peaks are separated by many streams flowing into the Terkuza river or words in Bovilla watershed. The Park is rich in the surface and ground waters. Water percolates in limestone creating wonderful caves. The vegetation represents a live museum by its vegetation structure, consisting in bushes and shrubs in lower altitude, high trees in the middle and natural pastures at the top. The Park is very interesting from fauna point of view. In the area, between others, are observed several species of amphibians, reptiles, birds and mammals, with specific protection status in national and international levels. Dajti Nature National Park is considered as one of the most appropriate natural site of Albania for ecotourism development, such as nature tourism, scientific and education tourism, adventure tourism, agriculture tourism etc. Several tourism facilities are operating in Recreational, Traditional and Sustainable Use Zones, *(see fig. 1)*. (ref. OSM,2022)[1]

G-O PROJEKT SHPK NUIS: L 71402020 P

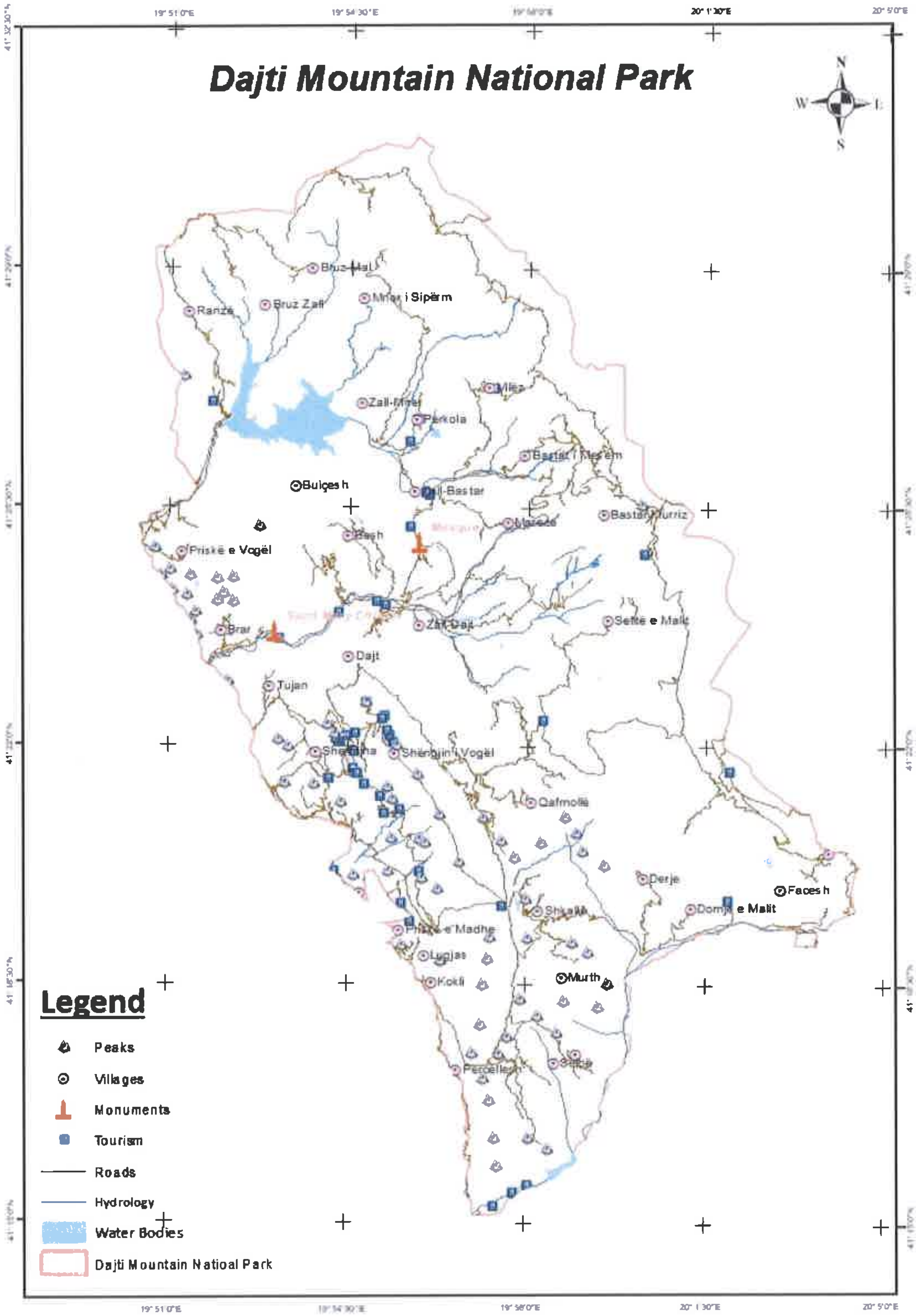


Fig. 1 - General map of Dajti Mountain National Park

B. Administrative aspects

The official administrative boundaries of DMNP are a) *North* - the administrative border, between the districts of Kruja and Tirana, from the top of Fravesh (794 m), continues with the quotas of 1'090 m, 1'227 m (Mj. Zithi) up to the quota of 1'627 m; b) *East* - quota 1'627 m, follows the ridge of the mountain range Xibër-Mali with Gropa, with quotas 1'473 m (mj. Rjepa), 1'388, 1'295, 1'613 m (mj. Popati). near Burimas village and the flow of Erzen. c) *South*, it is bordered by the flow of Erzen, the Skorana reservoir up to the Skorana Gorge; d) *West* - Gryka e Skorana, and continues with quotas 890 m (mj. Kurorës), near the village of Përcëlesh, in Priska e Madhe, continues with the Priskë-Surrel highway, follows the Surrel-Tirana road, until the vicinity of the municipality of Dajtit, then in quotas 573 m (mj. Qyteza), 445 m (mj. Shpatës), near the village of Brar and Priskë e Vogël, interrupts the Tërkuza river, quotas 1268 m (mj. Gamtit) to quota 794 m (edited by Fraveshi). (*see fig. 2*), (ref. AKPT)[2]:

The park is divided into 5 conservation and management areas as follows (*see fig. 3*):

- *Central Area* has an area of 9101.23 hectare and is divided in 3 subdivisions: Zone with special conservation, Natural environmental area and area with natural monuments. They are designated as high value areas for nature and biodiversity and include habitats in Mount Dajti, Mount Priska, Brrari and Fekeni. The second zone of protection is implemented in the central area, which provides undisturbed territory.
- *Recreational Area* has an area of 2365.13 hectare and is divided into 2 subdivisions: Active recreational area and Natural recreational area. They constitute an area of outdoor recreation opportunities with facilities that respect the functions of the park, ecological values, natural landscape and cultural and tourist values. The fourth level of protection applies to the recreation area.
- *Traditional Usage Area* has an area of 16,434.94 hectare, which enables the continuation of traditional activities. In the traditional use area, the fourth level of protection applies.
- *Sustainable Usage Area* has an area of 1184.27 hectare, in which existing economic activities are permitted and new activities may be opened only after obtaining the relevant permits. The fifth level of protection applies in the area of sustainable use.
- *Military Area* has an area of 131.33 hectare, which is used for military purposes or for government residences. (ref. AKZM, 2020)[3]

GEO PROJEKT SHPK 71403020 P

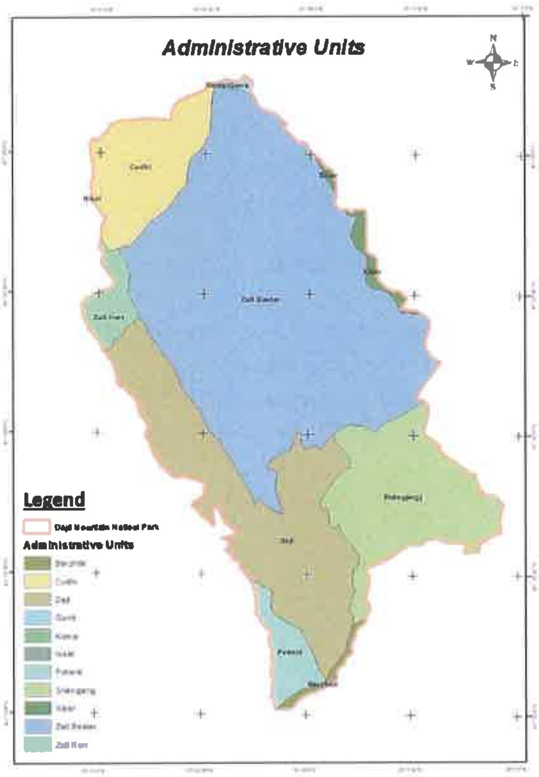


Fig. 2 - Administrative map of Dajti Mountain National Park

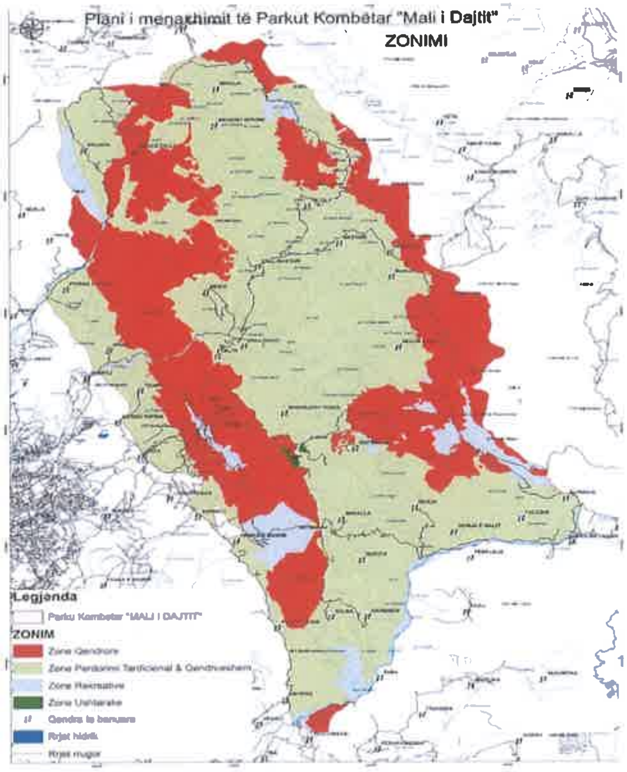


Fig.3 - Management areas of Dajti Mountain National Park

C. Habitat

The Park is covered by different types of vegetation, beginning from the Mediterranean evergreen scrubs at lower altitudes, the vegetation of oak belt from 600 - 900 m a.s.l, the belt of beech forest above 950 - 1,000 m a.s.l and the subalpine and alpine calcareous pastures above 1,300 - 1,400 m a.s.l. Dajti Mountain NP is not only part of the landscape of the city of Tirana, but it is the lung of this great urban ecosystem. Flora and fauna are quite diverse. The territory of the DNP is inhabited by ca. 991 plant species that make 24.75% of the Albanian plant species, embodied in 104 families and 486 genera. The high richness of the habitat types of the DNP shows that the floristic richness of the park should be higher than we've known so far. The flora of the conservation interest of the DNP includes 4 endemic species, such as the Sedge of Markgraf (Carexmarkgrafi), the Skanderbeg bellflower (Campanula skanderbegii), the Korabi bellflower (Campanula korabensis) and the Albanian pennycress (Noccaeaalbanica), and ca. 11 sub-endemic species. The endangered flora of the park is represented by 69 species that are part of the National Red List of the Protected Flora, whereas the species with European and global interest consist of six (Gentiana lutea, Ramondaserbica, Ruscus aculeatus, Galanthus reginae-olgae, Gladiolus palustris, Anacamptis pyramidalis). The DNP ecosystem is also rich with fauna species. The park is inhabited by 668 species where the order Coleoptera is represented by 140 species, birds are presented by 122, order Hymenoptera by 92 species, and butterflies (Lepidoptera) by 86 species. In the DNP there are 14 mamals, 18 reptile species, 7 Amphibes, 6 insect species and and 1 terrestrial mollusk which are with conservation interest, included in the Bern Convention and Habitat Directive, (*see fig.4*).

12 types of habitats with relevant codes have been identified in the DMNP territory:

a. Mediterranean streams with continuous flows characterized by the species Paspalo-Agrostidion and the dominant forest belt of Salix and Populus alba (3280); This habitat type extends along the Tirana River and into small plots in both streams behind Qafe Molla. This habitat type is of particular importance to living aquatic life and serves as a stabilizer of the aquatic bed and because of its diverse structure, with a slight dominance of the black willow (Salix eleagnos). The dominant species are represented by Salix spp., White poplar (Populus alba), Rubus spp., Plantago major, Lycopuseuropaeus etc.

b. Shrubs with Juniperus spp. (5210); Juniper bush associations in the NPMD occupy small areas, mainly distributed in subalpine and alpine pastures, on the limestone substrates of Mount Pits, Mount Murriza and less on Dajti Mountain. The vegetation of this habitat is mainly dominated by black juniper (Juniperuscommunis L.) and red juniper (Juniperuscommunis).

c. Alpine and subalpine grasslands in calcareous rocky sites (6170); In the DMNP, this habitat type covers the largest areas of Mount Murriza, less so in Dajti Mountain, but also meets in the Mount of Holes. The habitat extends mainly above the altitudes of 1300-1400m above sea level and reaches above 1600m or above the forests of Fagus sylvatica.

d. Oak species Quercus spp. Forever (6310); This habitat type constitutes one of the most important habitats located on the western and north-eastern sites of Dajti Mountain, Tujani Scale and less so in the direction of Qafe Molla. The habitat is important because its vegetation is represented by maize vegetation dominated by the always-green leafy plants such as: Prralli (Quercus coccifera) and Oak leaf green (Q. ilex).

e. Lowland meadows (with Alopecurus pratensis, Sanguisorba officinalis) (6510); Mountain meadows such as habitats lie in the alpine area of the Dajti Mountain Plain and Pits Mountain Plain. They constitute the most important habitat not only for shepherds and grass mowers, but also for the world of Insects, especially butterflies and dragonflies, but also for other herbivores.

f. Highland mountain meadows (6520);

g. Limestone rock slopes with hasmophytic vegetation (8210); The steep slopes of limestone clad with overlying ismophytic vegetation in the DMNP, are found along the Tirana River, beneath the Dajti plain, along the Dajti Mountain ridge and in some areas of the Mountain with Holes. This habitat is the environment for the growth of rare and endemic species of our fauna such as Scorpions, Spiders, Accipiter nisus, Hieraaetus penatus, Hieraaetus fasciatus etc.

h. Medio-European beech forests on limestone of the Cephalanthero-Fagion alliance (9150); This habitat type includes acidophilic broadleaf or coniferous mixed forests in which beech is dominant. The habitat extends vertically from 1,000m to 1,400-1,700m, both in Dajti Mountain, Feken, Priksa Mountain and less in Mount Murrize. The habitat is located almost entirely in calcareous geomorphological composition, with a relatively good soil layer. This habitat in the holes that form inland forms meadows with a very rich flora as in the case of Cherry Neck or Selita Meadows.

i. Tilio-Acerion alliance forests of rocky slopes, bogs and arid valleys (9180); This priority habitat type is patchy at moderate elevations of the DMNP. The habitat does not form continuous surfaces, but often mixes with forest elements, especially those of Beech and Oak. This habitat does not form pure and real forests within the territory of the park. The dominant species that give physiognomy to this type of habitat are: Broad leaf blade (Tiliaplatyphyllos), Maple leaf maple (Acer pseudoplatanus and Acer obtusatum), Frasheri (Fraxinus ornus), Screw (Ulmus glabra). The habitat prefers cool, moist environments. The vegetation is dominated by the species of maple leaf maple (Acer obtusatum).

j. Illyrian forests Fagus sylvatica (Aremonio-Fagion) (91K0);

k. Illyrian forests with oak and hornbeam (Erythronio-Carpinion) (91L0); The Dushku and Shkoza forest habitat is characterized by the presence of the Quercetum frainetto-cerris and Carpino-Quercetum frainetto-cerris associations, which are found at altitudes above 400 m, on the slopes above the Tujan valley, on the eastern slopes of Dajti Mountain and Western Zone. Zall Dajt-Zall Bastar. Its small surface extends to both sides of the Neck. Small areas are also found on the western slopes of Dajti Mountain. The trees of this habitat rarely reach more than 3-4 m high either in the Selita or after Qafa of Molla, or even in the villages of the Zall-Bastar area.

l. Riparian forests (Platanus orientalis) and Liquidambar orientalis (Platanionorientalis) (92C0). It is an important habitat locatedalong the bed of the Tirana River and itsstreams, in the upperreaches of Dajti. This habitat is notable for the Rrapitrees, which are not high in number, however. (ref. AKZM, 2020)[3]

G-O PROJEKT

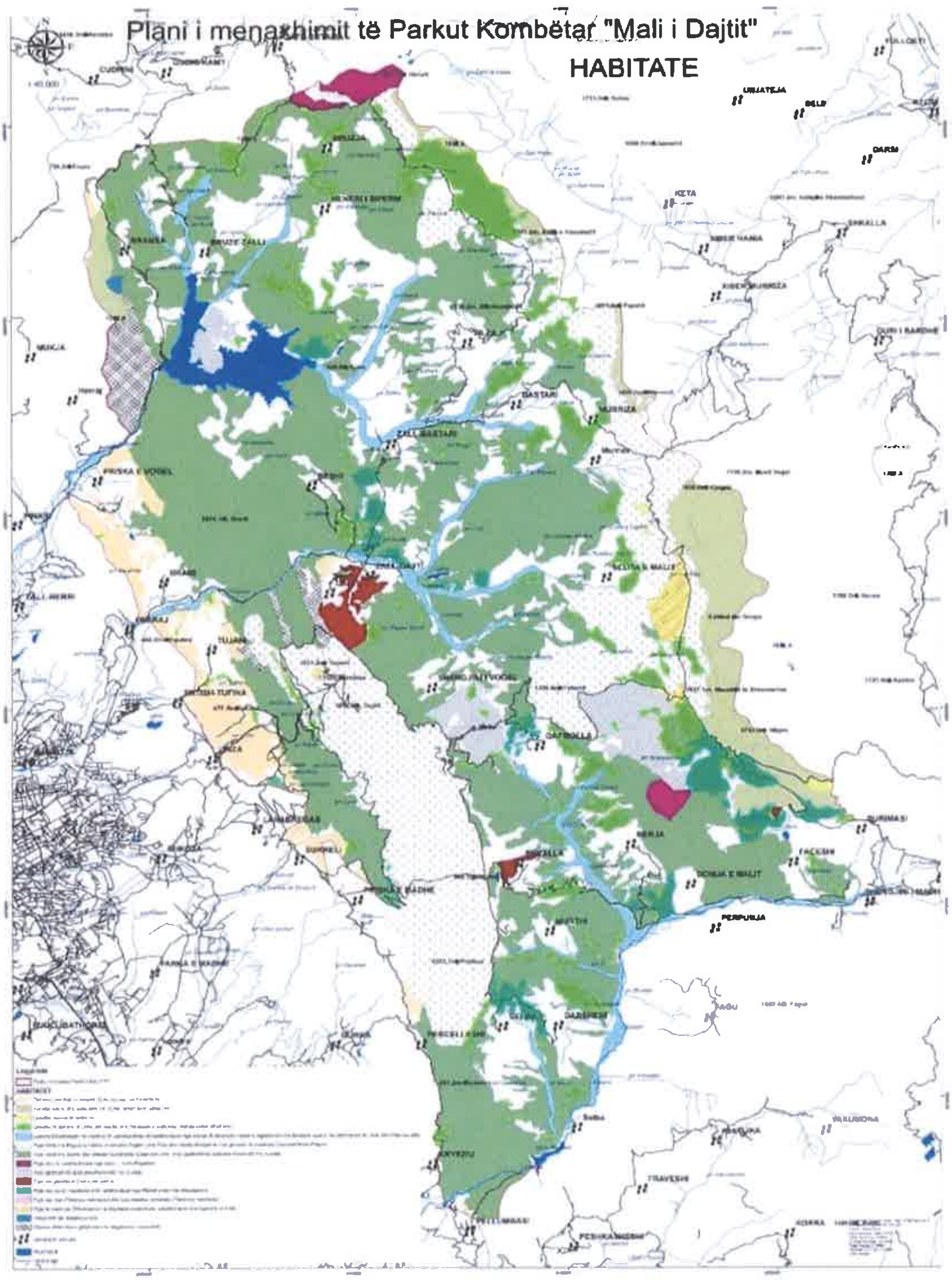


Fig. 4 - Habitat of Dajti Mountain National Park

D. Climate

The area is mainly included in two climatic subzones: Mediterranean hilly (up to 500-600 m altitude) and Mediterranean pre-mountainous (at higher altitudes); however, a mountainous Mediterranean climatic zone seems to be present in the high peaks as well. (Climatic Explorer)[4].

-**Rainfall** prevails in the hilly area, mainly with two peaks, autumn and winter, while the tops of the mountains are often covered with snow during the winter season. The meteorological data for this area taken from the station of Dajti village shows that the average rainfall experiences significant fluctuations in the area according to each month, where also temperatures the temperature fluctuates more, but the average maximum temperatures are much lower (approx. 18-19˚C), compared to that given for the Mediterranean subzone hilly (about 24-25˚C) (*see table 1*).

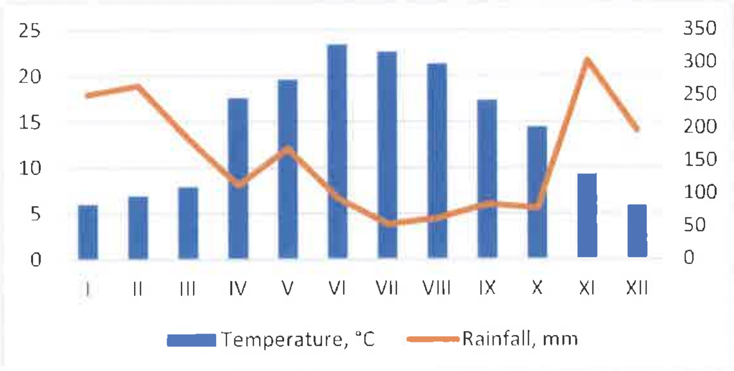


Fig. 5 Average 2010-20 of rainfall distribution by month in the thermometric place of Dajti village (Tirana)

Station	Number of days with rainfall			
	Rainfall ≥ 0.1mm	Rainfall ≥ 1.0mm	Rainfall ≥ 0.1mm	Rainfall ≥ 0.1mm
Dajt	131	112	66	58

Tab. 1 - Number of days with rainfall in Dajti Mountain National Park

-**Snow**; It's not a rare phenomenon and when it shoots down, it creates a layer, or even if it creates a layer, the residence time of this layer is very short. On average, 20 to 27 days of snow are observed in the whole area every year. These days are mostly observed in the months of January, February and December, the snow layer stays for a long time only during extreme winters associated with negative temperatures (*see table 2*).

Station	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Total
Dajt	8.0	6.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	5.0	27.0

Tab. 2 - Average days with snow in Dajti Mountain National Park

According to the distribution of the maximum snow height with a certainty of 2% (repetition period once in 50 years) for the area under study the height is 42 cm. (In March 1949) 50 cm of snow fell in Tirana and the negative temperature reached -13.0°C, such meteorological parameters for Tirana that has started measuring meteorological elements in 1925 have never been reached until today. In 30 years, it reaches 38 cm, in 20 years 34 cm, and once in 10 years it reaches the height of 20 cm snow.

-**Humidity;** Relative air humidity serves as an important indicator of air humidity, which has a direct impact on economic and human activity. As can be seen from table No. 16, Western Lowlands, which includes the study area, is characterized by the average annual value of relative air humidity that fluctuates from 60% to 70%. The western part of our country where it enters and the area under study has higher values of average relative humidity than the inner part, this is because the part the western part is under the especially pronounced influence of the Adriatic Sea. The highest values of average relative humidity are generally observed in the period cold of the year that is related to the cyclonic activity that takes place during this period. As can be seen from table No. November and December have the 16 highest values and then comes January. During the summer months, the average values of air humidity are lower especially in the months of July and August, which are the warmest months of the year. Based on the annual amplitude, the entire area under study belongs to the marine regime. The influence of the sea is shared in Tirana where the amplitude reaches 14%. In the area under study, the relative humidity maximum falls at 4 and 5 o'clock, while minimum at 14 and 15. Most of the night, relative humidity remains almost unchanged. In the study area, the average number of days with relative humidity ≥80% fluctuates for Tirana about 40.5 days.

Station	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Avg	Amplitude
Dajt	73	71	71	72	71	66	61	63	70	72	76	76	70	14

Tab. 3 - Average humidity (%) in Dajti National Park

A characteristic indicator is the relative humidity amplitude, which points out the changes observed in relative humidity values during the day, months and year. It is also characteristic that it increases rapidly from summer to autumn than its decrease from winter to spring.

-**Wind**; The wind regime is of special importance both for the formation of the climate and for practical purposes (in the design of bridges). To describe the wind regime in the area under study, we will base ourselves on observations at the meteorological station in Dajt. The main parameters of the wind include data on its direction (speed according to different directions) as well as its speed according to different directions (*see table 4*).

		N		NE		E		SE		S		SW		W		NW	
Station	%	c	s	c	s	c	s	c	s	c	s	c	s	c	s	c	s
Dajt	44.0	3.5	2.7	2.8	2.0	3.4	1.5	15.8	2.5	4.4	2.4	7.1	2.7	3.9	2.5	5.2	2.9

c - casuality

s - speed m/s

Tab. 4 - Avarage speed and distribution in %

G-O PROJEKT SHPK NUIS: L71403020 P

E. Geology and Pedology

From a regional point of view, is part of the Kruja tectonic zone and more specifically, in what is called the Kruja-Dajti anticlinal range. From a spatial point of view, it coincides with the carbonate mountain massif of Gamit, which constitutes a more or less central segment of the Krujë-Dajt structural range. In the formational sense, it is represented by dolomites, interspersed with dolomitic limestones, which also contain rudites in some layers. Between dolomites and dolomitic limestones, thin bituminous shales are found. (IGJEO, 2022)[5]

From the age point of view, the carbonate formation described above has been found to be of the upper Cretaceous and with a thickness that varies from 1200 m to 1400 m. Rising in the cut, above the Upper Cretaceous carbonate formation, follow the Paleocene deposits, represented by a mixture of dolomites, bioclastic limestones and biomicritic limestones, (*see fig.6*).

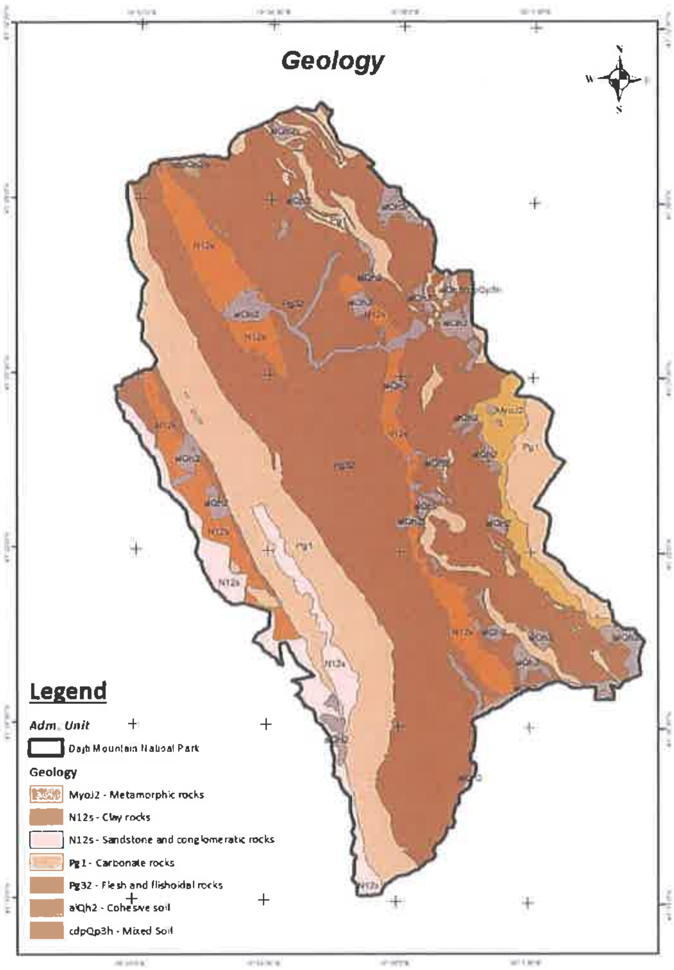


Fig. 6 - Geology Map of Dajti Mountain National Park

Soil cover is very diverse in terms of morphological qualities, chemical, physical and mineralogical properties as well as stone rates. The combination of relief, climate, vegetation, composition of the mother rock creates special soils with special qualities, where living microorganisms play a main role in the pedogenetic process, especially in the circulation of matter and energy.

In the context of DMNP, the relief is a key factor to understand this diversity as it directly affects the climate, the physico-chemical and biological processes of soil formation, the displacement of nutrients and products, and the movement and regime of waters. Under these conditions, the relief is essential to assess the growth capacity and the water balance of the soil. For example, in the steep parts less water enters the interior of the land than in the flat parts. In the first case it passes over the ground surface causing erosion and impoverishment of the soil in nutrients. This is especially noticeable when the soil is stripped of vegetation, disturbed by various factors such as over harvesting among forest stands as well as animal over trampling on unstructured soils. Therefore, human activities in the forest economy have an active impact on the quality and the functionality of the soils. Referring to the pedologic Albanian map shown below and the FAO-WRB classification of soil types, main soils in DMNP are Leptic Luvisol, Haplic Cambisol, Eutric Cambisol and Calcaric Cambisol. Their distribution rather follows the altitude range, (*see fig. 7*).

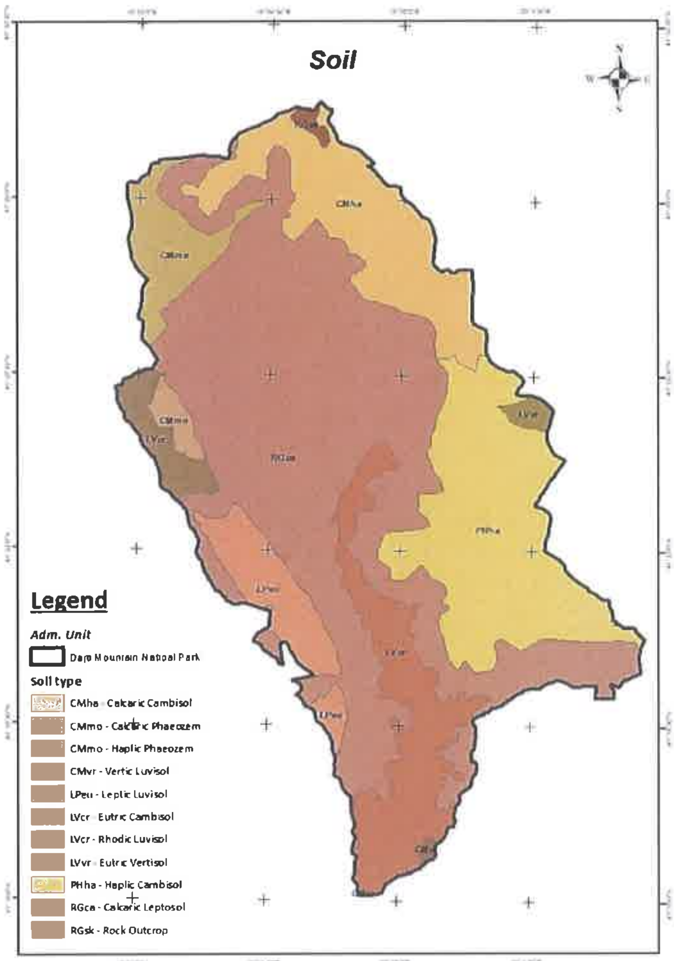


Fig. 7 - Soil Map of Dajti Mountain National Park

F. Hydrology

The territory is crossed by a dense hydrographic network, mainly ravines and streams, branches of the Terkuza River, small springs and some catchment. The most important streams are that of Zall Bastar and Bruz, which they also carry out the main transport of inert materials to the lower parts. IN figure 12-4 shows the performance of the multi-year average (1975-1992) of the flow waters of the Terkuza river measured at the Zall Herri station, which represents the entire amount of water that is collected from the entire watershed of Bovilla. After 1998, with the completion of the dam and the use for drinking water one a large part of this quantity (1.2 - 1.8 m3/s) goes to the Water Treatment Plant Bovilla Water (Kodra e Quqe, Tirana). Based on the fact that since 2006, the entire area of the Bovilla watershed of is included in Dajti National Park it is worth starting our description on the flora and vegetation of the pond, as well as on human activity and influence in this area, speaking before summarizing what this protected area and other areas represent protected around. Another important river of the area is the Ishmi River which is formed by the confluence of the waters of the Tirana River, the Tërkuza River and the Zeza River. These last two, which circulate and intersect the Bovilla watershed, for the part that serves the latter, preserve the characteristics of mountain streams, with rapid flow during the flood and with a small arrival time. During their upper flow, the waters of these streams cross in the form of canyons the limestone massif of the Krujë-Dajti mountains, respectively in the gorge of Shkalla and that of Bovilla. Tërkuza is the main branch of the Ishëm river and lies in the northwest of the Tirana district and in the south of the Kruja district. The length of the bed is 44.1 km, the surface of the basin is 182 km2, the average height of the basin is 458 m above sea level and the fall is 22 m/km. This river begins to originate from the mountains of Xibri and Koti (Pano, 2008).

In the upper part of the basin, the Tërkuza river flows through silty formations, with very low water content and permeability, with a wide bed and numerous branches, which extend to the mouth of Bovilla, near the White Rock. In this gorge, the river cuts the limestone massif in the form of a canyon, with 2.5 km long, with steep slopes and a narrow bed, sometimes reaching up to 3-4 m. In this area, the karst springs of Bovilla, as well as other bed flows, emerge. Sources B1, B2 and B3 come from the carbonate complex of the Krujë - Dajt range. This resource complex consists of fissure waters and karst waters (Eftimi R, 1998). Source B1 originates in the bed of the Tërkuza river, 50 m from the dam of the Bovillë reservoir. Source B2 originates below the body of the Bovillë Dam, on the right side, seen from the Catchment at a distance of 2 m from the axis of the dam, while source B3 originates in the former bed of the Tërkuza River near the dam. During multi-year measurements (unpublished data from the Boville Hydrotechnical Node) the flows of the three springs range from 130 L/s in the driest periods, up to 416 L/s. The catchment in which these sources are collected is part of the works of the Bovilla watershed. These networks appear in digital format with deficiencies and inconsistencies with the real situation on the ground, therefore in the following chapters the correct correction and digitization of these networks will be addressed based on the latest satellite images, the most updated orthophotos and field measurements. Below is a general presentation of the water network and water bodies in DMNP, *(see fig. 8)*. (ASIG, 2022)[6]

G-O PROJEKT SHPK NIPT: L4030201

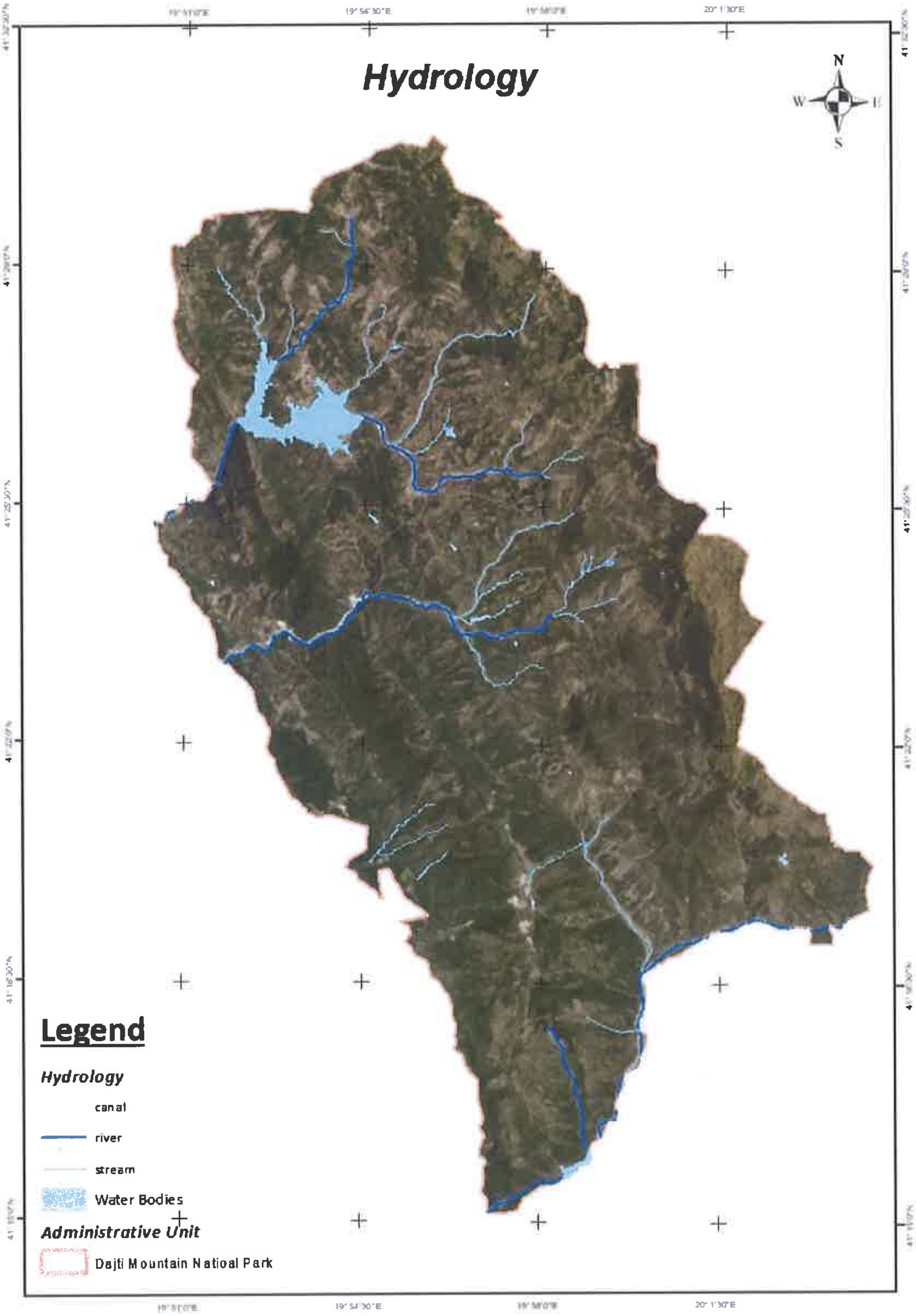


Fig. 8 - Hydrologycal network and water bodies of Dajti Mountain National Park

III. THE PHENOMENON OF WOOD FIRES

A. Land Use

The characterization of land use plays an extremely important role in the processing of territorial information aimed at the implementation of the wood fire prevention plan of the Dajti Mountain National Park. The structure of the DMNP is really complex and diverse, which includes forests and shrubs, pastures, meadows, agricultural areas, orchards, olive groves and vineyards, non-productive, rocky, bare stone quarries, mines, inhabited areas, land mixed with agricultural land, as well as water areas. In this sense, the characterization of the Park's territory was obtained through the information from Corine Land 2018 and will aim the main categories as for this study purpose (*see table 5*). (Copernicus, 2018)[7]

Land Use	Area (Ha)
Agricultural	5533.5
Artificial areas	29.2
Forest & Natural Areas	23232.1
Water Bodies	422.1
Total	***29216.9***

Tab. 5 Land use areas

In the territory of the Park the presence of forest & natural areas is predominant which occupies 80% of the soil, agricultural land (14%), water bodies (1%) and artificial lands (less than 1%). As a protected area we notice a small participation of urbanized areas, (*see fig. 9*).

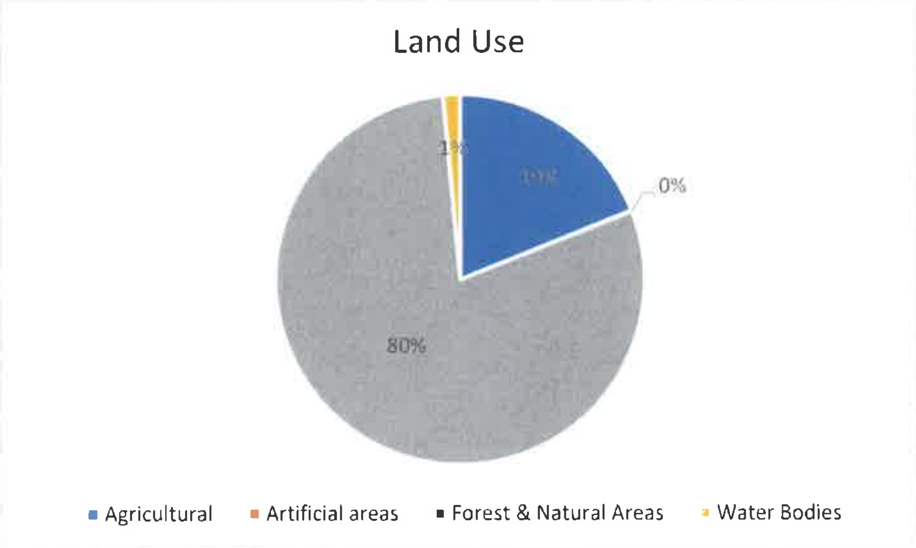


Fig. 9 - Land use Corine 2018

B. Forest Inventory

In order to determine the types of forests located in the Dajti Mountain National Park, it will be used the information extracted from the latest management plans for forest economies that includes this area. The FPMP is a basic document for forest breeding, drawn up according to forest economy units with field and office work, for knowing and obtaining data on soil, climate, fauna, biodiversity, forest stands, etc., as well as the measures that are foreseen for the administration and sustainable governance of the forest fund, the organization of production and the planning of the interwoven necessary silvicultural works. The study area contains forest economies Bruz-Rraze, Mner-Bastar, Shupal-Selite, Zall Herr-Priske, Dajt, Krrabe-Gurre 1, Shkalle and Verri and also the management plan for DMNP. The information relating to the description of the forest area is taken from these previous management plans, from the analysis of the orthophoto cards of the DMNP and from observations made on the field. Each type of wood has different degrees of naturalness and is affected by the type of use that the territories have undergone over time. The evolutionary dynamics of the rivers also affects the population of tall trees, which have ended up occupying precise bands, parallel to the banks. In Annex 1, the latest management plans for the DMNP area.

In the territory of DMNP vegetation is dominated by broadleaf forests. The vertical view has four distinct phyto - climatic generations:

- The Mediterranean Forest and shrub belt, mainly with evergreen trees and shrubs. It extends at altitudes of 300-600 m, where mackerel, chickpea, myrtle, hawthorn, needles, sagebrush and blackberries are characteristic of the area.

- Oak forest belt, with broad-leaved Oak species such as: Quercus frainetto, Quercus cerris, Bunga (Quercus petrea), and Quercus trojanae or degraded oak forest stages such as: Black hornbeam (Carpinusorientalis), White hornbeam (Carpinusbetulus), White hornbeam (Fraxinus ornus), Red juniper (Juniperusoxycedrus), Columbria (Prunus spinosa), Wild pear (Pyrus amygdaliformis), Driza (Paliurus spina-cristi) etc. This belt is located between the Forest Belt and the Mediterranean Shrub and the Beech Belt Belt (Fagus sylvatica). Elevation varies from 500-1,100 m above sea level.

- Beech Forest belt dominated by beech species and small ecosystems of black pine (Pinus nigra) and lynx (Pinus heldreichii).

- The Alpine Pastures or Mediterranean Mountain Pastures, mainly located in the eastern part of the park, are characterized by interesting ecosystems of herbaceous plants. It lies on a limited surface above 1600 m altitude. Among the endemic plants is the Ramonda serbica of the Gesneriaceae family, which develops on the eastern site of Dajti Mountain.

The woods currently present in the protected area still show a good degree of naturalness even if during the years they were the subject of destructive interventions by the owners of reserves affected by the prohibitions that prevented their use by faunistic-hunting purposes. This caused a break in the continuity that linked the various forests, damage which is now being attempted to remedy with forest recovery programs in the areas that had been transformed and improved.

C. The causes of fires

The multiple factors connected to the probability that a stand is affected by a fire they can be grouped into two main types: (MITE)[8]

-predisposing factors, connected to the intrinsic characteristics of the territory. The main factors that fall into this category are the topography, (exposure and slopes), vegetation (specific composition and silvicultural conditions), conditions meteorological (precipitation, wind, temperature and relative humidity of the area)

-determining factors, attributable to natural or anthropogenic causes. Anthropogenic causes are the most significant and can be divided into voluntary, when linked to the specific desire to start a fire to cause a damage to the environment, to things or people and involuntary, including the causes related to human action, but without will or malice.

It should be noted that in recent years the territory of the park has been affected by many phenomena of burning of waste that are abandoned, even close to forest areas.

D. The trend of forest fires in the Dajti Mountain National Park

The table below indicates the number of fires per year traveled by fire in the decade 2011-2021. Data was collected from forest fire service reports, previous studies and through stakeholder's communications (*see tab. 6*).

Year	Number of forest events
2011	7
2012	14
2013	5
2014	2
2015	3
2016	6
2017	12
2018	2
2019	7
2020	5
2021	10

Tab. 6 - Forest Events

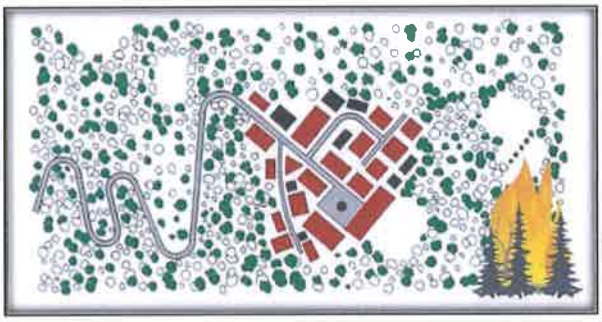
As seen in the data of the table above, the number of fires in DMNP has an irregular time distribution, where it is noted that the maximum number of events was reported to have occurred in 2012 and 2017. Regardless of these statistics, this park being a protected area shows special interest in creating all the necessary instruments for the prevention of these phenomena as well as the most efficient interventions. It is also noted that 50% of forest fires occurred during the summer season in the June-August period, but it is worth mentioning the fact of the presence of fires in the month of September, which due to climate changes appears quite hot and with a low amount of rain. Although there is no accurate data for the areas covered by the fires during these events, previous studies have determined the levels of danger for this area, where the DMNP area is included in areas with medium and low risk. This will be discussed at length in subsequent chapters.

E. Urban Forest interfaced areas

Urban forest interface areas also require special planning interventions. In fact, in this area the forest can be the vehicle for a fire that could damage civilian settlements. The opposite situation also occurs, becoming the forest the object of trauma from fires originating from activities in urbanized environments. For these reasons it is considered appropriate to have a survey that highlights the distribution and concentration of the interface. In general, this interface must absolutely privilege the reduction of the risk of fire over the conservation of structural and functional elements characteristic of the forest system itself. (Parco Ticino, 2020)[10]

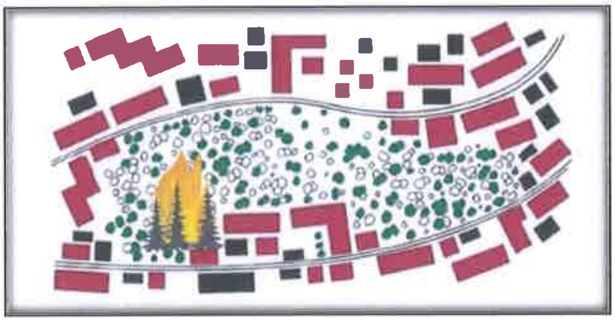
Thus, three different types of urban-rural interface can be identified:

- **Classic interface**: small and medium-sized settlements (suburbs of urban centers, peripheral hamlets, small villages, new suburbs, tourist complexes of a certain vastness, etc.), formed by numerous structures and houses relatively close to each other, in direct contact with the surrounding area covered with vegetation (arboreal and not).



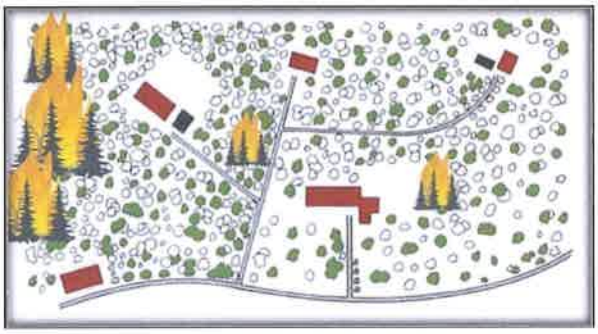
Classic Interface

- **Occluded interface**: presence of more or less vast areas of vegetation (urban parks, gardens of a certain size, "tongues" of land not yet built or not buildable that creep into inhabited centers, etc.), surrounded by urbanized areas.



Occulded Interface

- **Mixed interface**: isolated structures or houses distributed throughout the territory in direct contact with vast areas populated by shrub and arboreal vegetation. In general, there are few structures at risk, even with large vegetation fires. This is a typical situation in rural areas, where many structures are farmhouses, places of craft activities, etc.).



Mixed Interface

Most of the residential centers located in this territory are part of the mixed interface, while a small part is part of the classic interface (Shengjin i Vogel, Qafe-Molle, Surrel, Percellesh, Dajt and Priske e Madhe). The occluded interface is not present in the DMNP area.

F. Current zonation: homogeneous areas for danger, seriousness and risk of fire

The damage to vegetation caused by the passage of fire depends both on its behavior and on the type of vegetation cover. In fact, according to the pyro logical characteristics of the vegetation, fire can induce more or less serious trauma. In particular, the damage that fire causes on forest vegetation depends on numerous factors, starting, for example, on the form of government to which a forest is subject (coppice or high forest) or whether it has been affected by crop cuts and thinning. The latter affect the height of the dominant floor which limits the development of the shrub layer, the height of which in turn influences the severity of the damage caused by the fire. (MOD, 2021)[10]

According to a summary made by the study of the analysis of the territory and semantic fields for the Republic of Albania, it was found that for the District of Tirana there are 3 degrees of danger presented in the form of geospatial areas. It turns out that DMNP is part of these areas, considering the large amount of biodiversity that it contains, (*see fig. 10*). (MOD, 2021)[10]

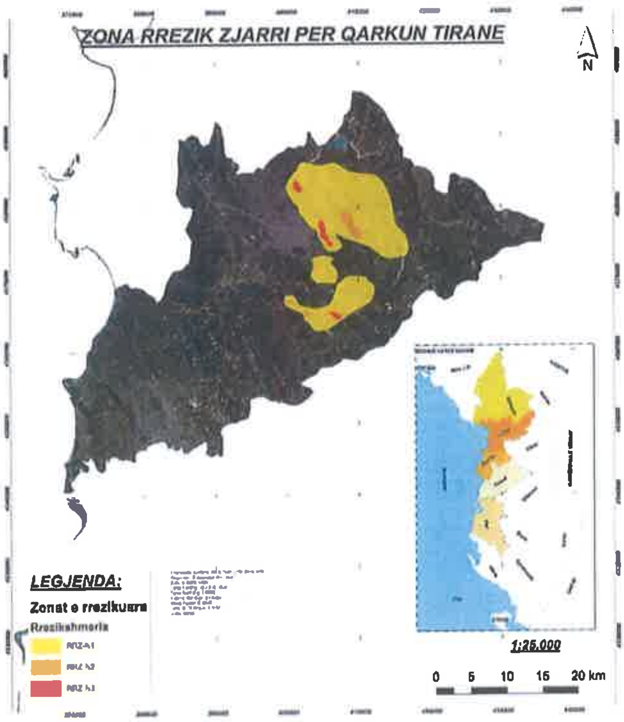


Fig. 10 – Risk areas, Region of Tirana

Taking into account that this study was done on a national scale, in later chapters a more in-depth analysis will be made for the DMNP surface, taking into account different elements such as geographic, demographic, climatic, etc.

IV. SURVEY ON THE FIELD

In the previous chapters, all the necessary materials that help to better know the topography of DMNP were identified. The data from the Open Street Map software (OSM) and State Authority for Geospatial Information (ASIG) was taken as initial material. This data will be necessary for the production of future documents for the creation of fire protection strategies. Geospatial information is important for these types of strategies, as it creates a clear panorama of the area being studied and serves to be used in different analyzes that can be performed according to the values or categorizations they have. These digital data often have discrepancies with the real situation on the ground, thus making it necessary to check the accuracy of this data, thus making different measurements as well as making a digitization process using high accuracy orthophotos or satellite imagery. The corrected information will be presented during the following chapters in images, but it is worth noting that it will also be submitted in shapefile format, where it can be used for different purposes in the future. In the appeal of the total maps, the terrain control information will be presented as a single one. In Annex 2 photos from the field.

A. Correction of basic data

Before starting with the correction of geospatial data by interpretation of satellite images and control of field measurements, the data will be reviewed to correct their basis, such as the incorrect location of an administrative unit or the addition of the labels for this data. The shapefile in the format of points containing the names of the villages is noted to need some changes as often the points that determine their location do not correspond to the satellite images. Some of these points will not be taken into account as they represent areas with a low population level. The exact location of these points serves for further calculations that will be made with geospatial software. Furthermore, each of these locations, since they are only in the format of points, will go through a digitalization process, converting them into the format of polygons, thus delineating the geographical border that these administrative units have. It is worth noting that these polygons will include the center area as it has the highest intensity of buildings, thus not including some individual buildings located in the surrounding areas. Digitization represents a line that closely surrounds the inhabited area, since inhabited centers of this size have no real borders but are known only as such units. It seems reasonable to perform such digitization for urban areas, with the aim that their location is not presented on the DMNP map only as a point but also as an area, thus making their identification easier when reading the final map, (*see fig. 11*). The table of attributes of residential centers will be enriched with basic data such as the administrative unit they are included in, its population and population density. Such information is necessary for various statistics and for their inclusion in future studies. Below is the map of the residential centers and the administrative units that they are part of after their arrangement, as well as a table with all the names of the main villages and their coordinates. (OSM)[1], (ASIG)[6]

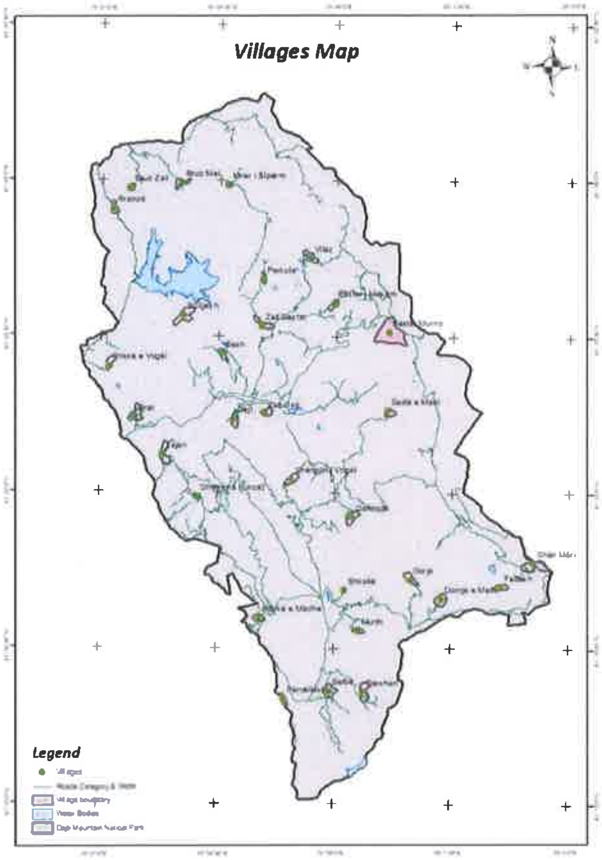


Fig. 11 - Map of Villages of Dajti Mountain National Park

Name	North			East		
Bastar i Mesëm	41°	26′	15.59″	19°	57′	56.93″
Bastar Murriz	41°	25′	36.73″	19°	59′	36.21″
Besh	41°	25′	6.67″	19°	54′	36.23″
Brar	41°	23′	40.37″	19°	52′	2.87″
Bruz Mal	41°	28′	56.71″	19°	53′	22.64″
Bruz Zall	41°	28′	49.64″	19°	51′	51.63″
Bulçesh	41°	25′	57.95″	19°	53′	28.47″
Dajt	41°	23′	38.42″	19°	54′	58.77″
Darshen	41°	17′	32.05″	19°	58′	55.12″
Derje	41°	20′	3.43″	19°	60′	19.05″
Domje e Malit	41°	19′	37.93″	19°	61′	14.80″
Facesh	41°	19′	54.37″	19°	63′	0.37″
Perkola	41°	26′	47.29″	19°	55′	49.35″
Shën Mëri	41°	20′	27.52″	19°	63′	57.77″
Mner i Sipërm	41°	28′	54.08″	19°	54′	45.11″
Murth	41°	18′	54.35″	19°	58′	44.99″

Përcëllesh	41°	17′	21.26″	19°	56′	32.42″
Priskë e Madhe	41°	19′	10.43″	19°	55′	48.13″
Priskë e Vogël	41°	24′	49.48″	19°	51′	16.28″
Qafmollë	41°	21′	27.56″	19°	58′	31.97″
Rranzë	41°	28′	21.51″	19°	51′	22.17″
Selbë	41°	17′	33.21″	19°	57′	54.21″
Selitë e Malit	41°	23′	50.96″	19°	59′	35.57″
Shëngjin i Vogël	41°	22′	17.90″	19°	56′	43.04″
Shermina (Linza)	41°	21′	54.22″	19°	53′	54.34″
Shkallë	41°	19′	49.05″	19°	58′	19.74″
Tujan	41°	22′	50.48″	19°	52′	51.54″
Vilëz	41°	27′	15.64″	19°	57′	14.21″
Zall-Bastar	41°	25′	43.79″	19°	55′	48.37″
Zall-Dajt	41°	23′	45.96″	19°	55′	54.50″

***Tab.** 7* - Coordinates of Villages

However, in the final map due to its presentation, this information will appear in the form of points, according to the location of the points in Tab.7.

B. Update of the road network

To update the road network of the Dajti Mountain National Park, data comes in shapefile of lines that are divided into different categories according to their use and function. The categorization comes as a product of OSM. It is noted that there are several types of roads such as those that connect residential centers and administrative units and are designated as primary, secondary or tertiary. Roads that create direct access to villages, which can be residential but also paths in areas with more rugged terrain. There are also small roads that have different functions such as services, crossings, etc. The interest of this study is to create a clear picture of this network, to develop information where it is missing and to modify it where inconsistencies with the real situation on the ground are observed. Therefore, a field inspection will be done in several different areas to analyze the typology of these roads, making it possible to highlight their accessibility in the event of a natural disaster such as a forest fire. (OSM)[1], (ASIG)[6]

For the purposes of the study, special attention will be given to the lines of the primary and secondary roads as well as the roads of the narrowest passages, which in most cases are not in good condition. During the digitization with the 2015 orthophoto and satellite images, as well as with the field control that was done in some areas of the park, it is noticed that there is a need for improvement, as there are obvious inconsistencies in the axis of the roads and some of those roads have a wrong classification. The following figures show the inconsistency of the basic data with the real situation on the ground and the modification made by digitalization (*see fig. 12*). The correction was made for the entire surface of the park, where in the new shapefile there are the new categorizations of the roads as well as the width of each segment, which was benefited from field measurements and digitization according to satellite images.

G-O PROJEKT SHPK NUIS: L71403020

Fig. 12 - Before and After Digitalization

The methodology used for this case consists in the categorization of this network based on two main conditions: i) The width of the road and ii) Its condition. Their condition has been verified in the field, being checked in different areas, in this way the view of the current road network in DMNP has been created. During this verification, random measurements were made by means of GNSS receivers to accurately determine their width. These measurements were then processed in the office thus creating a categorization of roads according to their width. In the park of Dajti there are several roads in very good condition, paved and equipped with the necessary road signs, such as "Rruga e Arberit" which is a main interurban road, still in development, which connects villages of Zall Bastar administrative unit, which is the largest unit in this park and it's located in the northern part. Also in the southwest area is Dajti road which connects two popular tourist attractions such as Dajti Peak and Shengjergji area. Some of the secondary and tertiary roads are paved, roads that connect the main roads with urban areas. The rest of the roads are divided into residential roads which are narrower and are unpaved but with a well-maintained gravel layer and path-type roads which have limited accessibility and can only be used by special vehicles such as 4x4 pick-ups or on foot. In some areas, these paths are used for hiking. Other categories, such as passageways, living street pedestrian etc. will not be taken into consideration for this study considering the small scale used for the production of maps. The unclassified roads have been modified to suit their function on the ground. In the table below, the categorization of roads according to their condition and accessibility, (*see tab. 8, fig. 13-16*).

Road Classification	*Condition*	*Width (m)*	*Length (km)*
Primary	Paved	5-8	26.6
Secondary	Paved	5	8.4
	Well-Kept Gravel	2	0.4
Tertiary	Paved	3-5	15.6
	Well-Kept Gravel	3	21.1
Residential	Paved	3	29.2
	Unpaved	2	3.6
	Well-Kept Gravel	2-3	10.1
Track	Unpaved	1.5	69.8
	Well-Kept Gravel	2	2.5
Path	Unpaved	1.5-3	12.1
	Well-Kept Gravel	2-3	36.8

Tab. 8 - Roads Classification

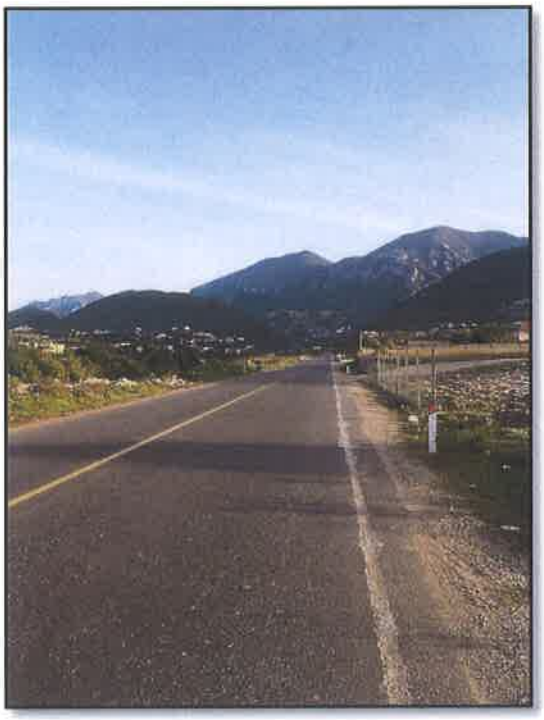


Fig. 13 - Asphalted Road

Fig. 14 - Well Kept Gravel Road

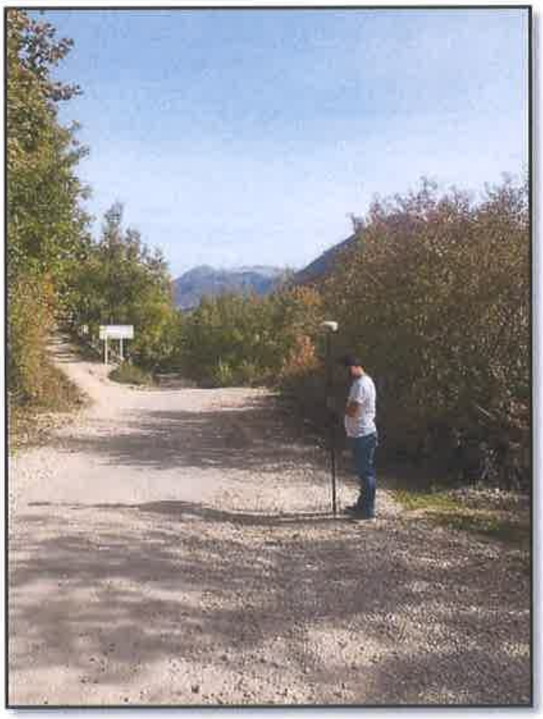


Fig. 15 - Residential Road

Fig. 16 - Paths

In the figures below, two different types of categorizations are presented, which are the product of digitalization and field measurements of these roads. The first figure shows the category of roads according to the class they belong to, while the second figure shows a categorization according to their conditions. Since the width of the road varies within each category, a sub-categorization was made according to this value, (*see fig.17-18*).

It is noted that the width of the paths does not exceed 2 meters and in general it is in a bad condition, which makes them accessible only by means of 4x4 vehicles or on foot, since their main function is touristic and for connecting the villages in the most rugged areas. These characteristics make these roads to be considered seasonal at the same time. In general, all villages have good access through dirt roads, which makes it an advantage in the fight against forest fires. Their frequency also affects the course of fire outbreaks, reducing the risk of movement.

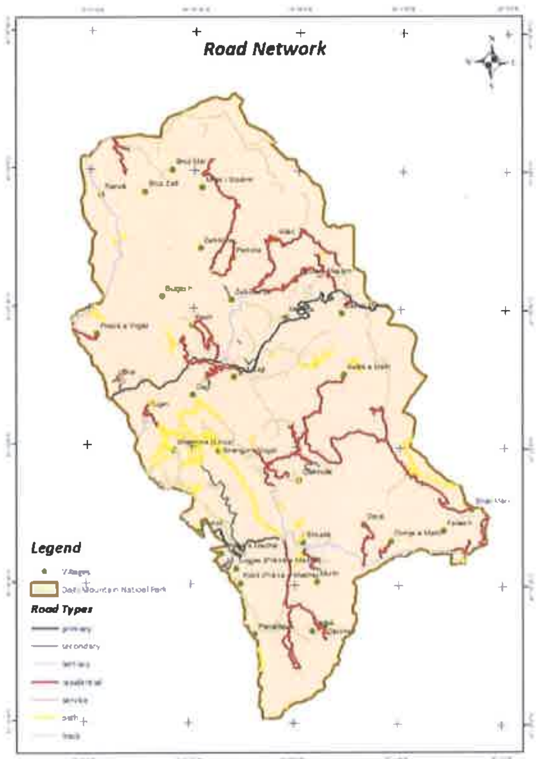


Fig. 17 - Road Types Network

Fig. 18 - Road Classification Network

C. Boundaries of Water Bodies

DMNP is an area rich in water resources, where there are dozens of different water surfaces along it. (OSM)[1], (ASIG)[6]. The main source for this area is the lake of Boville, which has a surface of 347 ha. Important is the horizontal and vertical appearance that this lake has, which is an advantage for water supply by means of aerial vehicles. Moreover, the park is also rich in other water resources such as reservoirs and small ponds, which can be used for water supply in case of forest fires. These bodies of water are concentrated in the northern area, where it is noted that they are rarer in other areas. In the southern area, there is the lake of Skrone, which has a considerable water surface. Since the flow of water from the river has a small amount, the water bodies located in the park area will be the basic source for the first intervention in cases of danger of forest fires. Depending on the function and accessibility they have, they will be categorized into three categories as follows, (*see fig. 19-22*):

- The **main source** is the lake of Boville, which has a great advantage over its surface and therefore the amount of water it holds. Furthermore, based on the calculation of the forest fire risk index, the geographical position of this lake is located at a radius of less than 10 km in the areas with the highest risk, making the aerial intervention very fast and effective.

Fig. 19 - Bovilla Lake

- The **primary sources** are the water bodies that are usually reservoirs or dams. This category will include all the areas bigger than 1 hectare, because they can be used for water scooping and fulfill all the parameters for such interventions. This analysis will be better explained on the next chapter. The geographical position of these water bodies has an advantage because they are well distributed on the area of the park and covering it with a radius of 5 km each.

Fig. 20 - Shkalle Lake

- **Emergency sources** can be considered the water bodies that have a smaller area than 1 hectare and does not have a great amount of water. These sources are usually seasonal and knowing that most fires occur during season with high temperatures, the possibility of these sources to be dry increases so they cannot be considered very reliable. In rare cases they can be used to extinguish small fires that are very close to these sources.

Fig. 21 - Watershed

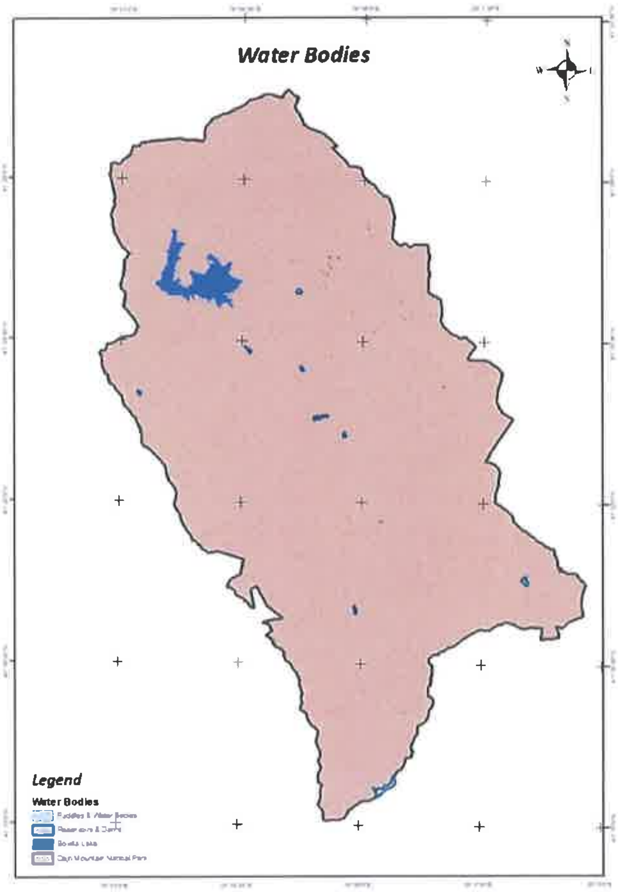


Fig. 22 - Categorization of Water Bodies for Dajti Mountain National Park

D. Fire Lookout Towers

A Fire Lookout Tower plays an important role in forest fire detection, which can be used to report the forest fire in a timely manner, and watchtower can be a tourist attraction. The construction of Fire lookout tower will better embody the guideline of forest fire prevention, and ensure the safety of people's life and property, and protect the forest resources in mountainous area. Finding fires while they are small is critical to effective fire management, making the lookout an important job to staff. In the old days fire lookouts not only kept an eye out and reported smokes but were often the first or the only resource available to go extinguish the fire. They would have to hike or ride miles to the fire with only a shovel to fight the wildfires. Fire lookouts are responsible for observing and reporting smoke or fires in their assigned areas. Knowledgeable about weather systems, fire weather, and fire behavior, lookouts utilize a variety of tools to get the job done; such as, binoculars, topographic maps, compasses, etc. Lookouts also use thermometers, anemometers, and other simple weather instruments to record and report daily temperature, wind speed, wind direction, and other weather conditions. Using two-way radios or cell phones lookouts communicate with field staff, dispatchers and fellow lookouts about weather, fire hazard conditions, fire emergencies, accidents and updates of wild land firefighting activities. The lookouts enjoy talking with visitors about the forest and fire prevention. Taking into account the difficult conditions of communication through the road network in DMNP as well as the advantages that the construction of such a tower brings, the most possible points will be calculated where their use will have the greatest efficiency.

To make this calculation, several factors will be taken into account. Initially, based on the technical specifications for the construction of a fire watch tower, the necessary free surface area to build such a tower will be determined. Usually, the base has dimensions that are between 3x3m and 5x5m. While their height varies around 18-25m. These towers are built in the highest parts of the relief such as peaks, therefore a reclassification of the height above sea level will be done for the area under study. Being that a person with tools such as binoculars can see up to 15-25 km as the crow flies depending on the weather, and taking into account the larger horizontal and vertical distances of the park, a network will be created square with dimensions 5x5 km. With the generation of this network, an intersection will be made taking into account other relief factors such as the road network, i.e., accessibility to the tower, areas most at risk from fires, etc. In addition, the rule of triangulation will be taken into account for monitoring forest fires. (USDA)[12] Triangulation is the process of pinpointing the location of a smoke or fire by taking bearings of it from two or three remote points. A ranger at Tower A would see smoke in the distance and take a bearing to it on his fire finder. This single line is not enough information to locate the fire because it could be anywhere along that line, close or many miles away. The ranger would radio Tower B and tell him the general direction of the fire. Tower B would then find the fire from his viewpoint and take a bearing. Where the two bearings crossed would pinpoint the fire and firefighters could be efficiently dispatched to put it out. Another cross from Tower C dials the location in even better. Taking into account the aforementioned factors, finding 5 places to build a fire lookout tower will be taken into consideration. Since the construction of fire watch towers is only a suggestion, the proposal for their placement will be made without taking into consideration the ownership of the land, if it is state or private property. Such information does not constitute interest in this study, but remains a general suggestion, (*see fig. 23*). In Annex 3 map of updated data.

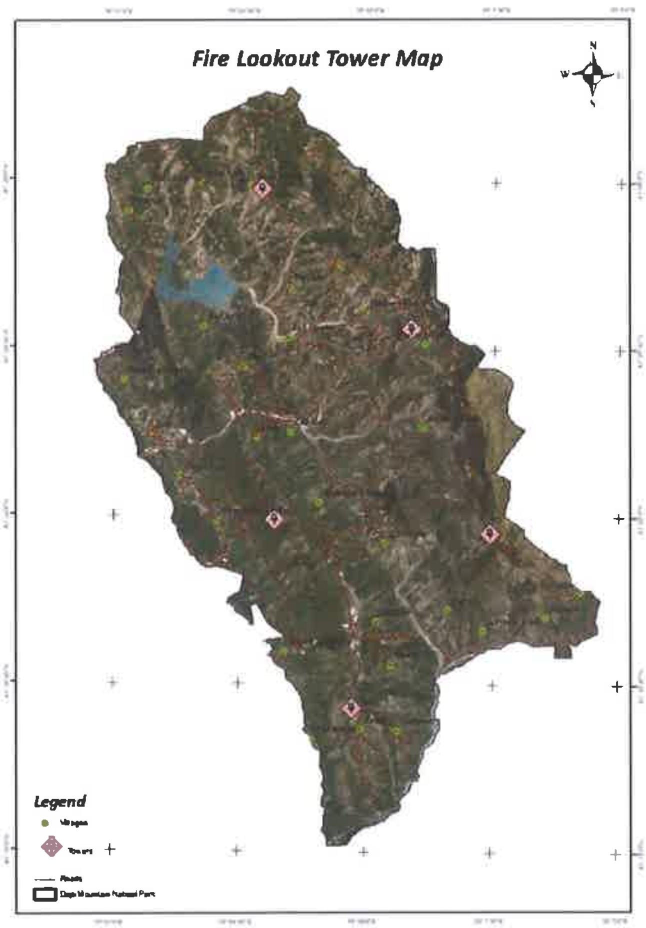


Fig. 23 - Potential installations of Fire Lookout Towers

Coordinates of the Fire Lookout Towers, *(see tab. 9)*.

Name	*North*	*East*
Tower A	41° 25' 55.7"	19° 59' 11.8"
Tower B	41° 21' 40.3"	20° 1' 26.2"
Tower C	41° 21' 55.5"	19° 55' 28.2"
Tower D	41° 28' 49.9"	19° 55' 2.6"
Tower E	41° 17' 59.9"	19° 57' 38.5"

Tab. 9 - Fire Lookout Coordinates

V. FLIGHT RISKS AND OSTACLES IN THE AREA

A. Analysis of LiDAR data for tree height and density

LiDAR laser scanning was performed in 2015 for the Republic of Albania, where all the surface was divided in three main zones, with different accuracies. These measurements were later used to produce new data for the forest areas. For this study it will be used the raster image that contains the height of the vegetation. DMNP is an area that is mostly cover by forest, so this data will be used and analyzed to determine the obstacles of the area or density of the vegetation. Biodiversity in the DMNP is mixed and, being such, offers a variety of tree heights, starting from low bushes that go up to 4-5 meters and tall trees up to 30-35 meters. Tree height data are in raster format, generated from LiDAR measurements and office calculations for the vegetation class. This raster contains only the height of the trees and not that above sea level, therefore this raster must be calculated based on the digital height model. This raster contains the height of vegetation over 2 meters, therefore every other cell that does not contain this parameter has the value "null data". Therefore, the raster will be transformed by giving each of these cells the value 0, with the aim that in the final calculation, the real height above sea level will be presented, and in the case where there is vegetation, the real height of the obstacle will be presented. In the figure below, you can see the distribution of tree heights along the park area. It is noted that in the area with a greater height from sea level, the presence of higher vegetation increases, (*see fig. 24*). (ASIG)[6]

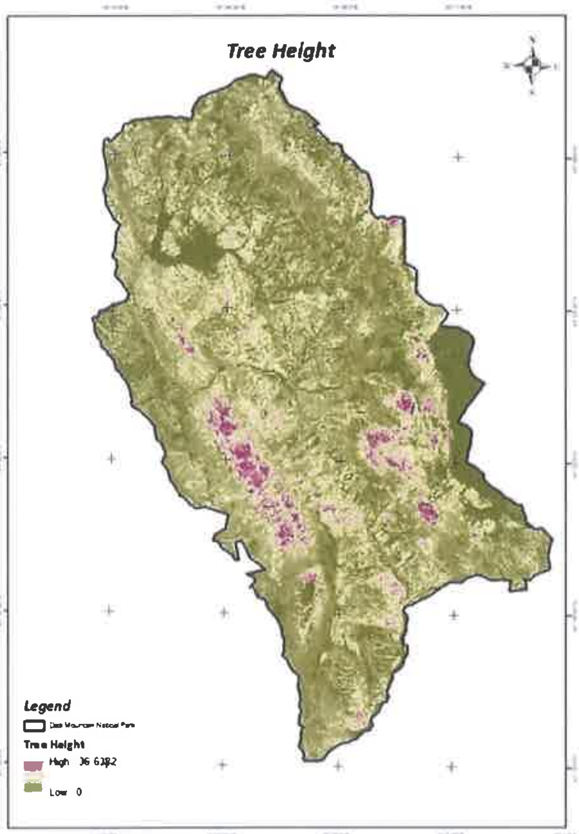


Fig. 24 - Tree height for Dajti Mountain National Park

In some way, a digital model of the surface will be created which contains only the height of the vegetation, since only the data of the height of the trees are possible. With this data, an analysis that can be developed is that of the categorization of these heights. Since the height of the vegetation often determines its type, a division will be made to see what distribution they have in this area. Therefore, for the low vegetation that at the same time contains the lowest risk, the height up to 5 m will be defined as the first category. With this height, in most cases, trees of the bush type are included. The other category is the one from 5 m to 10 m, where also in this category there can be bushes and young forests. From the height of 10 m and above, medium and high forests are found, where at the same time their density increases. This type of categorization is presented in the figure below, (*see fig. 25*).

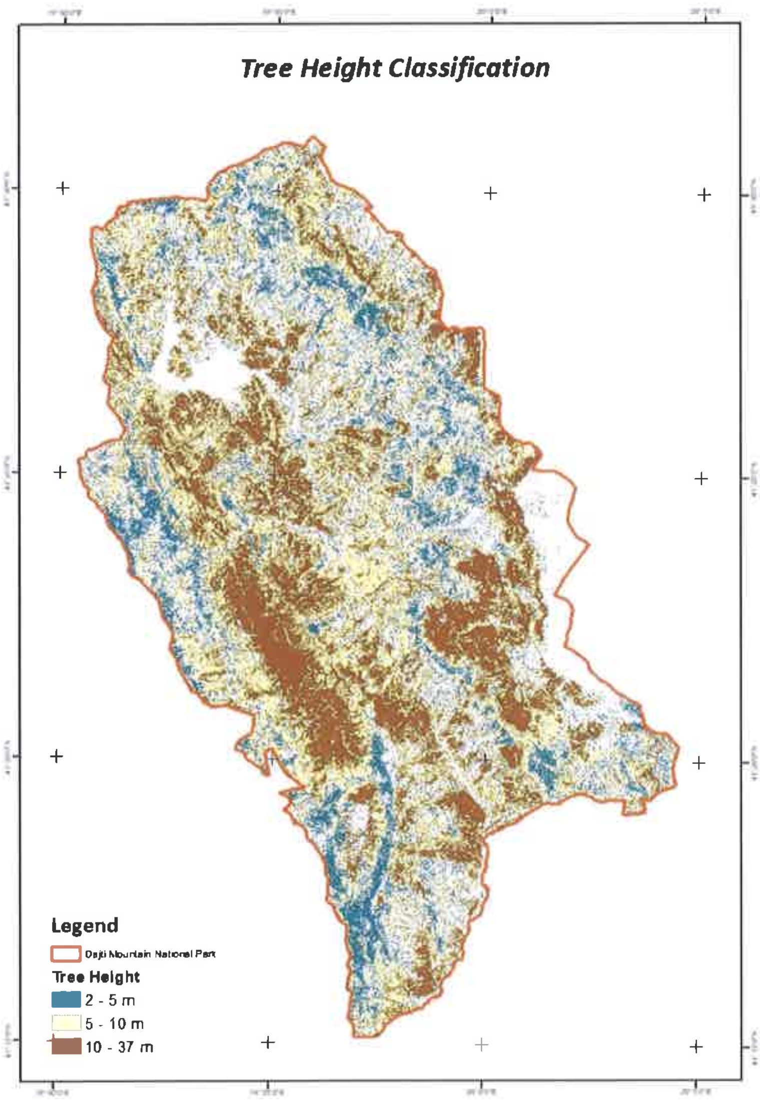


Fig. 25 - Tree Height Classification

B. Identification of obstacles on the fly in the area

Analyzing obstacles in flight for the area under study consists of identifying them through field control, determining their location and height above the ground. DMNP being a national park is rich in natural vegetation but also with human intervention. Mount Dajti, as the highest point that surrounds the city of Tirana, holds the television and telecommunication antennas, as well as the 220kW electricity line. There are two main lines that pass through this area, one near the border of the park and the other along the central part. In addition to the main lines, there are also two 110kW electric lines, which stretch along the main roads of the park. Also, the telecommunication antennas are located on the ridge of the Dajt mountain as well as in the Fushe Dajt. The height of the antennas varies from 25 to 35 meters. The image below shows all the obstacles located in DMNP. Also in the western part of the park is the Dajti cable car, which serves as a means of transport and a tourist attraction, (*see fig. 26*). See Annex 4 for locations of obstacles on the fly.

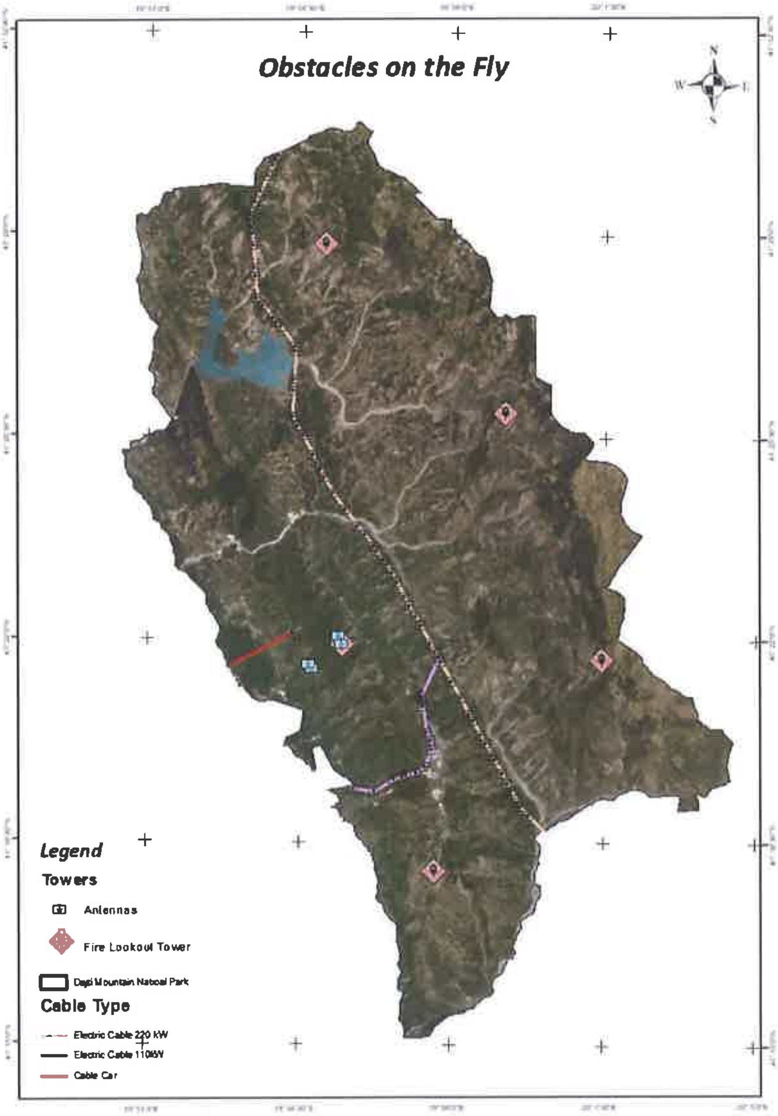


Fig. 26 - Obstacles on the Fly

In addition to the obstacles presented above, the digital model of the surface was also calculated in terms of tree heights. The product is a combination of the DEM raster and that of tree heights, (*see fig. 27)*. (ASIG)[6]

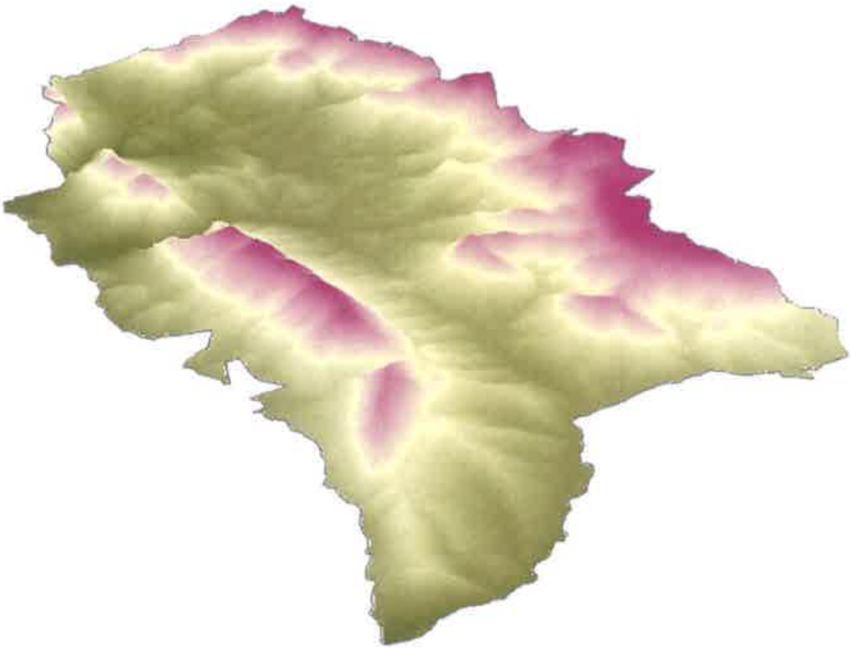


Fig. 27 - 3D view of the terrain

As seen in the terrain model, the geography of the park includes numerous gorges, sloping terrain in the southwest and east and southeast areas.

C. Air Intervention, Emergency Landing

After determining the shape of the DMNP relief and the flight obstacles located in this park, an analysis can be made regarding aerial intervention in the case of forest fires. The Republic of Albania has only one air base for launching helicopters, which is located in Farke, (*see fig. 28*). This base is located close to DMNP, which is an advantage for the fastest intervention in case of danger of fires in DMNP. The classification is based on the distance of this base, without calculating the reaction and flight time. Since these variables are not of interest to this study, only the distance traveled by the aircraft and which areas it captures according to distance was calculated. In annex 5 map of obstacles, terrain and intervention and in annex 6 distance from helicopter base for each village.

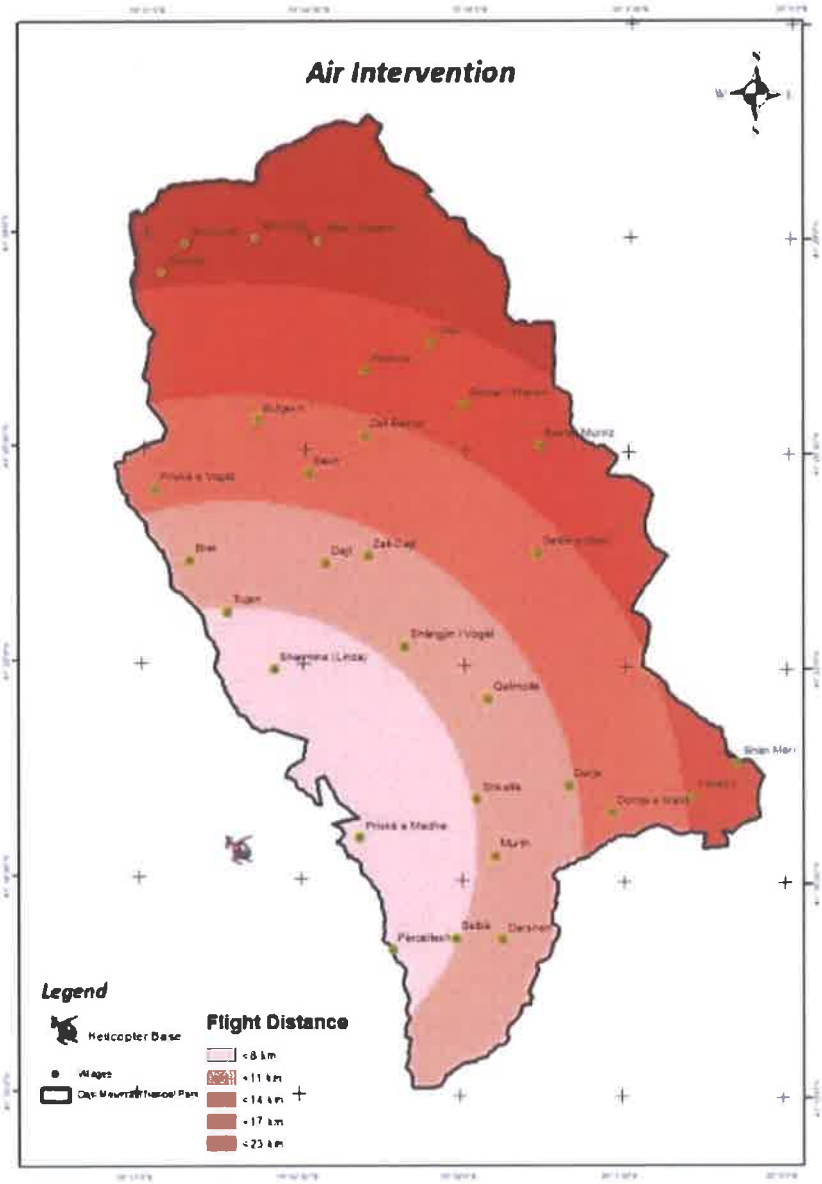


Fig. 28 - Distance from helicopter base in Farke, Tirana

VI. FOREST FIRE RISK MAP

The focus for this step will be to point obstacles for some sample areas by indicating the flight risk and intervention. Using the elevation data for the terrain and trees we do not only determine these obstacles but also can show the density of the danger, most probable direction of the hazard and in this way we ca build the best strategies. With this information we will build a zonation without risking human life.

A. Fire Factors Hazards

Knowing the topography of the area it is necessary when we are dealing with the preparation of fire protection and intervention strategies. Topography can be described as the configuration of the Earth's surface, including its relief and position of natural and man-made features, arranged across the landscape. In the wildfire environment topography plays an integral part in determining how a fire will develop and spread across a landscape. In wildfire terms, it is the space in which a fire can move comprising the physical shape and positioning of the features within that space. These influences will have a direct and indirect impact on fire behavior, and if the topographical influences are understood, fire officers can use this knowledge to determine the likely fire severity at different points across the landscape. Using the digital elevation model (DEM), which is a representation of the bare ground (bare earth) topographic surface of the Earth excluding trees, buildings, and any other surface objects, it is possible to calculate the main variables needed for analysis. To create a map that shows the areas with higher fire risk it is necessary to calculate the Forest Fire Risk Index, which uses a method that include fire hazards variables such as slope, aspect, land use and elevation. (Online Research) [13, 14]

-**Slope** has a major impact on fire behavior and an upslope will cause a fire to increase its intensity and speed. The steepness of a slope has an incremental effect on fire behavior and its speed. Fire intensity and rate of spread normally reduces when fires are burning downslope. The shape of the landscape will influence wildfire behavior in a number of important ways and consideration should be given to the following:

- Orientation and angle of slope in relation to the position of the sun
- Steepness of slopes
- Shape of the topographical features
- The effect of topography on the types and amounts of vegetation
- Water drainage features
- The effect of topography on wind direction and its strength
- Barriers to fire travel such as tracks, roads, streams, rivers, wetlands and other fire obstacles

As described above, the DMNP terrain is complex with frequent relief breaks. Using the DEM data, a classification of 5 categories was achieved. As showed in the picture above the majority of the area has an incline lower than 25 degrees and has a significant increase on the south eastern area where the slope is between 35 and 60 degrees, reaching degrees up to 80 degrees. Since high slope causes higher fire risk the classification will be:

- **Low risk:** <15° - **Medium risk:** 15-30° - **High Risk:** >30°

-**Aspect** can be described as the direction the surface of the ground is facing in relation to its orientation with the sun. Generally, southerly-facing slopes become warmer and drier throughout the day, whilst northerly-facing slopes remain cooler and damper. Although the angle of a slope is fixed the amount of solar radiation received will vary depending on the time of day and the position of the sun. The amount of solar radiation the surface absorbs has a direct influence on the temperature and humidity of the air and therefore the combustibility of available fuels. As a general rule, fires that occur in fuels that have been subjected to more solar preheating will be more intense. Reclassification of the direction of the slope will be:

- **Low risk:** North, North East, North West - **Medium risk:** East, South East, West - **High Risk:** South, South West

-**Elevation** is the height above the sea level, in the case of the risk of fire in the forest, there is a direct impact, since the rule applies that the higher the height, the smaller the possibility of the presence of such a phenomenon. In the mountain area, along with elevation raising, temperature will become lower and humidity will increase, so the probability of forest fire reduces. The criterion for elevation will be:

- **Low risk:** >800m - **Medium risk:** 500-800 m - **High Risk:** <500 m

-**Land use** is another important variable for this calculation. This factor was described in the chapter before. As shown in the picture below the area is dominated by forest and other natural areas. Using this information, the risk factor of the land use will be reclassified in three categories as below:

- **Low risk:** Water Bodies - **Medium risk:** Agricultural Land, Urban Areas- **High Risk:** Forest Area and other Natural Areas

-**Density** is considered as a vulnerability factor, because it concerns human life, thus the higher the density, higher the risk. When the population density is small, forest fires usually is caused by natural forces, such as lightning, spontaneous combustion, etc. When the population density is large, human activity becomes dominated.

- **Low risk:** <50 p/km2 - **Medium risk:** 50-100 p/km2 - **High Risk:** >100 p/km2

G-O PROJEKT SHPK NIPT: L 71403020 P

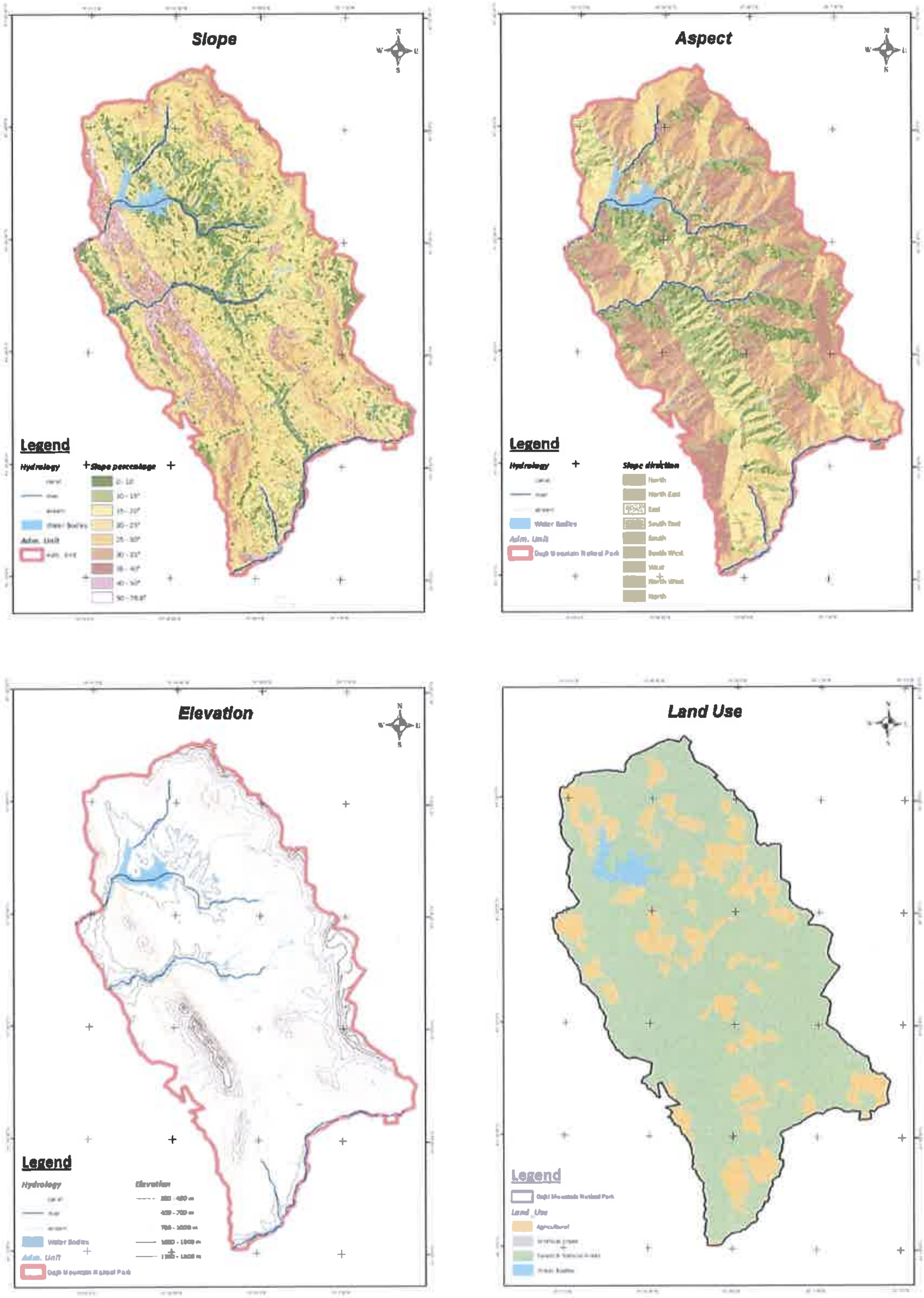


Fig. 29 - Fire Hazard Variables

B. Forest Fire Risk Index

The proposed method in this article is scenario-based and involves natural and human factors in each step. It implements and expands the analytic-deliberative process. Fig. 1 shows the flow chart of forest fire risk methodology. The first step (bottom of the figure) is to gather data and information from a variety of sources. Hazards and vulnerability were selected. Second, the factors to present the two aspects were addressed. The main objective of risk assessment is to assess the potential of forest fire hazard. There are four steps as follows: (1) collection of satellite images and other data for the forest fire risk assessment, (2) hazard identification and vulnerability analysis, (3) spatial analyst using GIS, and (4) export forest fire zone map. According to the various factors affecting forest fire, they are divided into several levels. The weight to each factor is determined by Grey Relativity Analysis (GRA). Table 10 gives the classification of fire hazard factors.

Factors	*Classes*	*Values*
Slope	Low risk	<15°
	Medium risk	15-30°
	High Risk	>30°
Aspect	Low risk	North, North East, North West
	Medium risk	East, South East, West
	High Risk	South, South West
Elevation	Low risk	>800m
	Medium risk	500-800 m
	High Risk	<500 m
Land Use	Low risk	Water Bodies
	Medium risk	Agricultural Land, Urban Areas
	High Risk	Forest Area and Natural Areas
Population	Low risk	<50 p/km2
	Medium risk	50-100 p/km2
	High Risk	>100 p/km2

Tab. 10 - Forest fire risk factors

Forest fire risk factors involve land use, elevation, slope, aspect and that are performed using ArcGIS software. The hazard identification map, (*see fig. 30*) is the combination of forest fire risk factors through map algebra algorithm, in order to reflect the risk of forest fires in the region. Red area indicated the highest level of risk, blue area shows the lowest level of risk.

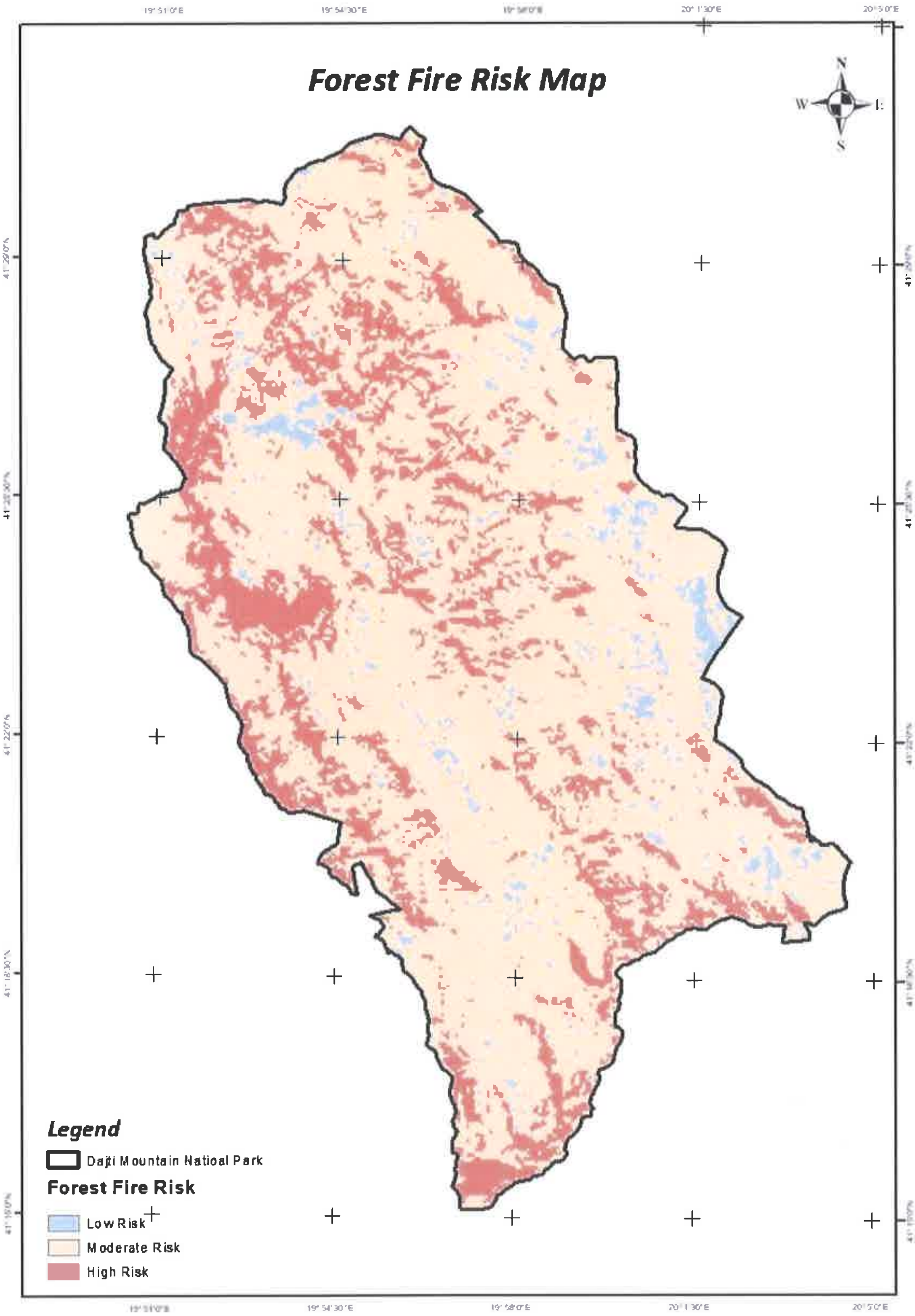


Fig. 30 - Forest Fire Risk Map

VII. EXPERIMENTAL FOREST FIRE TECHNICAL MAP AIB

The experimental map is a summary of all the data collected and corrected according to the relevant analyzes expressed in the previous chapters. With this map, interested parties will have a simpler view of the state of DMNP regarding the risk of forest fires.

The map will contain the following elements:

Road network - The transport network for vehicles and pedestrians. A good knowledge of this network helps in the intervention from the ground for the fire zones and also shows the connection between the inhabited centers, the different locations and the access to the possible observation towers.

Water network - This network includes all types of categories of water resources such as rivers, streams, reservoirs, dams, ponds, etc. The presentation of this element on the map is of particular importance as they are the main natural source for water supply for land and air vehicles in the event of a natural disaster such as a forest fire.

Administrative units - This category includes elements such as villages and boundaries of administrative units. After updating this information, residential areas will be clearly distinguished and with the addition of information in the future, different analyzes can be made on possible events. It will also contain additional data such as the DMNP border, the borders of the districts that limit the park, etc.

High voltage cables - The location of these cables is important for flight planning, as they can be obstacles during the flight. The types of voltage cables are also marked on the map.

Cable car track - Also an important element regarding aerial obstacles.

Antennas - This group of objects is concentrated in the highest part of the relief and is shown on the map with the corresponding symbol.

Digital Elevation Model - This data is presented in two different colors, where the park area stands out, and has the hillshade effect to understand the shape of the relief at a glance.

Forest Fire High Risk Areas - Areas that constitute the highest risk of forest fire risk, described in the relevant chapter.

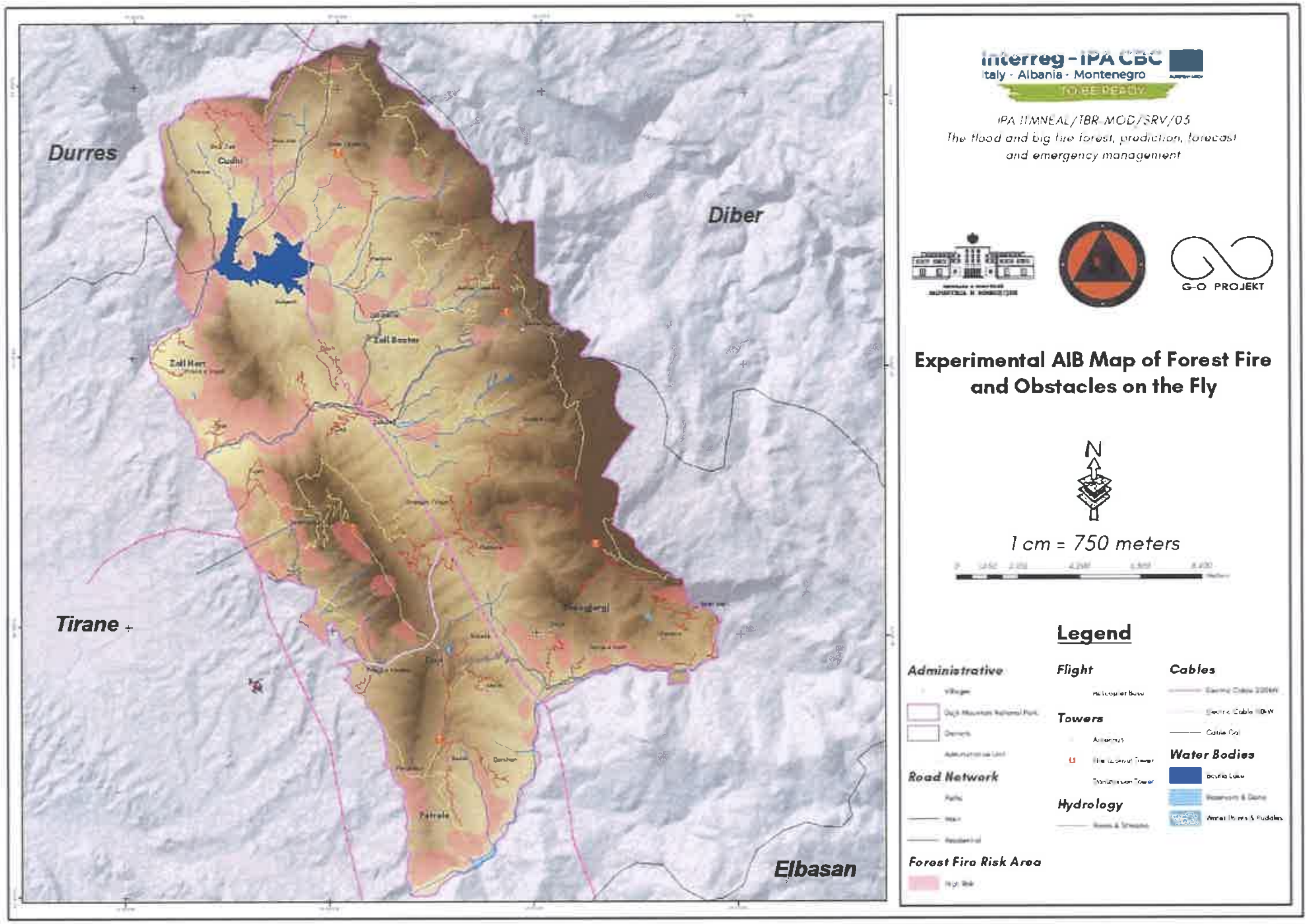


Fig. 31 - Experimental AIB Forest Map and Obstacles on the Fly

VIII. FINDINGS AND RECOMMENDATIONS

The geospatial information collected for this study, in the same time will be organized in a way that can increase strategy development and capacity building for each component of wildfire risk management.

- Having an updated road network will help conduct throughout the year specific interventions to reduce the wildfire risk in protected areas to increase road accessibility, opening new wildfire corridors, thinning and spacing etc.

- A permanent observation-signalization network (with several fire towers per district) is required in fire endangered forests, especially for protected areas.

- Protected areas due to their specifications must be considered separately from forest areas owned by municipalities. These specifications include the ecological values and importance of protected areas, higher risk due to high fuel load and human pressure as a result of recreational activities.

- DMNP, regardless of its diverse biodiversity and high altitude above sea level, appears as an area with medium risk for forest fires. Access by land is regular, with very few narrow roads that are not in good condition.

- The high voltage lines present in the park have a height that varies from 25 to 35 m for each pole, where great care must be taken during the flight movement in cases of large interchanges between these poles. The television and meteorology antennas are located at the highest points of the park where the possibility of fires is quite low and the field of view is clear.

- All relevant structures to wildfires must strengthen technical and scientific capacities to capitalize on and consolidate existing knowledge and to develop and apply methodologies and models to assess risks, vulnerabilities and exposure to wildfires.

- It is very important that the water supply points and water reservoirs should be shown on the forest maps and, possibly, signs should also be placed on the trunks of the forest trees and their position should be recorded on the GPS.

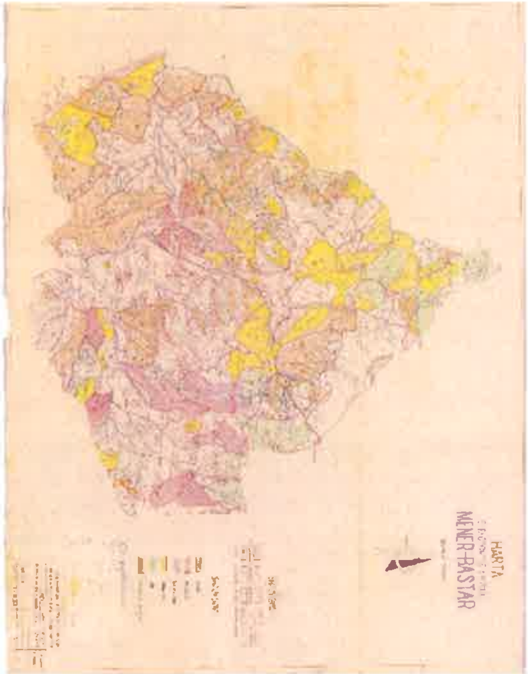
IX. REFERENCES

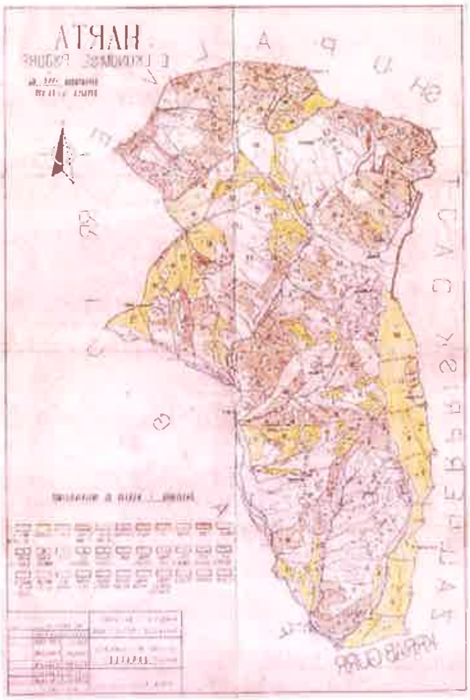
1. Open Street Map, data in shapefile format of road and water network, electrical cables, administrative units, topographic elements etc., available on: https://www.openstreetmap.org/
2. National Spatial Planning Agency, data in shapefile of administrative units, districts, municipalities etc., available on: https://planifikimi.gov.al/
3. National Agency for Protected Areas, DCM 402, 21.06.2006, available on: akzm.gov.al
4. Climatic Explorer, climatologic data for selected areas, available on: https://climexp.knmi.nl/
5. Institute of Geosciences, data in shapefile format, available on: https://www.geo.edu.al/
6. State Authority for Geospatial Information, data in shapefile and raster format, available on: https://geoportal.asig.gov.al/
7. Corine Land Cover 2018, available on: https://land.copernicus.eu/
8. Ministero della Transizione Ecologica, "Manuale tecnico di pianificazione antincendi boschivi nelle aree protette", available on: https://mite.gov.al/
9. Parco Ticino, "Piano delle attività di prevenzione e lotta attiva contro gli incendi boschivi 2017-2020", available on: https://ente.parcoticino.it/
10. Ministry of Defence, *"Analiza e territorit dhe fushat semantike, per percaktimin e raportit te alarmit"*.
11. United States Department of Agriculture, Fire Lookouts, Eldorado National Forest.
12. Pol. J. Environ. Stud. 2014;23(1):187–194, Fatih Sivrikaya, Bülent Sağlam, Abdullah E. Akay, Nuri Bozali: *Evaluation of Forest Fire Risk with GIS*, 2013.
13. Computational Sciences and Optimization (CSO), 2011 Fourth International, Chengcheng Gai, Wenguo Weng, Hongyong Yuan: GIS-Based Forest Fire Risk Assessment and Mapping, 2011.
14. Technical measures to prevent forest fires (Kaulfuß Susanne,2020) available on http://www.waldwissen.net
15. Technical report by the Joint Research Centre (JRC) of Pan-European wildfire risk assessment (ISSN 1831-9424, doi:10.2760/9429)
16. 16. Developing the European wildfire risk assessment (WRA). In: Atlas of the Human Planet 2020. Publications Office of the European Union, Luxembourg, pp. 37-38. ISBN: 978-92-76-27388-2, available on https://purl.org/INRMM-MiD/z-QW8I46GC

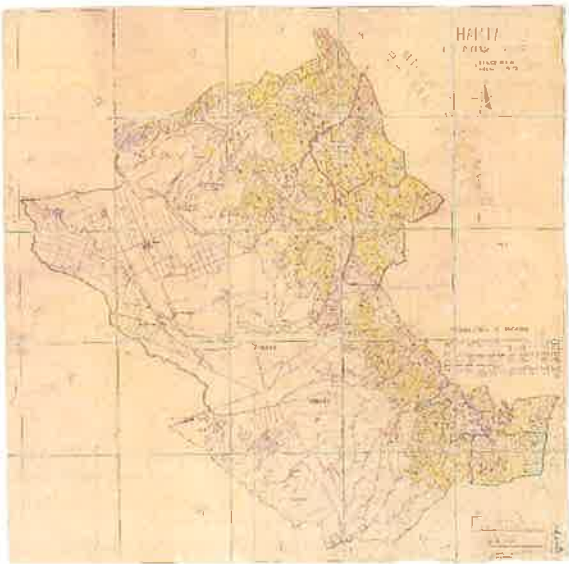
G-O PROJEKT

X. ANEXXES

Annex 1 – Images of the old management plans for Dajti Mountain National Park.







G-O PROJEKT

"Experimental Forest Fire Technical Map AIB
and Obstacle on the Fly on Sample Areas, Albania"

Annex 2 – Photos from the field work and measurements







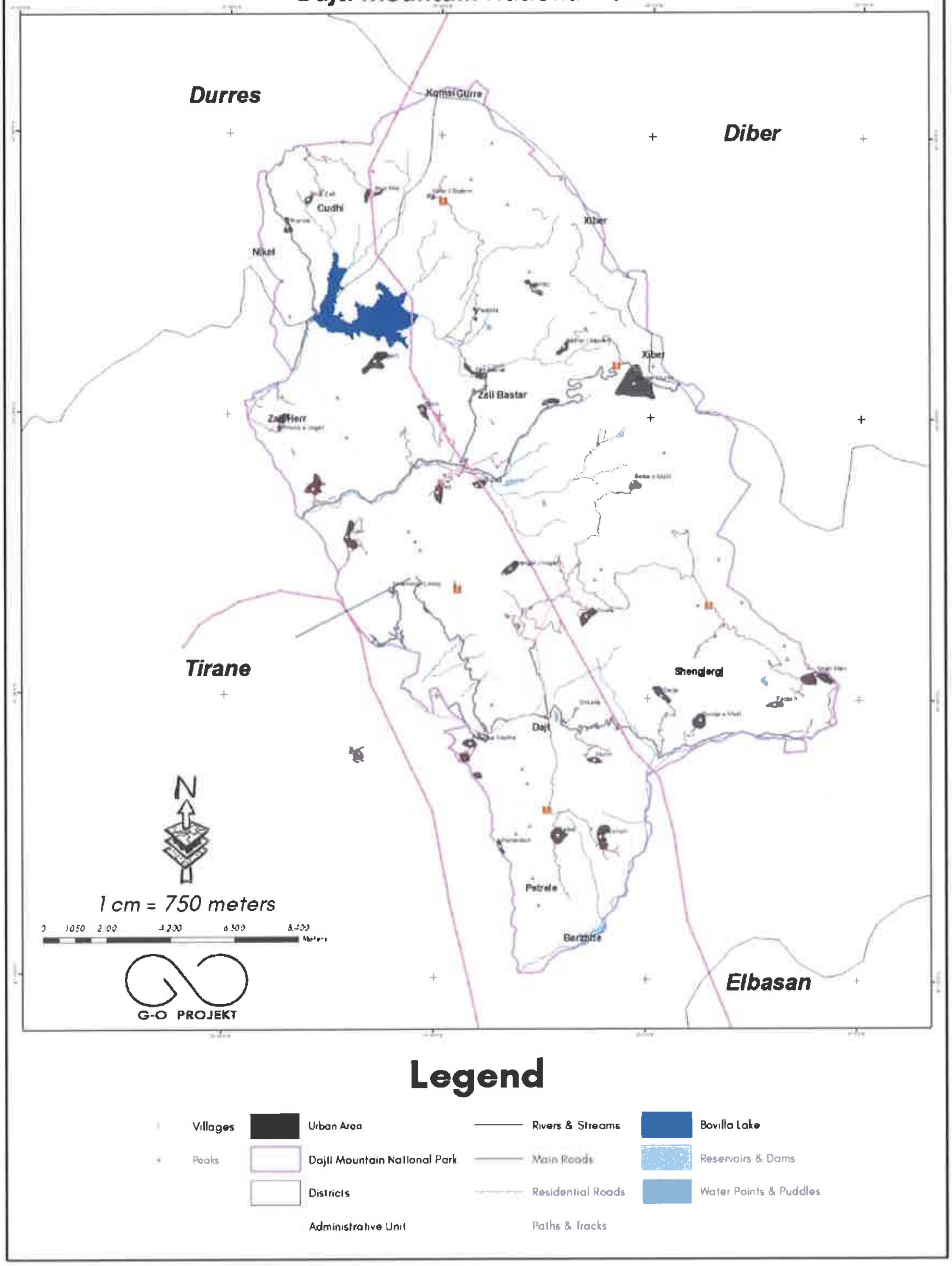





G-O PROJEKT
SHPK

Annex 3 – Administrative Map

Administrative Map
Dajti Mountain National Park



G-O PROJEKT
SHPK

Annex 4 - Location of obstacles in the area.

Object	***North***	***East***	***Object***	***North***	***East***
Transmission Tower	41.3560805	19.8833064	Transmission Tower	41.33931	19.97823
Transmission Tower	41.3532698	19.8859028	Transmission Tower	41.36034	19.96267
Transmission Tower	41.3587984	19.8808978	Transmission Tower	41.32013	19.99252
Transmission Tower	41.3282612	19.9864811	Transmission Tower	41.43069	19.90508
Transmission Tower	41.413405	19.9175054	Transmission Tower	41.31624	19.99676
Transmission Tower	41.3546008	19.96682	Transmission Tower	41.33378	19.98237
Transmission Tower	41.3452304	19.9738103	Transmission Tower	41.36335	19.96048
Transmission Tower	41.4888623	19.8881406	Transmission Tower	41.32327	19.9902
Transmission Tower	41.3994193	19.9303747	Transmission Tower	41.42533	19.90886
Transmission Tower	41.4089835	19.9206919	Transmission Tower	41.36154	19.96181
Transmission Tower	41.3705491	19.9550939	Transmission Tower	41.3499	19.97038
Transmission Tower	41.3830559	19.9457008	Transmission Tower	41.45921	19.89718
Transmission Tower	41.5048776	19.8978824	Transmission Tower	41.45795	19.89848
Transmission Tower	41.4415605	19.9054301	Transmission Tower	41.44959	19.90569
Transmission Tower	41.3967675	19.933132	Transmission Tower	41.41979	19.91289
Transmission Tower	41.4851813	19.8886663	Transmission Tower	41.48005	19.88927
Transmission Tower	41.3367846	19.9801779	Transmission Tower	41.48336	19.88893
Transmission Tower	41.3187975	19.9934758	Transmission Tower	41.50618	19.89871
Transmission Tower	41.3254211	19.9886161	Transmission Tower	41.41553	19.91591
Transmission Tower	41.3734432	19.952851	Transmission Tower	41.46292	19.89329
Transmission Tower	41.4175768	19.9144799	Transmission Tower	41.36552	19.95872
Transmission Tower	41.3763983	19.9506361	Transmission Tower	41.45657	19.89997

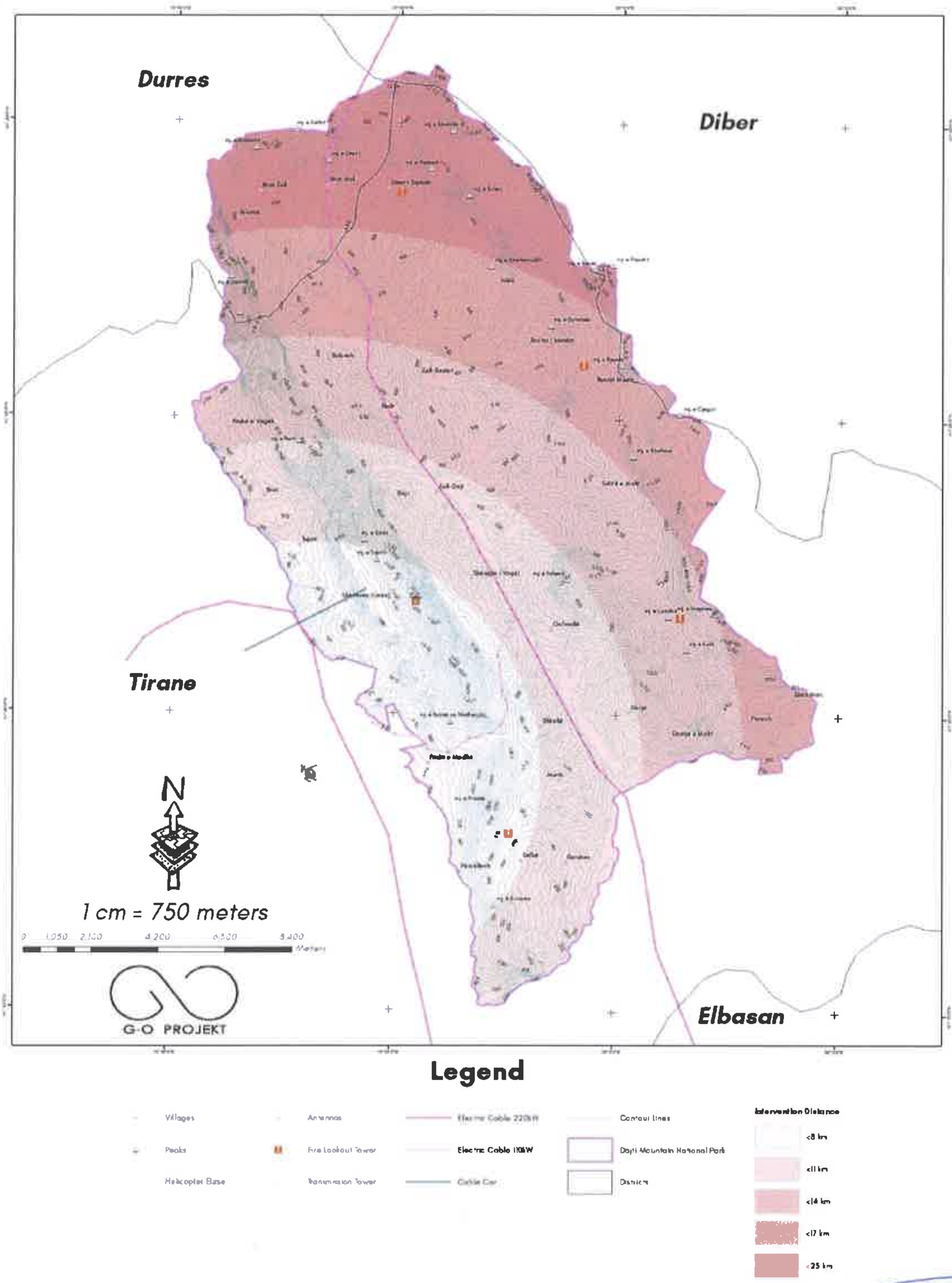
G-O PROJEKT

Transmission Tower	41.3435586	19.9751134	Transmission Tower	41.45102	19.90574
Transmission Tower	41.4926314	19.8900074	Transmission Tower	41.3883	19.94178
Transmission Tower	41.46488	19.8910427	Transmission Tower	41.47347	19.89003
Transmission Tower	41.4039903	19.9257291	Transmission Tower	41.3268	19.92619
Transmission Tower	41.4872991	19.8883069	Transmission Tower	41.32354	19.92969
Transmission Tower	41.4383433	19.9053067	Transmission Tower	41.32273	19.93773
Transmission Tower	41.3921194	19.9378205	Transmission Tower	41.32643	19.94514
Transmission Tower	41.4279549	19.9070341	Transmission Tower	41.32702	19.94809
Transmission Tower	41.4897021	19.8879958	Transmission Tower	41.32763	19.94996
Transmission Tower	41.4712553	19.8902917	Transmission Tower	41.32822	19.95373
Transmission Tower	41.385825	19.9435711	Transmission Tower	41.33026	19.95706
Transmission Tower	41.3935561	19.9363882	Transmission Tower	41.33499	19.95962
Transmission Tower	41.50311	19.8967129	Transmission Tower	41.33754	19.95895
Transmission Tower	41.3896404	19.9403954	Transmission Tower	41.34007	19.95754
Transmission Tower	41.5000325	19.8947925	Transmission Tower	41.35039	19.95551
Transmission Tower	41.3321963	19.9835462	Transmission Tower	41.34959	19.95568
Transmission Tower	41.3790227	19.9484098	Transmission Tower	41.34743	19.95611
Transmission Tower	41.4955968	19.8918528	Transmission Tower	41.36842	19.90559
Antennas	41.43214603	19.9866283	Antennas	41.35873	19.91264
Antennas	41.36120714	20.02393778	Antennas	41.35849	19.9128
Antennas	41.36530529	19.92458238	Antennas	41.35977	19.9115
Antennas	41.480541	19.91738481	Antennas	41.35966	19.91151
Antennas	41.29997998	19.96070845	Antennas	41.3672	19.92282
Antennas	41.35912958	19.91194346	Antennas	41.36765	19.9231
Antennas	41.35902502	19.91207615	Antennas	41.36547	19.92438
Antennas	41.35885834	19.91244522	Antennas	41.31604	19.8856

G-O PROJEKT SHPK NUIS:L71403020 P

Annex 5 – Obstacles and Intervention Map

Obstacles on the Fly and Intervention Map
Dajti Mountain National Park



Annex 6 - Distance of each village from helicopter base in Farka, Tirana.

Village	***Distance from Helicopter Base (km)***
Vilëz	16.4
Darshen	8.5
Derje	10.2
Besh	11.6
Shëngjin i Vogël	7.9
Selbë	7.1
Domje e Malit	11.4
Bastar i Mesëm	15.1
Brar	8.8
Qafmollë	8.8
Mner i Sipërm	18.5
Bastar Murriz	15.3
Përcëllesh	5.6
Facesh	13.9
Zall-Bastar	13.1
Dajt	9.0
Bruz Zall	18.3
Shkallë	7.4
Zall-Dajt	9.7
Priskë e Madhe	3.7
Selitë e Malit	12.8
Bulçesh	13.0
Priskë e Vogël	11.2
Tujan	7.2
Bruz Mal	18.5
Murth	7.8
Shermina (Linza)	5.5
Rranzë	17.6
Perkola	15.0
Shën Mëri	15.4

G-O Projekt sh.p.k.

Administrator

G-O PROJEKT SHPK NUIS: L71403020 P