Physical-geographical Position of the Lower Zeta

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Abstract

The Lower Zeta Basin is located in the central part of central Montenegro. The geographic coordinates of this area are 18° 56 'and 19° 45' east longitude and 42° 27 'and 42° 45' north latitude. The bottom of the valley of the Zeta River, Bjelopavlićka ravnica, is located predominantly at 45 - 50 m a. s. l. And it accounts for 25% of the total territory of the municipality of Danilovgrad. The largest part of the Danilovgrad municipality is the mountainous terrain.

The southwestern valley side consists of the slopes of the mountain Garča with its highest peak (Milunova Bobija 1436 m a. s. l.), and the northeastern valley side of the slopes of the mountain of Prekornica whose highest peak (Kula 1927 m a. s. l.).

The area of the explored area belongs to the morphological whole of the synclinorium of the Duga, Valley of Niksic and valley of the River Zeta. The terrain of the Lower Zeta can be divided into three parts: the valley bottom of the Zeta River, the left and the right lowest slopes.

In the Bjelopavlićka ravnivca the influence of the Mediterranean climate is dominant, slightly modified, which means that the area is characterized by long, hot and dry summers, while winters are relatively mild and rainy.

Keywords: basin, area, whole.

Introduction

1. Geological composition and geotectonics of the terrain

The investigated area belongs to the morphological whole of the synclinorium of Duga, Nikšićko polje and the valley of the Zeta River. The terrain of the Lower Zeta can be divided into three parts: the valley bottom of the Zeta River, the left and the right lowest slopes. The Zeta River extending along this area forms a valley of 28 km long and a width that reaches 6 km (Lazarev krst - Donje selo). Bjelopavlićka ravnica area is about 72 km². The lowest part of the terrain is the Zeta River basin, located at an altitude of 56-35 m above sea level.

The right lowest slope of the Zeta River is built from Mesozoic carbonates and rises to a height of 1,436 m (Milunova Bobija), while the left valley, which is distinguished by mountainous and mountainous regions, is also represented by carbonates. This terrain rises to a height of 1,927 m (Tower) on the mountain of Prekornica.

The largest part of the territory of the explored area belongs to the mountainous mountainous terrain (37%), which is between 200-1,000 m above sea level. Terrain below 200 m a. s. l. 28% of the surveyed area is occupied, while at a height greater than 1,000 m it is 35% of the total area.

The terrain of the explored area belongs to the zone of high karst and as such is mostly made by limestones of Mesozoic age. They are represented in the area: Velji and Mali Grač, in the southwestern part, as well as in the area of Prekornica and Lisca, northeast.

The peripheral part of the valley sides is characterized by paleogenic sediments that are represented by marl, clay, sandstone, breccias and conglomerates. There are them in the area of Zagorka, Tvorila, Frutka, Pjesivaca, Bar Šumanović, Vinicić, Brijestova, Slatina, Glizica and Donji Martinić.

The lowest parts of the terrain are represented by paleogenic and quaternary sediments. They are characteristic of the valley of the Zeta River. They are presented with clay, clay-sandy and sandy sediments.

High (karst) zone consists of anticlinorium (Katun Karst), synclinorium of Duga and the valley of Zeta and anticlinorium Prekornica and Vojnik, which pass into the northeast synclinorium Morača, Tušina and Vrbnice. Lytological and stratigraphic, three sections are clearly distinguished:

- Mesozoic carbonates that predominantly build a mountainous terrain, from the valley bottom of the Zeta River to the highest peaks. These are the areas around Velji and Mali Garač to the southwest and the areas of Prekornica, Lisca and Kamenica to the southeast.
- Paleogenic sediments, predominantly construct individual areas along the bottom of the valley of the Zeta River and on the immediate periphery of its bottom. These sediments build a more extensive areas in the form of strips at Zagorak, Tvorila and Frutak, to about Pješivci, on the southwest side of Zeta River, and between the Bare Šumanovića (Vinići, Brijestovo, Slatina, Glizica, Donji Martinići) to below the Piperi, north-east of Zeta River.
- Quaternary sediments that build the bottom of the valley of the Zeta River or are acutely covered with high carbonate terrains. The valley bottom is build by clay, clay - sandy and sandy sediments of lacustrine origin, alluvial sediments, terraced sediments and talus oxbow facies sediments.

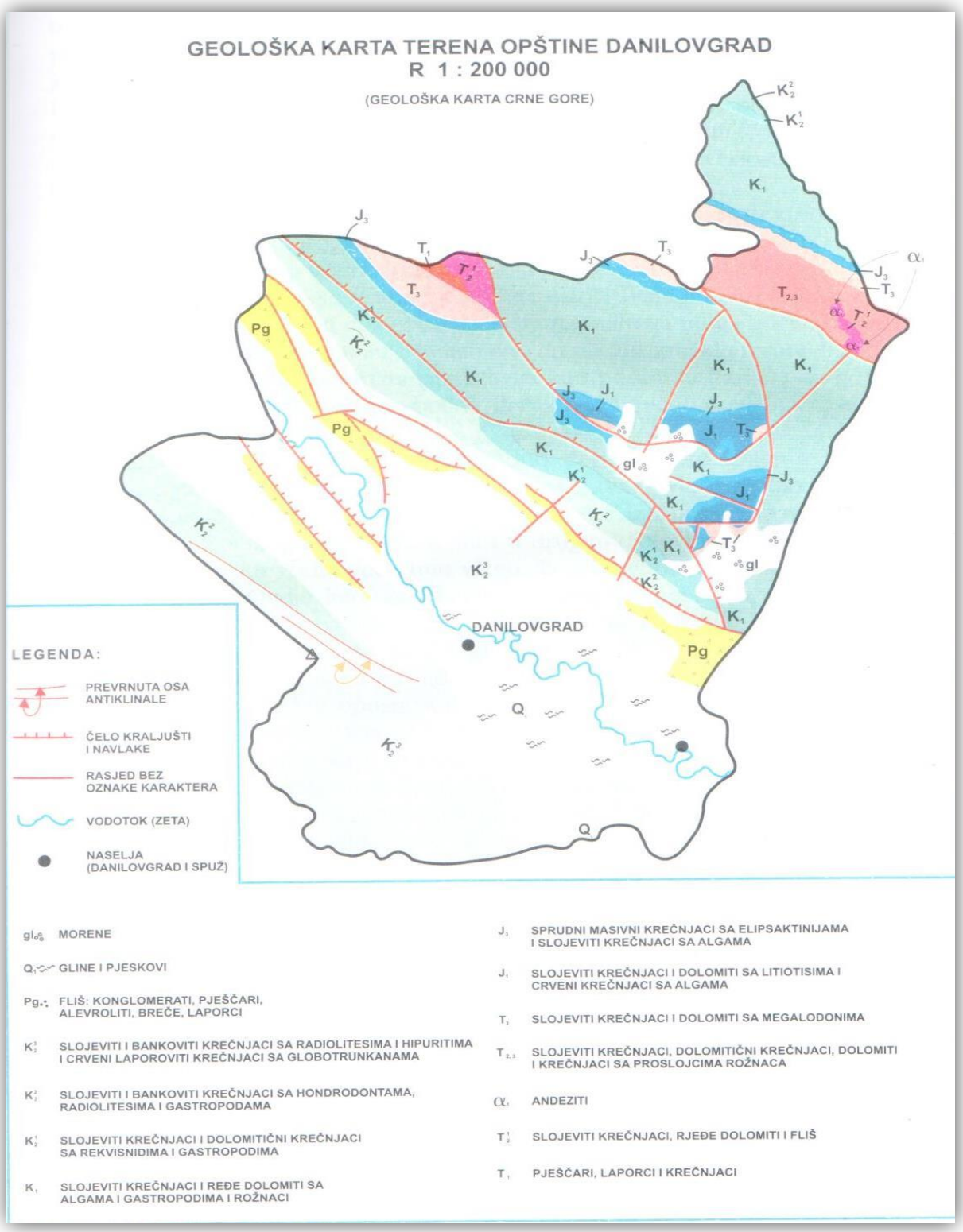
In the valley of the Zeta River are deep neotectonic faults of dinar provision, but are also indicated the faults that intersect with the main directions. The field is therefore neotectonical active, which is shown indirectly through the changes of the bed of the river Zeta, and indirectly through the tectonic movements of which are manifested by earthquakes.

2. Relief

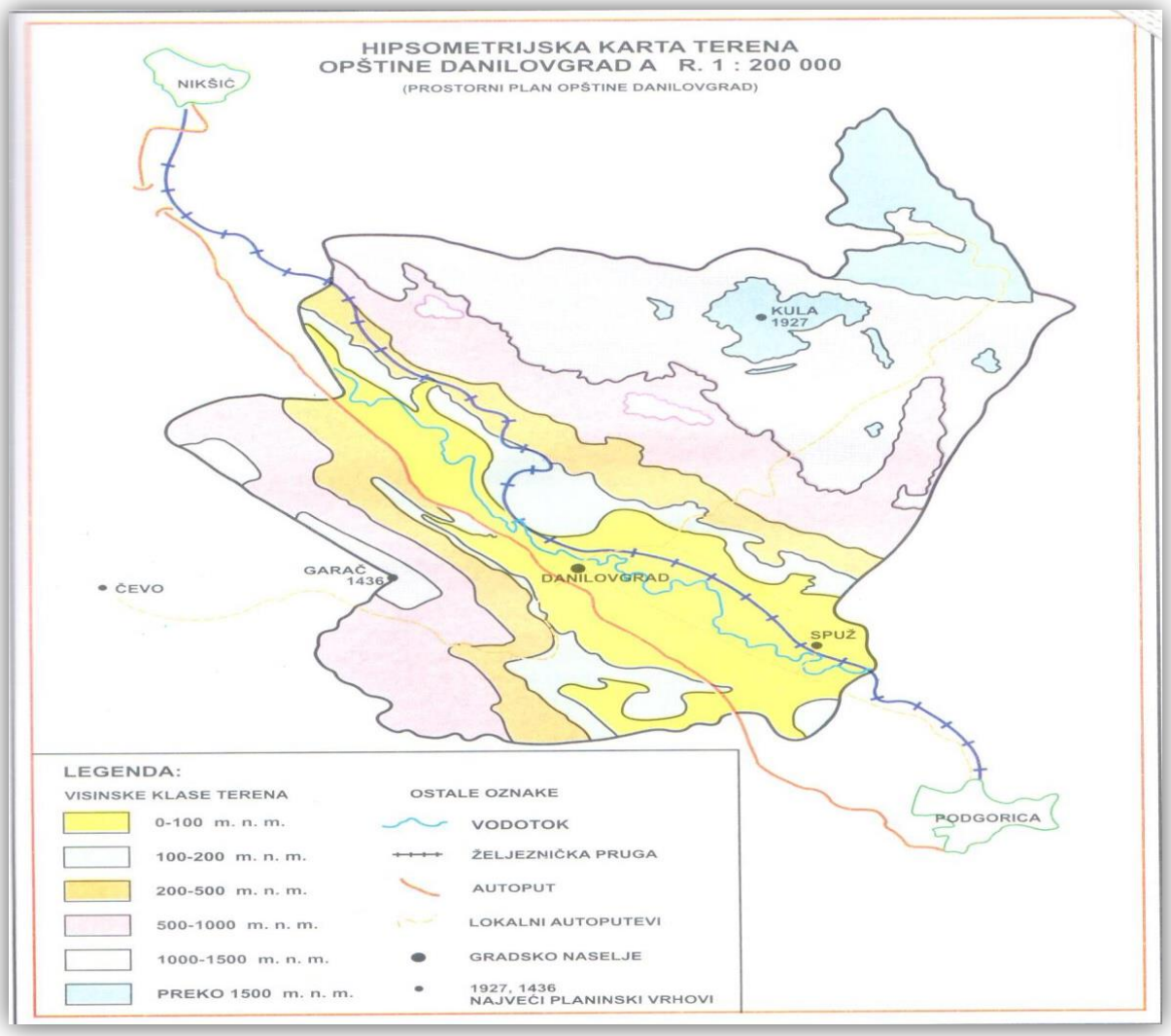
The research area includes 3 distinct morphological units:

- Valley of the river Zeta;
- Right lowest slope - Mount Garač and
- The lowest left slope - the mountain of Prekornica.

The valley bottom of the river Zeta is a pronounced morphological whole. It is located deep in the river valley in relation to the surrounding terrain. This plain, called Bjelopavlićka, symmetrically divides the Zeta River. In this area there are limestone hills, which rise from the plain (Kujava, Tvorilo, Podglavica, Spuška glavica, etc.). The surface of Bjelopavlićka ravnica is about 72 km^2.



Picture 1: Geological map of Donja Zeta (Burić,2000)



Picture 2: Hypsometric map of Danilovgrad municipality (Burić, 2000)

The right lowest slope - the mountain Garač, was built from Mesozoic carbonates. It is made up of Veljeg i Malog Garča (Milunova bobija 1436 m a. s. l.)
The leftmost slope - the mountain of Prekornica (Kula 1927 m a. s. l.) consists of hilly-mountainous areas, which are built of carbonates.
In the hypsometric structure dominates the terrain with heights of over 200 m a. s. l.

- Up to 200 m a. s. l. = 29% of explored space,
- From 200 to 1000 m a. s. l. = 38% of explored space and
- Over 1000 m a. s. l. = 38% of explored space.

2.1. Karst relief

The formation of the larger part of the Bjelopavlićka ravnica is related to the action of corrosive processes on limestone. This is evidenced by the hummingbird Spuska Glavica and others, which with its characteristic appearance stretches above the plain.

The northwestern part of the plain represents a tectonic basin, which is lowered along several tectonic lines. The southeastern, spacious part, has the character of the karst field. Along the northeastern side of the valley, the narrow zone of the paleogenic flysch extends - shards, sandstones, marble limestone, etc. The paleogenic flysch extends from the Gatačko polje, through the Nikšićko polje, and then through the Bjelopavlićka ravnica to Kuči.

The complex geological structure of the terrain, the changing and relatively favorable climatic conditions during the geological evolution, predetermined the complex and specific geomorphologic features of this area. It can be said that differences in lithological composition, intense tectonics, river, karst and glacial erosion, had a decisive influence on the present look of the explored terrain. In this field, the following forms were found: karstic relief, Fluvio - karst relief, glacial relief, pontine relief, fluvio - accumulation relief and marine relief.

Muzge, scrubs and oysters are the smallest Karst forms that are hiding in this area. There is no limestone on which there are no such forms.

In addition to the aforementioned mussels and pickles, the most frequent karstic forms in the Donja Zeta basin are nurseries, holes and bends.

The Karst and Fluvio karst reliefs are dominant in this area. Karst fields meet on the ground. At the contact of impermeable rocks and limestone was the most intense corrosion (the dissolution of limestone), and so the karst fields were created. Among the larger fields are known: Radovče polje and Kopiljsko polje, whose upper parts reach up to 700 m above sea level. They are built by Mesozoic limestones through which glaciophluvial and glacial sediments are deposited.

The southwestern part of the Bjelopavlićka ravnica is a karst field. What is very important is that there is no water in the karst.

Lesser Karst fields are also Kupinovo (at the foot of Bezbrojeva), Rajčev to (under the southern slopes of the Prekornica) and the other. In the area of the investigated area of the encountered valley depression of significant dimensions, they were found outside Kupinovo and north of Svračina. On the investigated terrain, many other karst and fluvio - karst forms were found indicating the extraordinary specificity of the shape of these reliefs on the investigated terrain. The dimensions of their occurrence are generally insignificant, but their reporting density is significant. Among the karst are especially characteristic: squares, mussels and oysters. Among the other fluvio - karst forms are: closed valleys (dry, with occasional or constant flow), hanging or semi - open valleys (dry and occasional flows), hanging open valleys (dry) and humus.

Sinks, caves and pits are the most important underground karstic forms on the investigated terrain.

Sinks occur at the contact of rock masses, along the discharge zones, along the troughs of occasional and permanent watercourses, and in places of direct discharge of atmospheric waters through numerous karstic forms.

The characteristic of the abyss is that they are very markedly shaped by the long-lasting operation of the poisonous waters. Such sinks are in contact with flysch and limestone in Brijestovo, Gliznica, as well as sinks in contact with quaternary glacial sediments and limestone in Zorski Lug. Regarding the impact of the karst relief on the floods, it is flies in the investigated area, and there are lake deposits in the surface, and there is floods, and the sinks are in the southwestern part of the plain, and there are the biggest floods because the sinks can not swallow water .

The head of the Zeta, Perućica and Obošticko oko, the three largest springs, with a flow rate of 50 m^3/s and have a higher amount of water than they surface in the Nikšićko polje. It should be noted that it was determined by staining that the water

from the water of Lake Liverovići (Župa Nikšićka) is coming out in Dobro Polje in Donja Zeta.

1.1. Land and vegetation characteristics

According to the productive value, there are eight classes of land in this area, whereas the land of the first credit rating class, in which there are no restrictions on production, do not exist on a larger scale.

Lands of the second class, which are characterized as very good land, represent the best lands in this area. They are suitable for intensive agricultural production and application of modern agrotechnical measures. This class of land belongs to the plantations and brown lands by the Zeta River, in Dobo Polje, Bogicevic, between Orja Luka and Danilovgrad, in Pažići, Gornji Ćurić, Drenovica, Kopit Petrović and Przine. This class includes a plantation near the Sušica river, between Grudice and Sladoje Kopit and Strahinjić and Gruda.

The third-class land is characterized as very good and good land, which also has exclusively agricultural purpose. It has some worse qualities than the other rating classes expressed mainly in higher inclination, less depth, poorer water - physical properties. This land class involves relatively large areas along the Zeta River, between Dobro Polje and Spuž, on the one side, and between Zagorje and Velje Polje and Velje Brdo, on the other.

The land of the fourth credit rating is categorized as good and medium good land. This class includes land on the terraces along the contacts between the valleys and the valley of the river Zeta. They are also represented in the plain part, along the Zeta and Sušica rivers, and even smaller watercourses. Fifth rating class of land is characterized as central and weaker, with significant restrictions on agricultural production. The land of this category of brown lesbian and pseudogenic species of the central part of Kosov Lug, between Kosić and Duboki Lazin and Grud, Ćurilacka Mlaka, the lowest parts of the Spuško polje, could be translated by appropriate measures in a better rating class.

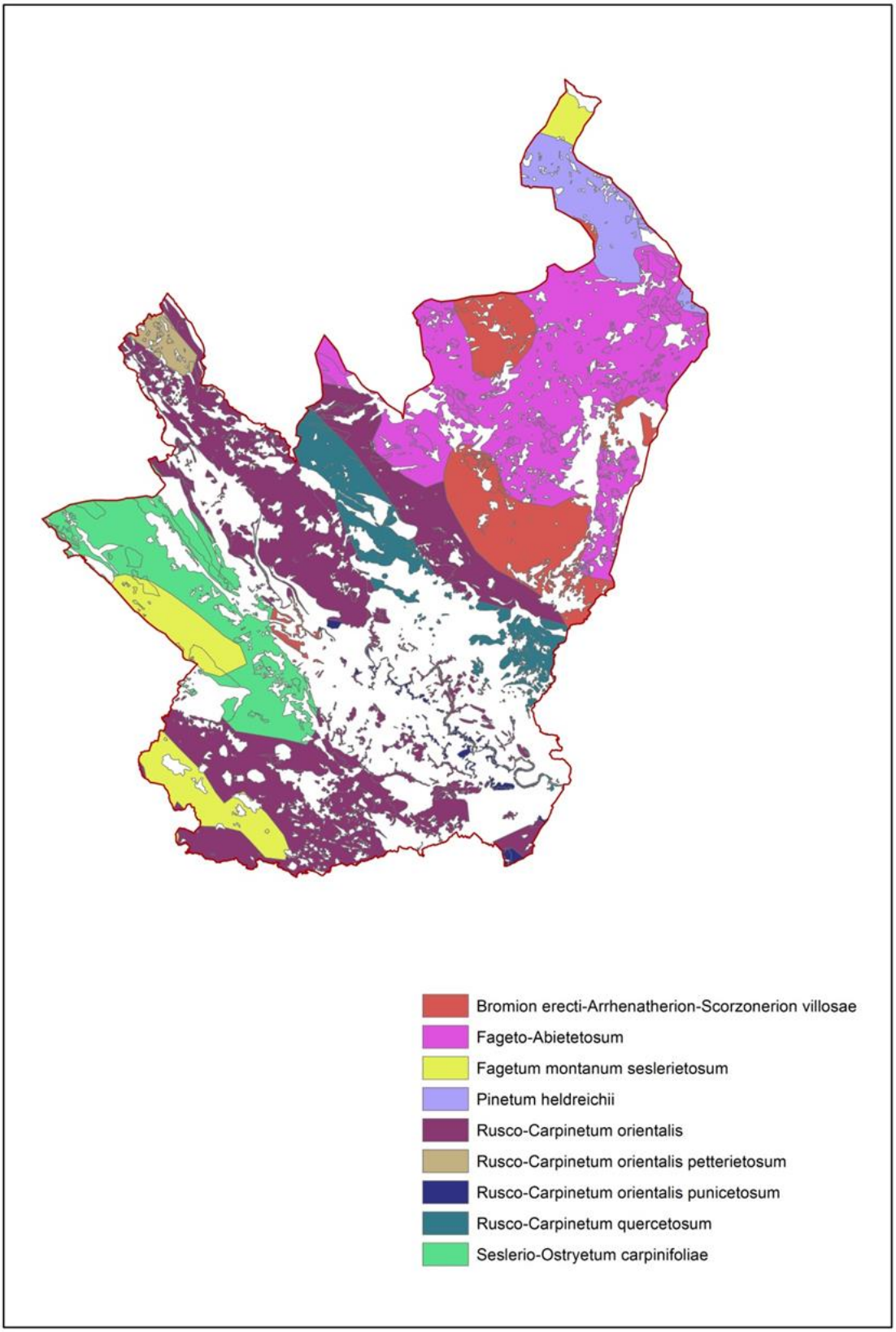
The sixth grade is designated as a land that is poor for agriculture and is made by it in fact a good forest land that is mostly under the forest. They are mostly used for pastures and poor meadows.

Seventh grade is a very poor land suitable only for forests, but also for pastures.
The eighth grade is the weakest land, infertile and inaccessible rock. The seventh and eighth classes are practically forests. Low forests and blackcurrant black grass and black ash are present between the belt of white-grass forests, from the bottom, and the beech belt, on the upper side. On the first floor of the wilderness, there is a passion, ruins and looms.

Beech forests were developed at altitudes above 1,100 m a.s.l. rarely lower. This forest on the floor of the tree rarely contains other species, such as: black grass, black ash, clinique, oak meadow, oak and jasmine. The forest of the swamp occurs above the beech and fir forest zone and above the subalpine beech.

Material and Methods

During the field surveys from ... to ... were performed / measured .... by means of a LEICA GPS. (Water lines were measured at places where the flood wave had reached the highest levels). Also, a staff gauge was used which can determine how big the floodwaves were in the area.



Picture 3. Map of forest associattion in the area of Danilovgrad,

Data on climatic elements of the research area for the period 1960 – 2009 were taken from Institute of hidrometeorology and seizmology. The tables contain data on the average monthly, annual maximum and minimum air temperatures, as well as the average monthly and annual quanity of precipitations. The tables also contain standard deviation as a statistical term that denotes an exception from the mean value. It also shows the percentage of cloudiness and insolation as well as the rose of the winds.

Results

Fluvial relief

During the Pleistocene (Ice Age), Morača had accumulated enormous deposits of fluvioglation material (up to 25 m thickness) and thus interrupted the flow of the Zeta between the Veliki Hram and the hill above Rogom. Fluvio-glacial application has been formed over the past one million years. She applied the flow of the Zeta with this application. In its narrow part, a pleistocene lake was created. In the lake there are sedimented thick deposits of multicolored clays, which cover the limestone ravine and fill the part of the tectonic subsoil. This material of Morača brought from the above streams, i.e. From the Morača hive, where the centre of the glacier was located. Thus, the entire Donja Zeta was buried. At the end of the Pleistocene, Zeta, the island's lake, broke the fluvioglacial dam and the lake disappeared, and Zeta merged with Morača.

1. Climate

In Donja Zeta the influence of the Mediterranean climate is dominant, slightly modified, which means that the area is characterized by long, hot and dry summers, while winters are relatively mild and rainy. The most important factor that determines these differences is the altitude, as well as the fact that the valley of the Zeta River penetrates the influence of the Mediterranean climate, which conditions the proximity of the Adriatic Sea.

1.1. Air temperature

The mean annual air temperature in the area of Donja Zeta, for the period from 1960 to 2009, is 14, 5ºS, the mean maximum is 15.8ºS and the mean minimum is 13.0ºS
August is the warmest month with an average temperature of 28.7 ° C, and the coldest January is 4.5 ° C (Table 1.)

1.2. Relative humidity

Relative air humidity is the highest in November and is 81%, and the lowest in July and August is 62 - 63%. The average monthly relative humidity for Danilovgrad (1960-2009) is 72% (Table 2.)

1.3. Cloudy and insolation

The average annual cloudiness is 5.2. During the year there are on average 115 cloudy days. The average number of clear days is 96.3 per year. The least cloudy days are in July and August (2 - 3), and most in November and December (14 - 15).

As for insolation, here is the sunset for a long time during the year, an average of between 6.2 and 6.5 hours per day.

Table 1. Air temperature for Danilovgrad 1960 – 2009.

Period 1960 - 2009	*I*	*II*	*III*	*IV*	*V*	*VI*	*VII*	*VIII*	*IX*	*X*	*XI*	*XII*	*Total:*
Mean value	4.5	6.2	9.6	13.5	18.2	22.2	25.0	24.5	20.0	14.7	9.5	5.7	14.5
Max	7.3	9.1	12.3	16.5	22.0	27.0	27.7	28.7	23.6	17.5	12.9	8.6	15.8
Min	1.8	2.3	4.9	10.8	14.6	19.4	22.8	19.4	16.3	10.6	5.2	2.4	13.0
Standard deviation	1.6	1.7	1.6	1.3	1.6	1.5	1.2	1.9	1.7	1.4	1.7	1.6	0.7

Table 2. Relative air humidity for Danilovgrad 1960 – 2009.

Period 1960 - 2009	*I*	*II*	*III*	*IV*	*V*	*VI*	*VII*	*VIII*	*IX*	*X*	*XI*	*XII*	*Total:*
Mean value	78	75	71	71	70	68	62	63	70	78	81	80	72
Max	90	91	84	83	81	80	84	80	84	88	90	88	82
Min	63	55	56	57	52	40	43	43	58	65	73	68	65
Standard deviation	7	9	7	7	7	8	7	8	7	6	5	6	5

Table 3. Average monthly precipitation 1960 – 2009 (mm).

Station	*Period*	*I*	*II*	*III*	*IV*	*V*	*VI*	*VII*	*VIII*	*IX*	*X*	*XI*	*XII*	*Total:*
Danilovgrad	1960 - 2009	240	220	200	182	106	82	50	83	165	242	337	313	2218

1.4. Wind

Due to the accuracy of the data, and given the proximity of Podgorica and Danilovgrad, the anemographic rose for Podgorica is shown (Figure 1). The reason for this is the lack of wind data at the climatic station in Danilovgrad.

The most frequent winds are from the southeast (12 days) and northwest (12 days). With 12% of the frequency of occurrence, with a mean maximum speed of about 20 m/s; slightly less frequent is the northern wind with 6%, but the average maximum speed is 30 m s. At least the western wind with only 3% of the frequency is the least. Strong wind, more than 8 before, occurs in February on average for a maximum of 5 days, with an average annual frequency of 2.8 days. Annually, it's an average of 46 days with silences.

On the basis of the rosy wind for Podgorica, it can be concluded that the greatest wind speed from the northern direction is 16.3%.

When wind speeds are observed, then we conclude that the most frequent is in the range 1-3 m/s 47.9% .

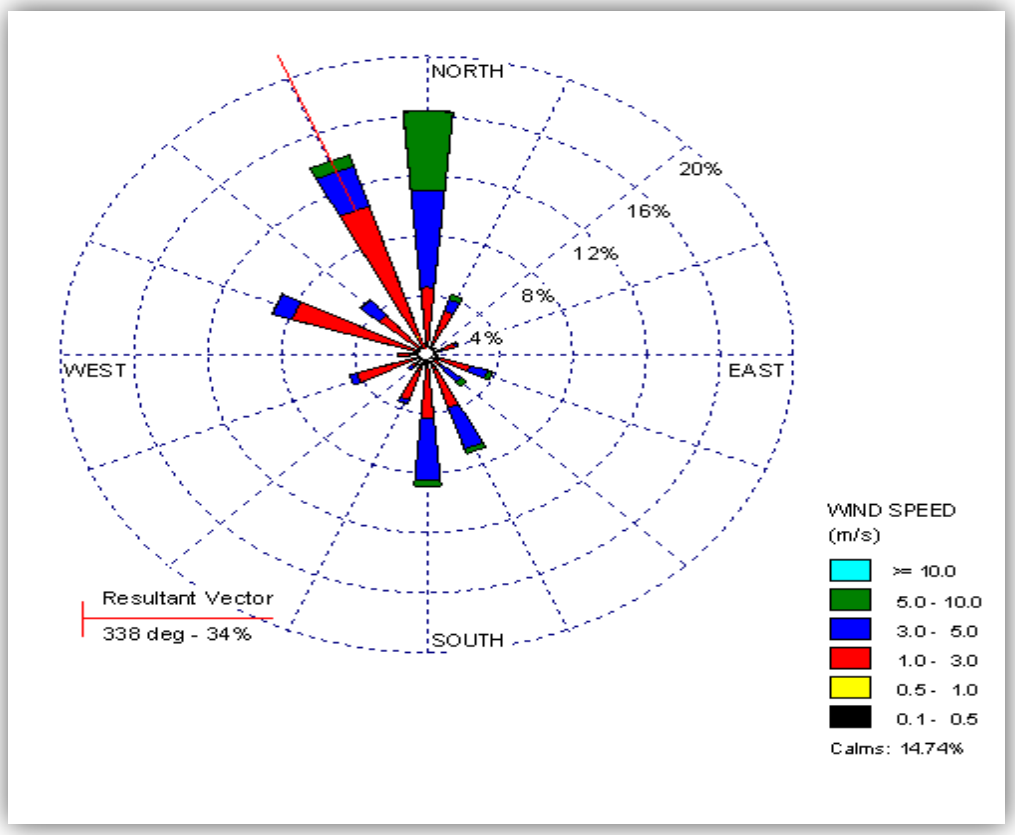


Figure 1. Rosy winds from Podgorica 1995 - 2003

1.5. Rainfall

Rainfall is typical for the modified Mediterranean regime characterized by precipitation with a sum of 2,300-2,500 mm annually. The highest rainfall in the mountainous region (about 2,500 mm) is eliminated annually, while these values for the wider area of the Bjelopavlićka ravnica range around 2,000 mm. In 1979, the

highest amount of precipitation was recorded and it is 3.062 dm^3. The snow cover is small with an average of about 10 cm per year and lasts about 5 days, and with 1 cm 10 days; While the maximum ever measured 53 cm. For floods, the most important data are the frequency of precipitation and the amount that is eliminated in a short period of time (Table 3).

Discussion

The use of space and its proper assessment rest on maintaining the basic functions of that space. Therefore, the developmental processes must be in line with ecological potentials. In order to achieve this, it is necessary to create a proper ecological basis of a concrete space based on scientific and professional backgrounds. In this paper, the ecological characteristics of the Donja Zeta basin area are considered in detail. In order to assess the vulnerability of natural ecosystems and the potential risks, a comprehensive approach is required. This is particularly true if we take into account that in the given case this is a very sensitive area. Based on the data presented, it can be seen that this is an area with pronounced climatic variations both in terms of high temperatures and long lasting droughts during the summer months, as well as the occurrence of record rainfall in the rainy periods. The expected climate change will only increase the intensity of these impacts in the upcoming period. The natural conditions as well as the anthropogenic impact are best reflected through the existing wildlife. The geological and hydrological characteristics, with all of its specificities, were also pointed out, especially when it comes to the limestone base and the karst areas.

In a scientifically grounded way, by analyzing a particular site, this work highlights its multi-functionality as well as the necessity of an ecologically-based approach in planning its long-term future use.

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