Regional Biodiversity and Action Plan of the South-East planning region

“Common plans for biodiversity conservation and sustainable targets for the development of a bilateral network of protected areas - COMBINE2PROTECT”

Project co-funded by the European Union and national funds of the participating countries

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Implementer: Centrefor Development of South-East Planning Region

The Regional Biodiversity Strategy with Action Plan of the South-East Planning Region is realized within the project ''Common plans for biodiversity conservation and sustainable targets for the development of a bilateral network of protected areas - COMBINE2PROTECT" within the INTERREG IPA CBC Programme between Greece and Republic of North Macedonia.

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LIST OF ABBREVIATIONS AND ACRONYMS

Bern Convention	Convention on the Conservation of European Wildlife and Natural Habitats
GDP	Gross Domestic Product
Bon Convention	Convention on the Conservation of Migratory Species of Wild Animals
SAPBD	Strategy and Acton Plan for Biodiversity Protection
SSO	State Statistics office
Habitats Directive	Directive on the conservation of natural habitats and of wild fauna and flora (92/43/EEC)
Birds Directive	Directive on the conservation of wild birds (2009/147/EC)
EU	European Union
IOA	Important Ornithological Area
PA	Protected Area
IBA	Important Butterfly Areas
IPA	Important Plant Areas
SEPR	South East Planning Region
NATO	The North Atlantic Treaty Organization
RGA	Regional Geodetic Administration

FOREWORD

The South-East region is characterized by preserved natural resources, developing tourism, developed agriculture, but still faces numerous problems in its environment which are the result of modern living and the wrong approach to the environment by the local population. The existence of these problems indicates the need for identification and finding appropriate solutions.

The development of a local action plan for biodiversity protection in the southeast region aims to seek ideas and encourage public participation by ensuring that priorities and solutions reflect what the region needs. Also, the preparation of this document encourages better implementation of existing local plans and strategies, helps create a vision for development of the region which is in line with the principles of sustainable development. The action plan which is an integral part of the biodiversity strategy and which will be managed by the competent municipal services, public enterprises and other affected stakeholders in carrying out their activities in the coming years will create preconditions for systematic and continuous solution of biodiversity protection problems because sustainable development is the mission and future of the region.

1. INTRODUCTION

The Regional Strategy for Biodiversity Protection (RSB) with Action Plan for the South East Planning Region (SEPR) is being developed within the project '' Common plans for biodiversity conservation and sustainable targets for the development of a bilateral network of protected areas - COMBINE2PROTECT" funded by the EU in the framework of the INTERREG IPA cross-border cooperation programme between the Greece and Republic of North Macedonia.

The main goal of this project activity is analysis of the deficiencies in the ecological data and preparation of a map of ecological sensitivity for the area of SEPR, as well as determination and undertaking of measures for preservation of the biodiversity and its sustainable use. In accordance with the basic principles defined in the Program for Development of the South-East Planning Region 2015 - 2019, the experts from the project team for preparation of RSB in SEPR in cooperation with the stakeholders in the Municipalities defined the functions of biodiversity, the importance they have for the inhabitants of the municipalities, as well as the activities that should be undertaken for protection and sustainable use:

- Preservation of natural ecosystems, rare and endangered species and their communities, conservation of unique geological, paleontological and geomorphological features of the area, ensuring the functioning of the environment and supporting the traditional way of life of the population
- Development function - respecting and strengthening the protection regime within the protected areas by preserving natural and landscape values, limiting natural resources, but also by encouraging the development of compatible activities that are in line with the primary goals of protection
- Scientific research function - organizing complex scientific research in order to understand the true values of the region in terms of biodiversity. Considering the possibilities for promoting the value of biodiversity to the general public, involving as many teams of young scientifically trained researchers, but also to follow the condition and trends of the natural populations of plant and animal species and their habitats and based on the obtained results to suggest programs for protection and development of the region
- Educational significance - raising public awareness about the threat and measures to be taken in order to protect nature and the environment as a whole, through the implementation of various activities such as teaching in nature, field work, camps etc. For educational purposes, it is necessary to renovate and build teaching and visitor centers, eco-paths, printed propaganda and educational material (posters, leaflets, monographs, etc.)
- Tourism function - it is necessary to identify and develop different forms of sustainable use of the space in accordance with the protection and preservation of basic natural values. Such activities should involve the local community as much as possible, especially hunting and fishing associations and non-governmental organizations as the sole bearers of all activities for protection and preservation of their environment
- Recreational function - development of preserved parts of nature in SEPR aiming for sustainable recreational tourism in accordance with the natural laws and resources of the region, adapted to provide recreation for different age groups.

1.1 BIOLOGICAL DIVERSITY AND ITS SIGNIFICANCE

Biodiversity is an indispensable resource that sustains our lives on Earth. Wildlife diversity (biodiversity, biological diversity or biodiversity) allows all living things (including the human population) to adapt to the inevitable changes, as well as to make the most efficient use of the resources available to them. All life on Earth with all its diversity and interconnectedness is a global biodiversity. Biodiversity is not an abstract phenomenon of interest only to a small circle of people. Biodiversity describes a complex system of all living organisms and the extinction of only one species can sometimes cause very serious changes in it. All living things (including modern man) are inextricably linked to resources and each has a specific role to play in the system. It is therefore unreasonable to believe that biodiversity can continue to be endangered without any (or at least significant) consequences for the well-being of modern man.

Biodiversity like other complex values must be fully considered. Biodiversity consists of: species diversity (species diversity for example: various species of birds, microorganisms, fish, etc.), habitat diversity (ecosystem diversity e.g swamps, rocks, pastures, etc.) and diversity of genes (gene diversity).

Examples of wildlife diversity are all around us and form the web of our survival on Earth. This diversity provides us with many basic services (production) food, medicine, clean air, drinking water and many others) which we often consider guaranteed, free and inexhaustible. The government and the public have been focusing on biodiversity issues (as part of the environment) relatively recently (since the 1990s) and this coincides with the publication of a wealth of scientific evidence of its vulnerability. It has been established for the first time that man irreversibly with negative effects seriously degrades the basis of life on Earth. More about the values of biodiversity for the region of interest to SEPR, its vulnerability and the efforts made to stop the decline of biodiversity is given in the following chapters.

1.2. GLOBAL AND NATIONAL STRATEGIC APPROACH TO PRESERVATION OF BIOLOGICAL DIVERSITY

The United Nations (UN) World Summit on Sustainable Development in 1992 in Rio de Janeiro adopted the Convention on Biological Diversity which provides the 11 framework for the conservation of biodiversity globally. CBD is an international agreement signed by 193 countries that have agreed that biodiversity is in the common interest of mankind. They pledged to work together to conserve habitats, species and genes, change the use of natural resources in a sustainable way and ensure that the benefits of genetic resources are shared equally locally, nationally and globally.

The Republic of North Macedonia ratified the Convention on Biological Diversity in December 1997 thus committing itself to implementing its commitments. The first Study on the state of biodiversity in R. N. Macedonia was developed in 2003 and the First National Biodiversity Strategy with an action plan of the Republic of N. Macedonia was adopted in 2004. So far, R. N. Macedonia has prepared five national reports to the CBD as well as several thematic reports.

1.2.1. NATIONAL STRATEGY FOR BOLOGICAL DIVERSITY – OVERVIEW OF THE SOUTH EAST PLANNING REGION

The Government of the Republic of N. Macedonia at its 58th session held on March 13 2018 adopted the National Strategy for Biodiversity with an action plan for the period 2018 - 2023. The Biodiversity Strategy and Action Plan (BSAP) as a national document defines the priorities for effective

and integrated conservation and the necessary actions, projects and programs for biodiversity conservation.

Pursuant to the Law on Regional Development (Article 5), eight planning regions have been determined for the needs of development planning: Vardar planning region, East planning region, South-West planning region, South- East planning region, Pelagonija planning region, Polog planning region, North- East planning region and Skopje planning region. With such an administrative division, the policy for balanced regional development in all fields - economic, social and environmental protection is encouraged.

This has necessitated coordinated action at both national and regional levels to prevent, reduce and mitigate the harmful effects on biodiversity. In the meantime, numerous studies for regional development have been prepared, one of them being the Regional Biodiversity Strategy with an Action Plan for the South-East planning region.

The South-East Planning Region as an important area for protection of biodiversity in R. N. Macedonia (mountain and forest ecosystems, aquatic ecosystems) is located in the border region. After many years of uncoordinated actions in the field of nature protection at the cross-border level, the prospects for the future are promising. For that purpose, the Republic of N. Macedonia has established cooperation with neighboring countries (at expert and institutional level) and is involved in various protection initiatives / activities such as revitalization and protection of Lake Dojran.

1.2.2. 2050 THE VISION OF ''LIVING IN HARMONY WITH NATURE'' – AFTER 2020 - GLOBAL STRATEGIC PLAN FOR BIOLOGICAL DIVERSITY

The decision to draft the Global Strategic Plan for Biodiversity for the period 2021–2030 was made in 2018 in Sharm el-Sheikh, Egypt reaffirming the countries' commitment to take urgent steps to conserve biodiversity. It is a ten-year leading international framework for action by all countries and stakeholders to save biodiversity and increase benefits for humans. The strategic plan covers a common vision, mission and strategic goals.

Mission

Take effective and urgent action to achieve the Sustainable Development Goals 14 and 15 ("Living on Earth", "Living underwater") as the foundations and integral parts of the 2030 Agenda for Sustainable Development and in harmony with Nature

Vision

The world in which all human beings enjoy prosperous and fulfilling lives and that economic, social and technological progress will take place in harmony with nature. By 2040, biodiversity will be valued, conserved, restored and used wisely, maintaining ecosystem services, maintaining a healthy planet and delivering benefits is essential for all people.

The 2030 Agenda is the dominant global and national framework for designing development activities. Virtually all elements of the Aichi Biodiversity Strategy Plan 2011-2020 are reflected among the goals, including two goals (Goals 14 and 15) that focus on biodiversity and many other goals that include biodiversity goals.

Strategic goals for the strategic plan for biodiversity 2021-2030

A. Promotion of a prosperous life in harmony with nature

B. Improving the status of biodiversity and the supply of ecosystem services

C. Establishment of knowledge and capacity for living in harmony with nature

1.2.3. „CLIMATE NEUTRAL EU“ – STRATIGIC PLAN FOR BIOLOGICAL DIVERSITY PROTECTION OF THE EUROPEAN UNION 2021-2030

In order to realize the vision "Climate Neutral EU" in the new EU Biodiversity Strategy, the following principles need to be harmonized:

1. Carbon sequestration (conservation of coal in soils) should always contribute to the health and resilience of the ecosystem and biodiversity.

2. Climate change adaptation policies should prioritize nature-based solutions, consider and avoid impacts on biodiversity, develop resilience and act synergistically in ecosystem restoration.

3. Drastically reducing consumption and increase efficiency in the use of energy, natural resources and fish / meat / dairy products. We need to replace the growth paradigm with one in which people live in harmony with nature and the planet.

4. Renewable energy sources and related infrastructures must be considered in the most favorable way possible for biodiversity, including through careful planning to ensure spatial planning, technical mitigation and balanced deployment of technologies in accordance with environmental capacity.

5. The resilience of ecosystems and species to climate change should be helped by addressing other stressors (such as space availability, food and water availability, impacts of invasive alien species), as well as specific biodiversity adjustment measures. seeking to optimize nature with the anticipated impacts of climate change in sight.

2. METHODOLOGY OF PREPARATION OF THE STRATEGY

- First coordination meeting of the project team for the project COMBINE2PROTECT (05 to 06 July 2018)

Within the project '' Common plans for biodiversity conservation and sustainable targets for the development of a bilateral network of protected areas - COMBINE2PROTECT" funded by the European Union through the Interreg IPA Cross-Border Cooperation Program between Greece - R. N. Macedonia, the first meeting of the project team was held in the period from 05 to 06 July 2018 (Thursday and Friday) in the Business Hall in Hotel Sirius, Strumica - R. N.Macedonia.

The meeting was attended by members of the project team including representatives of the Centre for Development of the South-East Planning Region, Aristotle University in Thessaloniki, Greece, the State Inspectorate for Environment, R.N. Macedonia and the Region of Western Macedonia from Florina, Greece.

The main purpose of the meeting was for the project team members to get acquainted with the project activities, deadlines and the role of each of the partners in the project activities. The meeting discussed the manner of communication between the partners, the activities related to the submission of progress reports, the necessary documents for the implementation of the project by the partners were presented, the deadlines for the implementation of activities, public procurement procedures and maintenance of further meetings.

- First working meeting of the project team within the project "COMBINE2PROTECT" (December 20 and 21, 2018)

The first meeting of the project team was held on December 20th and 21st (Thursday and Friday) at Aristotle University in Thessaloniki, Greece.

The meeting was attended by the members of the project team from: Centre for Development of the South-East Planning Region, Aristotle University in Thessaloniki, Greece, State Inspectorate for Environment, R. N. Macedonia and the Region of Western Macedonia from Florina, Greece.

The main purpose of the meeting was to present the design and content of the book on species/habitats and ecosystem services in protected areas with an emphasis on priority species and habitats. An expert hired by the project partner 4 - The Region of Western Macedonia from Florina, Greece presented a detailed analysis and description of the content of the book and topics covered in order for each partner to contribute individually taking into account the region. Additionally, the course of the project activities and the deadlines for their realization were discussed with each of the project partners. They also discussed the problems and challenges faced by project partners in the implementation of certain activities and how to deal with them and the activities that follow within the project.

- First expert meeting within the project "COMBINE2PROTECT" (21.03.2019)

Within the project "Common plans for biodiversity conservation and sustainable targets for the development of a bilateral network of protected areas - COMBINE2PROTECT " funded by the European Union through the Interreg IPA Cross-Border Cooperation Program between Greece and the Republic of N. Macedonia on March 21, 2019 (Thursday) in the premises of the Faculty of Natural Sciences and Mathematics at UKIM was held the first expert meeting. The obligations and methodology according to which the Strategy for Biodiversity of SEPR with the Action Plan will be prepared were presented, as well as maps of sensitivity for certain groups of plants and animals and grasses and forest habitats.

- Second working meeting of the project team within the project "COMBINE2PROTECT"

The second working meeting of the project team was held on May 29 and 30, 2019 (Wednesday and Thursday) in Florina, Greece.

The meeting was attended by the members of the project team from: Centre for Development of the South-East Planning Region, Aristotle University in Thessaloniki, Greece, State Inspectorate for Environment, R. N. Macedonia and the Region of Western Macedonia from Florina, Greece.

The main purpose of the meeting was to present the process and progress of the content of the book on species / habitats and ecosystem services in protected areas, with emphasis on priority species

and habitats as well as the trilingual web platform and infrastructure works presented by Greek experts engaged by Project Partner 4 - The Region of Western Macedonia from Florina, Greece.

Additionally, the course of the project activities and the deadlines for their realization were discussed with each of the project partners. It was also discussed about the problems and challenges faced by project partners in the implementation of certain activities and how to deal with them and the activities that follow within the project.

- Public Debate on the SEPR Biodiversity Strategy (30.07.2020)

An online Public Debate on the SEPR Biodiversity Strategy was held on 30 July 2020, at which the prepared documents were publicly presented and discussed.

3. BASIC CHARACTERISTICS OF THE SOUTH EAST REGION

The chapter Basic Characteristics of the South-East Region basically refers to the natural-geographical, socio-geographical and economic-geographical characteristics of the region, but in terms of their direct connection with biodiversity.

3.1. NATURAL GEOGRAPHICAL CHARACTERISTICS OF THE SOUTH-EAST REGION

3.1.1. GEOGRAPHICAL LOCATION

The territory of the South-East Region is located in the southeastern part of the Republic of North Macedonia. It is located between lines X-4553000 to the south and X-4629000 to the north and Y-7602000 to the west and Y-7666000 to the east. The region includes the territories of the Strumica-Radovis Valley, the Gevgelija-Valandovo Valley, the Dojran Trench and the upper part of the Lakavica Valley.

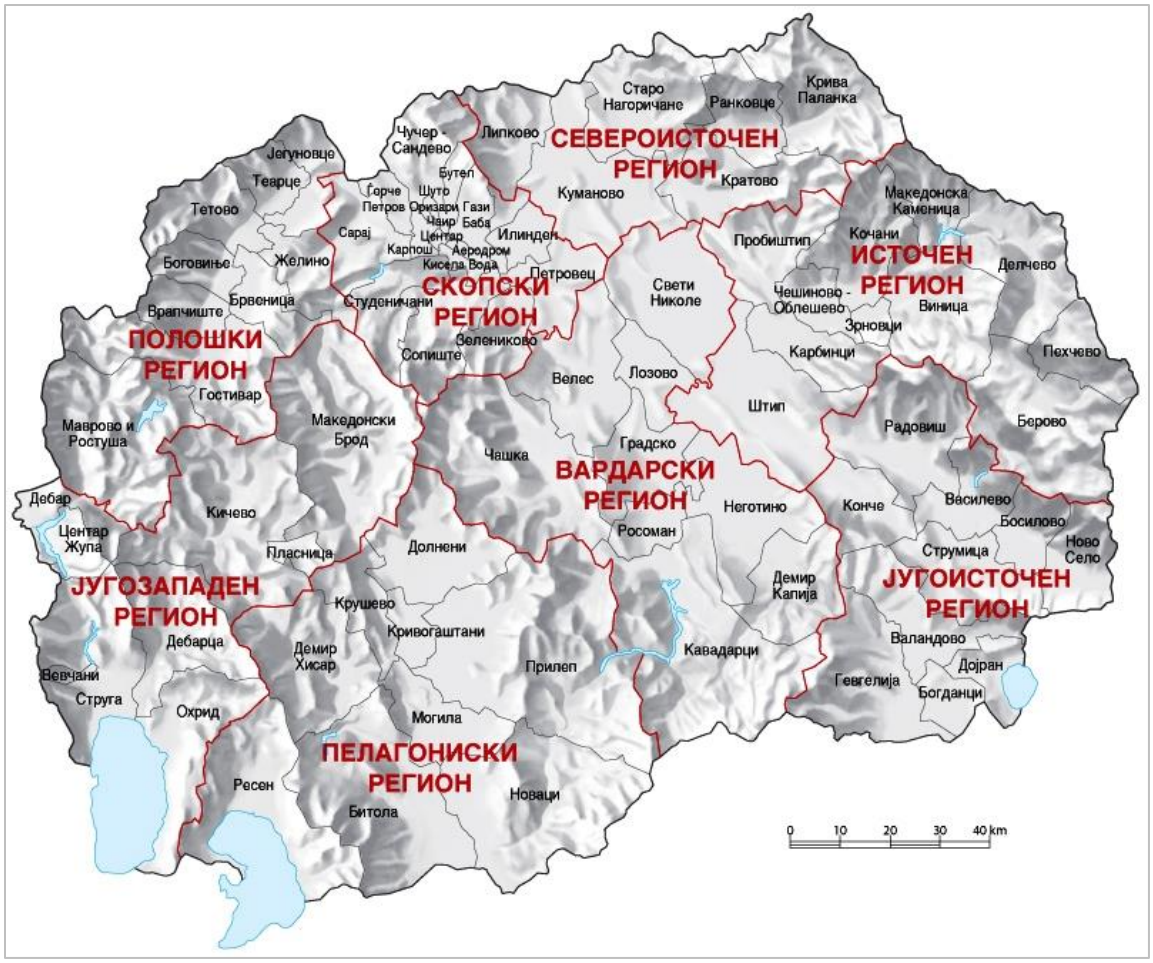


Figure 1. Statistical regions and Municipalities in R.N. Macedonia
Source: State Statistics Office of North Macedonia

South-East Region in the entire territory of the Republic of N. Macedonia the is closest to the Aegean Sea, i.e at a distance of about 90 km (Gevgelija-Thessaloniki).

The geographical position of the South-East Region is being upgraded with several highways and regional traffic communications. Through this region along the valley of the river Vardar stretches the traffic system from the highway and the railway along the Moravian-Vardar valley directly connect the territories of Serbia, N. Macedonia and Greece, and indirectly the more distant territories from Europe, Asia and the Mediterranean. Along the Strumica-Radovis Valley there is a highway from Stip-Radovish-Strumica-Petrich (in the Republic of Bulgaria) where it follows the road Sofia-Thessaloniki. These two roads are connected by several regional roads such as the relations Strumica-Berovo, Strumica-Valandovo, Valandovo-Dojran, Gevgelija-Dojran and several relations of local modernized and non-modernized roads.

The South-East Region touches two neighboring countries. To the east is the Republic of Bulgaria and to the south the Republic of Greece. Both countries are members of the European Union as an economic group that integrates most of the countries in Europe. They are members of the military-political alliance NATO, so the geographical position of the region in terms of connectivity with neighboring countries, economic groups and military political alliances have a favorable geographical position.

Regarding the Capital City of Skopje, the South-East region has a peripheral position because it is located at a distance of more than 100 km and the main city centers in the region are more than 150 km away (Radovish 125 km, Strumica 157 km, Valandovo 140 km, Gevgelija 180 km).

The sub-Mediterranean influences in the valleys of the South-East Region provide special conditions in the early vegetable agricultural production, so that this functional predisposition of the region has a positive impact on its geographical position. Based on several comparative advantages it can be concluded that the South-East Region in R. N. Macedonia has a good geographical position that can be upgraded with more appropriate road and railway infrastructure.

3.1.2. BORDERS

The South-East region covers the territories of the Strumica-Radovis Valley, the Gevgelija-Valandovo Valley, the Dojran Trench and the upper part of the Kriva Lakavica river basin.

The borders of the region stretch so that starting from the northernmost point where the Jamiska Reka river and the Lomija Reka river meet (at the source of the Zrnovska Reka river) it climbs along the Lomija Reka river to the Bel Kamen peak 1707 m. From this point it continues along the water-dividing line to the Kara Tepe hill. Descending along the Leva Reka river to 850 m (asl) climbs the elevation in the direction of east, along the water section through Vrikoviti Andak along the valley climbs to tt1272 m, along the water divider line (from the west) bypassing the peak Golem Goten tt1365 m, through the locality Muralija to tt1111 m near Suva Cesma. Then it continues along the watercourse Tevna Reka river near the elevation 979 m climbs to it and after the elevation Garvan descends to the confluence of the Bariicka Reka river in Bezgashtevska Reka river. Consequently, through the heights of Debeli Rid and again along the Bezgashtevska Reka river to the confluence of river Lenishka. From this position, through the heights тт634 m тт826 m тт876 m and the heights along the water dividing line тт1232 m, тт1285 m тт1245 m тт1255 m тт1230 m, through the pass Laki 1135 m it climbs to the elevation 1216 m in the locality Palazlija in the watershed line at тт1245 m to тт1637 m. Then the border line of the region descends to Kadin Cesma (the source parts of the river Lebnicka Reka) and after river Vrla Reka, the rivers Kuzmanica, Tupavica and Lebnica reach the state border with the Republic of Bulgaria (AKN, 2007).

Following river Lebnicka Reka, border continues and overlaps with the state border between R. N. Macedonia and Bulgaria, and afterwards with the state border towards Greece to the point at tt2112 m on the mountain Kozuf.

From tt2112 m on the mountain Kozuf the border of the region along the water section continues to the north to elevation 1777 m from where after the water section it turns east to the locality Ursa tt 1637 m, turns north and northwest through the heights Kovachev Kamen, Krusha tt1146 m, tt Bor (occupying the source headwaters of the rivers Mrsha, Kriva Reka and Orejavica) up to tt1211 m. The border line continues to the north along the water dividing line on the left side of river Stara Reka in the direction of Musa Bel tt1096 m, tt932 m towards Porumreshka Chuka tt925 m, Studena Glava tt938 m, the locality Begovi Nivi along the water division (between Gevgelija and Tikvesh Valley) тт495 m. Here the border descends a little along the river Mala Javorica and then again climbs to tt329 m and then along the watershed through the hill Studor descends to the river Vardar (AKN, 2007).

Continuing onwards from river Vardar, the border turns and downstream goes to the inflow of river Lutkova. After continuation to the elevation 228 m, it climbs to tt468 m (border of the Municipalities of Demir Kapija, Konce and Valandovo). From this position the border goes along the water division through elevation 613 m, tt789 m, locality Waganer, elevation 982 m (southwest of the peak Volchjak tt 1155 m), elevation 1035 m to Kosharachki Livadi tt 1112 m, along the water division line

to tt1189 m, elevation 1031 m, elevation 1064 m tt1123 m, along the Bel Kamen hill tt1151 m, elevation 1074 m, elevation 1153 m, elevation 1143 m towards Kodza Chuka tt1015 m, Jubrlova Chuka tt963 m, pass 863 m, elevation 901 m, Kula tt935 m to elevation 905 m , Gorna Chuka tt924 m (border of the municipalities of Negotino, Stip and Konce), turns to the northeast elevation 844 m, descends to tt 511 m, through the stream Ikomos, elevation 447 m, along the valley reaches the river Kriva Lakavica (AREC, 2007).

From the river Kriva Lakavica, the border continues upstream along Penliv and Borov Dol rises to the elevation 648 m and to the elevation 665 m, through Krundorov Dol and elevation 666 m continues to the Krushkova Ritka tt599 m and descends to the river Madenska. From there to the heights it continues to tt596 m, it goes down and along the ravines it goes to tt583 m. It continues along the heights to the locality Gorun and tt658 m. While passing, it descends to the valley of Suv Potok from where it continues along it (west of tt617 m) to the locality Orljak, turns along the hill to the east and southeast and before tt809 m descends to the landfill Topolnicko Ezero. Through the elevation 721 m continues downhill along Topolnichka Reka to the elevation 1024 m (near tt1025 m) from where it descends along the river to Kuchishka Reka and downstream along it to tt1224 m, tt1306 m bypasses the elevation Tiken Chuka tt1405 m from the west side and through the pass 1510 m descends to the river Jamiska and downstream to the confluence with the river Lamia (AREC, 2007) as a starting point.

The borders of the South- East region depending on the extension of the rural areas at certain positions deviate from the natural boundaries of the valleys, but are basically identified with the heights and river flows. They mainly follow the administrative boundaries of the Municipalities that are part of the region. The openness and functional aspects of the borders in the South-East region are generally realized through the entry-exit points of the roads in the valleys and border crossings. That is through Demir Kapiska Gorge to enter the Gevgelija-Valandovo Valley and Maden Sateska to enter the Strumica-Radovis Valley, along Kriva Lakavica, through the regional road Strumica-Valandovo through the Kosturino pass and the border openings at Novo Selo, Dojran.

3.1.3. TERITORY SIZE AND ADMINISTRATIVE ORGANIZATION

The South-East Region is one of the eight planning regions in the Republic of N. Macedonia within the defined borders. It is established in accordance with the Law on Balanced Regional Development in 2007 and represent basic unit for development planning in the Regional Development Strategy.

The region covers an area of 2775 km^2 (RGU 1982) or 10.8% of the total area of the country. Within this area according to the census from 2002 there were 168,678 inhabitants (SSO of the Republic of N. Macedonia, 2002; SSO of the Republic of North Macedonia, 2004;) organized in 188 settlements with an average population density of 61 inhabitants/km^2. The table shows the number of populations, the size of the area and the number of settlements by municipalities.

Table 1. Population, area and number of settlements by municipalities in the South-East Region in the Republic of North Macedonia

Municipality	Population (Census 2002)	Area km^2	Population Density inh/km^2	Populated places
Bogdanci	8707	114	76	4
Bosilovo	12576	153	82	15
Valandovo	11890	331	36	29
Vasilevo	11409	231	49	18

Gevgelija	22988	485	47	17
Dojran	3421	156	22	13
Konce	3713	233	16	14
Novo Selo	12382	268	46	17
Radovish	26812	502	53	36
Strumica	54780	302	182	25
Total	**168678**	**2775**	61	**188**

Source:
State Statistical Office for North Macedonia, (2002) Population Census in North Macedonia, 1948, 1953, 1961, 1971, 1981, 1991, 1994, Book IX, Skopje
State Statistical Office for North Macedonia, (2004) Census of population, households and residences in North Macedonia, 2002, Book X, Skopje.
RGA 1982, SR Macedonia through cadastral records, Skopje.

Figure 2. South-East region with composed municipalities (Source: State Statistical Office of the Republic of North Macedonia, 2015)

The territory of the South-East Region is administratively organized so that there are 10 municipalities, such as Bogdanci, Bosilovo, Valandovo, Vasilevo, Gevgelija, Dojran, Konce, Novo Selo, Radovish and Strumica with a total of 188 settlements. Five Municipalities have their headquarter in the city (Bogdanci, Valandovo, Gevgelija, Dojran, Radovish and Strumica) and the remaining (so-called rural municipalities) in villages. The average size of the settlements is 15 km^2. The average population density is 61 h/km^2 but excluding urban settlements (which significantly increase the population density), the real population density is significantly lower (especially considering that since 2002 a large part of the rural area is in the phase of population reduction and deagrarization).

3.1.4. RELIEF

3.1.4.1. TECTONICS

The territory of the South-East region belongs to three different tectonic units such as: the Vardar Zone, the Serbian-Macedonian Massif and the Kraishtid Zone (Arsovski M. 1997). It is a relatively diverse tectonic structure where first two zones prevail while the border zone only slightly touches the territory of the region.

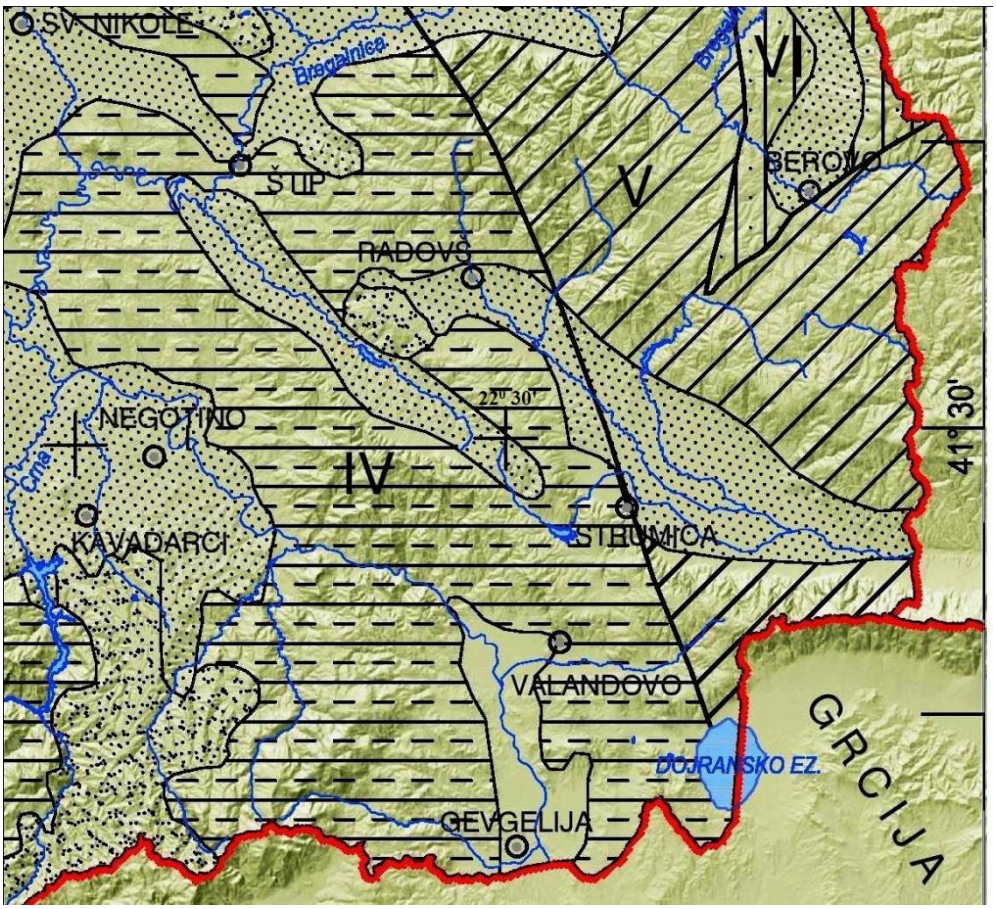


Figure 3. Tectonic zones that characterize the South-East Region,
IV-Vardar Zone, V-Serbian-Macedonian massif, VI-Kraishtid Zone
(Markoski B. 2016, adapted from Arsovski M. 1997)

The tectonics of the South-East Region are characterized by Neogene-Quarter volcanic areas and imposed neotectonic depressions. The Neogene-Quaternary volcanic areas are characteristic for the areas of the Kozuf volcanic area and the Damjan-Radovis volcanic area. Today they are characterized by different types of ore alike tools from mineral metal raw materials. The imposed neotectonic depressions are characteristic for the bottoms (plain parts) of the Strumica-Radovis Valley, Krivo Lakavica Valley and the Gevgelija-Valandovo Valley. Several tectonic zones are characterized by

numerous fault lines of different types, so that in the whole territory, and especially in the area of Valandovo (due to the activity of tectonic faults on the mountain Belasica) are frequent seismic activities with relatively high magnitudes.

3.1.4.2. GEOLOGICAL COMPOSITION

Geological composition of the Strumica-Radovis Valley. The territory of the Strumica-Radovis valley is characterized by a complex geological-tectonic structure with a number of different lithological characteristics, geological age and tectonic structure. There are different types of rocks from different geological periods. Precambrian metamorphic rocks, rifey-Cambrian shales, old Paleozoic metamorphites, granitoid rocks, Jurassic sediments, igneous rocks, Paleogene sediments and volcanites to the youngest Neogene and Quaternary sedimentary complexes are present (Mijalov P., 2004)

The Precambrian metamorphites are represented by various varieties of gneisses, shales and magmatites. Gneisses prevail in the area where largest masses are in the eastern, southern and western parts of the mountain Plachkovica, the eastern, central and northern parts of the mountain Belasica and on the southwestern slopes of the mountain Ograzden. The shales are represented by amphibolites, mikashists and leptinolites on the mountains Plachkovica, Ograzden and Belasica. The magmatites have a local distribution around the Old Paleozoic granite pits in gneisses in the eastern and southern slopes of Ograzden, along the river Sirava, around the village Durutli on Plachkovica and northeast of the village Podarez to Mount Goten.

The Rifey-Cambrian rocks are a feature of the Serbian-Macedonian mass in the valley. They are characterized by a greenish color and are also known as a green complex of gneisses and mikashists that are found east of Radovish and in Izveden as a narrow belt between the coarse-grained gneisses and mikashists.

The Old Paleozoic rocks are represented by magmatites and metamorphites which within the Strumica-Radovis Valley occupy large areas. From the metamorphites there are varieties of various shales, marbles, metadiabases, metariolites and metagabros. These rocks are present on Plachkovica, Smrdesh, Plaush and Belasica. The carbonate shales have the largest distribution in Plaush and Smrdesh, or more precisely between the villages Varvarica, Rich and Kosturino. The most widespread from the Paleozoic magmatites are the granitoid rocks with various varieties on the mountains Belasica, Ograzden and Plachkovica. They are most characteristic on the mountain Ograzden where they are part of the Ograzden granitoid batholith occupying the central, northern and southwestern slopes of the mountain.

Tertiary sediments are represented by Upper Eocene sandstones, clays, marls, tuffs and conglomerates.

Dacites are found on the hill called Vrv, and andesites occur in the form of piercings in Pilav Tepe and the stream Shtuka.

Pliocene sediments were found in large areas in the lower parts of the Strumica-Radovis Valley. They are mainly represented by coarse gravel, sand and clay.

Quarter formations are characteristic of the whole valley and along the river flows. They are represented by proluvial and alluvial deposits of gravel, sand and clay. Near the spa Bansko and near the village Veljusa limestone deposits are also recorded.

Proluvial-deluvial deposits of sediments in the form of floodplains are especially pronounced at the foot of the mountains Belasica, Ograzden and Plachkovica. They are composed of larger and smaller sediments from which are formed large deposits of gravel and sand sediments that are of different types of rocks from the geological substrate of the mentioned mountains.

In the lower parts, around the river Strumica as an important recipient of the waters from the valley there are typical alluvial sediments of finer gravel and sand.

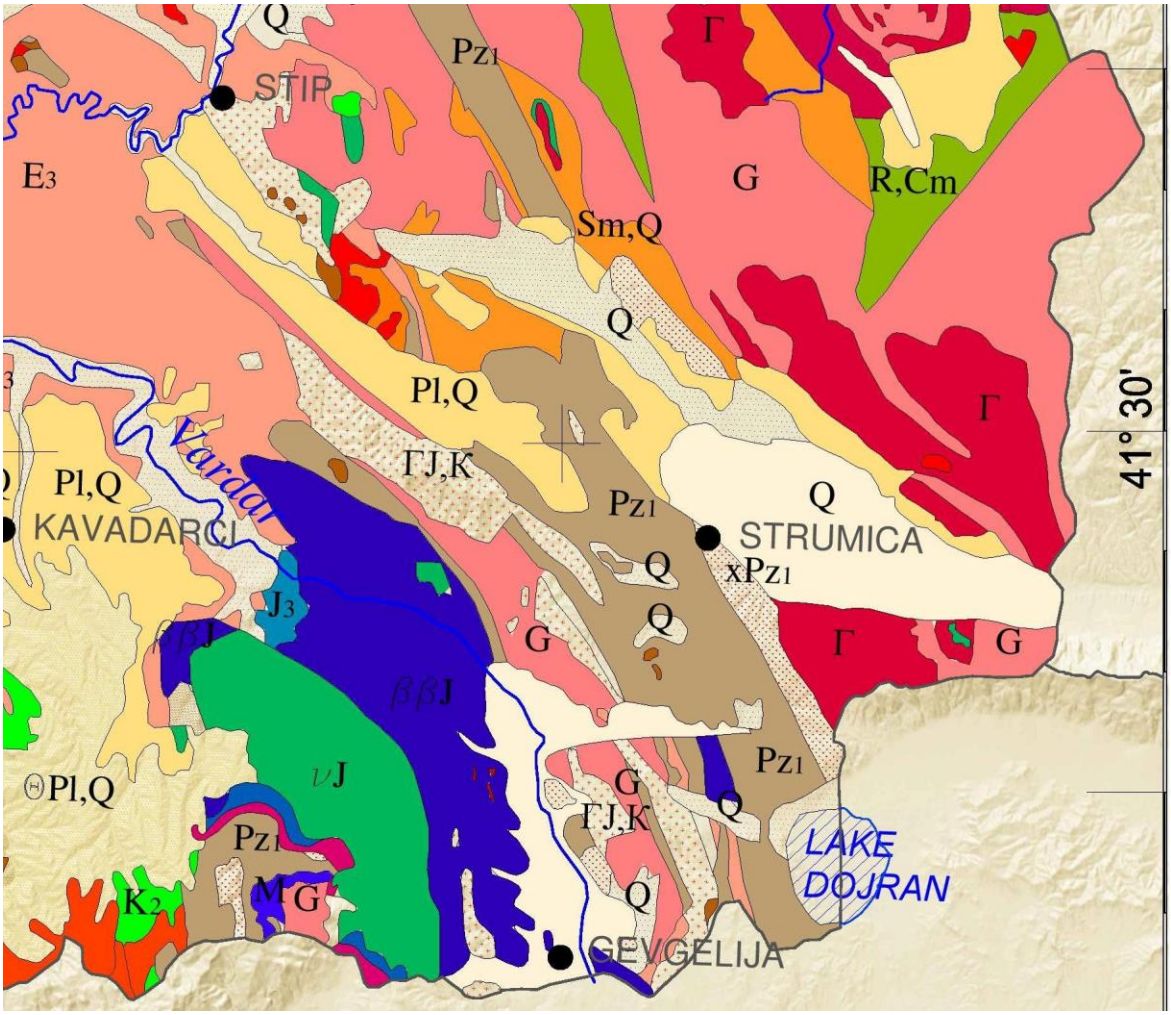


Figure 4. Simplified geological map of the territory of the South East Region in R.N. Macedonia (VGI, 1977, Geoloska karta 1:500 000)

The geological structure of the Gevgelija-Valandovo Valley. The geological structure of the Gevgelija-Valandovo Valley is also diverse with the presence of rocks from all geological periods such as Precambrian, Paleozoic, Mesozoic and Cenozoic.

The oldest rocks are considered to be gneisses and marbles (Pendzerkovski, Hadzimitrova, 1975). They are found more in the western slopes of mountains Gradeshka Planina and Plaush, in the central parts of the valley, the eastern slopes of Kozuf and in smaller areas of the mountain Belasica.

Paleozoic age distinguishes many rock formations such as metamorphosed gabbro and diabase, amphibole shales with marbles, metacquarce porphyrites-rhyolites, quartz-sericite shales, fillets, sandstones, limestones, limestones, limestones and limestones.

There are rocks of Mesozoic age in the valley found as various colored clay shales, ashes, sandstones, serpentinites, quartzmonzonites, various varieties of gabbro, granites, diabases, splits and others.

The Cenozoic is represented by a basal series of limestones and sparse limestones, quartzlates, andesites, dacites, sands and gravels, marl clays, deluvial-proluvial and alluvial sediments.

Geological composition of the area of Kriva Lakavica. The following geological formations are found in the upper basin of the river Kriva Lakavica: Precambrian metamorphic rocks, Paleozoic metamorphic and igneous rocks, Mesozoic sediments and igneous rocks and Cenozoic tertiary sediments and volcanic rocks (Mijalov R., 2004).

The Precambrian is represented by mica and amphibole shales predominantly along the ridges of the Serta and Smrdesh mountains.

The Old Paleozoic rocks are represented by amphibole shales and marbles and a shale-carbonate series mainly spread on the mountain Serta to the move to the village Konce and the mountain Smrdesh. from the igneous rocks, serpentinites and gabbro are present here.

Mesozoic sediments and igneous rocks are represented by granitoid rocks and Upper Cretaceous conglomerate sediments.

Tertiary sediments in the area are represented by Upper Eocene sandstones, conglomerates and volcanic rocks. The volcanic rocks are mainly present on the right side of the river Kriva Lakavica in the areas around Damjan, Ruevo Brdo, Pilav Tepe, Ploca, Orlova Glava and other places.

Pliocene sediments are present mainly along the left valley side of the river Kriva Lakavica, represented mainly by sand.

Deluvial clayey-sandy and gravelly sediments are distributed on the eastern slopes of Mount Serta where they are largely covered with Neogene sediments.

The alluvium is spread on both sides of the river Kriva Lakavica and along the valleys of its tributaries along which the accumulation of eroded material takes place.

Geological composition of the area of Dojran Valley. The geological composition of the area of Dojran Valley is mainly represented by a series of amphibole shales with marbles, metacvarporphyryite-rhyolites and fluvio abrasion sediments. Observing the integrity of the geological basis of the territory of the South-East Region (according to the representation of the rocks) it can be freely concluded that it is basically silicate.

3.1.4.3. RELIEF STRUCTURE

The relief structure in the South-East Region is formed by several mountains, valleys, ditches, valleys and gorges.

3.1.4.3.1. MOUNTAINS

As morpho structures of elevation, the mountains are a dominant element in the relief of R. N. Macedonia and in that context in the South-East Region. The hilly-mountainous terrains cover 78.8% of the territory of the country and only the mountains cover 47.7% of the total area (Markoski 1995, 2004). In the area of R. N. Macedonia (including the Balkan Peninsula) a mountain is considered to be a prominent and characteristic elevation with at least 700 m absolute altitude, at least 500 m relative altitude above the surrounding terrain and an average slope greater than 10. In addition, a mountain should be considered as stand-alone whole, should be clearly separated by a deep valley, pass, valley or depression from another mountain. If not, then it is a mountain system or mountain range. Often, what the locals call a mountain is actually a relief part of a larger mountain massif (Markoski, 2004).

According to that "local" criterion or according to the local names and terms for mountains, in R. N. Macedonia has over 50 mountains. According to the height the mountains in R. N. Macedonia are divided in to high (2000-2753 m) with a subgroup of 5 very high mountains (2500-2753 m), medium high mountains (1000-2000 m) and low mountains (below 1000 m). There are 13 higher than 2000 m, 22

medium-high, and 3 low mountains (below 1000 m above sea level) (Markoski, 2004). There are mountains from the three categories in the South-East Region. In addition, data on the mountains that stand out in this region are presented.

Table 2. Mountains and massifs in the South-East Region. (Markoski B., (2004) Cartographic definition and differentiation of mountain spatial units in the Republic of North Macedonia, Bulletin of Physical Geography (01) 25-34, Skopje; Mileski I., own studies)

	Name of mountain	Branches with dominant peaks	Altitude meters	Area km^2
1	**Kozuv**	Mountain massif: Zelen Breg 2165 m, Dudica 2132 m, Smreka 2112 m, Gladnica with Chardak 1936 m, Adzibarica with Chici Kaja 1767 m, mountain Marjanska with Dve ushi 1766 m	2165	493,7
2	**Belasica**	Radomir 2029 m (in Bulgaria), Tumba 1881 m (in N. Macedonia), Visoka Chuka 1845 m, Samer 1877 m	2029	140,8
3	**Malesevski**	Dzami Tepe 1803 m, Pecov Chukar 1490 m, Babin Chukar 1403 m, Dzami Tepe 1394 m, Chengino Kale 1745 m	1803	452,0
4	**Plackovica**	Lisec 1754 m, Chupino 1725 m, Goten 1420 m, Turtel 1689, Kartal 1462 m, Izveden 1331 m	1754	816,7
5	**Ograzhden**	Ograzhden with Ograzhden 1744 m, Obesnik with Dva Kamena на 1285 m, Gramadna with Dabovski Chukar	1744	269,6
6	**Konecka (Serta) with Gradeshka and Plaush**	Konechka with Volchjak 1159 m, Gradeshka with Vrshnik 1031 m and Plaus with Kapa Tepe 996 m	1159	361,4
7	**Smrdesh**	Elenica 971, Krasta 951 m, Zmieva Dupka 909 m	971	201,5

Note: The mountain surfaces refer to the whole mountain according to the criteria for its determination, so that some extend beyond the territory of the southeastern region (Markoski, 2004).

The mountains in the southeastern part of the country are basically elongated in a northwest-southeast and east-west direction. Mountains in the eastern part of the country are usually built of less

resistant crystalline rocks and are therefore characterized by more rounded ridges and peaks and not so deep cut valleys.

Kozuf

Kozuf is a high mountain massif which extends in the southern parts of R. N. Macedonia along the Macedonian-Greek border. Kozuf covers an area of 493.7 km^2 (Markoski, 2004). It stretches in a southwest-northeast direction. It is tectonically located between the Vardar zone on the east and the Pelagonian Horst anticlinorium on the west side. This massif has undergone several phases of orogenic movements with varying intensity. It is basically composed of Paleozoic shales and above them the higher parts are represented by Triassic limestones and volcanic rocks. During the Oligomyocene, intense orogenesis occurred which shifted the old crystalline masses in a radial direction.

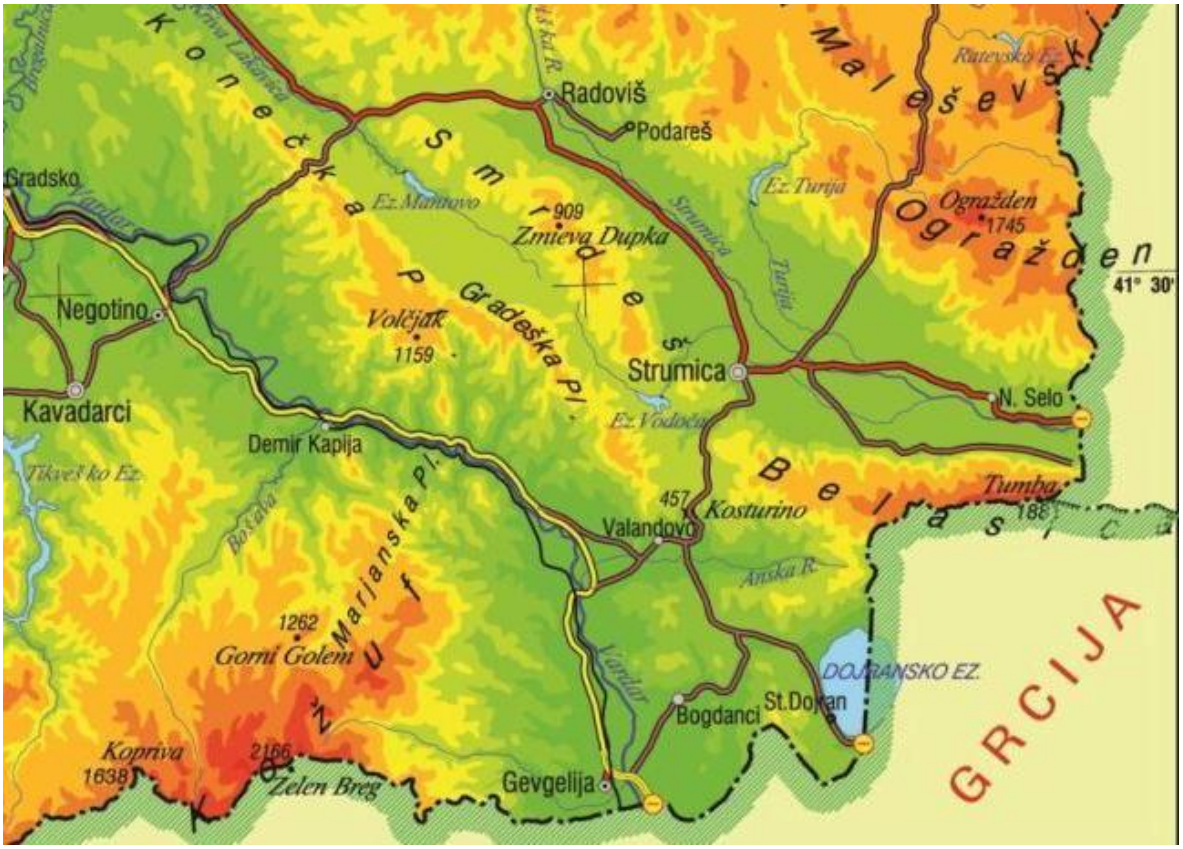


Figure 5. Excerpt from a map with the locations of the mountain massifs Kozuf, Belasica, Konechka, Planina, Gradeшкaka Planina, Smrdesh and Ograzden in the South-East Region of the Republic of N. Macedonia (Map: Markoski B. 1999)

Intense volcanic activity occurred along the fault cracks represented by strong eruptions and eruptions of andesitic lava and pyroclastic material. From the andesites, several heights and volcanic piles have been built, such as: Vasov Grad, Ostrec, Momina Chuka, Kopriva and others. Volcanic activity resumed in the late Pliocene and ended in the early Pleistocene, making it one of the youngest in the Republic of N. Macedonia (Dumurdzanov et al, 2004). The mountain ridge of Kozuf is relatively rounded except between the highest peaks Zelen Breg (2165 m) and Dudica (2138 m), but also to the south of Greece where the south side has numerous sections. At the highest parts of Kozuf are the spring

headwaters of rivers: Dosnica, Boshava, Blastica, Petrushka, Sermeninska and Konjska Reka. Together with the tributaries have large longitudinal falls with several smaller and several larger waterfalls, as well as floodplains at the foot. During the Pleistocene, although considerably to the south and not very high Kozuf was occupied by strong glaciation, of which in today's relief more cirques, valves, moraines remained. There are huge fluvioglacial deposits along the river valleys, especially along the river Konjska Reka (Manakovi, 1979).

Forms of karst relief have been developed especially around the village Huma, where the karst field Brce is located (Radovanoviћ, 1931). Cretaceous limestones in the source part of the river are intensively karstified. Bosava (Kekić, 1976) and several caves (Dark Cave - Mrezicko, Peshterski Kamen) are registered in the northwestern part in Triassic limestones (Temovski, 2016). There are also numerous forms of denudation relief, the most characteristic of which are the earth pyramids in the village. Konopishte.

Belasica

Belasica is a mountain in the southeastern part of R. N. Macedonia and belongs to the Osogovo-Belasica mountain group. Its highest altitude is 2029 m (Radomir peak in Bulgaria) so it belongs to the group of high mountains. The mountain stretches in 3 countries: the southern part belongs to Greece, the eastern-highest to Bulgaria and the northern and extreme western part of R. N. Macedonia. It rises between the Strumica and Petrich valleys in the north, the Dojran, Butkovska and Valandovo valleys - in the south, the small valley of Kosturino - in the west and the valley of the river Struma - in the east. It is bounded by faults from the above relief units, among which it rises remarkably like a typical horst with a parallel direction. The part in R. N. Macedonia covers an area of 140.8 km^2 (Markoski, 2004).

The mountain geotectonically belongs to the Serbian-Macedonian massif and is built mostly of Paleozoic shales and granites. At the foot of the northern slope along the northern parallel fault, there are thermal springs especially in the village. Bansko. The mountain ridge of Belasica is rounded and unbroken. The curvature of the ridge indicates the long-term action of the fluvial denudation processes, while the non-disintegration of the ridge and the weak cutting in the mountainous sides of the watercourses indicate the young rise of this horst. The length of the mountain ridge from Kosturino in the west to the river Struma in the east is 58 km. The border line with Greece in this part goes exactly along the ridge of Belasica to the border between Bulgaria, Greece and N. Macedonia at the top of Tumba (1883 m). Belasica is intersected by almost parallel river flows due to which the mountain sides have a ribbed appearance. Due to the large fall of the watercourses, several tectonic and erosive waterfalls have been built of which the most famous are: Smolare, Kolesh, Gabrovo and others. At the foot, river streams, which have great mechanical strength, accumulated large amounts of fluvial material and formed a floodplain on which rural settlements developed.

Maleshevski planini

The Maleshevski planini mountain are in the extreme eastern part of R. N. Macedonia and part continues on the territory of the Republic of Bulgaria. The mountain has an equilateral extension with an arched curvature to the south, so that the southernmost parts touch the South-East Region. The ridge has a length of about 30 km. Its area (up to the border with Bulgaria) is 452.0 km^2 (Markoski, 2004). On the northeast side, the mountain gradually merges with Vlaina and there is no clearly defined passage between them except for the saddle Ajduchki Premin (1612 m). Geologically, it is mainly composed of Precambrian gneisses and Mikashists and in the lower parts of Paleozoic shales and Pliocene sediments. Maleshevo Mountains are medium high with a height of about 1300-1600 m, except the border part, which rises to 1803 m at the highest peak Jami Tepe. Besides it a prominent peak is Chengino Kale (1748

m), which is important because it is the easternmost point in R. N. Macedonia. The ridges and peaks of the mountain are rounded, slightly prominent and covered with grass vegetation or sparse forests. There are several small puddles and peat bogs around the top of Chengino Kale. The Maleshevo Mountains are very divided with the tributaries of Bregalnica on the north side and the tributaries of Turija and Dvorishka Reka on the south side. Their valleys are deeply incised in the crystalline rocks while they have a large longitudinal fall and therefore there are several small waterfalls especially on Bregalnica and its tributaries. In the higher part of the mountain the source of the largest river Bregalnica in the area is located which is also among the longest rivers in R. N. Macedonia. There are deep ravines in the Neogene rocks, sands and sandy clays and intense soil erosion has developed.

Plackovica

Plachkovica is a medium-high mountain massif in the eastern part of R. N. Macedonia which covers an area of 816.7 km^2 (Markoski, 2004). Plachkovica mountain rises between the Strumica-Radovis Valley and the valley of the river Turija (a tributary of Strumica) in the south, the Kocani Valley in the north and the valley of Osojnica in the east. To the west it is quite fragmented and eroded, gradually descending to the valley of Bregalnica and its left tributaries Kriva Lakavica with river Madenska. The northern side towards Kochansko Pole is especially steep and clearly expressed, while the other sides fall gradually. Plachkovica is a typical horst which geotectonically belongs to the Serbian-Macedonian massif. It is built mostly of slate and gneiss. The main one stretches from northwest to southeast in a length of about 30 km. The valley of Zrnovska Reka has almost symmetrically divided Plachkovica into eastern and western part. The western part is slightly lower with the highest peak Turtel 1689 m. Due to the presence of marble in the geological structure of this part several caves were created around Turtel. Five caves have been explored so far with Great Cave as the longest with a length of about 260 m. The smaller caves are: Zup, Ajduchka, Turtel and Ponor. The eastern part of Plachkovica is higher and has the peaks Lisec (1754 m), Cupino Brdo (1725 m), Bel Kamen (1707 m), Kara Tepe (1625 m) and others. Although not very high, the highest peak Lisec is among the peaks in R. N. Macedonia with the greatest view or the farthest horizontal line of sight. The valley of the Zrnovska River is quite narrow and deep and along the riverbed there are numerous rapids and small waterfalls with huge giant pots or "whirlpools" (Devicin Vir, Suljov Vir). There are small waterfalls up to 8 m high on other mountain watercourses (Dzudzevski waterfalls) (Milevski, 2012c). Most of the mountain has a southern exposure and belongs to the Strumica-Radovis Valley.

On the south side, as part of Plachkovica is Goten mountain which the locals consider a separate mountain. It stretches between the rivers Plavaja and Turia. The following peaks stand out on Goten: Gramadic (1429 m) as the highest peak, Adzi Chuka (1299 m) and Kalbak Dashi (1178 m). The geological composition is dominated by crystalline shales and gneisses and the fluid-denudation relief with pronounced recent erosion is dominant (Manakovi and Andonovski, 1979).

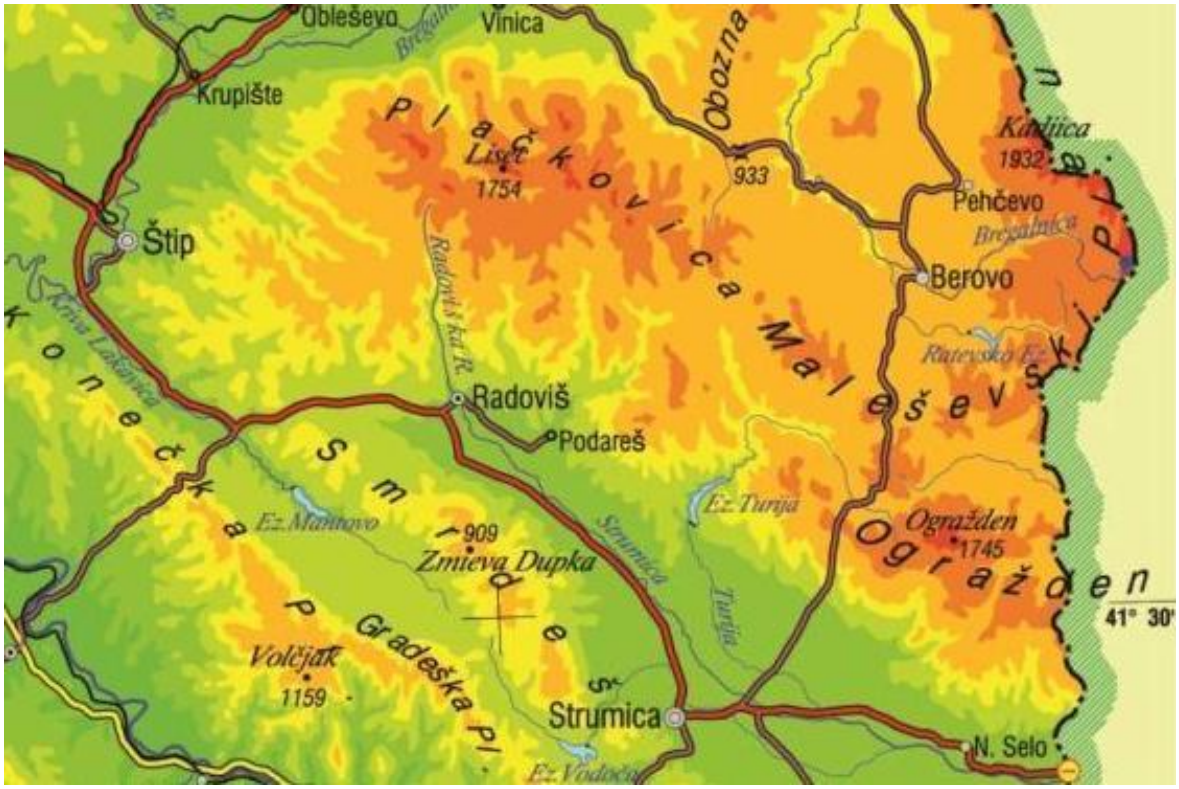


Figure 6. Excerpt from a map with the locations of the mountain massifs Plachkovica, Maleshevski Planini, Ograzden, Konechka Planina, Gradeshka Planina and Smrdesh in the South-East Region of the Republic of Northern Macedonia (Map: Markoski B. 1999)

Ograzhden

Ograzden is a typical Horst mountain part of the Osogovo-Belasica mountain group. It stretches between the Turija River in the northwest, Bezgashtevska, Prevedenska and Dvorishka River in the north and the Strumica-Radovis Depression in the south and continues in the east on the territory of Bulgaria to the Struma Valley. To the border with Bulgaria, the mountain is 25 km long and covers an area of 269.6 km^2 (Markoski, 2004). The main one is quite fragmented but generally has the same dinarides alike direction of stretching as the mountain itself. From the central highest part of Ograzden from the peak of the same name with a height of 1744 m, the mountain branches on two branches: one to the southeast and the other to the northwest. The mountain sides are sloping to the south-southwest and the watercourses are predisposed with fault lines. Through such a fault, the Stuchka River brakes into the northeast and penetrated deep into the central part of Ograzden. Geologically, the mountain is composed of gneisses, mikashists, crystalline shales and granites. The Ograzden granite massif covers an area of about 150 km^2 and is surrounded by two-slip gneisses. Dominant geomorphological processes are fluvial denudation, with numerous often deeply incised and tectonically predisposed valleys. The rivers that flow from Ograzden have a large longitudinal fall, with frequent small waterfalls and floodplains at the foot. Strong denudation processes have developed on the southern slopes, with various forms in the granitoid rocks.

Konecka, Gradeshka and Plaush mountains

Konechka with Gradeshka Planina and Plaush is a low mountain massif which stretches between the Tikvesh Valley in the west, Demir Kapija Gorge and Valandovska Valley in the south, the valley of Kriva Lakavica and Bela Reka in the east and the valley of Bregalnica in the north. This quite fragmented mountain massif has a direction of NW-SE extension of up to 60 km in length and 5-13 km in width. It covers a significant area of 361.5 km^2 (Markoski, 2004).

Figure 7. The western slopes of Konechka Mountain (Serta) with the mountain Kozuf во заднината (Capture: Markoski B. 2007)

The mountains are located in the direction of NW-SE which makes up the massif, although they are not clearly differentiated as independent units. To the north the massive borders with Konechka mountain (between Tikvesh Valley and the valley of Kriva Lakavica). In the middle is Gradeska Mountain (between Demir Kapija gorge and the valley of Bela Reka) and to the south is Plaush (between Valandovo Field and the valley on the Bela Reka). The main one is almost straight, and its height gradually increases from north to south from 800 to 1100 m. The ridge is rounded and represents an old erosive plain. Only elevations rise which represent the highest mountain peaks such as Volchjak (1159 m) and Bel Kamen (1151 m) on Konechka, then Vrsnik (1031 m) and Jamicki Vrv (1030 m) on Gradeska and Kara Tepe (996 m) on Plaush. The ridge of Konechka and Gradeska mountains is a watershed between Vardar and its tributary Bregalnica, while the ridge of Plaush is a watershed between the watershed of Vardar and Strumica (Struma). The massif of Konechka with Gradeska and Plaush mountains lie geotectonically in the Vardar Zone.

From geological perspective, the upper part of the massif is built of Paleozoic shales and marbles and at the foot are Neogene sediments. The mountain massif is quite fragmented with numerous, mostly torrential watercourses which give it a ribbed appearance. Some valleys are deeply cut in the form of small canyons such as the river Celevechka, Ak Bunar and others. Due to the bareness of the terrain and the geological composition, the recent erosion is very pronounced. In a few small localities there are short caves in the carbonate rocks such as at Bel Rid (1107 m).

Smrdesh

Smrdesh is a low mountain which stretches between the Strumica-Radovis Valley in the east, the Lakavica Basin (valley of Kriva Lakavica) in the west, gorge Dervenska Klisura in the north and the valley of Turija in the south. The mountain is 27 km long in the direction of NW-SE and covers an area of 201.5 km^2.

From geological perspective, it is usually made of crystalline shale, gneiss, mica, phyllite and marble. In the extreme northwestern part, there are tertiary effusive rocks: andesites, tuffs and breccias, and laterally along the mountain there are Pliocene sediments (Arsovski, 1997). Due to the diverse usually irresistible geological composition, fluvio-denudation forms predominate in the relief. The Paleo-volcanic relief is present in the extreme northwest with several piles, plates (Ploca, Ostra Cuka) and weakly expressed calderas. In the central part around Krasta (951 m), the marbles have surface and some smaller underground karst forms.

3.1.4.3.2. Valleys

Apart from the mountains, a characteristic morpho structural element of the relief in R. N. Macedonia are the valleys (there are about twenty of them). They are surrounded by mountains and their bottom is usually filled with lake sediments (as a remnant of the Neogene lake phase). Due to the large slopes and the impact of man, the valley sides especially the southern ones, are exposed to strong erosion. The eroded material is transported to the foothills, introduced into rivers or accumulated at the bottom of valleys.

The valleys themselves are interconnected by composite valleys, usually deeply incised in the form of gorges. Valleys such as tectonic faults and depressions are generally formed during the Aegean extension phase (mid-Miocene to Quaternary) with the sinking processes of individual blocks. Until the beginning of the Middle Miocene, the present territory of R. N. Macedonia was characterized by a significantly reduced, wavy flattened relief. This plane, with dynamic tectonics, starting from the Middle Miocene to the present day is differentiated (broken) into a number of structural blocks of rising (horsets) and sinking (grabbing). This process is followed by strong volcanism in many areas (Petkovski, 1998).

The sinking of the grab blocks in the form of closed depressions together with the favorable climatic conditions, conditions the formation of the so-called "Neogene lakes" (Manakovi, 1968). At the beginning of the Quaternary with the disintegration of the Aegean mainland and the formation of the river system of the Vardar, most of the existing lakes leaked or dried up (with the exception of: Lake Ohrid, Lake Prespa and Lake Dojran). This means that the lake phase is replaced by fluvial, i.e. gradual formation of today's valleys, with most of the accumulated sediments being eroded and evacuated. This process is still ongoing, because at the bottom (and on the sides) of most valleys, there are still significant deposits of lake sediments (sands, sandstones, clays) up to 2000 m thick (Izmajlov, 1963). These sediments are layered and indicate certain changes in the development and evolution of the valleys and lakes in them, in accordance with climate change at that time (Dumurdzanov et al 2004).

Based on the stated characteristics in the South-East Region, the Strumica-Radovis and Gevgelija-Valandovo Valleys, the Dojran Trench and the upper part of the Krivo Lakavica Valley are formed.

Strumica-Radovish Valley

Strumica-Radovish valley lies in the southeastern part of R. N. Macedonia. It is surrounded by the mountains Plachkovica (1754 m), Goten (1429 m) and Ograzden (1744 m) from the north and

northeast, Belasica from the south, then the branches of Plaush (997 m), Elenica (970 m) and Smrdesh (970 m).) from the southwest and west, as well as the hilly terrain Yurukluk from the northwest. The enclosure with mountain massifs indicates that it is morpho genetically lowered along fault lines. The descent is performed in the middle of the tertiary. The final shaping of the main morphological features is during the Pliocene-lake phase when the old prehistoric relief is covered with strong lake sediments. The valley is characterized by a complex and diverse geological structure ranging from the oldest Precambrian metamorphic rocks, various Paleozoic shales and Mesozoic rocks, to the youngest Neogene and Quaternary sediments.

From geographic point of view the valley consists of three parts: Strumica, Radovis and Damjansko Pole. The last field, although it is in relief in this valley by piracy through Madenska Reka hydrographically today belongs to the Bregalnica watershed. The altitude of these fields varies with the highest being Damjansko Pole from 440 to 475 meters and the lowest is Strumica with an altitude of 190 to 250 meters. Along the valley of Bela Reka and Trkajna, the smaller ones stand out: Popchevsko and Kosturinsko Pole. The area of the valley is 1482.8 km^2. The flat part covers about 740.0 km^2 which extends in the hypsometric belt from 150 to 500 m (Markoski, 2006). It is in the direction of extension NW-SE. The river Strumica as main water recipient flows in the same direction.

The valley has a temperate-continental and altered Mediterranean climate. In Radovish and Damjansko Pole which are slightly higher, there is a lower average annual temperature (12.3°C), than Strumicko Pole (13°C). Precipitation in Strumicko Pole is about 600 mm and in Radovishko Pole is 520 mm.

Hydrographic phenomena are diverse, among which the most important are groundwater, springs, natural watercourses and artificial reservoirs. There are arterial waters in Strumicko Pole. The most important watercourse is the river Strumica, and the more important tributaries are Oraovechka River, Plavaja, Turija, Vodocnica and Trkanja. Two artificial reservoirs Vodoca and Turija and several smaller reservoirs have been built.

The most common soils are alluvial and deluvial, which are of the greatest cultural value, and redness, saline soils, forest brown soils, etc. are also present. In the Strumica-Radovis Valley are located two urban settlements (Radovish and Strumica) and 105 rural settlements, where a total of about 130,000 inhabitants live.

Since the distant past, significant communications have passed through this area, connecting the southern with the central areas of the Balkan Peninsula. Such were the famous Serski Pat. Today through this area passes a highway that leads from Stip and through the Valley connects with the border with Bulgaria. At Strumica there is a branch that leads to the Republic of Greece, and at the village Dabilje there is a road that goes through Ograzden to Berovo. The good traffic connection enables development and economic cooperation with other areas. Several industries have been developed. The industry has developed mining, textile and food industry and other economic functions. Most of the population is engaged in agriculture. This valley is one of the most fertile in R. N. Macedonia stands out as a separate agrarian region. As a result of the favorable natural conditions, diverse agriculture has been developed, with special specialization of the Strumica Field for horticultural crops. In this area, and especially in the Strumica Field the breeding of silkworms used to be developed.

Gevgelija-Valandovo valley

Gevgelija-Valandovo Valley is located in the southern part of the territory of R. N. Macedonia. It is bordered by water dividing lines that lead to the mountains: Kozuf, Marjanska, Plaush, Belasica, Boska and Kara Balija. It stretches along the river Vardar from the village of Udovo in the north to the Ciganska Gorge in the south (in the processing it is taken to the state border with Greece). It covers an area of

1000.1 km^2 and extends from 46 to 2100 m above sea level. With Fakirov Rid it is divided into Valandovo and Gevgelija depression, where the same name valleys exist.

Figure 8. Valandovo valley in the northeastern part of the Gevgelija-Valandovo Valley (Photo: I. Milevski, 2008)

Valandovo valley is at an altitude of 50 to 200 m and covers 115 km^2, and Gevgelija Field is at an altitude of 46-200 m and covers 249.4 km^2 (Markoski, 2006). The large height difference between the bottom of the valley and the highest parts of Kozuf caused the rivers to transport large amounts of fluvial material, which they accumulate in the form of floods. The recent floodplains of: Konska, Kovanska and Sermeninska Reka on which rural settlements have been developed, are especially emphasized. The valley is characterized by several hills with a height of 30 to 50 m. Such are: the hill near the railway station in Gevgelija, near the village Mrzenci, Stojakovo, near the village Bogorodica and village Pobregovo (Manakovi и and Andonovski, 1979).

Dojran valley

The Dojran Valley is located in the extreme southeastern part of the Republic of N. Macedonia. It stretches between Mount Belasica and its tributaries in the north, the low mountain Kara Balija (697 m) in the west and the low mountain Krusha (860 m) in the east (in Greece). Most of the valley especially the plain part lies in the northern part of Greece and on the territory of R. N. Macedonia covers an area of 105 km^2, with an altitude of 148 m to 1310 m, the peak Chatal Cesmi on Belasica (Markoski B. 1992).

The valley has a triangular shape and in its lowest part is located Dojran Lake, which is a relic of the much larger lake that existed during the Pliocene and the beginning of the Pleistocene (Manakovi и and Andonovski, 1979b).

3.1.4.3.3. PALEORELIEF

In addition to the presence of various recent relief phenomena, there are also paleo-relief elements present on the territory of R. N. Macedonia. They are so called relief forms whose construction process lasts longer. The paleo-relief forms and areas incudes: the paleo volcanic relief, the fossil coastal lake relief and the grab valleys.

The following areas stand out as paleo-relief areas on the territory of the South-East Region:

- Kozuf-Mariovo volcanic area,
- Damjan-Buchim Paleovolcanic area (Vulcan bought Pilav Tepe and Ploca) and
- The Demir Kapija Gorge.

Kozuf-Mariovo Paleovolcanic relief area

The Kozuf-Mariovo Paleovolcanic relief area is the second largest in R. N. Macedonia. It stretches along the border with Greece from the village of Konjsko on Kozuf to Nidze and to the north it covers the Vitachevo plateau. The total area covered with pyroclastic and erupting volcanic material is about 600 km^2 with an average thickness of over 400 m, so that the total mass of effusive material is about 300 km^3 (Arsovski 1997). Unlike some other Paleovolcanic areas, the volcanic activity in the Kozuf-Mariovo Paleovolcanic area took place rapidly in a very relatively short period, i.e. only in the Upper Pliocene and Lower Quaternary. It is the youngest andesitic volcanism in this part of the Balkan Peninsula. It had a very explosive character due to which the volcanic ash was blown away by the winds over a long distance in the Tikvesh Basin and in Pelagonija. The volcanic relief along the Macedonian-Greek border is represented by rows of piles and volcanic ridges which rise in the relief. As isolated volcanic forms they are separated from each other by deep-cut watercourses, i.e. valleys and ravines. They have special names, such as: Momina Chuka, Dudica, Sharena, Vlasov Grad, Ostrec, Sokolovec and others. They are made of acidic andesitic lions that are carriers of: copper, arsenic, lead, nickel and other very rare minerals characteristic only for this region.

The northern part of this Paleovolcanic area especially the Vitachevo plateau is built of volcanic tuffs, which lie almost horizontally with a slight slope to the north. Their depth ranges from 2 to 20 m and they are stratified, which indicates that they formed in an aquatic environment as a lake volcanogenic facies. This tuffogenic mass includes large blocks and volcanic bombs of various sizes.

Dajman-Buchim Paleovolcanic relief area

The Damjan-Buchim Paleovolcanic area occupies a small area of only about 26 km^2. Damjan is in the relief of volcanic piles known as Pilav Tepe and Ploca composed of andesitic lions. Around them especially in the southern direction there are layers of volcanic fossils and tuffs, which cover an area of 12 km^2. The age of this volcanism is defined as Miocene (Arsovski, 1997). Unlike Damjan, Buchim e is a volcanic eruption in the middle of a block.

It is concluded that the Quaternary volcanic activity in R. N. Macedonia was quite alive. It started in the late Eocene or Oligocene and ended in the Pliocene. Volcanic eruptions were initially calmer, usually with the ejection of mantle material, and by the end of the Miocene they intensified and became more intense. The volcanic eruptions were mostly continental, but towards the end of the volcanic activity, the consolidation and deposition of the material from the eruptions, partly took place in the already created lakes. The most active volcanic centers in the area are predisposed to regional and local dislocations (NW-SE), which separate the Vardar zone from the Serbian-Macedonian massif and the

Pelagon. The hotspots themselves are usually at the intersection of the mentioned primary and transverse secondary fault lines.

Vollcanic cones and Plocha near Shopur. - The volcanic cones Pilav Tepe and Plocha are located near the gorge of Madenska Reka, a right tributary of Kriva Lakavica, about 12 km west of Radovish. The cones are part of the Damjansko-Buchim Paleovolcanic area (Arsovski, 1997) which covers an area of 26 km^2. Pilav Tepe is on the right side of Madenska Reka and has a typical conical appearance with a relative height of about 100-120 m and an absolute height of 566 m. It is composed of solid compact andesites, indicating explosive volcanism which is defined as Miocene.

Figure 9. Volcanic cone Pilav Tepe, near the village Shopur, Radovish region

1 km south of Pilav Tepe is the second characteristic volcanic cup in the shape of a neck known as the Plate. The relative height is about 150-200 m and the absolute is 658 m. In composition it is the same as Pilav Tepe, i.e. from compact andesitic lions. On almost all sides around Plocha there are layers of pyroclastic material - volcanic cracks and tuffs, especially on the SE side towards the village Damian. Both piles are intersected by the valley - the gorge of Madenska River due to which their prominence and relative height in the Quaternary period has increased. Due to selective erosion, there are almost vertical rock sections on the Plate. The tops of both buys are relatively flat.

In addition to the above, 1 km east of Pilav Tepe there is another conical elevation which is probably a parasitic cup of the main volcanic center.

Demir Kapija Gorge

The Demir Kapija Gorge is the most striking gorge on the river Vardar. It starts from the confluence of the river Boshava and extends to the village Udovo in the length of 19.5 km. The gorge is cut between the branches of Konechka (Serta) and Gradeshka Mountain on the northeast and the

branches of Kozuf, i.e. Marijanska Mountain with Krastovec (899 m) on the southwest. In this part, the river Vardar intersects Mesozoic limestones, under which there are basalts, diabases and granites.

The sides of the gorge are 500-600 m high and, in some places, quite steep especially in the initial part near Demir Kapija where they are almost vertical. Due to the limestone composition of the sides, karst relief occurs with several caves the longest of which is Bela Voda. At the bottom of the gorge there are large deposits of alluvial sediment from the river Vardar and the local tributaries. That is why it occurs on several small river islands, the largest of which is Demir Kapija Island. In the initial part of the gorge is the short (1.1 km), but typical canyon of the Iberliska River (left tributary of the Vardar), with vertical limestone sides 250-300 m deep.

Figure 10. The most impressive part of the Demir Kapija Gorge, deeply incised in limestone rocks (Photo: B. Markoski, 2013)

3.1.4.3.4. SIGNIFICANT WATERFALLS IN THE SOUTH EAST REGION

Due to the geotectonic and morpho structural conditioning, the predominantly mountainous relief in R. N. Macedonia has a large average slope and is quite divided by river valleys. The situation is similar in the South-East Region so that in it along the river flows and their beds in the mountainous parts, numerous rapids waterfalls and waterfalls have been formed. Thus, on the mountain Belasica due to its distinct choral structure and differentiated tectonic movements the following waterfalls are located:

- Koleshinski Waterfall (Belasica);
- Smolare Waterfall (Belasica);

• Gjavolski Waterfall (Belasica);

• Gabrovo Waterfalls (Belasica);

• Prstenski Waterfalls (Belasica);

Smolare Waterfall is located on the north side of Mount Belasica. The waterfall is tectonically predisposed with a fault structure, which lies transversely to the direction of water flow of the Smolarska River. In the geological composition the dominant role is played by the two-slice gneiss granites. The total height of the vertical section of the waterfall is 39.5 m. It consists of two parts of which the upper one is smaller (7 m) and the lower one is higher (32.5 m) in height but both parts form a whole. At the bottom of the waterfall is formed a giant pot, the length of which, in the direction of the river, is 5 m, the width is 11 m, and the depth ranges from 0.5 to 0.7 m. The waterfall is located in a dense beech forest (Vasileski D. 1999).

Koleshino Waterfall is a tectonic waterfall on the Baba River on the north side of Mount Belasica. It is built in two-sloping gneisses with a vertical section height of 17 m. The section at this waterfall is divided into two parts and first there is a section with a height of 2.5 m above which there is another larger one with a height of 14.5 m. The two mentioned sections, which are separated by a giant pot, form a whole. The giant pot is 4.1 m long, 5 m wide, and the greatest depth ranges from 0.4 m in summer to 0.6 m in spring. Koleshino Waterfall is constant throughout the year, and the flow of the river. Baba is 150 l/s, (Vasileski D. 1999).

Gjavolski Waterfall is a tectonic waterfall formed on the southwestern side of Mount Belasica in the upper course of the Bashiboska river, with a vertical section height of 17 m. When cutting the river into the muscovite gneisses, a section with a spherical shape and a diameter of 5 m was created. In the lower part of this waterfall, a giant pot with a length of 5.5 m and a depth of 2.3 m has been built. The water flow throughout the year is constant and averages 55 l s. The waterfall is located in a forest terrain and is quite attractive (Dzilvidziev & Stojcevski, 2016).

Figure 11. Gjavolski waterfall on Belasica (Capture: G. Dzilvidziev, 2015)

Figure 12. The second largest fall of Prstenski waterfall on Belasica

(Capture: G. Gilvidziev, 2015)

The Prstenesti Waterfalls are located on the west side of Mount Belasica near the same called village. They are erosive waterfalls and are formed as a result of the uneven vertical intersection of the Ring River in the fillets and sandstones. The first waterfall is 16.5 m high and consists of two vertical sections (5.5 m and 11 m) under which there is a giant pot. The second waterfall has a vertical section height of 16 m. Immediately above this waterfall is the third waterfall, which is 9.2 m high. All three waterfalls are constant throughout the year, and the river flow averages about 70 l/s. The plane tree is present along the riverbed near the waterfalls (Dzilvidziev & Stojcevski, 2016).

Gabrovo Waterfalls are located on the north side of Mount Belasica. According to the origin they are tectonic waterfalls, built as a result of the tectonic faulting of the Belasica Horst. The geological structure is dominated by granites. There is a total of three waterfalls formed on the Gabrovska River with a height of 4 to 8 m. In the lower parts, the three waterfalls have built giant pots. The waterfalls are located in a dense forest and are attractive all year round.

3.1.4.3.5. KARST PROCESSES AND FORMES

Karst terrains in R. N. Macedonia has almost all (surface and underground) karst phenomena and they are characterized by the appearance of a number of specific karst phenomena and processes. Karst terrains are formed in different types of rocks (carbonate, evaporitic) with different age (from Precambrian to quaternary) and are vertically located from the lowest to the highest parts of R. N. Macedonia. In addition to the appearance of the epigenetic or even isolated as a "normal" karst, on the territory of R. N. Macedonia, the occurrence of hypogenic karst has also been registered (Temovski, 2013b).

The karst in R. N. Macedonia covers 12% (3078.46 km^2) of the total area of the country (Temovski, 2012). Most of the karst terrains are located in the western part, slightly less in the central part, while the least karst is present in the eastern part of the Republic of N. Macedonia. In the South-East region, karst is present on insignificant areas. The karst fragments are mainly represented by Paleozoic marbled limestones. The limestone terrains are mainly spread on Smrdesh Mountain, Plaush and Karabalia. The main characteristic of the surface distribution of karst rocks is that they do not cover a larger area but are divided into larger or smaller parts (the so-called "karst oases" according to Manakovi, 1980), (Temovski 2012).

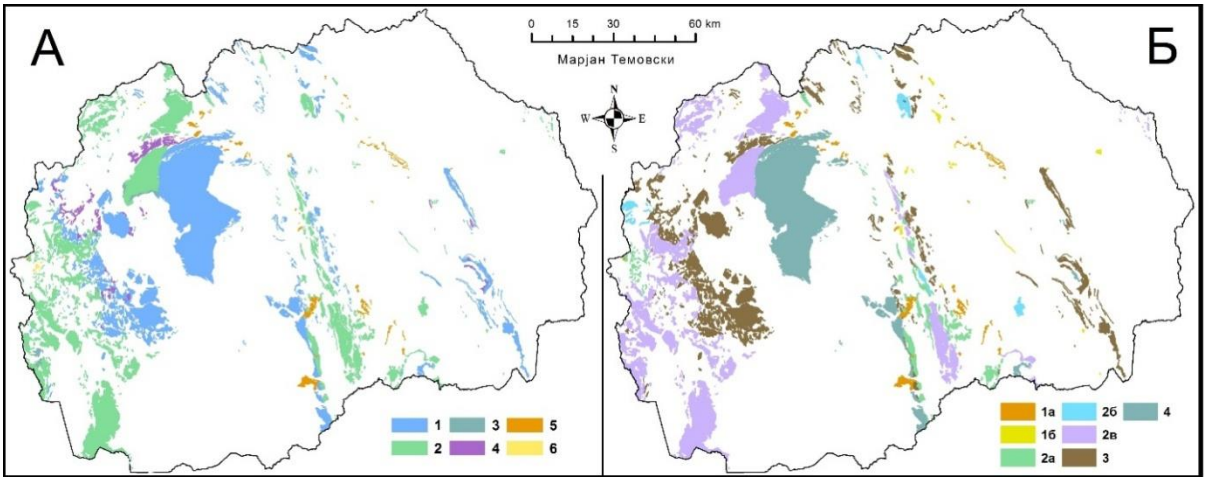


Figure 13. Map of surface distribution of karst areas (adapted from Темовски 2012). According to type (А): 1 – marbles; 2 – limestones
3 – dolomites; 4 – carbonate shales and marbles; 5 – calcareous limestones, scale and travertine; 5 – gypsum and anhydride. According to age (Б: 1 – Cenozoic (1а – Neogene and Quaternary; 1б – Paleogene); 2 – Mesozoic (2а – Cretaceous; 2б – Jurassic; 2в – Triassic); 3 – Paleozoic;
4 – Precambrian

3.1.4.3.6. MORPHOMETRIC FEATURES (HYPSOMETRY)

The territory of the South-East Region in terms of altitude extends from the lowest point at 46 m asl. (exit of the river Vardar from the Republic of N. Macedonia) to the top Zelen breg 2165 m asl the highest peak of Mount Kozuf. Hypsometry is measured at equidistance at 50 and 100 m relative heights, so that the sizes of the surfaces can be perceived by hypsometric belts for analysis of the spread of vegetation features in spatial and altitude terms. The following table shows the hypsometric sizes of the surfaces measured separately in the Gevgelija-Valandovo, Dojran and Strumica valleys.

Table 3. Overview of hypsometry in the area of Gevgelija-Valandovo, Dojran and Strumica valleys (Markoski B. 1992)

Hypsometric Scale	Gevgelija-Valandovo Valley	Dojran Valley	Strumica-Radovish Valley	Total
Column No	1	2	3	1+2+3
46-50	14.7	/	/	14.7
50-100	160.4	/	/	160.4
100-150	87.4	33.2	/	33.2
150-200	84.4	11.7	2.8	98.9
200-250	78.1	9.4	229.9	317.4
250-300	72.9	10.4	93.5	176.8
300-400	118.2	15.6	179	312.8
400-500	97.3	10.1	145.6	253.0
500-600	74.9	6.9	130	211.8
600-700	56.9	3.4	108	168.3
700-750	19.7	0.5	53.5	73.7
750-800	18.1	0.5	55.3	73.9
800-900	33.6	0.5	97.5	131.6
900-1000	19.4	0.4	100.9	120.7
1000-1100	14.9	0.4	82	97.3
1100-1200	13.2	0.5	72.6	86.3
1200-1300	11.9	0.6	59	71.5
1300-1400	6.3	0.4	40.5	47.2
1400-1500	5.3	/	24.5	29.8
1500-1600	4.8	/	6.6	11.4
1600-1700	3.7	/	2.7	6.4
1700-1800	2.5	/	1.7	4.2

1800-1900	0.7	/	0.4	1.1
1900-2000	0.6	/	/	0.6
2000-2100	0.3	/	/	0.3
TOTAL	**1000.1**	**104.5**	**1486**	**2590.6**

3.1.4.3.7. RIVER ISLANDS – ADA

In the relief forms in the South-East Region there are several larger river islands along the riverbed of Vardar through the Gevgelija-Valandovo Valley. More characteristic are the river islands-Adas of Vardar near the village Gjavato and near the village Josifovo.

Ada on Vardar near the village Gjavato. One of the largest river islands is Ada near the village Gjavato in the north part of Gevgelija. This island is about 420 m long in the direction SI-SW, and about 130 m wide. It is composed of fine river sand mostly covered with grass vegetation. At high level of Vardar, a significant part of the island is flooded, because its height is about 3 m (Milevski, 2014b).

Ada of Vardar near the village Josifovo. At the village Josifovo near Valandovo by digging a new river branch of Vardar for protection from meandering, two large river islands were created up to 500 m long and up to 250 m wide. The islands have a height of up to 5 m. They are mostly covered with grass and shrub vegetation (Milevski, 2014b).

3.1.5. CLIMATE

3.1.5.1. CLIMATE FACTORS

The main climatic factors on the territory of the South-East Region are the relief structure and the proximity of the Aegean Sea.

The relief as previously presented consists of several more striking mountains such as Plachkovica, Ograzden, Belasica, Konechka, Gradeska and Plaush massif, Kozuf and the lower mountains Smrdesh and Karabalija.

In the relief structure as a climatic factor from the macrostructural relief are important the valleys and fields such as Strumica-Radovis Valley with Strumica, Radovis and Damjansko field in its composition, Gevgelija-Valandovo Valley with Gevgelija and Valandovo Field in Valley. The valleys as a factor in the South-East region influence the climate modification through their openness to the Aegean Sea (Gevgelija-Valandovo Valley open to the south along the valley of the river Vardar, and Strumica-Radovish Valley open to the east or to the valley of the river Struma) so that in valleys feel direct Mediterranean influences. The more specific features of the climate in the South-East region are discussed below through a brief analysis of the basic climatic elements and phenomena.

3.1.5.2. CLIMATE ELEMENTS AND PHENOMENA

Some basic data related to air temperature, winds, precipitation, relative humidity, sunshine and clouds are functionally presented as climatic elements and phenomena for the territory of the South-East Region. Therefore, the definition of climatic types in the region is formed.

- ***Air temperature***

The immediate findings regarding the air temperature in the territory of the South-East Region are based on the data for:

-average monthly and annual temperatures

-absolute minimum temperatures

-absolute maximum temperatures

-temperature amplitude

-Frost days

The characteristics of the temperatures in the territory of the South-East Region are closely correlated with influence of the Aegean Sea as one of the important factors in the formation of the climate in the region. The whole region is relatively close to the Aegean Sea so that the Mediterranean climate influence is felt in almost all measuring stations.

The direct data regarding the average monthly and annual air temperatures in the territory of the South-East Region are shown in Table 3.4.

Table 4. Overview of average monthly and annual air temperatures on the territory in the South-East Region (Lazarevski A., 1993)

Measurement Station	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XI	Год.
Gevgelija	3,4	5,5	8,5	13,2	18,4	22,8	25,0	24,6	20,2	14,2	9,0	5,2	14,2
Valandovo	3,6	5,7	8,8	13,6	18,5	22,7	25,2	24,9	20,6	14,9	9,8	5,4	14,5
Demir Kapija	2,1	4,8	8,3	13,4	18,1	22,4	24,7	24,4	20,1	14,1	9,0	3,9	13,8
Nov Dojran	3,6	5,4	8,1	12,8	17,9	22,2	24,7	24,6	20,4	14,8	10,1	5,7	14,2
Strumica	1,6	3,9	7,8	12,9	17,7	21,7	23,8	23,3	19,2	13,2	8,0	3,0	13,0
Radovish	1,1	3,4	6,7	11,6	16,6	20,7	22,9	22,6	18,4	12,9	7,8	3,0	12,3

The data show that in all measuring stations the average annual air temperature is higher compared to other regions of R. N. Macedonia and ranges around 13-140^{o}C. A small exception is the measuring station Radovish because it is located in the north at a higher altitude and under the more direct influence of the mountain Plachkovica.

Temperatures in the summer months on average at all measuring stations are around 22-25^{0}C, and in the winter months around 2-5^{0}C. This means that the whole region is characterized by a relatively warmer climate compared to other regions in the Republic of N. Macedonia.

Analyzing the absolute monthly minimum and annual air temperatures on the territory in the South-East Region it is concluded that they are -19.5^{0}C in Gevgelija, -14.1^{0}C in Valandovo, -22.0^{0}C in Demir Kapija, -13.0^{0}C in Nov Dojran, -24.0^{0}C in Strumica and -21.0^{0}C in Radovish. This means that in relation to some other valleys throughout the interior of R. N. Macedonia these values are slightly lower. It is characteristic that in the period from May to September in the valleys of this region no minimum temperatures with negative values are observed (Lazarevski A. 1993).

The average number of frosty days is 53.7 in Gevgelija, 43.1 in Valandovo, 61.7 in Demir Kapija, 29.3 in Nov Dojran, 72.6 in Strumica and 68.7 in Radovish.

Contrary to the minimum temperatures due to the Mediterranean influences in the South-East region, there are relatively higher maximum temperatures compared to the other regions in the

Republic of N. Macedonia. The maximum annual temperatures in the analyzed measuring stations are 44.3^{0}C in Gevgelija, 43.5^{0}C in Valandovo, 44.5^{0}C in Demir Kapija, 43.0^{0}C in Nov Dojran, 43.4^{0}C in Strumica and 41.0^{0}C in Radovish. It is concluded that this region in R.N. Macedonia is characterized as warmer than the others. This is shown by the data on the number of summer days which in the analyzed measuring stations is 134.3 in Gevgelija, 134.1 in Valandovo, 130.9 in Demir Kapija, 118.6 in Nov Dojran, 124 in Strumica and 111.5 in Radovish. From these indicators it is concluded that this region has the largest number of summer days, because all listed stations are at the top of the list of measuring stations in R. N. Macedonia.

- ***Wind***

Winds are a meteorological phenomenon that occurs mainly due to changes in air pressure and changes in air temperature. It has an impact on the weather and climate of a certain area at a specific time. The influence of wind is basically seen through the frequency (expressed in permilles) and the wind speed (expressed in m/sec). In the measuring stations on the territory of the South-East Region values are recorded as in table 3.5.

Table 5. Average annual wind frequency from eight directions on the territory in the South-East Region (in per mille) (Lazarevski A., 1993)

Measurement Station	N	NE	E	SE	S	SW	W	NW	C
Gevgelija	224	23	70	101	73	29	27	136	317
Valandovo	24	102	13	69	57	36	10	315	374
Demir Kapija	18	6	151	131	24	26	57	159	428
Strumica	77	35	51	64	88	95	75	167	348
Radovish	51	22	116	77	50	41	196	175	272

The data show that in Gevgelija Field prevail winds from north with 224 permille, northwest with 136 permille and southeast direction with 101 permille, in Valandovo Field prevail winds from northwest with 315 permille, northeast with 102 percent, the winds from the northwest with 159 permille, the east with 151 permille and the southeast direction with 131 permille. In Strumica Field the wind from the northwest direction with 167 permille is the most common and in Radovishko Pole the winds from the west direction with 196 permille are the most frequent 175 permille and east with 116 permille.

It is noticed that the values of silences are high (mainly over 300 permille) which is in correlation with relatively higher temperatures compared to other regions of R. N. Macedonia.

- ***Precipitation***

Precipitation is a meteorological phenomenon that is closely dependent on orographic factors and the proximity of a specific territory in relation to the seas. Of course, this is also related to the cyclonic and anticyclonic influences in the wider region. In the case of the territory of the South-East Region, the proximity of the Aegean Sea and the penetrations of air masses and fronts along the valleys of the rivers Vardar and Struma are determinants of the amount of precipitation.

In addition, in table no. 00 shows the average monthly and annual rainfall in the South-East Region.

Table 6. Overview of average monthly and annual rainfall in the South-East Region (mm/m^2) (Lazarevski A., 1993)

Measurement Station	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XI	Год.
Gevgelija	61,5	60,1	71,4	52,5	68,4	46,8	31,9	31,3	39,1	75,4	98,0	74,8	711,2
Valandovo	59,1	50,4	57,5	50,0	65,1	46,0	34,6	25,1	38,8	64,3	84,4	67,3	642,6
Demir Kapija	64,8	44,8	50,8	41,9	59,0	48,7	33,0	24,2	35,4	59,2	63,2	61,7	586,7
Nov Dojran	52,0	53,2	42,3	54,0	65,2	50,9	33,5	33,7	39,2	68,3	87,9	61,5	681,3
Strumica	43,6	47,8	49,8	48,4	66,6	49,2	40,8	29,0	40,0	58,2	74,5	54,6	603,0
Radovish	43,8	49,5	47,2	36,1	53,1	39,1	37,0	22,6	33,2	49,5	64,4	45,0	520,4

The average annual rainfall in the South-East Region is basically around 600 to 700 mm/m^2 (Lazarevski A. (1993), and a small exception is the measuring station Radovish which has a slightly more continental character than other measuring stations. notes that the distribution of precipitation is highest in the winter months of the year and almost twice lower in the summer months of the year, especially the months of July and August where the lowest amounts of precipitation were observed in all analyzed measuring stations.

Precipitation is mostly rain (occasionally accompanied by hail) and snow. Dew and frost phenomena are more characteristic of the autumn and spring months.

During the vegetation period from April to October, only 1/3 of the annual average falls. Of course, a special problem is the uneven distribution of precipitation during a month, so drought periods are frequent. This problem in the context of agricultural production is solved by using water from rivers and agro-ameliorative systems and especially from the reservoirs Turija, Vodoca, Mantovo and a series of smaller reservoirs.

Other meteorological elements and phenomena

Sunshine. The territory of the South-East Region is globally characterized by southeastern exposure, where at the local level southern and southwestern exposures of the terrain prevail, so it is characterized by a relatively high degree of sunshine during the year. Specifically, the number of sunny hours during the year in Gevgelija is 2609 hours, in Valandovo 2564, in Demir Kapija 2253, in Strumica 2472 and in Radovish 2320 hours (Lazarevski A. 1993).

The months of June, July, August and September are characterized by the greatest sunshine with about 300 hours per month.

Cloudiness. The average annual cloud cover in all measuring stations in the South-East Region is below 5 tenths. That is, in Gevgelija it is 4.2 tenths, in Valandovo 4.4, in Demir Kapija 5.0, in Strumica 4.6 and in Radovish 4.9 tenths. This means that the Mediterranean influences are reflected on the clouds in the region (Lazarevski A. 1993).

Relative humidity. The average annual relative humidity in the measuring stations on the territory of the South-East Region is as follows, i.e. in Gevgelija it is 71%, in Valandovo 71%, in Demir Kapija 68%, in Strumica 74 and in Radovish 72%. The weather from May to September is characterized by the lowest values (Lazarevski A. 1993).

3.1.5.3. CLIMATE TYPES

Based on the presented meteorological factors and the data on the individual meteorological elements and phenomena on the territory of the South-East region several climatic types can be identified. In the plain parts of the Gevgelija-Valandovo Valley and in the Dojran Valley (up to about 500 m above sea level) the presence of the Mediterranean type of climate is felt, in the Strumica Field (also up to about 500 m above sea level) the changed Mediterranean climate influences. In the lower parts of Radovishko Pole, Damjansko Pole and the source parts of the river Kriva Lakavica the climate is moderately continental, and in the higher parts of the mountains Plachkovica, Ograzden, Belasica and Kozuf the continental and mountainous climate is felt.

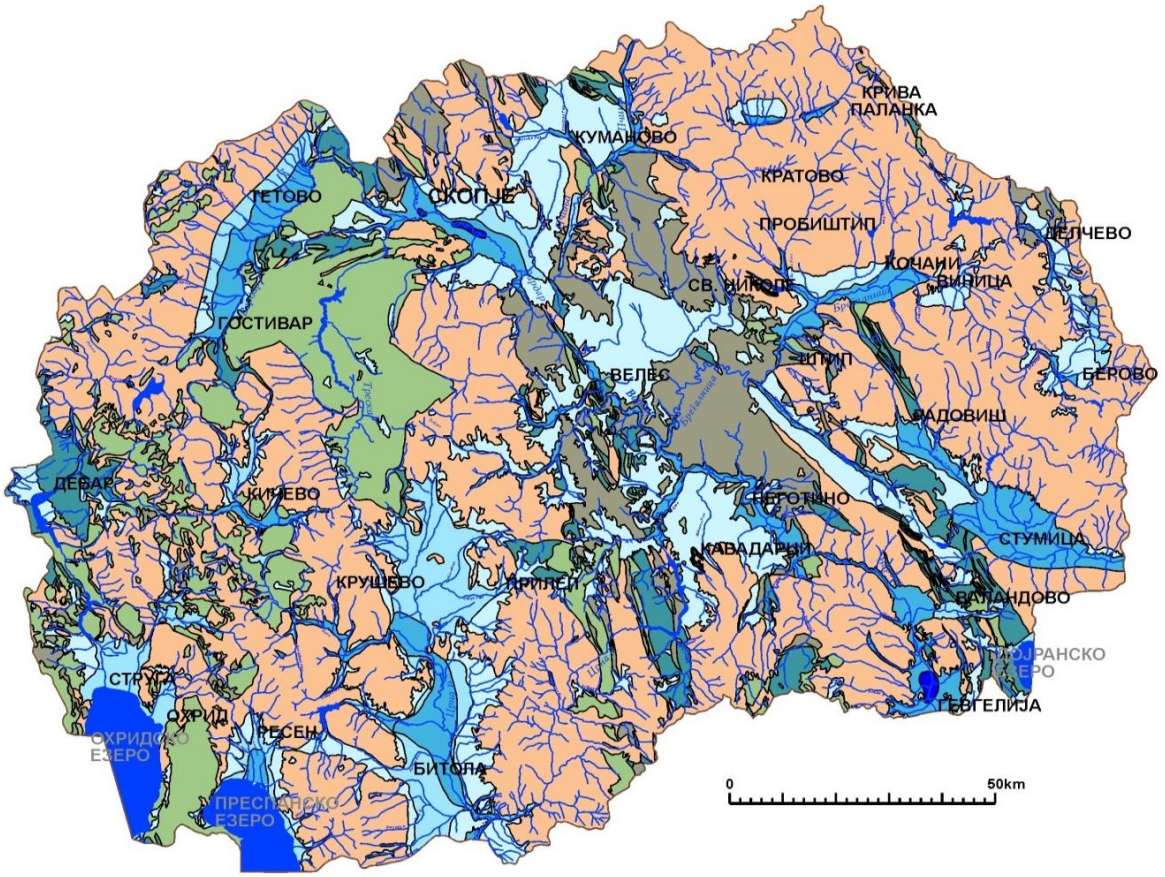
3.1.6. HYDROGRAPHY

3.1.6.1.GROUNDWATER

Groundwater on the territory of R. N. Macedonia are spread in issued (aquifers) in:

-connected quaternary and neogenic lithological formations with intergranular porosity or so-called compact type of issued and

-carbonate rock masses with karst-crack porosity, the so-called karst-fissure type of protrusions.



ЛЕГЕНДА:

КЛАСА НА ВОДОПРОПУСНОСТ

11	Терени изградени од неврзани карпи со ниска водопропусност (делувиум, пролувиум - песоклива прашина; прашинест песок; чакал и др.) K_f= 0.086-0.86 m/den;T = 15-50 m ^{2}/den;Q_{bun}=0.5-2 l/s	31,32,33	Терени изградени од карбонатни карпи со висока до многу висока водопропусност, карстно пукнатински тип на издани 10 карстни појави/km^2; Q_i> 10.0 - 1000 l/s; локално > 1000 l/s; q_{sp}?10l/s/km^2
12	Терени изградени од неврзани карпи со средна водопропусност (алувиум - песок; чакал; прашинест песок и др.) K_f= 0.86-8.6 m/den;T = 50-300 m ^{2}/den;Q_{bun}=2-10 l/s	41,42	Терени изградени од ефузивни и други цврсти карпи со средна водопропусност Q_{bun}= 2 - 10 l/s; Q_i= 2 - 10 l/s; q_{sp}?1.5 l/s/km^2
13	Терени изградени од неврзани карпи со висока водопропусност (алувиум - песок и чакал) K_f= 8.6-86.4 m/den;T = 300-1500 m ^{2}/den;Q_{bun}=10-50 l/s	60	Терени изградени од различни цврсти карпи слабо водопропусни до водонепропусни пукнатински тип на издан само локално плитко под површината на теренот со ограничен простор Q_{bun}< 2 l/s; Q_i< 2 l/s; q_{sp}?0.2 l/s/km^2
14	Терени изградени од неврзани карпи со многу висока водопропусност (крупнозрни чисти чакали) K_f= > 86.4 m/den;T = > 1500 m ^{2}/den;Q_{bun} > 50 l/s	80	Главно безводни терени локално многу слабо водопропусни изградени главно од флишоидни и лапоровити седименти

Figure 14. Hydrogeological map of Republic of N. Macedonia

Source: Z. Ilijoski, 2015

The compact type of aquifers is classified into four hydrogeological categories - classes: 11, 12, 13 and 14. This type of aquifers is spread over about 5,000 km^2, which represents 19.5% of the territory of the country (Ilijoski Z. 2015). From the aspect of representation of groundwater reserves for water management use, the environments in classes 12, 13 and 14 are profitable, such as the aquifers formed

in the alluvial sediments of: Vardar, Crna and Bregalnica, i.e., distributed in Pelagonija, Polog, Skopje, Kocani, Gevgelija-Valandovo and Strumica Neogene depression.

From the mentioned groundwater reserves on the territory of the South-East region there are two Neogene depressions rich in groundwater, the Gevgelija-Valandovo and Strumica Neogene depression.

In both valleys the main areas in which the groundwater is more pronounced are Strumica Field, Valandovo Field, Gevgelija Field and Dojran Valley. In these areas the groundwater is relatively rich and with a relatively high level (i.e. at shallow depths the presence of groundwater is present). Arterial waters are also known in the Strumica Field.

Groundwater is largely useful and exploited for economic purposes and for water supply to the population.

The karst-crack type of aquifers are usually classified in the classes of high to very high water permeability - classes 32 and 33. These outcrops are spread over an area of 2,620 km^2, which represents 10.2% of the country, of which 2520 km^2 are in the western part of the country, and only 100 km^2 are in the eastern part (Ilijoski Z. 2015). This type of issue is not typical for the territory of the South-East Region.

- ***Thermal, thermo-mineral and mineral waters***

Thermal, thermo-mineral and mineral waters are very present in R. N. Macedonia. Neotectonic processes of alpine orogeny are the cause of numerous occurrences of thermal waters. They are mostly related to the neotectonic fault structures in the Vardar zone or to the transverse faults located in the depressions. In that sense, on the territory of the South-East Region appear several geothermal zones, of which the most characteristic are the Strumica zone (along the fault line of contact between the field and the mountain Belasica) and the zone Smokvica - Negorci - Gevgelija

Geothermal waters are generally used for balneological needs, and lately for thermal energy, especially in the greenhouse economy. In the South-East Region, locations where the thermal waters are exploited for balneological needs are village Bansko (Strumica), village Negorci (Gevgelija) and for the same purpose the thermo-mineral waters in the area of the village Smokvica. In addition to those mentioned in the South-East Region, there are other occurrences of thermal waters, which are not used or are used primitively, such as the waters in the village Raklish (Radovish), village Toplec (Nov Dojran) and others.

Strumica Spa. It is also known as Banja Bansko, because it is located on the east side of the village. Bansko 12 km southeast of Strumica. There are 13 thermo-mineral springs, the strongest of which is the Parillo spring (40 l/s), and there is one exploitation well with a yield of over 40 l/s. The water temperature in the springs is 71°C in the main spring and 56°C in the others. In terms of mineral composition, they all have the same mineralogical composition, which confirms that they all have the same origin. The geological composition of the terrain is shale Old Paleozoic granite covered with thick tertiary sediments. The hydrothermal system belongs to the group of crack systems whose reservoir is built in granite. The feeding of the tank takes place through the granites that make up Belasica on one side and Ograzden on the other side of the Strumica Valley (Group of authors, 1999).

Negorska Banja. Negorska Banja is located below the southeastern slopes of Mount Kozuf, and only 5 km northwest of the city of Gevgelija, at an altitude of only 59 meters. It is surrounded by 36 ha of dense and beautiful forest. Unlike most baths in the country, which are said to have been used since Roman times, this bath is said to have been first used by Shukri Pasha in 1903 who was the first to build two swimming pools there. There are two springs in the area of the bath. The first is called Vrela Banja and has a temperature of 40 ^{0}C, while the second is called Lada Banja and has a temperature of 38 ^{0}C. Water is rich in calcium, magnesium, rubidium, cesium, radon and other minerals. Both baths help treat

rheumatism, sciatica, hypertension, various gynecological diseases, as well as neutralizing gastric acid (Group of authors, 1999).

In addition to thermal and thermo-mineral waters, there are cold mineral waters in the South-East Region, most of which are unoccupied and flow freely. Mineral waters of subarter origin are also distributed in the tertiary basin of the Strumica Valley.

With hydrogeological examinations from the Geological Institute of Skopje in the period 1973 - 1976, about 170 localities were explored throughout the Republic of N. Macedonia, including the sites in the South-East Region. According to the ionic composition, most of the mineral waters belong to the hydrocarbonate waters, followed by the hydrocarbonate-chloride, sodium-calcium, hydrocarbonate-sulfate, and the least represented are the hydrocarbonate-sodium waters.

According to the mineralization and the dry residue, the most numerous are the mineral waters with mineralization of 1-3 g/l.

According to the temperature, the waters with a temperature lower than 20^{o}C prevail, which represents over 80% of the mineral waters in the country.

According to the pH value, waters with a pH value of 7-8 (113 occurrences) predominate. According to the gas composition in R. N. Macedonia is dominated by mineral waters with carbon dioxide (85 occurrences), waters without gases or untested (61 occurrences) and the rest are with other gases.

3.1.6.2. WATER SPRINGS (CADASTRIAL NUMBER, AREA, DISCHARGE, TEMPERATURE, CONTINUITY)

The territory of the South-East Region in the context of the geological basis, the geomorphology of the terrain and primarily due to the characteristics of the climate (relatively small amounts of precipitation) is characterized by the presence of springs with relatively lower water yield.

The springs are mainly present in the mountainous areas of Plachkovica, Ograzden, Belasica and Kozuf, while in the mountainous and hilly areas of the mountains Konechka, Gradeshka, Plaush, Smrdesh and Karabalia water sources are significantly rarer. According to the above, several larger rivers descend from the higher mountains, which are mainly formed by a series of springs that have an insignificant amount of water. They are mainly in the group of sources with an output of about 1 l/sec.

Because some major sources do not stand out in terms of yield, no special elaboration is given for individual sources.

An important conclusion for the territory of the South-East Region is that in the valley plains there are larger amounts of water of the type of groundwater. It is a result of the wider spread of the plain parts of the Strumica and Radovish Fields in the Strumica-Radovis Valley and the inflow of water through the river Vardar (as the main recipient of the waters from the Republic of North Macedonia) in the Valandovo and Gevgelija Fields of the Gevgelija-Valandovo Valley. Thus both valleys in their plain parts are relatively well supplied with water.

The situation with springs and groundwater in the upper part of the Kriva Lakavica river basin is more enviable.

3.1.6.3. RIVER NETWORK

The river network on the territory of the South-East Region mainly consists of the rivers Vardar and Strumica and the special catchment area of Lake Dojran. Vardar. The river Vardar is the largest and most important Macedonian river which in R. N. Macedonia has a basin of 20,525 km^2, and together

with those rivers whose inflows are located in our country and the springs and upper parts in neighboring Former Yugoslav Republic and Greece, the total catchment area has a value of 22,475 km^2. The total catchment area from the source to the estuary in the Aegean Sea is 28,410 km^2. It springs near the village Vrutok (Gostivar region) from karst spring at an elevation of 683 m and leaves the territory of the country near Gevgelija at an elevation of 44 m. Its length is 301 km, while to the inflow into the Aegean Sea it has a total length of 390 km (Group of authors, 1999). Its valley is composite and consists of 5 valleys (Polog, Skopje, Veles, Tikvesh and Valandovo-Gevgelija) and 4 gorges between the valleys (Vardarski Derven, Taorska, Veles and Demir-Kapiska Gorge). It has great international, regional and local significance because from it all important roads in the country start or gravitate towards it. It is especially important that in the north it connects with the valley of the river. It must continue with the Danube and Central Europe, and to the south with Thessaloniki and the Eastern Mediterranean. The valley is also significant in that it is influenced by the Mediterranean Sea from the south and the temperate-continental climate from the north. This further has a great impact on the overall climate of R. N. Macedonia. The valley of Vardar in which the capital Skopje is located is subject to frequent floods. Only in the period from 1916. until 1979 There were 5 major floods, the penultimate of which (November 16, 1962) caused huge damage in Skopje.

The main tributaries of Vardar are: Lepenec, Pchinja and Bregalnica on the left side and Treska and Crna Reka on the right side. Within the territory of the South-East Region the river Vardar is important for the region because it drains the source parts of the river Kriva Lakavica (223.7 km^2 area belonging to the Municipality of Konce) and Madenska River (with about 50 km^2 area belonging to the Municipality Radovish) which drain through the river Bregalnica into the river Vardar. The river Vardar drains the entire territory of the Gevgelija-Valandovo Valley from Demir Kapija to the border with Greece. In that context, it covers an area of 929.21 km^2 of which the plain area on 46-200 meters altitude in Valandovo plain it covers 115 km^2 and in Gevgelija plain it covers 249.4 km^2. The area of the immediate basin in the Gevgelija-Valandovo Valley in Vardar is joined by several larger left tributaries such as rivers: Chelevechka, Gradeshka, Anska and Luda Mara and several larger right tributaries such as Stara, Smokvicka, Kovanska, Sermeninska and Konjska Reka. In addition to the above, there are a number of shorter permanent and occasional watercourses that flow directly into Vardar.

Kriva Lakavica. Kriva Lakavica is the largest left tributary of Bregalnica 42 km long with a total catchment area of 417.5 km^2. The spring is located on the western slopes of the mountain Smrdesh at an altitude of 570 m and the inflow downstream from the City of Stip at 251 m above sea level. The average height of the watershed is 540 m. Its total drop is 319 m and the average drop is quite low and is 7.6 ‰ (Group of authors, 1999). An artificial reservoir "Mantovo" has been built in the upper course of the river near the village of Gabrevci. A larger tributary is the Madenska River which receives it from the right side. The water from Kriva Lakavica is used for irrigation of arable land.

Madenska River. Madenska Reka is a right tributary of Kriva Lakavica (river Bregalnica) 17.6 km long with a total catchment area of 65.3 km^2. The source is located on the southwestern slopes of Plachkovica near the village Pocivalo at an altitude of 900 m and the inflow is at Novo Selo downstream of Lake Mantovo at 355 m. In front of the inflow, Maderska Reka breaks through the mountain Smrdesh and built the interesting but short Dervent Gorge. Its total fall is 545 m and the average fall is 30.9 ‰ (Group of authors, 1999).

Anska Reka. Anska Reka is a left tributary of Vardar. It springs in the western slopes of the mountain Belasica at an altitude of 550 m and flows in the southern, lowest part of the Valandovo Valley in a length of 27 km. It flows into Vardar near the village of Marginci at 58 m. Its total fall is 492 m and the average fall is 18.2 ‰. The catchment area is 168 km^2 (Group of authors, 1999). Its name derives from the fact that in its original part during the 18th and 19th century there were several inns that served for the rest of the caravans that traveled to Thessaloniki, ie to Strumica. Several smaller streams

flow into Anska Reka, especially in its upper course (Ring Dere, Kodza Dere, etc.) which feed it with water.

Luda Mara. Luda Mara is a left tributary of Vardar. It springs in a hilly-mountainous area that extends east of Bogdanci at an altitude of 400 m and flows in the lowest part of the Gevgelija-Valandovo Valley in a length of 19.5 km. The area of its catchment area is 104.2 km^2. It flows into Vardar at a distance of 6 km from the Greek border at 48 m. The average height of the watershed is 240 m. Its total fall is 352 m and the average fall is 18 ‰ (Group of authors, 1999).

Gradeshka Reka. Gradeshka Reka river is a left tributary of Vardar 12 km long with a total catchment area of 37 km^2. Its source is located on the southern slopes of Gradешкака Mountain at an altitude of 820 m and in Vardar it flows into the Demir Kapija Gorge south of the village Gradec 76 m above sea level. The average height of the watershed is 490 m. Its total drop is 744 m and the average drop is 62 вредност (Group of authors, 1999).

Stara Reka or Petrushka Reka. Stara Reka or Petrushka Reka is a right tributary of Vardar which it receives in the Gevgelija-Valandovo Valley. It springs at the foot of Marjanska Mountain and flows to Miletkovo through hilly and mountainous terrain, where it receives a large number of tributaries (Klisura, Kriva Reka, Crnevska Reka, etc.) which feed it with water. From Miletkovo to the estuary in Vardar it flows through the flat and low Miletkovsko Pole. The length of the river is 22.3 km and the area of the watershed is 89.8 km^2 (Group of authors, 1999). Its waters are used for irrigation of the arable lands of Miletkovsko Pole. In its lower course Stara Reka also appears under the name Petruska Reka.

Sermeninska River. Sermeninska Reka is a right tributary of the Vardar which receives it in the Gevgelija-Valandovo Valley. It consists of Belica and Zabicka Reka which spring in a mountainous area below Kozuf at an altitude of 1700 m. It flows into Vardar at a distance of 4 km from the Greek border at 46 m above sea level. Its total length is 24 km and the size of its basin is 62 km^2. The average height of the watershed is 420 m. The total fall is 1654 m and the average fall is 69 ‰ (Group of authors, 1999).

Kovanska River. Kovanska Reka is a right tributary of the Vardar which receives it in the Gevgelija-Valandovo Valley. Its total length is 22 km and the size of its basin is 62 km^2. The source is located on Kozuf Mountain at an altitude of 1700 m and in Vardar it flows into Gevgelija Field, at a distance of 12 km from the Greek border at 53 m above sea level. The average height of the watershed is 600 m. Its total fall is 1647 m and the average fall is 74.8 ‰ (Group of authors, 1999).

Konjska River. Konjska Reka is a right tributary of Vardar which receives in the Gevgelija-Valandovo Valley which is 30 km long and is also the last right tributary that Vardar receives on our territory. With its source part that consists of the rivers Cresha and Sliva, Konska Reka penetrates deep into the massif of Kozuf. The spring is located at an altitude of 1520 m and the inflow at 44 m above sea level. The average height of the watershed is 680 m. Its total fall is 1476 m and the average fall is 49 ‰ (Group of authors, 1999). Through its course it receives several tributaries, the most important of which is the Sarandorska River, which is formed by three karst springs near the village of Huma. The total area of its basin is 130 km^2. In the lower reaches it is also known as Suva Reka.

The territory of the Strumica Valley mainly drains the river Strumica with its tributaries. For a more complete acquaintance with the river system in the valley, the characteristics of the river Strumica and several of its larger tributaries are presented below.

Strumica River. The Strumica river basin covers the southeastern part of the R. N. Macedonia extends in a northwest-southeast direction. The source headwaters consist of several watercourses that are formed and descend from the highest parts of the mountain Plachkovica. The source is considered to be the source of Radovishka River which is at an altitude of 1540 m above sea level. In Radovishko Pole, Radovishka Reka merges with Oraovicka Reka from where to the entrance to Strumica Pole it is called Stara Reka. Entering the Strumica Field the river bears the name Strumica. The course of Strumica through the Strumica Valley, in which it receives a large number of torrential watercourses that deposit huge sediments in the riverbed, used to be quite difficult and the riverbed was shallow, and the outflow

of water from it is common. As a consequence, permanent wetlands were formed near the river, among which the largest was Monospitovo Swamp. With the land reclamation carried out after the Second World War this process was stopped. Under Novo Selo Strumica river comes out of the Strumica plan and flows through the Kljuca Gorge formed between the mountains Ograzden in the north and Belasica in the south, where it crosses the border with R. Bulgaria at an elevation of 186 m and flows into Struma on the territory of neighboring R. Bulgaria. In R. N. Macedonia the river Strumica has a length of 75.1 km and drains a catchment area of 1520 km^2. It has a total drop of 1354 m, ie a relative drop of 18 ‰. The average flow of Strumica near Novo Selo is 6.16 m^3/sec, the average minimum water is 1.16 m^3/sec and the average maximum water is 14.5 m^3/sec. The greatest flow occurs at the end of winter and in the beginning of spring i.e in the months of February, March and April. Thus, in February the average high water is 60.50 m^3/sec. The lowest flows are in the months of August and September with a minimum of medium waters in August, when only 0.05 m^3/sec flows here (Group of authors, 1999).

Along its length, the river Strumica receives four larger tributaries, three of which are on the left and one on the right. The left tributaries of Strumica are the Oraovicka River, the river Plavija and the river Turija, and the right tributary is only the river Vodochnica. (Minister of Agriculture, Forestry and Water Economy, 2017)

Oraovichka River. Its source is in the locality of Jamija on Plachkovica at an altitude of 1,380 m, and the confluence with the Radoviska River is at an altitude of 318 m. It is 18 km long and covers a catchment area of 51 km^2 and has an average slope of 59 ‰ (Group of authors, 1999). It flows from north to south and has a pronounced torrential character. Blue. It springs from the highest parts of Plachkovica below the peak Asanli at an altitude of 1,432 m, and in Strumica (Stara Reka) it flows under the village. Give at an elevation of 300 m. It is 26.7 km long, covers a catchment area of 140 km^2 and has an average relative decline of 42.4 ‰ (Group of authors, 1999). In the upper course it is called Smiljanska Reka and its main tributary is Sirava Reka.

Turija. It is the largest tributary of Strumica. In the upper part it is formed by two branches - Shiroki Dol which springs on Plachkovica at an altitude of 1,065 m and flows to the southeast and Bezgaqeva River which springs at the same altitude on the mountain Ograzden and flows to the northwest. They merge between Gramadic and Malinska Planina and hence the river Turija which flows to the south and in the middle course is known as Nivicanska River. On this section in 1972 was built the artificial reservoir Turija with a volume of 48 million m^3 of water. In the river. Strumica flows into the village Bosilovo at an altitude of 215 m. It is 44.7 km long, covers a catchment area of 263 km^2 and has a relative decline of 19 ‰ (Group of authors, 1999).

Vodochica. It is the only larger right tributary of the river Strumica. It springs from the mountain Smrdesh at an altitude of 660 m and flows into Strumica east of the village Zubovo at an elevation of 205 m. It is 37.2 km long, covers a catchment area of 374 km^2 and has a relative decline of 12.2 ‰ (Group of authors, 1999). In the upper course it is called Bela Reka, and downstream from the village Vodocha is named after the name of this village. From the beginning it flows in a west-east direction, then between the villages Popchevo and Vodocha it flows to the north and after the village Vodocha flows east again. On the river Vodochnica near the village Popchevo in 1966 was built the artificial reservoir - Lake Vodocha with a volume of 26.7 million m^3 of water. The river Vodochnica has a larger tributary the river Trkajna.

Trkajna. Trkajna is a right tributary of the river Vodochnica (river Strumica) 17.7 km long with a total catchment area of 77 km^2. The spring is located on the mountain Plavush at an altitude of 640 m and flows near the city of Strumica at 218 m. Its total fall is 422 m and the average fall is 23.8 ‰ (Group of authors, 1999). After the drainage of the wetlands in Strumica valley as a special problem in the watershed of the river Strumica has highly developed erosive processes and forms. The numerous torrents and torrential watercourses present here deposit a huge sediment in the plain part and cause significant damage to the arable land and other buildings in the plain part. The river system of one and

several built reservoirs and reclamation interventions, both in terms of drainage and in terms of irrigation solve the problem of using water for economic purposes especially in the field of agriculture.

3.1.6.4. LAKES

On the territory of the South-East Region, several lakes stand out as hydrographic objects. More important are Lake Dojran as a natural tectonic lake and the reservoirs Mantovo (in the watershed of Kriva Lakavica), Lake Strumica and Lake Turija (in the watershed of the river Strumica) and Lake Paljurci in the watershed of the river Luda Mara (left tributary of the Vardar). The following are some more specific features of these lakes, i.e reservoirs.

Dojran Lake. It is located in the southeastern part of R. N. Macedonia. It extends in the Dojran Valley which tectonically descended between the mountains Belasica, Krusha and Kara Balija. Its origin is thought to have occurred during the Pleistocene. The altitude of the mirror on the lake is 148 m. It has an almost circular shape, so the length in the north-south direction is 8.9 km, and the width is 7.1 km. It covers an area of 43 km^2 out of which R. N. Macedonia owns 27.4 km^2 and Greece owns 15.6 km^2. The basin of the lake covers 271.8 km^2 of which 75.4 km^2 or 27.7% are on the territory of R. N. Macedonia and most of the 196.4 km^2 is on the territory of the Greece. The deepest part is about 10 m and the average depth is 6.7 m (Group of authors, 1999; Markoski B., Chepreganov T., Grozdanoski R., Nikolovski D. D. 2013).

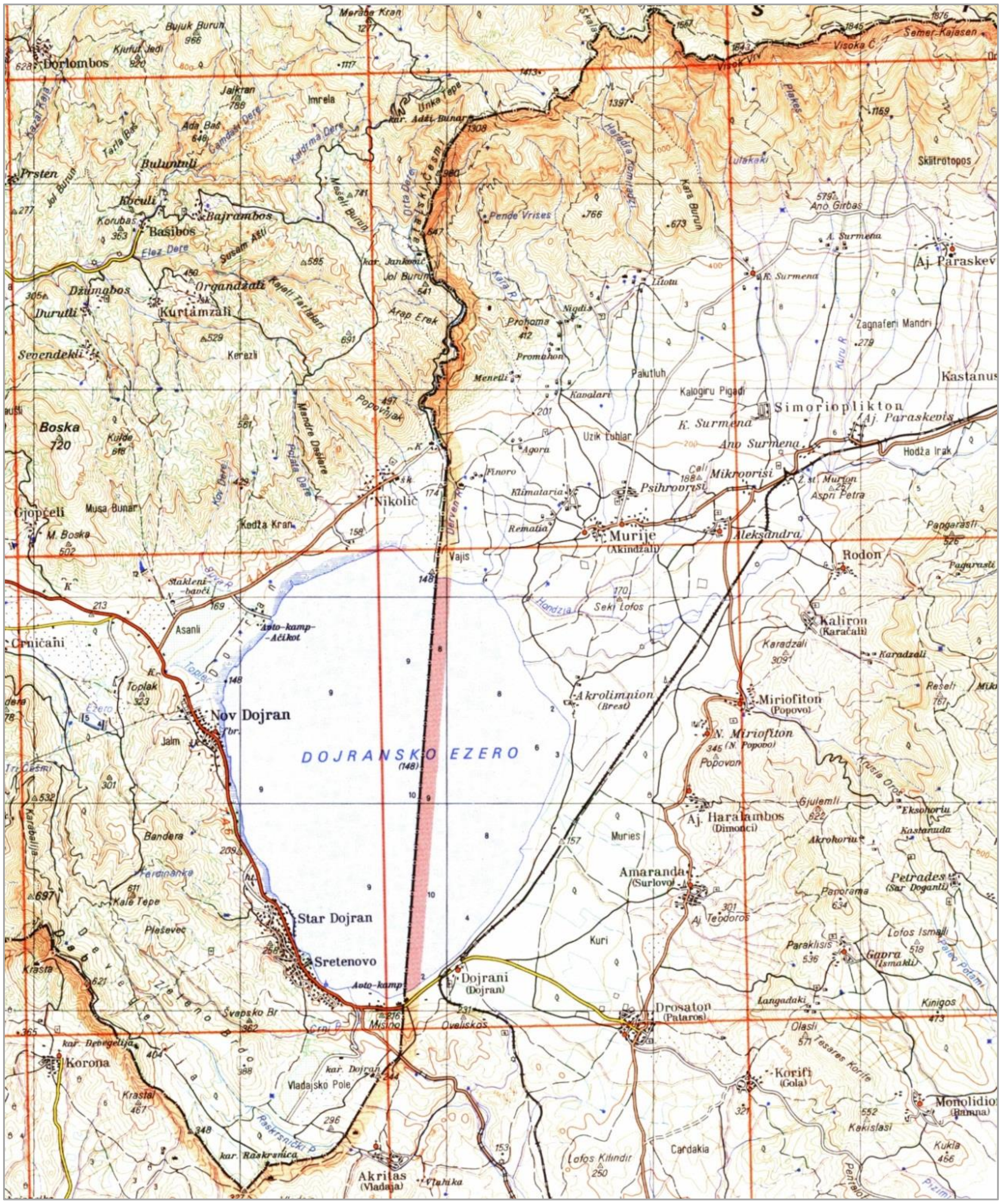


Figure 15. Topographic position of Dojran Lake in the Dojran Valley (Excerpt from TK100, MCI, Belgrade)

Dojran Lake is characterized by a low and unbranched shoreline which is about 25 km long (of which about 15 km are in the R. N. Macedonia). Lake Dojran gets its water mainly from Golema Reka (13.6 km with a basin of 94 km^2), Surlovska Reka and the Toplec canal which brings groundwater from the locality Toplec in the area of the village Gjavato near the river Vardar in Gevgelija (Bogdansko) Pole and several other smaller rivers. The inflow of water seems to be insufficient against the evaporation and utilization of the water from the lake, so that the variations in the level of the lake are frequent. The

temperature of the water in Dojran Lake in the summer period of the year is mostly over 20^0C and in winter the lake in the coastal parts freezes. The transparency of the water in the lake is up to about 3.5m. The movement of water is closely dependent on local winds. Dojran Lake is characterized by a coastline that is mostly overgrown with swamp vegetation. It is rich in phyto and zooplankton and fish stock. It also has a variety of birds. The cormorant used for traditional fishing is characteristic. The lake has no surface runoff, and the water is lost by straightening and capturing the irrigation water (Golaya canal on the Greek side). The lake and its ecosystem are extremely vulnerable to anthropogenic influences and climate change, which was especially manifested at the beginning of this century (2000-2002) when the lowest water level and 80% volume reduction was registered. This situation had an impact on water quality, reduction of plankton, reduction of biodiversity, but also many negative economic and social consequences. To reduce the consequences for the lake ecosystem, a hydro system was built to bring additional quantities of water from the Gjavato well system.

Strumica Lake (Lake Vodoca). Strumica Lake or also known as Lake Vodoca was built in 1966 on the river Vodocha at a distance of about 8 km from the city of Strumica. This reservoir has a length of 3.25 km, a width of about 600 m, so that it covers an area of 1.94 km. It has a depth of 42 m and a water volume of 26.730.000 m^3 of water (Nikodinovski, B. 2000).

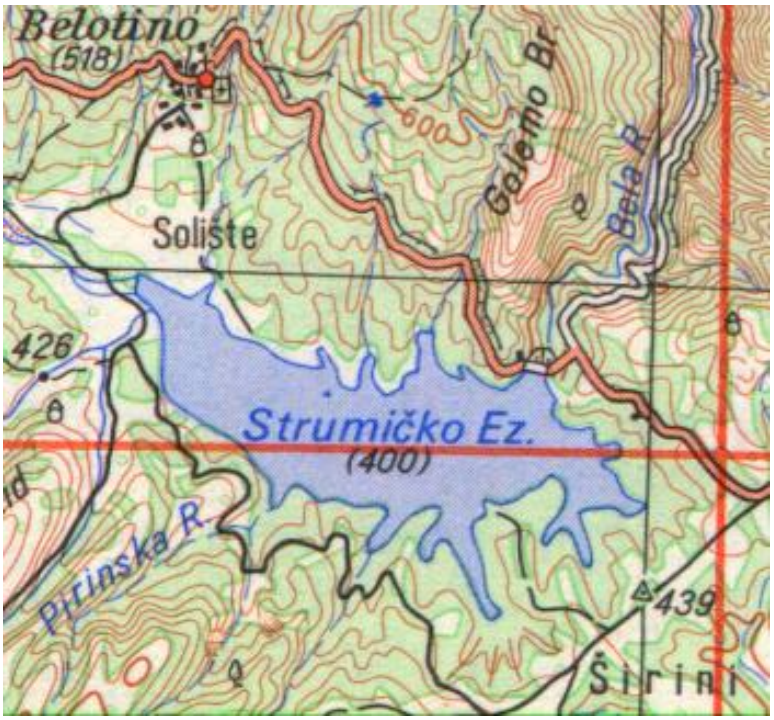


Figure 16. Topographic location of Vodoca lake (Excerpt from ТК100, ВГИ, Belgrade)

It is intended for water supply of the population from Strumica and irrigation of about 4,200 ha of arable land in the Strumica Valley. Lake Vodocha due to its proximity to the city of Strumica allows it to be used for recreational activities of local character but also as a complementary tourist motive within the wider tourist offer (Grupa autori, 1999).

Lake Turia. Lake Turija is an artificial reservoir built in 1972 on the river of the same name Turija in the Strumica Valley. It is located 16 km northeast of Strumica (Nikodinovski, B. 2000). The dam is

earth-embankment with a clay core through which gravel and stone are poured. The crown is 417.3 m long, 8 m wide and 78 m high. The length of the lake part is 4.5 km, the width is 500 m. It covers an area of 0.16 km^2. The total volume of the accumulation pool is 48.000.000 m^3, of which 3.000.000 m^3 is dead space (Group of authors, 1999). It is used for irrigation of 10,000 ha of arable agricultural land in Strumica Field (Stojmilov A. 2002) water supply and electricity production.

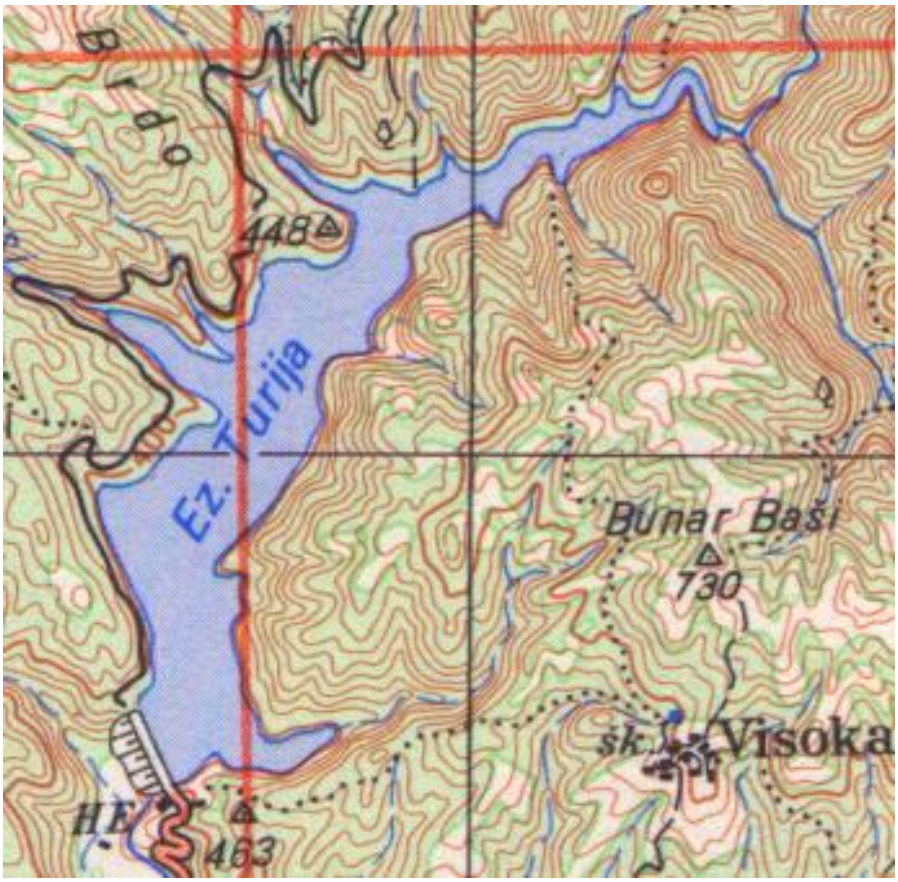


Figure 17. Topographic location of Turija Lake
(Excerpt from ТК100, ВГИ, Belgrade)

In the Strumica river basin there are other smaller artificial reservoirs that are mainly intended for irrigation of agricultural areas. Such are the small accumulations Ilovica and Drvoska in the Municipality of Bosilovo, Novoselska in the Municipality of Novo Selo and Markova Brana in the Municipality of Strumica.

Lake Mantovo. Lake Mantovo is an artificial reservoir built in 1978 on the river Kriva Lakavica in the southeastern part of R. N. Macedonia near the villages of Dolni Radesh, Gabrevci, Dolna Vrashtica and Garvan to the west where the dam is located. The dam is a stone embankment with a clay core. It is located 15 km from the village of Konce, 18 km from Radovish and 25 km from Stip. The lake is at an altitude of 402 m has an elongated shape and extends in an east-west direction with several elongated bays on both sides of the lake. Its total length is 5.5 km, average width 0.8 km, and total area 4.49 km^2. The greatest depth is 20 m and is measured next to the dam. According to its capacity, the lake accumulates water up to 47.5 million m^3. Water temperature in summer reaches 24^{0}C. The main sources of water inflow are the rivers Kriva Lakavica, Konechka Reka and Gabreska Reka. Also, as a larger

catchment area, several torrent valleys flow into the dam such as: Zgorechki, Skorushki and Borovski Dol (Kostov, V. 2015).

The basic functions of the lake are irrigation of Radovishko Pole, water supply of the Municipality of Konce and provision of water for the needs of the mine Buchim. However, of all these functions, the lake today is used only for water supply of the Buchim mine, which annually provides about 2 million m^3 of water, so that the utilization of the lake's water potential is only about 10% (Igeographia, January 26, 2015). The lake is rich in rich and diverse biodiversity so that many species of freshwater fish and birds are found. The most common types of fish are carp, catfish, Prussian carp, perch, chub, bleak, nase, common roach and tench. Frogs, water turtles and water snakes are also found in the reservoir (Kostov, V. 2015). Near the lake is the hill Gabrovska Chuka unexplored archaeological site and on the hill rise vertical granite rocks with a height of 2 to 25 meters. The lake administratively belongs to the territory of the municipality of Konce.

Figure 18. Topographic location of Mantovo Lake (Excerpt from ТК100, ВГИ, Belgrade)

Lake Paljurci. Lake Paljurci is an accumulation whose dam was built in 1977 in order to use the water for irrigation of agricultural areas in the Municipality of Bogdanci. The lake is built on the river Luda Mara 4 km east of the town of Bogdanci. The dam is filled with a clay core, made of local material. The height of the dam is 22.5 m. The total volume of the dam at normal level is 2.9 million m^3, and the useful volume is 2.6 million m^3 (Group of authors, 1999). The storage area is quite favorable in terms of its stability and there is no danger of landslides and landslides (Municipality of Bogdanci, 2014).

In the vicinity of the lake, on the territory of the Municipality of Bogdanci other reservoirs have been built. Out of these, Taljushnica, Motorna and the Tyrolean intake of the Gabrovska River are associated with the Paljurci reservoir.

Figure 19. Topographic location of Paljurci Lake (Excerpt ТК100, ВГИ, Belgrade)

3.1.7. PEDOLOGICAL COMPOSITION

3.1.7.1. SOIL TYPES AND DISTRIBUTION IN THE SOUTH EAST REGION

The relatively pronounced tectonic activity on the territory of the South-East Region and the diverse geological base with the presence of rocks of different ages and origins have enabled the formation of different types of soils in the region. In addition to the peripheral geological formations in the region, the rock masses in the central parts have a great role in the formation of the soil in which besides magmatic and metamorphic rocks there are also typical sedimentary rocks of limestone and marble. From these rocks in the formation of the soils are reflected influences towards the fields in Strumica-Radovish, towards the fields in Gevgelija-Valandovo Valley and towards Dojran Valley.

The different types of soils in the South-East Region are distributed so that **K**-colluvial soils predominate in the plains and more directly along the river Strumica in Radovishko Pole and the river flow of Vardar in Valandovo and Gevgelija valley are spread **J**-fluvial soils.

Peripherally from the Strumica Field towards the mountain Ograzden are spread soils of type **R**-regosol, **E**-leptosol and **ATa**-regosol colluvial terraced. Going high on the mountain Ograzden are spread **B**-brown forest soils and **Lm/U**-rankers that extend in the higher parts of the mountain Plachkovica.

In the lower parts of Plachkovica (towards Radovishko Pole) and along the mountain Smrdesh are found areas under **Lc/R**-cinnamon forest soil and regosol, **B/R**-brown forest soil and regosol, **Lm/U/R/E**-ranker, regosol and leptosol, **Lc-**cinnamon forest soil, **Rz**-rendzina and other smaller fragments.

In the upper gray parts of Kriva Lakavica, in addition to the above, **Lc/R**-cinnamon forest soil and regosol, **R/E**-regosol and leptosol are also found.

V-resins are found in the area around Lake Strumica and walking on the heights of the mountain Belasica **B**-brown forest soils spread, and at the foot along Belasica, **J-**fluviatile soils spread. **B**-brown forest soils, **B/R-**brown forest soil and regosol, Lc-cinnamon forest soil, **R/E**-regosol and leptosol, **Lm/ U/ R/E**- ranker, regosol and leptosol. In the area between Valandovo Field, Gevgelija Field and Dojran Trench are widespread soils of the types **B**-brown forest soils, **R**-regosol, **R/E**-regosol and leptosol, **ATa**-regosol colluvial terraced, **B / R**-brown rego forest soil, and **Rz**-rendzina, **Lc-**cinnamon forest soil, **K**-colluvial soil, **Lvd**-brown soil on limestones and dolomites.

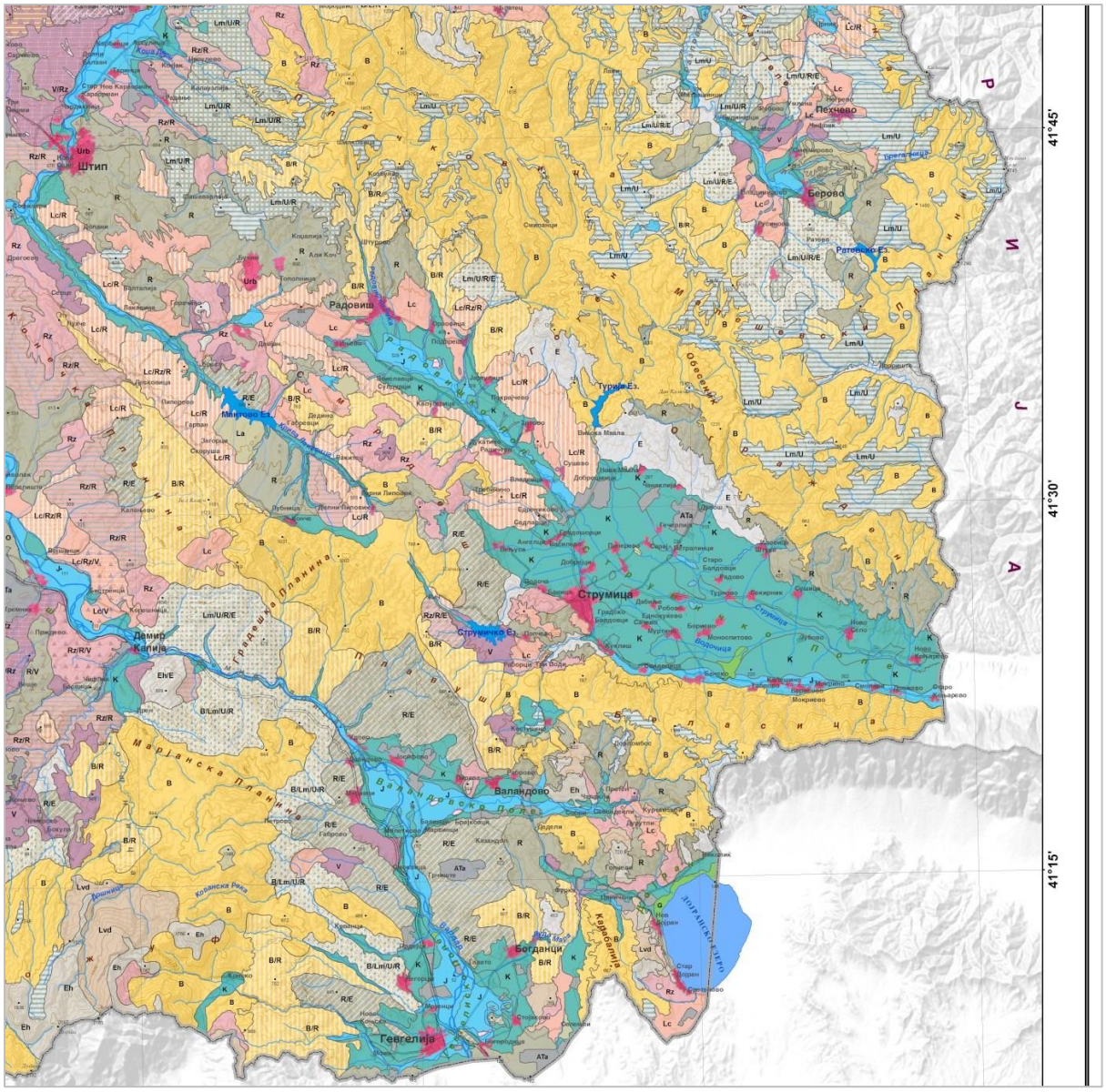


Figure 20. Excerpt from the soil map of the Republic of N. Macedonia Soil types with markings: **K**-colluvial soils **J**-fluviatile soils, **R**-regosol, **E**-leptosol, **AT**a-regosol colloidal terraced, **B**-brown forest soils, **Lm**/**U**-rankers, **Lc /R** -cinnamed forest soil and regosol, **B/R**-brown forest soil and regosol, **Lm/ U/R/E**-ranker, regosol and leptosol, **Lc**-cinnamon forest soil, **Rz**-rendzina, **Lc/R**-cinnamon forest soil and regosol,**R /E**-regosol and leptosol, **V**-resins, **B**-brown forest soils, **B/R**-brown forest soil and regosol, **Lc**-cinnamon forest soil, **Lm/U/R/E**-ranker, regosol and leptosol, **Lvd** -black soil on limestones and dolomites, **B/Lm/U/R**-brown forest soil and ranker (Source: Agricultural Institute - University "Ss. Cyril and Methodius" in Skopje, 2015)

R/E-regosol and leptosol, **B/R**-brown forest soil and regosol, **B**-brown forest soils, **Lvd**-brown soil on limestones and dolomites, **B/Lm/U** are widespread along the hills and slopes of Kozuf and Marjanska Mountain. **R**-brown forest soil and ranker and other types of soils present in smaller fragments. According to the soil type areas in the South-East Region the most common are **B-**brown forest soils (in mountainous areas), **K-**colluvial soil (mostly in the plains of the valleys), **R/E**-regosol and leptosol (along the periphery of the mountains around Gevgelija Valandovo Field), **Lc/R**-cinnamon forest soil and regosol and **R-**regosol. Other soils are spread on smaller areas and in different locations (Agricultural Institute - University "St. Cyril and Methodius" - Skopje, 2015)

Soil use. Colluvial and fluvial soils, mainly distributed in the plains of Gevgelija-Valandovo and Strumica-Radovis valley are used for agricultural production of various crops but according to climatic conditions and water potential are mostly used for growing horticultural and viticultural crops. Of course, various other agricultural and fruit crops are also present.

Soil degradation. In some locations in the territory of the South-East Region due to geological, geomorphological and pedographic characteristics the so-called degraded terrains and soils are present. They are mainly areas with a greater slope, exposed to southern and southwestern exposures, without adequate vegetation (especially from forest), so they are subject to a greater degree of erosion, especially during heavy rains. Man also participates in the degradation of soils through the exploitation of mineral metallic and non-metallic raw materials (typical examples are the mines Buchim and Damjan, as well as the new locations in the settlements Ilovica and the locality Kazandol).

Soil rating (bonitet). The soils in the South-East Region according to the bonitet classes belong to different classes. However, since a significant part of the territory is flat areas, a large part of the soils, especially colluvial, fluvujatil and resinous are characterized by higher bonitet classes. If the irrigation conditions and the conjuncture of the crops are added to that quality, it is concluded that most of the plain territories have areas with a relatively high class of soils. Regionally, this group includes the territories of the plains in Damjansko Pole, Radovishko Pole, Strumica Field, Valandovo Field, Gevgelija Field and Dojran Field. Other soil types, mainly distributed on mountain ranges and elevations, are characterized by a lower class (mainly from V-VIII-class, and therefore forest and grassy plant species are present on those areas and in such a capacity they are used.

3.2. SOCIO-GEOGRAPHIC FEATURES OF THE REGION

3.2.1. POPULATION

3.2.1.1. DYNAMICS AND REASONS FOR THE POPLUATION DEVELOPMENT TREND

In addition to the natural features of each region, the characteristics of the population are also important. This also applies to the territory of the South-East Region. But in conditions of an unpopulated population census in R. N. Macedonia in a long period of time it is difficult to present relevant analyzes regarding the demographic and demographic characteristics of the population in the country in a specific region or municipality. Therefore, the analysis of population development in the South-East Region is made on the basis of presenting the data by settlements (through different time periods) so that the review by the smallest administrative units will provide more relevant data and analysis. In the context of the above, data on the dynamics of the population, households and dwellings by settlements and municipalities that are part of the South-East Region are presented (Annex 1). Such an approach will provide an overview of the development of the population in the rural and urban environment, and accordingly will follow certain conclusions related to the trend of other demographic structures of the population.

In the absence of a relevant population census, households and dwellings (and other demographic components of the population) in R. N. Macedonia in the last 17 years (which is a relatively long period of time for a territory and a country that is in serious transition changes) demographic analyzes for the territory of the South-East Region are made, so that the main benchmarks are: spatio-temporal components of change; changes in the number of members per household; and on the basis of direct field observations.

The spatio-temporal analysis was made so that the territorial units at the level of the settlement were put into circulation and through the series of censuses that were held after the Second World War. The data are presented in tabular form, grouped by municipalities and settlements according to the current administrative-territorial organization (since 2004).

The data show that:

• The population through the rural censuses after the 1971 census is basically (with rare exceptions) declining. The reason for that is the intensified process of industrialization and urbanization that took place in that period on the territory of R. N. Macedonia. But the process of rural population decline has become more intense since the 1994 census and has been particularly pronounced since the 2002 census. This process was influenced by the new social order and adjustment in which various industries, especially those from the primary sector were left without proper organization in the purchase of agricultural production. Thus, a large part of the population moved to the city centers, and especially to the state Capital Skopje.

• Due to natural conditions but even more so due to social changes immediately after the Second World War a large part of the settlements were completely displaced. These are mainly rural settlements from the hilly and mountainous areas in the South-East Region which were mostly inhabited by Turks who (in the period from 1950 to about 1960) moved to their home country, i.e the Republic of Turkey. It is about over 45 settlements, which is 25% of the total number of settlements in the South-East Region. There is a large number of settlements whose population is drastically reduced by 2002 which means that until today 1919. according to field observations are displaced or in a phase of displacement. The reasons are mainly in the disorganized purchase of agricultural production and the abolition of institutional infrastructure, so that the population is forced to move to nearby city centers or further (mainly to the state center which instead of decentralizing functions through political decrees increases centralization)

• Only urban settlements have a permanent increase throughout all censuses. Other municipal centers (regardless of the status of city or village based municipality) are declining especially in the period from 1994 until 2002 from the field observations we conclude that this trend has intensified after the 2002 census, so we are free to conclude that the reason for this is the pronounced "attention" to the construction and modernization of Skopje as a state center, deprivation of functions of much of the institutional infrastructure and stationing in the capital, insufficient attention to the living needs of the population from the interior of the specific region, giving the local capacities below cost and outflow of capital from the region. This is confirmed by the fact that even the city of Strumica as the largest center in the region is experiencing a slight decline in population.

• Viewed by municipalities (more recently) as separate regional units in the South-East Region, the situation is most unfavorable in the municipality of Konce, then Radovish, Dojran and so on. The most favorable situation is in the Municipality of Gevgelija.

• A separate column shows the number of households by settlements intended in the 2002 census. (because then the process of household stratification is almost complete). It is noted that in over 90% the average number of members per household is about 3 members. This means that households have lost the economic power of productive households, which is especially important for the rural (agricultural-livestock) economy. The average number of members per household is also an indicator of the vital components of the demographic development of the population. So a large number of the

population is in the older age groups, i.e it is represented by over 12% old population (as a theoretical figure that indicates serious problems in the demographic development of a particular population). The data in certain settlements show individual extremes, but these are situations that affect an insignificant number of population that is certainly associated with certain social "problems".

Table. 7. Overview of dynamic of the population across the censuses from 1948-2002 and households in 2002 per по populated places and Municipalities within South East Planning Region

Municipality	1948	1953	1961	1971	1981	1994	2002	Households 2002
Bogdanci	5328	5290	6064	7030	8316	8901	8707	2597
Bosilovo	7433	8654	10152	11200	12405	12797	12576	3214
Valandovo	10240	11305	8784	9200	11176	12092	11890	3545
Vasilevo	7682	8633	8792	9511	10966	11741	11409	3306
Gevgelija	12281	13307	14960	17142	20056	22267	22988	7221
Dojran	3807	3767	3395	3112	3442	3603	3421	1021
Konce	5312	5896	5198	4938	4212	3780	3713	1057
Novo Selo	10412	11845	12920	13762	14132	13907	12382	3244
Radovish	18011	19991	17161	20987	24363	27089	26812	8270
Strumica	26794	29883	33627	42435	49844	55906	54780	16230
TOTAL	**107300**	**118571**	**121053**	**139317**	**158912**	**172083**	**168678**	**49705**

Source: State Statistics Office of Republic of N. Macedonia, (2002) Census of the population in Republic of N. Macedonia, 1948, 1953, 1961, 1971, 1981, 1991, 1994, Book IX, Skopje.

3.2.1.2. POPULATION BY SEX AND AGE

The population by sex in the South-East Region is basically (at the level of the total population) represented by about 50%. However, looking at the characteristics of the population by gender in some areas, it is noticed that in the rural area the male population is slightly more represented. We see the reason for this in the social and cultural aspects according to which the female population in search of a safer and more comfortable life more often chooses to live in cities, so that part of the female population from rural areas moves to urban areas (in local cities, but the same or more towards other cities in the Republic of North Macedonia, especially towards Skopje). As a result, in the cities and in

some of the larger settlements and municipal centers the female population is slightly more represented.

In the general demographic development, this is a serious problem that for a relatively long period of time has a negative impact on the natural movement of the population and its vitality in general.

This situation indicates the fact that the population in the region is obsolete. At the same time, in the rural area the number of the old population is increasing more and more. This is also due to the fact that in this period of analysis the influx of elderly people is generationally higher as a result of large families from the forties, fifties and sixties of the 20th century.

The population in urban areas is somewhat more vital, because the influx of young people in cities is higher. It is on different bases, schooling, higher education, different professional orientation in accordance with the newer technical-technological processes of work and living and a number of other socio-economic conditions.

3.2.1.3. OTHER DEMOGRAPHIC CHARACTERISTICS OF THE POPULATION

Natural population development. The natural development of the population is closely dependent on the rates of fertility, nubility and consequently on the rates of birth and mortality. In the South-East Region due to the more suitable conditions for business, the population has experienced the processes of demographic transition relatively earlier. The population of this region (compared to some other regions of the Republic of N. Macedonia) has started the processes of higher education relatively earlier or has experienced cultural and traditional values so that the natural movement of the population is up to about 5 per mille.

Educational structure. The educational structure of the population in the South-East Region given the fact that a relatively large number of settlements are demographically vital so there are appropriate educational institutions that are the foundation for orientation towards a higher level of education. This means that the region has a relatively good educational structure of the population.

Population by activity. The population by activity in the region can still be characterized as economically active, although an increasing number of economically inactive people who avoid working in certain activities (especially in the field of agriculture and animal husbandry) due to inadequate organization of purchase of production, price of products , absence of food facilities and so on. Due to generational and cultural changes, the number of dependent population (young population of children and students) is permanently decreasing. On the other hand, people with personal incomes are in stagnation or a slight increase due to the generational characteristics of large families. Due to the more suitable natural (relief, climate, hydrological, pedological) conditions in the South-East Region, the population is mostly oriented towards work in the agricultural sector (especially in the field of gardening, viticulture and other agricultural branches). on the other hand, the population in the urban areas is also engaged in work in the secondary and tertiary sector.

Structure of the population per nationalities. The nationalities` structure of the population in the South-East Region is made up of Macedonians (over 90%), Turks, Roma and Serbs. The Turkish population is more represented in the municipalities of Radovis and Konce. It was largely emigrated to Turkey in the 1950s. The Roma population is mostly found in the cities of the region. The Serb population is found mainly in the Gevgelija-Valandovo Valley as a remnant of the migrations that took place between the two world wars.

Migrations. In general, the South-East Region is characterized by several aspects of migration processes. Between the two World Wars, the territory of the Gevgelija-Valandovo Valley is characterized

by immigration of the Serb population that still lives in these areas, such as the settlements of Josifovo, Udovo, Sretenovo, Nikolic and others.

Immediately after the Second World War, due to changes in the society, there was a mass emigration of the Turkish population from the South-East Region to the Republic of Turkey. It is a population that mainly existed in the hilly and mountainous settlements, was mainly engaged in animal husbandry and as a result today many of those settlements are completely displaced.

The penetration of the processes of industrialization and urbanization and insufficient conjunctural management in the hilly and mountainous villages of the mountains Plachkovica, Ograzden, Konecka and Kozuf caused migration to the plains, so that part of this population moves to the rural settlements in the mountainous area. settlements. As economically stronger with high conjunctural horticultural, viticultural and other agricultural production, the population in the plain settlements remained for a long time.

The process of migration from village to town from the plain villages in the surrounding towns in the South-East region has been happening in the last 2-3 decades due to poor organization of production, purchase and sale of agricultural production, from one and due to increasing deprivation of institutional infrastructure facilities and functions, by the larger regional city centers, and especially by the capital Skopje which caused mass migration to it from this region.

In the given conditions, a special process is the occasional migration of the population to the European countries where it is mainly engaged in agricultural activity, but it is more profitable for them than to work on their own properties. The trend continues even if no social measures are taken in the context of reducing and eliminating disproportions in the cost of labor and production, this process will certainly be reflected in a process of permanent migration to European countries (mainly Germany, Italy and Switzerland).

The intensity of migrations in terms of daily migration, ie emigration without relevant data and the absence of a population census can not be shown and it is irrelevant in the context of this study.

3.2.2.SETTLEMENTS

3.2.2.1. NUMBER AND CHANGES IN THE SIZE OF SETTLEMENTS

In the South-East Region of R. N. Macedonia in 10 municipalities there are 188 cadastral municipalities (settlements). From the total number of settlements in the region, according to the number of population in the 2002 census there are 32 completely displaced settlements, 22 are with 0-50 inhabitants, 6 are with 50-100, 23 are with 100-300 inhabitants. This means that 85 or 45% of the settlements are in the group of displaced and small rural settlements which according to field observations (after 18 years of the census) are in the phase of displacement. According to the population size of the settlements, 29 have 300-500 inhabitants, 22 have 500-800 and 12 villages have 800-1000 inhabitants and these are included in the group of medium settlements. They cost about 33.5%. Many of these settlements in the last 1-2 decades are displaced and thus transformed into a group of small settlements. Large settlements (including cities) include 33 settlements, of which 12 are with a population of 1000-1500 inhabitants, 11 have 1500-2000 inhabitants, 6 are with 2000-5000 inhabitants and 4 are with over 5000 inhabitants (SSO of RNM, 2002, 2004). It is concluded that in the period of demographic and social transition in the South-East Region, great changes have taken place in terms of population displacement in places with pronounced depopulation and deagrarization of space. It is especially pronounced in the mountainous, hilly and plain areas of the region.

There are settlements located in the plains of the valleys, more directly related to road infrastructure, city centers, agricultural land covered with reclamation systems and similar.

Density of settlements and population. The average size of rural areas is 14.7 km^2 per settlement. The population density is below the national average. Only the municipalities of Bogdanci, Bosilovo and Strumica (because of the city) are above the state average and all other municipalities are below it, ie as follows Bogdanci 76 inhb/km^2, Bosilovo 83 inhb/km^2, Valandovo 36 inhb/km^2, Vasilevo 49 inhb/km^2, Gevgelija 45 inhb/km^2, Dojran 26 inhb/km^2, Konce 16 inhb/km^2, Novo Selo 59 inhb/km^2, Radovish 53 inhb/km^2, Strumica 152 inhb/km^2.

Rural regionalization and classification of settlements. In the context of the immediate terrain of the settlements in the South-East Region, several rural areas stand out, namely Radovishko Pole, Strumica Field, Valandovo Field, Gevgelija Field and Dojran Field. Of course, these areas also include the municipal and city centers.

Functional features of the settlements. According to the functional characteristics of the settlements in the South-East Region, there are two types of settlements, one with monofunctional character (mainly rural settlements) and others with multifunctional character, including urban settlements (especially Strumica, Gevgelija, Radovish) and Valandovo). Rural settlements are basically characterized by the development of agricultural and livestock activity, more specifically focused on horticultural, viticultural and agricultural production, and in the hilly parts of the region and some development of livestock activity. The urban settlements are characterized as multifunctional from both economic and administrative, cultural, educational and health aspects. Their immediate functions are further considered separately at the city and municipal center level. The order is according to the general economic functional classification of the settlements, so they are processed according to the following order Strumica, Gevgelija, Radovish, Valandovo, Bogdanci, Bosilovo, Vasilevo, Novo Selo, Dojran and Konce.

Strumica. Strumica (Group of authors, 1999) is located in the southeastern part of R. N. Macedonia thirty kilometers west of the state border with the Republic of Bulgaria. The city is located in the southwestern part of the Strumica Valley, around $41^o26'$ N and 22^0 38 ’E and at an altitude of about 250 to 300 m. With its location Strumica has the role of a traffic crossroads for several cities in the South-East Region. Roads stretch from Strumica to Radovish and Stip to Skopje, Berovo, to the Republic of Bulgaria, and through Gevgelija and Dojran it connects with the Republic of Greece.

Strumica is one of the oldest settlements in the country. It dates back to the ancient period, so it is mentioned as early as 181. п. n. e. under the name Astranon (city of the stars) as the main residence of the Peonian tribe Astron. In the Middle Ages it is mentioned as Tiberiopolis as a Roman-Byzantine and ecclesiastical city and Strumica as a Slavic name of the city derived from the name of the river Strumica, a dative from the name of the river Struma.

The current site was rebuilt in the 10th century by King Samuel. During that period it grew into an important traffic and military-strategic center. After the death of King Samuel in 1018 and the disintegration of Samoil's empire, Strumica is a Byzantine military-strategic and administrative center for this part of North Macedonia, and the Strumica diocese continued to exist. He had such a role until the end of the XII century when together with the fortress town Prosek they became the seat of an independent principality of Dobromir Hrs. Namely, from the XI to XIV century it falls under several interesting spheres: Bulgaria, Byzantium and medieval Serbia.

At the end of the 14th century he fell under Turkish slavery. In this period it is named with the forms Ustrumdza, Ustrumca and Strumdza (in Turkish). Located on the famous Serski road during the Turkish rule, Strumica has the role of an intermediary for the exchange of agricultural and manufacturing goods. He retained such a role even after the construction of the Vardar Railway when goods were transported from Udovo to Eastern Macedonia.

This role in the region enabled a significant population growth, which in the period before the Balkan Wars Strumica had 18,000 inhabitants. After the Balkan Wars and the First World War, due to the emigration of the Muslim population in Turkey, the population of the city decreased. This has had a negative impact on crafts and trade. With the establishment of the political border with Greece, the city decreased in number of inhabitants and in 1921 6143 inhabitants were registered. In the period between the two world wars, Strumica is a small craft town with an underdeveloped economy.

In the post-war period, economic and population growth continuously (1948 10868 inhabitants; 1953 12149 inhabitants; 1961 15949 inhabitants; 1971 23034 inhabitants; 1981 29263 inhabitants; 1994 34067; 2002 34067 inhabitants). The increase after 1961 is emphasized (SSO of RM, 2002, 2004) due to the increased degree of industrialization and urbanization and immigration of the rural population in the city.

In addition to agriculture (horticultural crops, tobacco), the city is characterized by developed activities from the secondary (food, textile and tobacco industry) and tertiary sector. Today Strumica is an administrative, cultural, educational, health and economic functional center in one of the most developed agrarian areas in the country. As such, it has a wide zone of influence on the rural settlements from Strumica, but also from the area of Radovish and Valandovo.

Gevgelija. Gevgelija (Group of authors, 1999) is located in the southern part of R. N. Macedonia. The city is located in the southernmost part of the Gevgelija-Valandovo Valley at 410 08 'N and 22^0 31 ’E at about 60 m asl right next to the state border with the Greece. It is the lowest urban settlement in the country. As it is located next to the highway and the railway Belgrade-Skopje-Gevgelija-Thessaloniki, it is well connected by traffic. The highway has regional roads that connect with Strumica and Dojran. The name of Gevgelija is associated with several legends. According to one of them, the name comes from the Greek words Gevgelateo or zevgelatia meaning arable land. In medieval documents and records, the word Gevgelija was used to mean a feudal form of land ownership, which meant that the villagers had their own Gevgelija. From these forms it is assumed that the present name originated. According to other interpretations, the name may be derived from the words zevgar, zevgaria (due to the cultivation of the land with zevgar (chivt) oxen) or because of the thick shadows that in a foreign language were named with *гели-гели* meaning shadowy place, from where the toponym Gevgelija is derived from the dialect; or from the words gel ger with the meaning come back, etc. It is first mentioned as a village settlement in official Turkish documents from 1664. From 1665 to 1832 is a larger rural settlement, a farm settlement and the center of the nahija. In this period (1863) part of the population is engaged in silkworm breeding.

Located along the important roads that led from Thessaloniki and Dojran to Skopje and Strumica, in the middle of the XIX century Gevgelija recorded rapid economic development. Therefore, from 1850 to 1870 is an important economic center for this region, and from 1871 to 1886. The first trade and craft shops were opened in it. It progressed especially fast after the construction of the railway Skopje-Thessaloniki so that in 1877 the settlement had over 2000 inhabitants. With this economic and population growth, Gevgelija resembled a city settlement, and already in 1886. with over 3000 inhabitants and officially acquires the status of a city. After this, even more pronounced population growth was observed in 1890. Gevgelija had 4200 inhabitants. The city progressed until the Balkan Wars, to stagnate economically during the First World War and between the two world wars.

In the post-war period Gevgelija has seen an increase in population (1948 4967 inhabitants; 1953 5777 inhabitants; 1961 7332 inhabitants; 1971 9414 inhabitants; 1981 12399 inhabitants; 1994 14974, 2002 15685 inhabitants) (SSO of RM, 2002, 2004). Gevgelija is also developing economically. Agriculture, industry and tourism play a major role in the economy.

Gevgelija is a modern border town with all the necessary city functions, so it is a direct center of gravity for about 17 settlements but also for most settlements in Gevgelija-Valandovo and Dojran Valley.

Radovish. The city of Radovis (Group of authors, 1999) is located in the South-East Region of R.N. Macedonia, in the Strumica-Radovis Valley on 41^0 38 'N and 220 28 'E at about 380 m asl at the foot of the mountain Plachkovica. The Radovishka River passes through it.

Radovish is located on the road between Stip and Strumica, so it is almost equally distant from the two regional centers. Traces of material culture have been found on the territory of Radovish since prehistoric times. The findings from the Neolithic, Eneolithic, Hallstatt and Bronze Ages are especially interesting. But the city of Radovis is first mentioned in 1019. in the Letter of the Byzantine Emperor Basil II, and it was also called the medieval parish, which shows that the city function dates back to the Middle Ages. At that time Radovish was an important regional trade, craft and mining center. The name of the town of Radovis is associated with the name of the medieval princess of Slavic origin, Rada, who lived in the fortress above the town, whose ruins still exist. The territory of the municipality of Radovis is rich with explored and many unexplored archeological sites, monasteries and churches that are part of the rich treasury of cultural monuments.

During the Turkish rule in the early 16th century, this area was inhabited by a large number of Yuruci (Turkish nomadic tribe), so that a population of this ethnic group in Radovish and Radovish region can be found today. In the 19th and 20th century Radovish and the surrounding area were influenced by historical events related to the Razlovich, Kresna and Ilinden uprisings, the events of the Balkan Wars, the First and Second World War, so that the period after World War II is a period of today's appearance of Radovish.

In the post-war period, Radovish population is constantly growing, so that in 1948. has 4678 inhabitants; 1953 5255; 1961 6246; 1971 9639; 1981 12188; 1994 1506; and in 2002 15068 inhabitants (SSO of RM, 2002, 2004)). Radovish is also developing economically. In its immediate vicinity, the Damjan mine (now closed) and the Buchim copper mine, which is the main initiator of the economy in Radovis, were operating. As a result, several industrial enterprises operated in Radovis. In addition, agriculture, livestock, trade and other sectors play a major role in the economy.

Radovish is a modern city, the center of the municipality with all the necessary city functions, so it is the second immediate center of gravity (besides Strumica) for the settlements of the municipality and beyond.

Valandovo. Valandovo (Group of authors, 1999) is located in the South-East Region of R. N. Macedonia, in Valandovo Field, at the foot of Mount Plavush. The location of Valandovo is at 41^0 19 'N. and 22^0 34 ’E at about 100 to 150 m asl It is located in the immediate vicinity of the highway and the railway on the route Belgrade-Skopje-Thessaloniki, through which it connects with Skopje and Gevgelija, it is regionally in direct traffic communication with Strumica and Dojran. It is not known for sure when Valandovo was founded, but according to archeological excavations it is known for sure that the area of today's Valandovo was inhabited a long time ago, and today Valandovo lies on a Roman settlement known as Micro Constantinople meaning Little Constantinople. The Slavs in the area of Valandovo settled at the end of the VI century and the beginning of the VII century when they assimilated the existing population, so that the settlements got a new ethnic character and new Slavic names. In written sources, Valandovo was first mentioned in the 10th century under the name Valander, probably due to the beautiful location of the city in the valley.

It is mentioned in medieval monuments as a settlement when in a church charter of Tsar Dushan from 1349. under the name Alavandovo meaning flower city or city of flowers, as well as Lavender meaning fragrant flowers, which perfectly corresponds to the greenery and flowers in the space. From these names comes the present name of the city. Regarding the name, there is a legend that says that the city bears the name of its founder Vlando, etc.

During the period of its existence, Valandovo was exposed to a series of natural disasters and invasions of invaders. Slower economic development and lower population growth were observed after

the construction of the Thessaloniki-Skopje railway line and the emigration of Turks after the Balkan Wars. Namely in 1914. the town had only 985 inhabitants and resembled a village. It developed as a small town only after 1915-16. More precisely, then he took over the functions of Star Dojran, who was killed during the war. It becomes the seat of the then Dojran region and the population grows. In 1921 it had 1060 inhabitants. At the beginning of March 1931. the city was devastated by a catastrophic earthquake which significantly reduced its population.

After the Second World War the population is constantly growing (1948 1992; 1953 2178; 1961 2201; 1971 2779; 1981 3798; 1994 4357 and in 2002 4402 inhabitants (SSO of RM , 2002, 2004)). In the economy of Valandovo agriculture has a primary place (gardening and viticulture), and very modestly present industry (food, tobacco and textile industry). Thus, the town has an agricultural-industrial function in the region. Today Valandovo is an administrative and economic center for the rural population of its small area of influence.

Bogdanci. Bogdanci (Grupa autori, 1999) is a settlement located in the eastern part of Gevgelija Field, on the road that leads from Gevgelija to Dojran Lake, i.e at 41^0 12 'N and 22^0 35 'E at about 70 to 130 m asl 8 km north of the Macedonian-Greek border. It is a flat settlement. Its existence is mentioned from the beginning of the 18th century i.e 1715. The location in the past was in the locality "Gorno Selo" which is still called that today, and then the settlement was relocated to the southeast for 500-1000 m from the old settlement. The area covers 67 km^2 of which 1589.6 ha of arable land, 2103.3 ha of pastures and 2723.9 ha of forests. Bogdanci is characterized as a settlement with mixed functions. The settlement is urban well-arranged with properly built infrastructure and modern buildings. Regulation of the river Luda Mara has been performed, the reservoir "Paljurci" was built in 1957 and the irrigation system "Gjavato" and Kanal Bogdanci were built. Dominant activity is gardening. ATP "Mlaz" (one of the largest transport companies at the level of the Yugoslav Federation) was founded in 1958 and within it in 1985 a trailer factory has also been opened. The settlement was electrified in 1945. In 1957 the construction of a water supply system has started, and the following have been built: cooperative home, health center, pharmacy, school, hotel, veterinary station, agricultural cooperative, shops and catering facilities, monument to the National Liberation War, house of culture, an urban plan, etc. In 1961 had 3290 inhabitants, while in 1994 6031 inhabitants and in 2002 6011 inhabitants, of which about 5800 are Macedonians.

Bosilovo. Bosilovo is a settlement located in the central part of the Strumica Field, along the left side of the river Strumica is the seat of the Municipality of the same name. The role of the municipal center Bosilovo had during the period until 1965. The village is flat at 41^0 26 'N and 22^0 44 'E at about 210-240 m asl It is 8 km away from the city of Strumica. The area covers an area of 8.1 km^2. The arable land occupies an area of 708.6 ha, the pastures 39.5 ha, and the forests occupy 1.4 ha. The village has an agricultural function. It has an eight-year school, an ambulance, a post office, shops, catering facilities, a factory. The settlement in 1948 counted 1069; in 1953 1167; in 1961 1433; in 1971 1575; in 1981 1737; in 1994 1755 and in 2002 1701 inhabitants (Group of authors, 1999).

Vasilevo. Vasilevo is a settlement located in the central part of the Strumica Field, north of the city of Strumica. It is located at 41^0 28 'N and 22^0 39 'E at about 230-235 m asl and is a typical plain settlement. Vasilevo is the seat of the municipality of the same name. The area covers an area of 7.6 km^2. The arable land covers an area of 630.3 ha, the pastures account for 48.9 ha. The village has an agricultural function. It has an eight-year school, an ambulance, a post office, an agricultural cooperative, shops and restaurants, a National Liberation War monument, a house of culture, a veterinary station and an urban plan. Vasilevo is a large settlement, with a growing population. In 1519 numbered 55 families, of which 4 Muslim families. The settlement in 1948 counted 630; in 1953 718; in 1961 989; in 1971 1332; in 1981 1784; in 1994 2105 and in 2002 2050 inhabitants of which about 95% are Macedonians (Group of authors, 1999).

Novo Selo. Novo Selo is a settlement located in Strumica Field, east of the city of Strumica near the border with the Republic of Bulgaria at 41^0 25 'N and 22^0 58 'E at about 230 m asl It is a mostly flat settlement. Novo Selo is the seat of the municipality of the same name. The area covers an area of 19.21 km^2. Of these, 759 ha are arable land, 442 ha are pastures, 550 ha are forests and the rest are barren areas. The village has an agricultural function. There is an eight-year school in Novo Selo, with an ambulance, post office, agricultural cooperative, shops and catering facilities, a house of culture, a veterinary station and other institutions. The population in Novo Selo is constantly growing. In 1948 counted 1246; in 1953 1443; in 1961 1833; in 1971 2143; in 1981 2562; in 1994 2829 and in 2002 2692 inhabitants, 99% of whom are Macedonians (Grupa autori, 1999).

Dojran. Dojran is a settlement located along the shores of Lake Dojran. Today two separate but very close settlements Nov Dojran and Star Dojran are known. They are located near the border with the Hellenic Republic at 41^0 17 'N and 22^0 43 'E at about 150-230 m above sea level. Star Dojran is the seat of the municipality. The area of Nov Dojran covers an area of 18.3 km^2, of which 399 ha are arable land, 241 ha are pastures, 1132 ha are forests and the rest are barren areas. On the other hand, the area of Star Dojran covers a total of 9.21 km^2, of which 21 ha are arable land, 381 ha pastures, 490 ha forests and others are barren land. Dojran is characterized as a settlement with a predominantly tourist function, but regular occupation is also agricultural activity and fishing (Grupa autori, 1999). There is an eight-year school in Dojran, there is an ambulance, post office, shops, a number of catering facilities, a house of culture and other institutions. The population in Dojran is as follows:

Table 8. Population in Dojran

Inhabited place	1948	1953	1961	1971	1981	1994	2002
Star Dojran	190	105	107	260	270	348	328
Nov Dojran	1083	941	1116	1033	1035	1142	1199

Dojran with its characteristics on the shores of Lake Dojran as a municipal center has a number of functions and is a gravity center for the population in the municipality. But due to Lake Dojran, its gravitational influence has a national and to some extent international character.

Konche. Konce is located in the source area of the Kriva Lakavica river basin. It is located at 41^0 30 'N and 22^0 28 'E at about 550-600 m asl about 20 km southwest of Radovish with which it is connected by an asphalt road. The area covers an area of 45 km^2 and extends to the ridge of Konecka Mountain, so that the village is a hilly mountain settlement. The arable land covers an area of 1185 ha, the pastures 328 ha, and the forests occupy 2721 ha and the rest are barren areas. Accordingly, the village is characterized by a mixed agricultural and livestock function. There is a primary school in Konce, there is an ambulance, post office, shops and service facilities. Konce was an important and famous place in the Middle Ages. In 1519, Konce counted 100 Christian and 4 Muslim families. Konce is a settlement that in 1948. counted 1246; in 1953 1335; in 1961 980; in 1971 966; in 1981 979; in 1994 997 and in 2002 977 inhabitants, of which about 50% are Macedonians and Turks (Grupa autori, 1999). As one of the more developed and larger population, Konce is a municipal and gravity center for the population of the municipality of the same name.

3.2.2.2. OTHER ANTHROPOGENIC VALUES IN THE SOUTH EAST REGION

There are other anthropogenic values in the South-East Region such as archeological sites, cultural and historical monuments and cultural events.

Archaeological sites.The territory of the South-East Region is home to numerous famous historical sites and buildings of high cultural value. The Archaeological site "Isar" in the village of Marvinci, then "Idomena" - underground cultural monument, "Stakina Cheshma" in the Municipality of Valandovo, the archeological site "Stranata" near the village of Angelci, as well as the church "St. Petka "in the village of Trebicino, Municipality of Vasilevo, the archeological site Vardarski rid in the Municipality of Gevgelija, the Monastery of St. Stefan in the Municipality of Konce, the archeological site" Crveno Pole "near the village Barbarevo," Keramidarka "necropolis from the 11th century in the village of Mokrino, Municipality of Novo Selo, the church "Holy Trinity" in the Municipality of Radovis, the Monastery Church of the Holy Mother of God Merciful (Eleusa) in the village of Veljusa, the church complex of Sts. Leontij in the village of Vodoca as well as the famous site Carevi Kuli in the municipality of Strumica and other buildings that mark the civilization and cultural past of this area.

Cultural manifestations. A series of cultural and sports events, festivals, exhibitions and performances are organized in the settlements of the municipalities in the South-East Region which are organized in large numbers throughout the year. Some of the more important events are: Folk Fest Valandovo; Strumica Carnival; Strumica Open Festival; Fig tree Gevgelija; Leek Day, village Gradashorci, Vasilevo; Smolar Chestnut Festival, Novo Selo; May Day races in the village. Stojakovo, Bogdanci; Festival of original folklore Gajda in village of Injevo, Radovish; Manifestation ‘’Topol Kulturen Bran’’, Manifestation ‘’Dojranski Rakuvanja’’; Holiday of the Municipality of Bosilovo, etc.

3.3. ECONOMIC-GEOGRAPHICAL CHARACTERISTICS

The economic and geographical characteristics of the South-East Region are elaborated in a general sense but in such a way that they should provide functionality in the context of the Regional Biodiversity Strategy. In this regard, the characteristics of agricultural areas by cadastral crops, grouped as arable land, pastures, forests and bare ланд are presented below. Due to the comparison with the anthropogenic factor, data on the total population by municipalities in the region have been moved. The immediate functional features of the municipalities are also presented through the presence of the prevailing industries and the equipping of the municipal centers with institutional infrastructure Table 3.9. As mentioned earlier, the territory of the South-East Region consists of 10 municipalities. They differ according to geographical position, relief structure, hydrographic features, pedological characteristics, socio-geographical and economic-geographical characteristics. It is about four different geomorphological units, namely the Strumica-Radovis Valley, the Gevgelija-Valandovo Valley, the Krivolakavica Valley and the Dojran Valley. They all have certain peculiarities according to which the economic development takes place. However, from the data in the table, it is obvious that the main determinant in economic development is agricultural land. In the analysis, the sizes of arable land, pastures, forests and bare land are taken as the most relevant. It is noted that at the regional level about 1/4 of the land is under arable land. The municipalities of Bosilovo with 41.2%, Strumica with 34.1%, Vasilevo with 31.4%, Bogdanci with 28.6%, Novo Selo with 27.4% and so on are characterized by the highest representation of arable land. that a large part of the population is oriented towards work in the primary sector. This can be seen from the data on the presence of industries where PZ - Agriculture of cereals, Pi - Agriculture of industrial crops, Pg - Agriculture of vegetable crops, Pf - Agriculture of fodder crops, O - Fruit growing and L - Viticulture prevail.

The mentioned agricultural branches in different regions (municipalities) have different representation. Namely, in Strumica Field in the municipalities of Bosilovo, Vasilevo, Novo Selo and Strumica prevails Pg - Agriculture of vegetable crops with intensive greenhouse production of pepper,

eggplant, cucumber, watermelon, melon and various other vegetables. Other branches as well are also present, but agricultural crops predominate. From the other industries in Strumica there are developed I - Industry, Gr - Construction, Zn - Crafts, Co - Traffic, Trade - Trade, Tu - Tourism, catering (in Strumica and Novo Selo). Almost all agricultural branches are also present in Radovisko Pole, but PZ - Agriculture of cereals (wheat and barley), Pi - Agriculture of industrial crops (tobacco) prevail. O - Fruit growing is also present in this field (apricots, almonds, hazelnuts). In Damjansko Pole prevail Pzh - Agriculture of cereals (wheat, and barley), Pi - Agriculture of industrial crops (tobacco), Pf - Agriculture of fodder crops (clover, alfalfa) and S - Livestock. More characteristic for Damjansko Pole is that here (from all other regions in the region) is more developed R - Mining. The upper part of the Krivo-Lakavica Valley is characterized by agricultural branches of the type Pzh - Agriculture of cereals, Pi - Agriculture of industrial crops (tobacco), Pf - Agriculture of fodder crops (clover, alfalfa), O - Fruit growing and C - Livestock . In Valandovo valley are mostly represented the agricultural branches of the type Pg - Agriculture of horticultural crops, L - Viticulture (of different types of varieties), O - Fruit growing (pomegranates, kiwis, figs) and so on.

Table 9. Overview of the size of agricultural areas by cadastral crops, number of population and functional characteristics of the branches and equipping of the municipal centers with institutional infrastructure

Municipality	Number of settlements	Size km^2	Arable land ha	Pastures ha	Forests ha	Bare land ha	Population 2002	Industry category	**Infrastructure**
Bogdanci	4	114 100	4113 28,6	3085 27,0	3461 30,5	781 6,9	8707 /	**Pzh; Pi; Pg; O; L; I; Tu; So; Tr; Zn**	**Au; Uo; Am; Pr; Pz; H**
Bosilovo	15	153 100	6310 41,2	2808 18,3	5752 37,6	480 3,1	12576 /	**Pzh; Pi; Pr; Pf; S; P; Тр; Зн;**	**Ау; Уо; Ам; Пр; Пз;**
Valandovo	29	331 100	5634 17,0	5001 15,1	20759 62,7	1750 5,2	11890 /	**Pz; Pi; Pg; Pf; O; L; C; R; I; Tr; Zn;**	**Au; Yu; Ys; Bl; Pr; Pz;**
Vasilevo	18	231 100	7266 31,4	3820 16,5	11059 47,8	987 4,3	11409 /	**Pz; Pi; Pr; Pf; S; Sh; E; Tr; Zn;**	**Au; Uo; Am; Pr;**
Gevgelija	17	485 100	6261 12,9	4940 10,3	32776 67,6	4486 9,2	22988 /	**Pzh; Pi; Pr; O; L; Sh; I; Gr; Tu; So;**	**Au; Uo; Us; Uu; Bl; Pp; Pz; X;**

								Tp; Zn;	
Dojran	13	156 100	2530 16,3	2938 18,8	6779 43,4	3349 21,5	3421 /	**Pzh; Pi; Pg; Pf; O; L; S; Tu; Tp;**	**Au; Uo; Am; Pr; Pz; X;**
Konce	14	233 100	5165 22,2	2820 12,1	13830 59,5	1445 6,2	3713 /	**Pz; Pi; Pf; O; S; Sh;**	**Au; Up; Am; Pr;**
Novo Selo	17	268 100	7363 27,4	4802 17,9	13472 50,4	1189 4,3	12382 /	**Pzh; Pi; Pg; Pf; S; Sh; Tu; Tp; Zn;**	**Au; Uo; Am; Pr; Pz; H;**
Radovish	36	502 100	11767 23,4	7767 15,4	28925 57,6	1767 3,6	26812 /	**Pzh; Pi; Pg; Pf; O; L; S; Sh; P; I; Gr; Tu; So; Tp; Zn;**	**Au; Uo; Us; Uu; Bl; Pr; Pz; X;**
Strumica **%**	25	302 10	10308 34,1	2893 9,6	15279 50,7	1757 5,6	54780 /	**Pzh; Pi; Pr; Pf; O; L; C; Sh; E; P; I; Gr; Tu; Co; Tp; Zn;**	**Au; Uo; Us; Uu; Bl; Am; Pr; Pz; H;**
TOTAL	188	2775	66717	40874	152092	17991	168678		
%		100,0	24,1	14,7	54,8	6,4	/		

Legend

Industries: Pzh – Agriculture, cereals; Pi – Agriculture, industrial crops; Pr – Agriculture, vegetable crops; Pf - Agriculture, fodder; O – Fruit harvesting; Л – Viticulture; C – Animal husbandry; F – Forestry; E – Energetics; R – Mining; I – Industry; Gr – Construction; Zn – handcraft; So – Traffic; Tr – Trade; Tu – Tourism, hospitality industry; Institutional infrastructure Administration and office; Ou – Elementary School, Us – High school; Uu – University; Bl – Hospital; Am – Ambulance; Pr – Store; Pz – Market; H-Hotel

Gevgelija area is characterized by more conjunctural agricultural branches of the type Pg - Horticulture in horticultural production (pepper, tomatoes, cucumbers) and outdoor production (pepper, eggplant, cucumbers, cabbage, watermelons, melons), L - Viticulture (from different types of varieties), O - Fruit growing (pomegranates, kiwis, figs, almonds) and so on. Gevgelija Field is also characterized by well-developed I - Industry, Co - Traffic, Trade - Trade, Tu - Tourism, catering (balneological tourism in Negorska Banja and casino tourism in Gevgelija). In Dojran Field prevail L - Viticulture (of different types of varieties), Pz - Agriculture of cereals (wheat, barley) and O - Fruit growing (pomegranates, kiwi, figs, almonds). From the other economic branches for Dojran Field with Dojran Lake, the predominant branch is Tu - Tourism and catering. According to the data in the table, it is noted that large areas of the region, as much as 54.8% are under forests, but still - Forestry is not the predominant industry in the region. The reason for that is the fact that a large part of the forested areas (due to the specifics of the climate with Mediterranean influences) are low-stemmed woody oak plants and various shrubs that are mostly unproductive, and better quality forests are located in the higher parts of the mountains Plachkovica, Ограж , Belasica and Kozuf. these territories are relatively far from the valley plains (fields) where the population has found more conjunctural production in the agricultural sector, so that forestry is not at a higher level of development (except for the exploitation of wood for heating).

E - Energy in the region is represented through the hydropower plant of the accumulation Turija in the municipality of Vasilevo, thermo-mineral springs in the village. Bansko in the municipality of Novo Selo, then in the village. Smokvica and Negorci in the municipality of Gevgelija and the windmills on the Luta hill in the municipality of Bogdanci.

Recently, mining activities are being undertaken in the localities near the village of Ilovica in the municipality of Bosilovo and near the village of Kazandol in the municipality of Valandovo. They will unequivocally have reflections on the biodiversity in this area.

Institutional infrastructure. One of the important aspects in the study of the region is the equipping of the settlements with institutional infrastructure. In this context, the table shows a series of institutions such as Au - Administration and Administration, Wo - Primary School, Us - High School, Wu - University Institution, Bl - Hospital, Am - Ambulance, Pr - Shop, Pz - Market and X - Hotel. The data generally refer to municipal centers as the most important gravity centers of services to meet different needs.

In the city settlements Strumica, Gevgelija, Radovish and Valandovo are represented almost all facilities of the institutional infrastructure. The other municipal centers are characterized by a slightly more limited number of institutions in terms of the absence of higher-ranking institutions, such as high schools, university institutions, hospitals and hotels. Such are the municipal centers Konce, Vasilevo, Bosilovo, Novo Selo, Dojran. But within the municipalities in some of the municipalities there are separate institutions, such as hotels in Dojran, in Bogdanci, in the village of Bansko in the municipality of Novo Selo, medical institutions in the village. Bansko with the thermal-mineral bath Bansko and Negorska banja in the village of Negorci in the municipality of Gevgelija. Primary schools are present in a number of settlements, but in most of the settlements (especially those with a smaller population) there are almost no institutions, except perhaps a shop and a four-year primary school. The economic and functional characteristics of the municipalities in the South-East Region, in accordance with the functional significance of the individual municipal centers, can be seen through the number of business entities which is as follows: Bogdanci 206, Bosilovo 175, Valandovo 260, Vasilevo 150, Gevgelija 712, Dojran 74, Ko 60, Novo Selo 230, Radovish 140 and Strumica 6669 business entities (https://www.rdc.mk/southeastregion/index.php/mk/regionot/opshtinite-na-regionot).

Line infrastructure. The equipping of the South-East Region with line infrastructure is such that in the region there are only some line facilities such as railways, roads, power lines, reclamation systems and water supply systems. The railway passes only through the municipality of Gevgelija, while the other territories in the South-East Region function in traffic through road infrastructure. The road

infrastructure in the region generally relies on the roads along the valley of the river Vardar and along the valley of the river Strumica on which pass roads of type - A. They are followed by a series of regional roads that connect the separate regions in the South-East Region. More detailed data on the traffic network in the region are shown in the following table.

Table 10. Overview of highways and regional roads in the South-East Region of the Republic od N. Macedonia and relations

Type of road	Mark	Relation and connection
A Roads (highways, express and national roads)	A1	Border with R. Serbia (BC Tabanovce) - Kumanovo-Veles-Negotino, Demir Kapija-Gevgelija-border with R. Greece (BC „Bogorodica“) and section Grasko-Prilep (connection with A2)
	A4	Border with R. Kosovo (BC „Blace“)-cross road Stenkovec-ring road Skopje-Petrovec-Miladinovci-Sveti Nikole-Shtip-Radovish-Strumica-border with R.Bulgaria (BC „novo Selo“)
P1 Regional roads	P1103	Border with R. Serbia (BCP "Tabanovce") - Kumanovo-Veles-Negotino, Demir Kapija-Gevgelija-border with R. Greece (BCP "Bogorodica") and section Gradsko-Prilep (connection with A.
	P1102	Border with R. Kosovo (BCP "Blace") - intersection Stenkovec-bypass Skopje-Petrovec-Miladinovci-Sveti Nikole-Stip- Радовиш-Струмица-граница со Р. Бугарија (ГП „Ново Село“)
	P1105	Davidovo (connection with P1102) -Udovo (connection with A1) -Valandovo-Rabrovo-Dojran-border with R. Greece (Sretenovo) and section Star Dojran-border with R. Greece (Nikolic)
	P1108	Gevgelija (connection with P1102) -Moin-Konsko-Stinking Water-SC "Kozuf"
	P1109	Gevgelija (connection with A1) -Bogdanci-Furka (connection with P1105)
	P1302	Delchevo (connection with A3) -Pehchevo-Berovo-Dabile (connection with A4)
	P1310	Radovish (connection with A4) -Podaresh-Vladimirovo (connection with P1302) -Berovo-border with R. Bulgaria (BCP "Klepalo")
	P1401	Strumica (connection with A4) -Rabrovo-Valandovo-Balinci-Marvinci (connection with A1)
	P1402	Kuklish (connection with P1401) -Bansko-Novo Konjarevo (connection with A4)
	P1403	Connection with A4-Radovish-Vladevci-Vasilevo-Strumica (connection with A4)
P2 Regional roads	P2431	Radovish (connection with P1310) -Plachkovica-Argulica (connection with P2334)
	P2432	Strumica (connection with A4) -Veljusa-Vasilevo (connection with P1403)
	P2433	Radovish (connection with A4) -Konce-Zagorci-Leskovica (connection with P1103) -Selce-Sofilari (connection with A4)

	P2434	Link to P1401-Ric-link to P2433
P29 Regional roads	P29177	Connection with A1 - Miravci
	P29471	Podaresh (connection with P1310) -Jargulica-Pokrajcevo-Zleovo-Radichevo (connection with A4)
Локални патишта, 2014 г. (km)		893 km,

Source: http://investinseregion.mk/index.php/mk/2015-07-23-20-18-42/2016-01-18-13-09-56/77-jugoistocen-region/222-2016-01-20-11-27-22

The mentioned regional roads, in addition to the city and municipal centers, directly connect a number of other settlements. Besides them, there are several other local modernized (with asphalt surface) and non-modernized (with ground surface) roads, so that the settlements are relatively well connected by traffic. Exceptions are some of the rural settlements in the upper basin of Anska Reka and along the mountains Plaush and Serta. The electricity infrastructure in the South-East Region has long covered the entire region and all settlements. The water supply infrastructure in the Strumica-Radovis and Krivo-Lakavica valleys has been solved by building several multi-purpose reservoirs from which the population is supplied with water and irrigation water is provided through a properly built reclamation system. In the Gevgelija-Valandovo Valley, the water problem is solved through various interventions from the river Vardar in the context of ameliorative needs, and the water supply is provided from the mountain Kozuf and groundwater. The settlements in Dojran Field are supplied with water from the springs in Toplec and the canal Gjavato-Dojran Lake (built in 2002 to save Lake Dojran and uses groundwater that is pumped in the locality Gjavacko Pole). For the time being, the region is not functionally affected by infrastructure facilities from oil and gas pipelines.

4. BIOLOGICAL DIVERSITY

N. Macedonia occupies the central part of the Balkan Peninsula one of the richest European regions in terms of biodiversity (Kryštufek & Reed 2004). As a result of geology, geomorphology, climate (Mediterranean influence), hydrology and other characteristics of the SEPR make it a favorable place for the development of numerous habitats and animal organisms, many of which are of limited distribution or found only in that region. As a result of previous research conducted in SEPR, 844 species of fungi are known, of which 435 species are terricolic and 410 are lignicolic. Over 1/3 of the total flora in R.N. Macedonia is found on the territory of SEPR, represented by a number of endemic, rare or plant species whose *locus clasicus* (place where they were first described) is found in SEPR. 25 non-forest habitats can be expected on the territory of the South-East Planning Region, out of which five have the status of strictly protected habitats and 22 forest habitats out of which five also have the status of strictly protected habitats. Based on a rich literary review and current field research, it can be concluded that SEPR is home to an impressive number (392) of water invertebrates. Data on the diversity of terrestrial invertebrate fauna from SEPR showed the presence of a total of 1956 taxa belonging to a total of 16 groups of invertebrates based on the literary data, it can be concluded that 40 species of fish live in the waters of the SEPR. Regarding the diversity of reptiles and amphibians, 46 species of reptiles (32) and amphibians (14) are nationally known, out of which 41 (28 reptiles and 13 amphibians, i.e. 89% of the

total national herpetic diversity) can be observed in the southeast planning region. A total of 262 species of birds have been registered in the area, out of which 318 have been confirmed for the Republic of N. Macedonia (Velevski & Vasić 2017) which represents a huge 82% of the diversity of bird species. So far 60 species of Mammals have been registered in the territory of South East Region.

4.1 SPECIES DIVERSITY

4.1.1. ALGAE DIVERSITY

- **Basic information for algae in Republic of N. Macedonia**

Regarding the group of lower plants, algae are an extremely rich group with species in R.N. Macedonia. Green, silicate and blue-green algae are dominant in the microflora with a total of 2,169 species identified to date. The most numerous are silicate and green algae.

- **Endemism among the algae determined in Republic of N. Macedonia**

According to current knowledge algae are a microflora group with the highest endemism with identified 196 endemic species and subspecies in R. N. Macedonia. The largest number of endemics has been identified for Lakes Ohrid and Prespa and a smaller number in Lake Dojran, Pelister mountain and the river Babuna. Silicate algae (Bacillariophyta) with the highest diversity of 1,206 taxa (166 endemic), blue-green algae (Cyanophyta) with 283 species (15 endemic) and green algae (Chlorophyta) with 209 species (2 endemic). Other types of algae are less common such as Euglenophyta with 27 species (1 endemic species), Heterokontophyta with 25 species, Dinophyta with 16 species, Rhodophyta with 8 species, Cryptophyta and Glaucophyta with one species each. Regarding the research of the algal flora in the ecosystems of the South-East planning region in R. N. Macedonia, the research so far is quite scarce, sporadic and incomplete. Only individual ecosystems such as Dojran Lake or Vardar River have been the subject of more extensive research to date and have published data on the microflora. Most of the other ecosystems in this planning region have not been researched at all or the data are very scarce.

- **Review of current data on algae in the South East Planning Region in Republic of N. Macedonia**

  - **Lake Dojran**

Lake Dojran has been experiencing an ecological catastrophe in the last 30 years as a result of the harmful impact on humans and their negligence. Its prolonged ecological agony leads to forced changes in the biological component of the ecosystem, the extinction of numerous plankton species (Appendix 2 - Table 1) and the survival of the most resistant species. In terms of algae, it is the dominance of dangerous blue-green cyanobacteria with the notorious genus Microcystis, which was identified with a total of nine taxa (Figure) in 2015, which is a precedent worldwide.

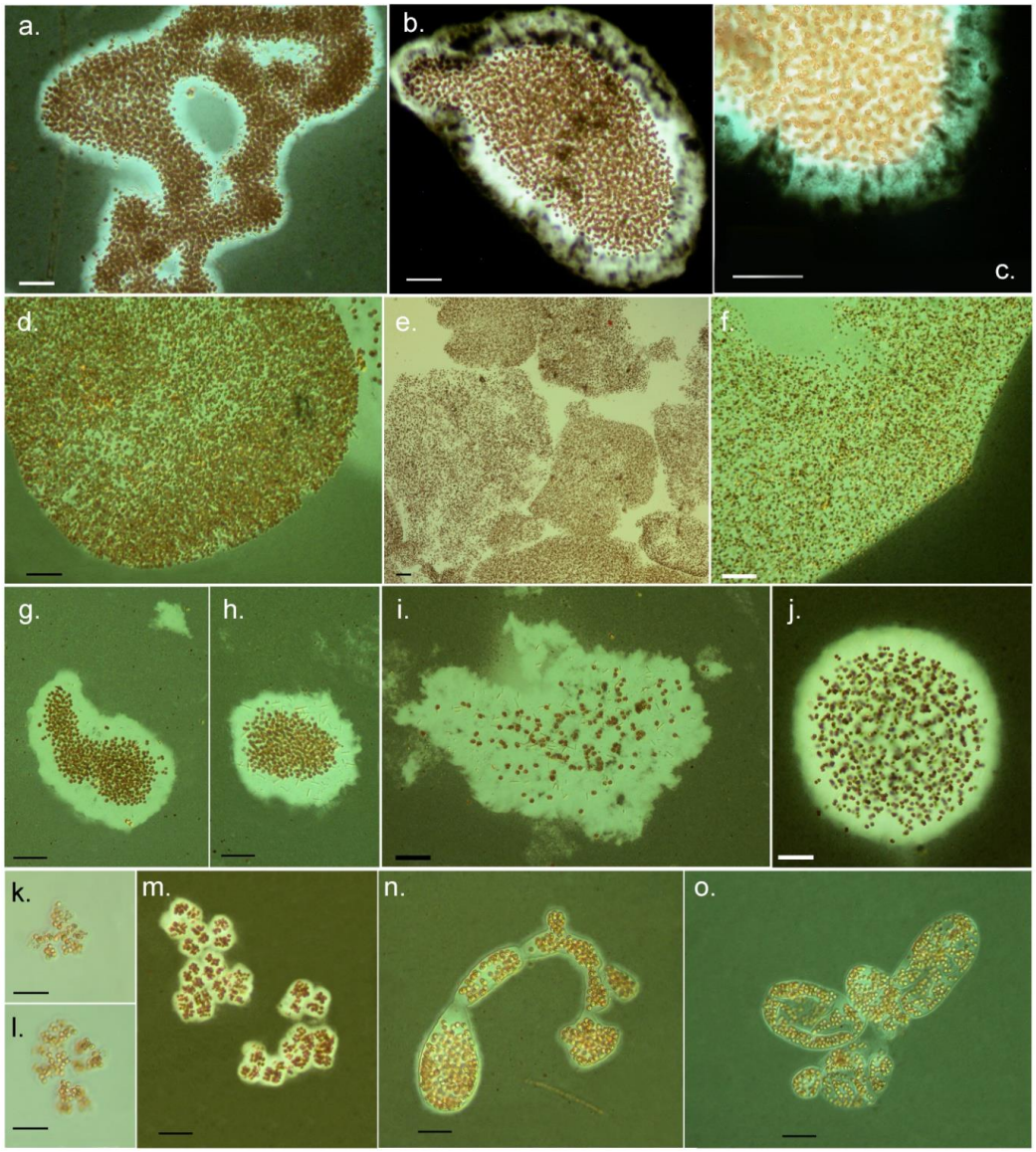


Figure 21. Unique biodiversity of genus Microcyctis spp. in Lake Dojran (2015). **a**. Microcystis aeruginosa, **b**. и **c**. Microcystis botrys, **d**. Microcystis flos-aquae **e**. и **f**. Microcystis ichtyoblabe **g**-**h**. Microcystis novacekii **i**. Microcystis protocystis **j**. Microcystis smithii **k**-**m**. Microcystis viridis **n**-**o**. Microcystis wesenbergii.

Algae in Lake Dojran have undergone major and fundamental changes in the last 30 years as a result of deteriorating environmental conditions in the lake. A large number of algal species (more than 130) have disappeared from the lake and in their place there are individual dominances of the most resistant species (‘water flower’ of dangerous algae species), species that have adapted to the new conditions in the lake. Nowadays, in the lake are determined species indicators of high trophism and saprobidity and new species are described that have never been observed in the lake ecosystem (Appendix 2 - Table 2).

- **Anska Reka River**

Anska Reka river as an aquatic ecosystem has a significant impact on the entire Valandovo valley as well as the river Vardar into which it flows. Therefore, it is logical to present the relatively rich and well-researched microflora of this ecosystem (Appendix 2 - Table 3).

- **Strumica region**

The region of Strumica and the catchment area of the river Strumica are quite scarce in terms of microflora research. The only data on the composition of algae in this catchment can be found in the study conducted in the framework of the preparation of the Preliminary Watershed Management Plan prepared in 2015. In those studies, the species presence of only the silicate algae group (Bacillariophyta) was processed and the other algae were completely omitted. Therefore, lists of examined ecosystems are displayed only in relation to silicate algae including Vodocha reservoir (Appendix 2 - Table 4); Turia reservoir (Appendix 2 - Table 5); Vodocica Rive (Appendix 2 - Table 6); Strumica River (Appendix 2 - Table 7) and Plavaja River (Appendix 2 - Table 8). For a large part of the river catchment area from the Strumica region there is no data on the microflora such as for the rivers Trkajana, Turija, Oraovicka, Vodocica, micro-accumulations Drvoska, Ilovica, Novoselska and Markova Brana.

- **Municipality of Bogdanci**

The microflora in the area of the municipality of Bogdanci is not sufficiently researched for those reasons for the river Luda Mara and the Paljurci reservoir there is no data.

- **Municipality of Radovish**

The appendix provides an overview of the registered microflora for the river Stara Reka (Appendix 2 - Table 9), the river Kriva Lakavica (Appendix 2 - Table 10), while for the rivers Sushica, Pirava, Sirava and Plavaja there is no data on the microflora.

- **Municipality of Konce**

An overview of the registered microflora for the Mantovo Lake is attached (Appendix 2 - Table 11).

- **Municipality of Gevgelija**

Attached is an overview of the registered microflora for the river Vardar - downstream within the municipality of Gevgelija (Appendix 2 - Table 12), while for the reservoirs Bogorodica, Topolec, Dos, Kalica and Chinarli there is no data on the microflora.

4.1.2. FUNGI DIVERSITY

- **Review of current data on fungi in SEPR in North Macedonia**

The data on the diversity of fungi in the area of SEPR originate from their own field research, scientific research projects, application projects organized by the Macedonian Ecological Society and the Research Society of Biological Students, as well as published data from 1999 until today. Thus, from these previous researches, 844 species are known for the area of JIPR, Tortić & Karadelev (1986), Karadelev (1993, 1995a, b; 1998, 1999, 2000, 2001a, b, c;), Karadelev & Nastov (1998) , Kajevska et al. (2002, 2006, 2007a, b; 2008 a, b, c, d, e, f; 2009, 2011, 2013 a, b; 2018), Karadelev & Stojanovska (2002-2003), Karadelev & Spasikova (2004, 2004 -2005, 2009), Karadelev & Rusevska (2004-2005, 2008, 2013, 2016a, b), Chavdarova et al. (2011), Rusevska et al. (2014, 2015), Rusevska & Karadelev (2014-2015).

The aim of this project is to valorize and propose important areas for fungi by analyzing the current data on terric and lignic macromycetes in different habitats of SEPR and at the same time to get a clearer picture of mycodiversity in this areas well as for R. N. Macedonia. The identification of important species of fungi (rare, endangered, protected) will also serve in the identification of important habitats and sites.

The analyzes within this project provided a clearer picture of microdiversity in the area of SEPR. The data from the analyzes will be used to supplement the knowledge regarding the selection of areas for protection with rare and endangered species of fungi.

As a result of the research conducted so far in the South-East Planning Region, 844 species of fungi are known, out of which 435 species are terricilous and 410 are lignicolous. Most species 745 belong to the genus Basidiomycota systematized in 74 families, 92 species belong to the genus Ascomycota, systematized in 27 families, 6 species of the genus Myxomycota (Protozoa) of 5 families and one species of the genus Zygomycota. In terms of taxonomic affiliation most of the identified species belong to the families Agaricaceae, Boletaceae, Meruliaceae, Mycenaceae, Polyporaceae, Russulaceae and Tricholomataceae of the type Basidiomycota. 5 species of lichens are known and all belong to the type Ascomycota. From the performed analyzes 18 species of underground fungi were ascertained.

Most of the data originate from beech and oak-hornbeam forests while a smaller number of species are characterized by other communities such as: pine forests, riparian communities, pine plantations, meadows and pastures.

Most of the lignicolous species are collected on beech and oak, unlike other substrates such as: white and black pine, fir, spruce, wild foyer, fir, hornbeam, maple, birch, hazel, plane tree, etc. which are characterized by a smaller number of species or individual specimens. Some lignicolous species are specific to certain substrates. Thus, the species: *Antrodiella hoehnelii, Ascotremella faginea, Bertia moriformis, Bjerkandera adusta, Fomes fomentarius, Inonotus hispidus, Ischnoderma resinosum, Laxitextum bicolor, Marasmius alliaceus, Oudemansiella mucida, gland, Pleurotus Tost.* are typical of beech, while the species: *Daedalea quercina, Exidia truncata, Fistulina hepatica, Ganoderma lucidum, Hymenochaete rubiginosa, Peniophora quercina* and *Vuilleminia comedens* are characteristic of oak. *Exidia pithya, Dacryobolus karstenii, Dichomitus squalens, Phaeolus schweinitzii, Trichaptum fuscoviolaceum, Tubulicrinis gracillimus* and *T. subulatus* are typical of pine. It is interesting to emphasize the characteristic species for the Greek Juniper: *Antrodia juniperina, Hyphodontia juniperi, Mycena juniperina, Peniophora junipericola, Pyrofomes demidoffii* and *Xeromphalina junipericola*. Other species including *Fomes fomentarius* and *Ganoderma applanatum* are known parasitic species of beech, *Fomitopsis pinicola* is a parasite on pine tree, *Phellinus tuberculosus* often occurs as a plum parasite, *Piptoporus betulinus* occurs on dry birch stems, *Vuilleminia cory* on live stems of hazel wood.

Mycorrhizal fungi which include species of the *genera Amanita, Boletus, Russula, Tricholoma, Cortinarius, Lactarius, Xerocomus*, etc. are most common in beech forests. These include the species *Amanita rubescens, A. vaginata, Boletus queletii, B. reticulatus, Cantharellus cibarius, Cortinarius variecolor var. marginatus, C. venetus, Lactarius acerrimus, L. blennius, L. chrysorrheus, L. glaucescens, L. pallidus, L. piperatus, L. subumbonatus, L. uvidus, L. vellereus, Russula cyanoxantha, R. foetens* and other

which interact in associations with beech. In oak forests the most common mycorrhizal partners of the oak appear: *Amanita muscaria, Boletus aereus, Lactarius volemus, Russula persicina, Suillellus rhodoxanthus, etc.*, and in the pine plantations *Lactarius sanguifluus, Onnia tomentosa, Suilllin granulatus, S.luteus, Tricholoma imbricatum, Tricholomopsis rutilans* and others. From the other mycorrhizal species, the most important are *Leccinum aurantiacum* and *L. scabrum*, which always occur under birches.

Saprobic species grow on grassy areas and include paltry puffball (*Bovista plumbea*), representatives of the genus *Omphalina*, fairy ring mushroom (*Marasmius oreades*), king trumpet mushroom (*Pleurotus eryngii*), champignons (*Agaricus campestris* and *A. macrosporus*) and others. Some of the species such as: *Hericium coralloides, Ischnoderma resinosum* and others are indicators of old forests.

As for the edible fungi present in the researched area, thirty species can be listed that can be used for food while a dozen species are poisonous. The most famous of the consumed species are: *Amanita caesarea, A. rubescens, Armillaria mellea, Auricularia auricula-judae, Macrolepiota procera, Marasmius oreades, Cantharellus cibarius, Craterellus cornucopioides, Boletus aereus, B. ulisusus, B. aestivalreat, B. , P. eryngii, Hydnum repandum, Russula cyanoxantha* and others. Summer and bronze boletus, eggplant and foxglove are well-known commercial fungi and are collected from the local population. The most important poisonous species are *Amanita muscaria, A. phalloides, A. pantherina, Coprinellus micaceus, Galerina autumnalis, Inocybe geophila, Stropharia coronilla* and others. Consumption of poisonous species of the genera *Amanita, Galerina* and Inocybe can lead to death.

4.1.3. PLANT DIVERSITY

- **Review of current data on flora in SEPR in North Macedonia**

The beginnings of floristic research in the researched area are dating from the end of the 19th century. Among the first researchers is the Czech botanist Eduard Formánek who in the period from 1890 to 1900 published 14 papers on the flora of different parts of the Balkan Peninsula and most of them provide floral data for the territory of the Republic of N.Macedonia. In the mentioned period he visited several localities in the researched area - Balia, Flora, Adzibarica-Momina Chuka, Przhigrad, Mircevica, Gevgelija - Huma and others. After his death, his herbarium collection was processed and revised by Klaus Vandas in his famous study "Reliquiae Formánekianae" (Vandas, 1909).

The works of E.v. Hálacsy also date from this period. Hálacsy (1891, 1893, 1906) provided a bulk of information including information on the newly discovered species *Centaurea formaneki* from the Demir Kapija gorge.

Adamović (1909) published the monograph "Die Vegetationsverhältnise der Balkanländern" (1909) which is of great importance for the knowledge of the vegetation of the Balkan countries including N. Macedonia in which he introduces some new vegetation terms including the term pseudomacia. This term refers to communities with low forest or shrub vegetation from the southernmost parts of North Macedonia (dominated by oak - *Quercus coccifera*). Pseudomacia is one of the most dominant vegetation types that develops in the researched area (it reaches the northern border of its distribution in the vicinity of Demir Kapija) in conditions of pronounced influence of the sub-Mediterranean climate. Physiognomically, it is very reminiscent of the macchia that grows on the shores of the Mediterranean, from which it differs in the smaller presence of evergreen deciduous woody and shrub species as well as EU-Mediterranean floral elements.

Kosanin (1921, 1924) data on the researched area refer to the problems related to endemism and relict as well as to the chronology of the Balkan species of the genus Ramonda (1921).

Velenovský (1910) from the vicinity of Gevgelija (Huma) describes the species *Hypericum dimoniei* which is still the subject of additional taxonomic research.

During the I and II Balkan War (1912-1913) as well as during the I World War on the territory of N. Macedonia as a reserve officer of the Bulgarian army was T. Nikolov who also collected herbarium material from the vicinity of Strumica, Belasica, Dojran, Valandovo, Gevgelija, Bogdanci, Flora, Prilep, Mariovo, Dren Planina, Shar Planina-Ljuboten and others. Its herbarium material was later processed and the data were published by Stojanov (1928), who had previously given an extensive floristic contribution referring to Mount Belasica (1921).

From this period dates the data of Becker (1924) for the newly discovered species of the genus Viola (*Viola stojanovii*) whose locus classicus is located on the mountain Belasica.

The German botanist Bornmüller who during the First World War was on the territory of North Macedonia sent by the directorate of the "Institut für Allgemeine Botanik" from Hamburg, is of special importance for getting to know the flora of N.Macedonia as well as for the researched area. During that period he stayed for about 8 months on the territory of N. Macedonia and collected about 13,000 herbarium specimens from a number of sites.

During his stay in the southern and southeastern parts of N. Macedonia he visited several sites (Udovo, Marianska Mountain-Arzali, Kaluchkova, Valandovo, Rabrovo, Dedeli, Kisil-Doganli (around Dojran Lake), from which he collected rich herbarium material. During his floristic research in N. Macedonia he received herbarium material from several researchers who were part of a wider German research team who worked in the same area, and thus from Biesalski he received herbarium material from the vicinity of Valandovo, Rabrovo, Udovo, Negorci. , Marvinci, Mala Rupa, Dudica, by A. Müllenhoff from the vicinity of Veles and Dedeli-Gevgelija, from HR Steilberg from Dedeli (vicinity of Dojran), Dr. L. Schlutze donated herbarium material from Konjsko, Dudica, Kichi Kaja, Two Ears, K. Scheer from the vicinity of Alshar, Rozhden, Tribor, the vicinity of Dojran Lake-Dedeli and Valandovo, Dr. Gross from the vicinity of Dojran Lake - Nikolic and Asanli, Crna Reka, Kanatlarci, Shell Erevci, O. Seyffert presented him with herbarium material collected right next to the trenches dug along the river Vardar near Gevgelija. A small number of herbarium specimens Bornmüller received from the following persons: W. Becker (Udovo, Dedeli), F. Doflein (Kaluchkova, Veles, Skopje, Pelister, Laser (Kaluchkova), Meyer (Prespa Lake), W. Müller (Gevgelija).

The processed herbarium material was published in his famous work "Beiträge zur Flora Mazedoniens I-III" (Bornmüller, 1925-1928) as well as in the work "Bearbeitung der von H. Burgeff und Th. Herzog in den Kriegsjahren 1916/18 in N.Macedonia gesammelten Pflanzen, I-III "(Bornmüller 1926, 1927, 1932), which refers to the revision of the herbarium collection by H. Burgeff (originating from the southern parts of N.Macedonia - Dojran and surroundings collected during the First World War they provide numerous data on N.Macedonia as well as descriptions of the newly discovered species from this area - *Centaurea rufidula*, as well as the still taxonomically unrefined species Verbascum burgeffii and Verbascum doiranense.

In 1921, Doflein's famous work - "Mazedonien" was published which dealt with 38 chapters that refer to different parts of the territory of the Republic of N.Macedonia. among them for several localities from the southern parts of N.Macedonia - Kaluchkovo, Udovo, Marvinci, Plavush Mountain, the gorge of Vardar near the village. Gradec, Mala Rupa, Dojran Lake, Strumica, Belasica, Gevgelija, and others. They contain very interesting authentic data relating to various aspects - the natural values of those areas, climatic characteristics, very important floristic and faunal data, the way of life of the local population, some of their ethnological characteristics - diet, clothing, agriculture, etc.

With special importance from this period are several works of Teodor Soska (Soška, 1939, 1940, 1953) who in the period between the two world wars studied the flora of the gorges in N. Macedonia and published several floristic works relating to the gorges of the river Vardar, as well as the surroundings of Gevgelija, Valandovo, Dojran and Strumica.

Separate articles dedicated to the flora of N.Macedonia prepared Rudski (1938, 1943). For the flora in the vicinity of Strumica as well as for the high mountain vegetation, Chernjavski, Rudski & Soska (1937) give a brief overview of the vegetation that develops on the territory of N.Macedonia.

After the Second World War, the floristic research on the territory of N.Macedonia and including in this area intensified. The research and data of Micevski (1956, 1963, 1964, 1969, 1971, 1973, 1985, 1987, 1988, 1993, 1995, 1998, 2001) should be singled out, in which numerous floristic taxa have been processed, as well as various Plant communities of several vegetation types (aquatic, swamp, meadow vegetation, vegetation on hilly pastures, etc. His numerous papers list new species for science (*Alyssum gevgelicensis* and *Nepeta macedonica*), as well as a number of new species for the flora of the country registered for the first time in the researched area (A*stragalus physocalyx, Centranthus calcitrapa, Elatine alsinastrum, Isoetes phrygia, Juncus maritimus, Klasea lycopifolia, Laserpitium archangelica, Lemna gibba, Lupinus angustifolius subsp. Reticulatus, Mercurialis huetii, Polypogon maritimus, Succisella inflexa, Tamarix smyrnensis, Teesdalia nudicaulis* and others).

Significant are the researches by Hans Em (1966, 1974) dedicated to the dendroflora and Cirimotic (1958) for the mountain Dub near Dojran. Šilić (1979) published a monograph on the genera *Satureja L., Calamintha Miller, Micromeria Bentham, Acinos Miller and Clinopodium L.* in the flora of Yugoslavia describing two new species of science whose Locus classicus are found in this area (*Calamintha vardarensis* Šilić и. Satureja fukarekii Šilić). Pulević (1981) cites data on the genus Crocus, while more recent are the data of Matevski (2010, 2016), Matevski et al. (1997, 1998, 2005, 2019), which list several new floristic rarities from the research area, while The data of Čarni et al. (2010, 2014, 2018) refer to the vegetation researches of different vegetation types that have been undertaken on the wider territory of N.Macedonia, including the localities of the researched area, in which numerous floral data are given.

- **Important floristic localities**

Listed below are floristically important sites in SEPR (sites with endemic, rare and important plant species).

- **Belasica Mountain**

Alnus viridis, Asplenium scolopendrium, Colchicum bivonae, Crocus tommasinianus, Himantoglossum calcaratum, Himantoglossum hircinum, Ilex aquifolium, Lathraea rhodopea, Lilium albanicum, Vaccinium vitis-idaea, Periploca graeca and *Viola stojanowii.*

- **Monospitovo marsh (Monospitovo, Bansko, Gabrovo)**

Alopecurus creticus, Anthemis meteorica, Cladium mariscus, Elatine alsinastrum, Elatine triandra, Equisetum sylvaticum, Glinus lotoides, Hippuris vulgaris, Hydrocharis morsus-ranae, Isoetes phrygia, Neottia ovata, Ophioglossum vulgatum, Osmunda regalis, Periploca graeca, Radiola linoides, Ranunculus lingua, Romulea bulbocodium, Tamarix smyrnensis, Thelypteris confluens and *Trapa natans.*

- **Dojran Lake**

Hydrocharis morsus-ranae, Marsilea quadrifolia, Nymphaea alba, Salvinia natans, Trapa natans and *Utricularia vulgaris.*

- **Dojran Lake surrounding (Nikolic, Asanli, Star and Nov Dojran)**

Abutilon avicene, Anacamptis pyramidalis, Anogramma leptophylla, Anthemis auriculata, Anthemis meteorica, Aster linosyris, Astracantha thracica, Centranthus calcitrapa, Colchicum bivonae, Dracunculus vulgaris, Fumana arabica, Hymenocarpos circinnatus, Juniperus excelsa, Lagoecia cuminoides, Quercus coccifera, Romulea bulbocodium, Satureja fukarekii, Sedum aetnense and *Sternbergia lutea.*

- **Dub mountain**

Dracunculus vulgaris, Periploca graeca, Quercus coccifera and *Romulea bulbocodium*.

- **Bogdanci: Paljurci**

Centaurea rufidula, Corynephorus divaricatus, Dracunculus vulgaris, Helianthemum aegyptiacum, Hymenocarpos circinnatus, Isoetes phrygia, Lupinus angustifolius subsp. reticulatus, Periploca graeca, Quercus coccifera and *Romulea bulbocodium*.

- **Bogdanci: Churchulum**

Astragalus physocalyx, Dracunculus vulgaris, Quercus coccifera and *Romulea bulbocodium.*

- **Valndovo: Plavush**

Adiantum capillus-veneris, Colchicum bivonae, Dracunculus vulgaris, Quercus coccifera, Sternbergia lutea and *Ziziphus jujuba.*

- **Valandovo (Valandovo-Soure of Anska Reka Reka-Tatarli-Bajramos)**

Alyssum serpentinum, Colchicum bivonae, Dracunculus vulgaris, Fumana arabica, Galium setaceum, Juniperus excelsa, Romulea bulbocodium and *Sternbergia lutea.*

- **Wetland within Negorski Banji**

Cladium mariscus, Crepis zacintha, Ophioglossum vulgatum and *Periploca graeca*.

- **Gevgelija-Stojakovo (meadows)**

Imperata cylindrica

- **Gevgelija: Konska Reka-Huma-Sermenin**

Adiantum capillus-veneris, Arbutus andrachne, Clinopodium vardarense, Colchicum bivonae, Echium maculatum, Hypericum dimoniei, Ilex aquifolium, Juniperus excelsa, Klasea lycopifolia, Periploca graeca, Sideritis raeseri, Quercus coccifera, Satureja fukarekii, Stachys horvaticii and *Viola frondosa.*

- **Kozuf: Smrdliva voda-Asan Ceshma, Adzibarica-Flora-Dve Ushi-Visoka Cuka**

Blechnum spicant, Daphne blagayana, Fumana bonapartei, Ilex aquifolium, Lilium albanicum, Ramonda nathaliae, Rhamnus alaternus, Ruscus hypoglossum, Saxifraga federici-augusti subsp. grisebachii, Silene fabarioides, Thelypteris confluens and *Viola frondosa.*

- **Vardar Gorge (Gradec-Udovo-Petrovo Selo)**

Alyssum gevgelicense, Anacamptis pyramidalis, Anthemis meteorica, Astracantha thracica, Colchicum bivonae, Periploca graeca and *Quercus coccifera.*

- **Radovish-Plackovica**

Romulea bulbocodium

- **Ograzhden**

Sedum aetnense and *Vaccinium vitis-idaea.*

4.1.4. DIVERSITY OF FAUNA

4.1.4.1. INVERTEBRATES

4.1.4.1.1. AQUATIC INVERTEBRATES

A significant part of the diversity in aquatic ecosystems refers to aquatic macroinvertebrates (aquatic or aquatic invertebrates). They are a heterogeneous collection of evolutionarily diverse taxa that make them particularly interesting to study. The term macroinvertebrates is not a taxonomic category but an artificially established terminology that refers to part of the faunal groups of invertebrates that inhabit the aquatic ecosystem. The diversity of aquatic invertebrates represented by planets, snails, mussels, worms, leeches, crabs and aquatic insects clearly surpasses that of fish and macrophytes. It is estimated that the number of invertebrate species inhabiting aquatic ecosystems is more than 100,000 (Allan and Flecker, 1993). Compared to most other groups of aquatic organisms they are less mobile, easy to collect, and have a relatively long life cycle. In this way, macroinvertebrates reflect the unfavorable conditions in the aquatic environment during any stage of their development and that is why they are an indispensable element in biological research in assessing the ecological status and potential of water bodies.

In this group of invertebrates there are a number of taxa sensitive to changes in the aquatic environment that may lead to their local or global extinction. In this respect they are one of the most affected groups of aquatic organisms, although globally few of them are found in international conservation directives compared to plants and vertebrates. Aquatic ecosystems with high ecological values are those that support the survival of affected species for conservation due to their vulnerability to extinction, endangered species, endemic forms due to limited distribution area and rare species. For these reasons, nowadays more attention is paid to the protection of benthic macroinvertebrates and to reducing the risks of their extinction.

For the needs of the current project "'Common plans for biodiversity conservation and sustainable targets for the development of a bilateral network of protected areas - COMBINE2PROTECT" analysis and valorization of macroinvertebrates for the Municipalities entering the South-East Planning Region in N. Macedonia was performed. A detailed list of macroinvertebrate species has been prepared (Annex 3; Table 1) based on bibliographic data and project reports relating to the project area. The

hierarchical classification of species is according to the nomenclature given in De Jong et al. (2014). Thereby, the distribution of the affected species, the species under legal protection, but also the endemic and rare species in the area of interest was determined which contributed to the allocation of priority localities/ areas in SEPR and the preparation of a map of ecological sensitivity.

- **Literary review of previous research on aquatic invertebrates in the South East PLannig Region''**

It is evident that the area of the South-East Planning Region is abounds with a rich hydrographic network that offers suitable habitats for 9 groups of aquatic insects. A detailed review of the literature data as well as the analysis of the results of previous research showed that most (94 taxa) of aquatic invertebrates belong to aquatic insects of the order Diptera (Figure 22) Which is dominated by the family Chironomidae (80 taxa). Additionally, there is a great variety of Fairy Horses (Odonata, 54 species), Springflies (Plecoptera, 37 taxa), aquatic beetles (Coleoptera, 32 taxa), as well as Mayflies (Ephemeroptera, 28 taxa). Although caddisflies (Trichoptera) are one of the qualitatively dominant groups in aquatic ecosystems, these aquatic insects are not the focus of trichoptera research in the country leaving only 12 species known for SEPR. This fact is supported by the fact that recently Oláh (2010) describes a new species of caddisfly (Trichoptera) for the science *Rhyacophila liutika* Oláh, 2010 from the locality Koleshinski Vodopadi which indicates the specific but still not well-known fauna of the trichoptera of the region.

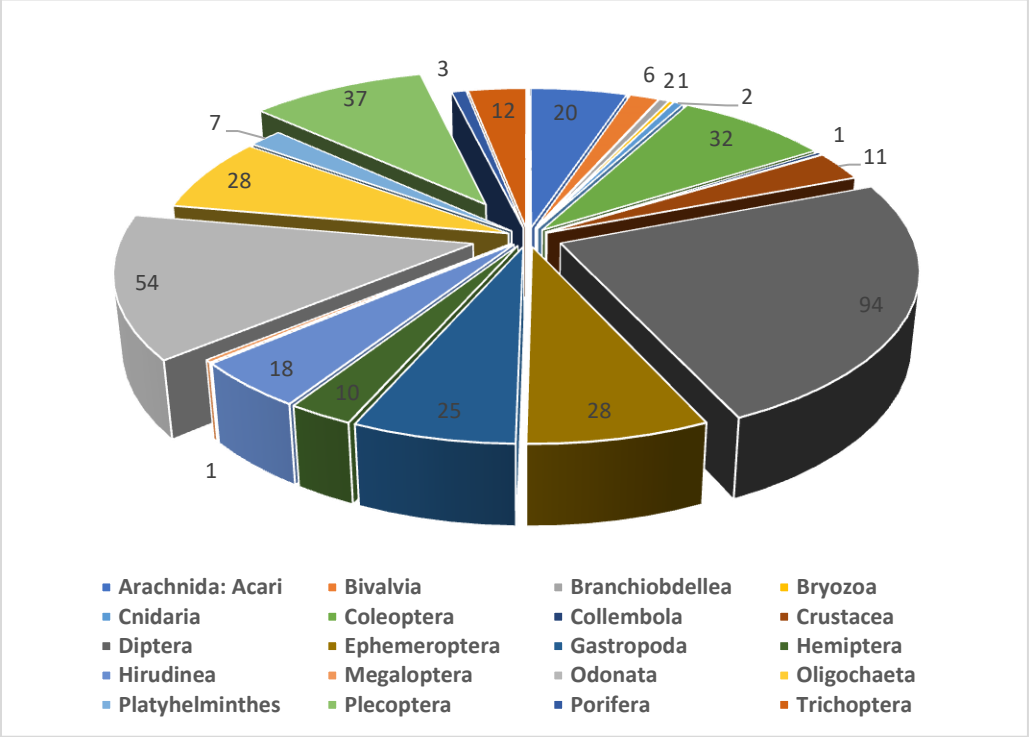


Figure 22. Diversity of taxa within the fauna group of aquatic invertebrates in the waters of South East Planning Region

Aquatic worms (Oligochaeta, 28 taxa), aquatic snails (Gastropoda, 25 species), water ticks (Arachnida: Acari, 20 species), leeches (Hirudinea, 18 taxa), crustaceans (Crustacea, 11 species), true

bugs (Hemiptera, 10 taxa), flatworms (Platyhelminthes, 7 species), mussels (Bivalvia, 6 species) and sponges (Porifera, 3 species) contribute significantly to the overall biodiversity of the area of interest. According to the number of taxa (1-2), nettles (Cnidaria), freshwater worms (Branchiobdellea), Bryozoa, Collembola, and Megaloptera are less important (Fig. 22).

Based on a rich literary review and current field research it can be concluded that the area of interest is the habitat of an impressive number (392) of water invertebrates (Appendix 3; Table 1). The following text provides a literary overview of the diversity of water invertebrates in the municipalities within the South-East Planning Region (SEPR).

- **Municipality of Radovis**

In Annex 3 Table 2 summarizes the entire available literature related to the diversity of water invertebrates from the waters of the municipality of Radovis. The oldest data date back to 1960 when Guéorguiev (1960) studying beetles (Coleoptera) from former Yugoslavia registered 3 species in the rivers Radoviska and Oraovica (*Agabus* (*Dichonectes*) *biguttatus*, *Gyrinus* (*Gyrinus*) *dejeani*, *Gyrinus* (*Gyrinus*) *distinctus*). The researches of Ikonomov (1978, 1982) follow which determines 4 species of stoneflies (Plecoptera) out of which the Macedonian endemics *Brachyptera macedonica* Ikonomov, 1983 in the river Stragarnica and *Taeniopteryx stankovitchi* Ikonomov, 1978 in the rivers Oraovicka and Stragarnica. At the same time, these species are on List 2 of Protected Wild Species in the Republic of N.Macedonia (Official Gazette of the Republic of N. Macedonia, No. 139/2011).

Jović (2009) gives an overview of dragonflies in R. N. Macedonia and for the waters of the municipality of Radovis lists 6 species of which *Ophiogomphus cecilia* (Fourcroy, 1785) found in the river Strumica near the village Vladievci is a species of exceptional importance to the Union included in the lists of Annex II and Annex IV of the Housing Directive 92/43 / EEC (Annex 3; Table 12).

The territory of the municipality of Radovis has been the subject of several recent studies so a significant contribution is made by the research within the project "Monitoring of the Strumica River Basin" (2017-2018) where detailed research has been conducted on various groups of aquatic invertebrates. In this study, a total of 34 macroinvertebrates collected in the rivers Plavaja and Radoviska were registered, out of which the *Serratella spinosa* (Ikonomov, 1961) (subendemite) and *Rhithrogena bulgarica* Braasch, Soldan & Sowa, found in 1985 (Balkan) in the course of Radovishka River. Additionally, *R. bulgarica* has been observed in the upper course of the river Plavaja. In the waters of the municipality of Radovis (river Plavaja and Podaresh) is found the stone crayfish *Austropotamobius torrentium* (Schrank, 1803) which is included in the lists of Annex II and Annex V of the Habitats Directive 92/43 / EEC as well as in Annex III of Berne Convention for the Protection of Wildlife and Natural Habitats in Europe (Annex 3; Tables 12 and 13). Based on the given literary review for macroinvertebrates from the waters of the municipality of Radovis (Appendix 3; Table 2), the presence of a total of 56 taxa was recorded of which 14 were evaluated as important for protection (Appendix 3; Figure 2).

- **Municipality of Konce**

For the waters on the territory of the municipality of Konce there are literary data only for the accumulation Mantovo which is used for irrigation of about 126,000 ha of arable land in Strumica-Radovis and Krivolakavica Valley (Stojmilov, 2003). For that purpose, the Vrastica tunnel was built in the length of 8,257 km, which exits on the other side of the Radovish field near the village Injevo.

The results of the research of Smiljkov et al. (2008) within the project "River Basin Management Plan for the river Bregalnica" (2013-2014) have a significant contribution from this faunistic and taxonomic aspect to this accumulation. They refer to a large number of faunal groups of

macroinvertebrates from the Mantovo Reservoir where the presence of a total of 47 taxa was recorded (Appendix 3; Table 3), out of which 7 were evaluated as important for protection (Appendix 3; Figure 2).

The basic eco-geographical feature of the bentocenosis from the Mantovo Reservoir is dominated by species with wide geographical distribution (such as *Limnodrilus hoffmeisteri, Chaoborus (Chaoborus) crystallinus, Procladius (Holotanypus) choreus, Gamirus, Chirus Baetis rhodani,* etc.), registered in many reservoirs and rivers in the Balkans and beyond.

However, the unique feature of the biodiversity from the accumulation is given by the presence of the river crab *Astacus astacus* (Linnaeus, 1758) and the swan mussel *Anodonta cygnea* (Linnaeus, 1758) (Appendix 3; Tables 12 and 13). Freshwater crayfish in our country is a protected wild species from List 2 of Protected Wild Species in R. N. Macedonia. The detected declining trend of river crayfish populations across Europeclassified this species in the category of "vulnerable" (VU) species of the IUCN Red List of Threatened Species at the global level (2019), and its inclusion in the list of Annex V of the Directive for habitats 92/43 / EEC, as well as in Annex III of the Bern Convention for the Conservation of Wild Fauna and Flora and their Natural Habitats in Europe is of particular importance for maintaining a favorable status of river crayfish populations. On the other hand, although it is a common species in our country, according to the IUCN European Red List of endangered freshwater mollusks (Cuttelod et al., 2011) the swan mussel A. sygnea has the status of near threatened (NT). Its presence in the Mantovo reservoir gives this ecosystem additional value as an important habitat of this species.

- **Municipality of Vasilevo**

For the territory of the municipality of Vasilevo there are data on macroinvertebrates only from the reservoir Turija which is used for irrigation of about 10,000 ha of arable land in the Strumica Valley as well as for water supply and electricity production.

Within the project Project "Monitoring of the Strumica River catchment area" (2017-2018) the research showed a strong reduction of species diversity (Annex 3; Table 4). The benthic community in the deeper parts (25 m) of the reservoir is inhabited by only 2 species, i.e the eutrophic indicators *Limnodrilus hoffmeisteri* and *Tubifex tubifex* (Oligochaeta). These species occur in waters with high concentrations of nutrients, but also in sediment rich in organic matter as well as at lower concentrations of oxygen in the water above the bottom. Affected species, species under legal protection and endemic and rare species have not been identified in the waters of the municipality of Vasilevo.

- **Muincipality of Bosilovo**

The research on the territory of the municipality of Bosilovo is mainly focused on the Monospitovo Swamp (Shapkarev, 1981; Jović, 2009; Jović and Mihajlova, 2009) and the Monospitovo Canal ("Monitoring of the Strumica River catchment area", 2017-2018) where 82% are registered (23 taxa) out of a total of 28 taxa identified in the area (Appendix 3; Table 5). The greatest diversity is found in Monospitovo Swamp (14 taxa) which is dominated by qualitatively dragonflies (Odonata) and leeches (Hirudinea). Swamp dragonflies have been evaluated with the status of least affected species (LC) on the IUCN Red List of Threatened Species Globally (2019), as well as on the IUCN European and IUCN Mediterranean Red List of Threatened Dragonflies (Riservato et al. , 2009; Kalkman et al., 2010) (Appendix 3; Table 12).

An important faunal element for the swamp is the leech *Theromyzon tessulatum* (O.F. Muller 1774) which is a very rare species for the country observed only in Monospitovo Swamp and Lake

Dojran. This leech lives mainly on the body of aquatic birds and therefore is rarely found in the free state in the aquatic environment Annex 3; Tables 12 and 13).

As for the Monospitovo Canal, the composition of the fauna of macroinvertebrates differs significantly from that in the Monospitovo Swamp. Dominated by representatives indicative of increased concentrations of nutrients in water and more intense decomposition processes: *Limnodrilus hoffmeisteri* and *Psammoryctides albicola* (Oligochaeta), tolerant diphtheria larvae of *Culex sp.* and *Chironomini* (Diptera) and Asodus shrimp *Asellus aquaticus* (Crustacea) on List 2 of Protected Wild Species in the Republic of N. Macedonia (Official Gazette of the Republic of North Macedonia, No. 139/2011).

The review of the available literary data showed that there are data on sources on the territory of the municipality of Bosilovo. Namely, Guéorguiev (1960) studying the water hardliners (Coleoptera) from Yugoslavia lists 5 species (*Haliplus (Liaphlus) variegatus, Hydroglyphus geminus, Hydroporus pubescens, Laccophilus minutus* and *Noterus clavicornis*) for the sources in the vicinity of the village Bosilovo (Appendix 3; Table 5).

- **Municipality of Strumica**

The review of the literary data showed that the diversity of water invertebrates in the municipality of Strumica is relatively well researched (Appendix 3; Table 6). The results of the research of Guéorguiev (1960), Ikonomov (1961, 1963), Adamović (1990), Peters and Hackethal (1986) and Jović (2009) deserve special attention. The authors found great diversity in three orders of aquatic insects on Odonata (27 species) mainly in Kamenita Bara, Manastirski Potok, Strumica river near the village Robovo and the river Trkanja, Coleoptera (22 species) in the swamps and ponds of the Strumica Field and Ephemeroptera (21 species) in the rivers of the municipality of Strumica.

Within the Odonata only *Cordulegaster bidentata* Selys, 1843 has the status of a near-affected (NT) species on the IUCN Red List of Threatened Species globally (2019) while all other species are categorized as the least affected (LC) species. This species together with the dragonfly *Caliaeschna microstigma* (Schneider, 1845) are found on the site Manastirski Potok and they are evaluated as closely affected (NT) according to the IUCN European Red List of endangered dragonflies (Kalkman et al., 2010) and the IUCN Median Red list of endangered dragonflies (Riservato et al., 2009) could in the future be part of one of the three categories of affected species. The site Monastirski Potok provides favorable conditions for the maintenance of populations and the dragonfly *Ophiogomphus cecilia* (Fourcroy, 1785) included in the list of Annexes II and IV of the Habitats Directive 92/43 / EEC and in Annex II of the Bern Convention on Wildlife Conservation and fauna and their natural habitats in Europe (Appendix 3; Tables 12 and 13).

Within the rare beetles, the species *Hygrotus (Coelambus) confluens* (Fabricius, 1787) is observed in the swamp near Strumica. More important species are also identified including the subendemite *Baetis meridionalis* Ikonomov, 1954, the Balkan endemic species *Electrogena macedonica* (Ikonomov, 1954) and *Paraleptophlebia lacustris* (Ikonomov, 1962) as well as the species *Serratella maculocaudata* (Ikonomov, 1961) on the List 2 as protected wild species in N. Macedonia (Official Gazette of the Republic of N. Macedonia, No. 139/2011) (Appendix 3; Tables 12 and 13).

The presence of the rare species the crayfish *Potamon ibericum* (Bieberstein, 1809) which according to the IUCN Red List of Global Threatened Species (2019) has the status of near affected (NT) has been detected at the sites Gabrovski Potok and Trkanja River. From decapod crabs in the waters of the municipality of Strumica was observed Natura 2000 species *Austropotamobius torrentium* (river Strumica, Novo Konjarevo, Source between the village Bansko and the village Gabrovo) which is included in the list of Annex II and Annex V of the Habitats Directive 92/43/EEC and is of particular

interest to the Union (Annex 3; Tables 12 and 13). On the territory of the municipality of Strumica, the river Trkanja and the spring in the village Kosturino is considered one of the most important sites taking into account the presence of the extremely rare Balkan endemic *Grossuana euxina subsp. serbica* Radoman, 1973 which is also a protected wild species in R. N. Macedonia (Official Gazette of the Republic of N. Macedonia, No. 139/2011) (Appendix 3; Tables 12 and 13).

Also, the waters on the territory of the municipality of Strumica have been the subject of several recent studies and especially important are the findings presented within the project "Monitoring of the catchment area of the river Strumica" (2017-2018). Within this study, a large number of (29) aquatic invertebrates were recorded in the Trkanja River and the Vodocha Reservoir. This reservoir is intended for water supply of the population from Strumica and irrigation of about 4,200 ha of arable land in the Strumica Valley. The Vodocha Reservoir is home to many rare species such as the aquatic snail *Viviparus mamillatus* and the shell *Anodonta anatina*. During the research for the needs of the project, these species were identified for the first time in the fauna of R. N. Macedonia (Appendix 3; Tables 12 and 13).

Based on all previous data, a relatively high number of taxa (98) can be concluded for the waters of the Municipality of Strumica (Annex 3; Table 6), of which 40 are evaluated as important for protection (Annex 3; Figure 2).

- **Municipality of Novo Selo**

The oldest information about aquatic invertebrates in the Municipality of Novo Selo dates back to the 1960s when Guéorguiev (1960) registered the aquatic beetles *Agabus (Gaurodytes) bipustulatus* and *Hydroglyphus geminus* in the small lake at Visoka Chuka. In the period from 1979 to 2009, detailed research on the fauna of dragonflies (Odonata) follows (Karaman, 1979, 1981; Peters and Hackethal, 1986; Adamović, 1990; Jović and Mihajlova, 2009; Jović, 2009). The authors in the waters of the Municipality of Novo Selo determined the presence of 15 species of dragonflies in the area (Appendix 3; Table 7) where the greatest diversity (11 species) was observed in the waters of the river Strumica near the village Smolare. The dragonfly *Epallage fatime* (Charpentier, 1840) noted in one of the streams on the south side of Mount Belasica has the status of least affected (LC) according to the IUCN European Red List of Threatened Species at Global Threat (2019) and the IUCN Mediterranean list of endangered dragonflies (Riservato et al., 2009). However, the species is considered to be closely related (NT) to the IUCN European Red List of Dragonflies (Kalkman et al., 2010) (Appendix 3; Tables 12 and 13).

Recently Oláh (2010) describes a new species of water moth (Trichoptera) for the science *Rhyacophila liutika* Oláh, 2010 from the locality Koleshinski Vodopadi which indicates the specific but still not well-known fauna of trichopters for the territory of this Municipality. This new species for science is stenoendemite, so far identified only at the already mentioned site located in the beech forest above the village Koleshino.

Within the borders of the Municipality of Novo Selo the presence of the priority species for protection freshwater crayfish *Austropotamobius torrentium* (source before Kolesino, source above Smorali, on Visoka Chuka, at Konjarnik) was noticed which significantly emphasizes the importance of the area in terms of rich biological diversity. The latest data for the territory of the municipality of Novo Selo are contained in the study "Monitoring of the catchment area of the river Strumica" (2017-2018). Within these researches a total of 21 taxa of water invertebrates collected in the river Strumica near the village of Novo Konjarevo.

Based on all previous data, it can be concluded the presence of 38 taxa in the waters belonging to the municipality of Novo Selo (Annex 3; Table 7) of which half (19) have been evaluated as important species for protection (Annex 3; Figure13).

- **Municiality of Valandovo**

The detailed literary review showed that for the waters of the Municipality of Valandovo there are data on the presence and distribution of 44 water invertebrates (Appendix 3; Table 8) of which almost half (21 species) were evaluated as important for protection (Appendix 3; Figure 2). Research in this area has mainly focused on the ranks of aquatic insects Odonata (Karaman, 1969; Peters and Hackethal, 1986; Vinko et al., 2017) and Plecoptera (Ikonomov, 1974, 1982; Murányi et al., 2014). Within the group of dragonflies (Odonata) the Balkan endemic *Caliaeschna microstigma* (Schneider, 1845) from the locality Dedeli stands out, which according to the IUCN European (Kalkman et al., 2010) and the IUCN Mediterranean Red List of endangered dragonflies (Riservato et al., 2009) has the status of a near threatened (NT) species.

Great species diversity (34 species) is observed in the stoneflies (Plecoptera) collected from several localities on the river Karani from the mountain Belasica (Ikonomov, 1974, 1982; Murányi et al., 2014) and on the streams Vodenik, Chinarnik and stream near Dedeli (Murányi et al., 2014). In the framework of these studies Murányi et al. (2014) for the first time in the municipality of Vasilevo the extremely rare Macedonian endemic *Rhabdiopteryx doiranensis* (Ikonomov, 1983) was registered and so far observed only in a stream that flows into Dojran Lake near the locality Achikot (Ikonomov, 1986). At the same time, the authors gave a description of the hitherto unknown larval stage of the species on material collected from a stream near the village Dedeli. Besides this species, the waters of the municipality of Valandovo are inhabited by 12 other species of stoneflies of conservation importance of which *Brachyptera macedonica* (Ikonomov, 1983) and *Capnioneura valandovi* (Ikonomov, 1978) are extremely rare Macedonian endemics while the other 10 are Balkan endemics. Balkan stonefly *Leuctra graeca* Zwick, 1978 and *Amphinemura arcadia* (Aubert, 1956) are very rare species in our country and on the territory of the municipality of Valandovo are noted only one or two sites (Karani River, under the first waterfall near Bashibos, Chinarli stream and Parts). On the other hand, *Capnioneura balkanica* Baumann & Kacanski, 1975, *Isoperla pesici* Muranyi, 2011, *Leuctra metsovonica* Aubert, 1956 and *Protonemura rauschi* Theischinger, 1976 can be observed in several localities and are considered rare in the country (Appendix 3; Tables 12 and 14).

Of particular importance for the municipality of Valandovo is the locality Sobrecki Izvor 5 km east of Valandovo where the extremely rare Balkan endemic *Grossuana euxina subsp. serbica* Radoman, 1973 is identified and which is a protected wild species in R. N. Macedonia (Official Gazette of the Republic of N. Macedonia, No. 139/2011) (Appendix 3; Tables 12 and 14).

- **Municipality of Dojran**

Based on a rich literary review largely summarized in the "Study for valorization of the Monument of Nature Dojran Lake" (2016), it can be concluded that a significant part of the faunal groups of water invertebrates are relatively well researched (Appendix 3; Table 9).

On the territory of the municipality of Dojran sponges and cnidaria have been observed only in Dojran Lake. The sponges (Porifera) are represented by 3 species of the family Spongillidae of which the Macedonian endemic *Eunapius carteri dojranensis* Hadzisce, 1953 is a rare species in the country located on List 2 of Protected Wild Species in the Republic of N. Macedonia (Official Gazette of the Republic of N. Macedonia, No. 139/2011) (Appendix 3; Tables 12 and 14).

The Cnidaria is represented with 2 species belonging to the genus *Hydra* ("Study for valorization of the Monument of Nature Dojran Lake", 2016), while the flatworms (Platyhelminthes) list 7 species of planars for Dojran Lake and the surrounding waters (Appendix 3 Table 9). Out of these,

Dendrocoelum lacteum (Muller 1774) and *Schmidtea (Dugesia) polychroa* (Schmidt 1861) occur with a significant share in lake zoocenosis from the shallow coast mainly on a solid surface.

The freshwater gastropod fauna (Gastropoda) is represented by 20 species (Roding, 1966; Radoman, 1983; "Study for valorization of the Monument of Nature Dojran Lake", 2016) Appendix 3; Table 9). *Graecoanatolica macedonica* the endemic snail by which the is lake recognizable, in the littoral near Star Dojran and Kaldrma (typical locality of the species) during the research conducted in 2015 the presence of empty shells was recorded but not of viable populations.The notation of shells by *Gastropoda macedonica* suggests assumption but and hope for the existence of refugial areas in Lake Dojran that enable the survival of small, isolated populations of the species.

Rare Balkan endemic *Grossuana euxina subsp. serbica* Radoman, 1973 (Gastropoda) is found in the spring Aznak Kajnak 3 km from the village Nikolic (north of the lake) and in the springs Toplec near the road Valandovo - Dojran. It is a protected wild species in R. N. Macedonia (Official Gazette of the Republic of N. Macedonia, No. 139/2011) (Appendix 3; Tables 12 and 14).

The Bivalvia class (mussels) is represented by 5 species (Appendix 3; Table 9) of which 3 species (*Anodonta cygnea, Dreissena presbensis* and *Unio crassus*) have high conservation importance (Appendix 3; Tables 12 and 14). Within the mentioned study from 2016, a detailed literary review is given for the diversity of water worms and branchioids from Dojran Lake. The presence of 22 taxa of the class Oligochaeta and 2 species *Branchiobdella parasita* (Braun 1805) and *B. pentadonta* Whitman (1882) of the class Branchiobdellea living as ectobionites of river crab (*Astacus astacus*) have been established. An endemic species of *Haber (Isochaeta) dojranensis* (Hrabe 1958) gives an important feature of the fauna of aquatic worms from Lake Dojran (Appendix 3; Table 9).

The fauna of Hirudinea is represented by 12 species of leeches mainly residents of standing waters (Appendix 3; Table 9). Two species among them are of greater conservation importance. The leech *Theromyzon tessulatum* (O.F. Muller 1774) is a rare species for the country observed only in Dojran Lake and Monospitovo Swamp. This leech lives mainly on the body of aquatic birds and therefore is rarely found in the free state in the aquatic environment. With its inclusion in Annex V of the Habitats Directive 92/43/EEC, the medicinal leech *Hirudo medicinalis* Linnaeus, 1758 is an important species for the Union. Its removal from its natural habitat or exploitation may be subject to management measures (Annex 1; Table 12). The species is also part of Annex III of the Berne Convention for the Protection of Wild Fauna and Flora and Their Natural Habitats in Europe (Annex 3; Table 12).

Unique data on the diversity of Arachnida: Acari found in the waters of Lake Dojran and are given in the "Study for valorization of the Natural Monument Lake Dojran", (2016) which found the presence of 20 species in the waters of Lake Dojran Lake (Appendix 3; Table 9).

Crabs (Crustacea) are represented by 9 species (Appendix 3; Table 9) of which *Argulus foliaceus* (Linnaeus 1758) is a well-known ectoparasite of carp (Cyprinus carpio) and other fish. From the amphipod shrimp the invasive species *Orchestia cavimana* Heller 1865 and *Gammarus roeseli* Gervais 1835 are found. In addition to the analysis of the amphipod shrimp in the project area is also the endemic amphipod shrimp *Niphargus pancici dojranensis* G. Karaman 1960 which identified and described in the spring part of river Deribash above Star Dojran.

The isopod shrimps are represented by 2 species of which *Asellus aquaticus* is well represented in the waters of the lake while the Macedonian endemic *Balkanostenasellus skopljensis meridionalis* Karaman S., 1954 inhabits the streams that flow into Lake Dojran. In Dojran Lake and its shoreline waters there are 3 species of decapods (Decapoda). The presence of the Balkan endemic ''Kozica'' *Atyaephyra stankoi* Karaman, 1972 has not been confirmed during the research conducted during 2015 which is why it is arguable whether the species is still part of the zoocenosis in Lake Dojran. The situation is similar with the other two species of deciduous crabs, the river crab *Astacus astacus* (Linnaeus, 1758) and the Dojran freshwater crab *Potamon ibericum* (Bieberstein, 1809) which in the past occurred in large numbers in the shallow coast and in the streams that flow in the lake ("Study for

valorization of the Monument of Nature Dojran Lake", 2016). River crayfish in our country is a protected wild species from List 2 of Protected wild species in the Republic of N.Macedonia. Detected trend of declining populations of river crayfish across Europe classified this species in the “vulnerable” (VU) category of the IUCN Global List of Threatened Species (2019) and its inclusion in the Annex V list of the Habitats Directive 92/43 / EEC as and Annex III of the Bern Convention for the Protection of Wild Fauna and Flora and their Natural Habitats in Europe is of particular importance for maintaining a favorable status of river crayfish populations. Dojran crayfish species is rear species in the country which according to the IUCN Red List of Global Threatened Species (2019) has the status of Nearly Affected (NT) (Annex 3; Tables 12 and 14).

From the analysis of the diversity of aquatic insects it can be concluded that Lake Dojran and the riparian waters are characterized by an extremely high diversity of dipter representatives (74 taxa) belonging to 3 families. Among them, Chironomidae occurs with 71, Ceratopogonidae with 2 and Culicidae with 1 species.

The representatives of the order of Odonata give an important mark to the fauna of Lake Dojran and the surrounding waters. The lake has a great diversity of habitats, different substrates, a well-developed belt of macrophytic vegetation and thus supports the survival of diverse fauna of dragonflies. Of great importance for the territory of the project area are the researches of Buchholz (1963), Bilek (1966) and Karaman (1969, 1979, 1981) which determined the presence of 16 species of Odonata. Some time later Peters and Hackethal (1986) and more recently Bedjanić and Bogdanović (2006), Jović and Mihailova (2009), Jović (2009), "Study for valorization of the Dojran Lake Natural Monument" (2016) and Vinko et al. (2017) supplement the list of 32 new species for the area of the municipality of Dojran Summarically, Lake Dojran and its immediate surroundings are home to a total of 48 species of dragonflies (Appendix 3; Table 9). The zoogeographical analysis given in Karaman (1981) dominance of refugial elements, which speaks in favor of the age of the fauna of this area. From the valorization of aquatic invertebrates given in Table 12 of Annex 3 it can be concluded that 10 species (*Brachytron pratense, Caliaeschna microstigma, Coenagrion ornatul pulum, Coenagrion ornatul aenea, Epallage fatime, Erythromma najas, Lestes macrostigma, Lindenia tetraphylla* and *Sympetrum depressiusculum*) of dragonflies have a high conservation value (Appendix 3; Table 12).

Ikonomov (1982) and Murányi et al. (2014) for the Dojran Valley found the presence of 10 species of stoneflies (Plecoptera) in the streams that flow into Lake Dojran (Appendix 3; Table 9), including Macedonian (3 species) and Balkan (3 species) endemics (Appendix 3; Tables 12 and 14). The Macedonian endemic *Rhabdiopteryx doiranensis* Ikonomov 1983 has so far been observed only in one stream that flows into the Dojran Lake near the locality Achikot (Ikonomov, 1982) and more recently, in the Valandovo Field (Murányi et al., 2014). No less important are the other Macedonian endemics *Capnioneura valandovi* Ikonomov, 1978 and *Brachyptera macedonica* Ikonomov 1983, with a limited range of distribution in the southern parts of R. N.Macedonia. In addition, Murányi et al., 2014 registered *C. valandovi* in a stream, near the village Nikolic, while *B. macedonica* cites Ikonomov (1982) for Stara Reka (Dojran Valley) at the locality Achikot (Appendix 3; Table 9).

Among the stoneflies (Plecoptera) the coastal waters of Lake Dojran (Stara Reka, stream near Achikot, Nikolic) are inhabited by the Balkan endemics *Capnioneura balkanica* Ikonomov, 1978; *Amphinemura quadrangularis* Zwick, 1978 and *Isoperla pesici* Muranyi, 2011. Thus, *C. balkanica macedonica* has so far been recorded only in streams and rivers in the southern parts of R. N. Macedonia and Greece (Peloponnese) (Ikonomov, 1982; Murányi et al., 2014). The stonefly *A. quadrangularis* and *I. pesici* were recently registered in a stream near the village Nikolic (Murányi et al., 2014).

There are scarce data on the order Coleoptera from Lake Dojran. Guéorguiev (1960) and "Study for valorization of the Monument of Nature Dojran Lake" (2016) provide information on the presence of 7 species of stoneflies.

Data on aquatic Hemiptera (tree bugs) are summarized in the report of "Study for valorization of the Monument of Nature Dojran Lake" (2016), where 6 species of aquatic tree bugs were registered in Dojran Lake in the belt of macrophytic vegetation.

The analysis of the bibliographic data relating to the space of the project area showed that the order Trichopetara is represented by a small number of species (5). Among them, the trichopters *Mystacides azureus* (Linnaeus 1761) and *Oecetis ochracea* (Curtis 1825) were first observed in Lake Dojran during the research conducted for the needs of the "Study for valorization of the Natural Monument Lake Dojran" (2016).

In the literature there are data on the presence of the *Caenis macrura* Stephens, 1835 and *Cloeon dipterum* (Linnaeus, 1761) in the littoral of Dojran Lake which are widespread in the standing and weak waters of R. N. Macedonia ("Study for valorization of the Monument of Nature Dojran Lake", 2016).

In the shallow shore of the lake (Kaldrma and Nov Dojran) in the animal settlement of reed, rare populations of the larva of *Sialis sp.* which belongs to the order Megaloptera.

The faunal group of moose animals (Bryozoa) is represented only by *Plumatella fruticosa* Allman 1844. This colonial representative is found mainly on reed stems, usually at a depth of 2 m ("Study for valorization of the Monument of Nature Dojran Lake", 2016).

After the revision of the taxonomic status of the macroinvertebrates and based on all the data so far, it can be concluded that an extremely high (256) number of taxa for the area of the municipality of Dojran (Annex 3; Table 9).

- **Municipality of Gevgelija**

The entire available literature regarding the diversity of water invertebrates from the waters of the municipality of Gevgelija is summarized in Annex 3; Table 10. Research in this area has mainly focused on the ranks of aquatic insects Odonata (Peters and Hackethal, 1986; Jović and Mihajlova, 2009; Jović, 2009; Bedjanić and Vinko, 2012; Vinko et al., 2017) and Plecoptera (Ikonomov , 1982). The authors identified 11 species of dragonflies (Odonata) in the waters of the municipality of Gevgelija, mainly in the river Vardar near Gevgelija, in Stara Reka, in Konjska Reka near the village Novo Konjsko and in Sermeninska Reka near the village as well as 19 species of stoneflies (Plecoptera) in the rivers Konjska, Petrova and Sermeninska.

Of the dragonflies of great conservation importance is *Coenagrion ornatum* (Selys, 1850) registered at the locality Negorci (Appendix 3; Table 14). This dragonfly is a species of special importance for the Union and is on the list from Annex II of the Habitats Directive 92/43 / EEC, in our country it is a protected wild species according to the National List 2 of Protected Wild Species in the Republic of N.Macedonia (Official Gazette of the Republic of North Macedonia, No. 139/2011) and according to the IUCN European and IUCN Mediterranean Red List of endangered dragonflies (Riservato et al., 2009; Kalkman et al., 2010) the species has the status of near affected (NT). In Konjska river near the village Novo Konjsko and in the Armenian River near the village Mrzenci *Epallage fatime* has been observed, which according to the IUCN European Red List of dragonflies (Kalkman et al., 2010) has the status of a near-affected (NT) (Appendix 3; Tables 12 and 14).

Out of the total number (19) of stoneflies (Plecoptera), 7 Balkan endemics were observed including the rare *Protonemura rauschi* Theischinger, 1975 in the waters of Sermeninska and *Leuctra metsovonica* Aubert, 1956 in Konjska Reka (Appendix 3; Tables 12 and 14).

Within the other groups of aquatic invertebrates less species diversity was registered. Thus, Guéorguiev (1960) in a small stream near the village Bogorodica registered the aquatic stoneflies *Hydroporus tessellatus* and *Scarodytes halensis* (Coleoptera). Ikonomov (1962, 1963) identified 3 species

of flattened mayflies (*Heptagenia coerulans, Heptagenia longicauda* and *Oligoneuriella pallida*) in the lower reaches of the Vardar.

A special contribution to the diversity of aquatic invertebrates in the municipality of Gevgelija have the research of Šapkarev (1981) who noticed 3 species of leeches (Hirudinea) in the village Negorci, while Slavevska-Stamenković et al. (2017) for Stara Reka near Miravci and Konjska Reka under the villages Gornichet and Konjsko lists the Dojran crooked crab (crab) *Potamon ibericum*. The Dojran freshwater crab (Crab) according to IUCN The Red List of Threatened Species at the Global Level (2019) has the status of a closely affected (NT) species (Appendix 3; Tables 12 and 14).

Based on all previous data, it can be concluded the presence of 39 taxa for the waters of the municipality of Gevgelija (Annex 3; Table 10) of which 19 species are of special interest for protection (Annex 3; Figure 2).

- **Municipality of Bogdanci**

The detailed literary review showed that for the waters of the municipality of Bogdanci there are data on the presence and distribution of 23 water invertebrates (Appendix 3; Table 11). Research in this area has focused only on leeches (Šapkarev, 1981) and dragonflies (Karaman, 1969; Peters and Hackethal, 1986; Jović and Mihajlova, 2009; Jović, 2009; Vinko et al., 2017) which are mostly are registered in the river Luda Mara between Gorni Bolovan and Dolni Bolovan and in the fishponds east of Crnichani and near Stojakovo.

Out of a total of 20 species important for protection (Appendix 3; Figure 2), on the territory of the municipality three species have a special conservation importance. It is about the leech *Hirudo medicinalis* Linnaeus, 1758 in the wet habitats with silt and dense vegetation in the vicinity of the village Bogorodica and the dragonflies *Cordulegaster heros* Theischinger, 1979 in the river Luda Mara between Gorni and Dolni Balvan (flowing in the lake Paljurci) and *Lindenia tetraphylla* (Vander Linden, 1825) noted in the vicinity of the village Bogorodica (Appendix 3; Tables 12 and 14). According to the IUCN Red List of Global Threatened Species (2019) the leech H. medicinalis is a near affected (NT) species. The species is included in the list in Annex V and its removal from natural habitat or exploitation may be subject to management measures. Additionally, the species is part of the list in Annex III of the Bern Convention for the Protection of Wild Fauna and Flora and Their Natural Habitats in Europe (Annex 3; Tables 12).

The two dragonflies, *C. heros* and *L. tetraphylla* are protected species from List 2 of Protected Wild Species in R. N. Macedonia (Official Gazette of the Republic of N. Macedonia, No. 139/2011). They are of particular importance to the Union listed in Annex IV to the Housing Directive 92/43/EEC. Only *C. heros* is part of Annex II of the same Directive and in order to maintain its favorable conservation status it is necessary to designate Special Areas of Conservation (SACs) within the Natura 2000 ecological network. Although according to the IUCN Global Endangered Species Red List (2019) and the IUCN European Red Dragonfly Red List (Kalkman et al., 2010) the species is considered to be closely affected (NT), the IUCN Mediterranean Red Evaluation A list of dragonflies (Riservato et al., 2009) has shown that this species is actually considered vulnerable (VU). The situation is similar with *L. tetraphylla*, which although considered the least concerned (LC) by the IUCN Red List of Endangered Species at the global level (2019), the decline of its populations was the reason for its placement in the category of vulnerable (VU) by the IUCN European Red List of Dragonflies (Kalkman et al., 2010) (Appendix 3; Tables 12).

4.1.4.1.2. TERESTRIAL INVERTEBRATES

In order to valorize the diversity of terrestrial invertebrate fauna in the South-East Planning Region, a detailed analysis of the existing literature presented by a total of 80 references was performed.

The analysis of the diversity of spiders (Araneae) and opilions (Opiliones) is based on the master thesis of Matevski (2018) enriched with the works of Doflein (1921), Drenski (1928), Nikolić (1981) and Schönhofer and Martens (2009).

The analysis of the diversity of diurnal butterflies (Lepidoptera) is based on the monograph of Schaider & Jaksic (1989), and of moths based on the monographs of Daniel (1964), Thurner (1964), Pinker (1968) and Klimesch (1968).

Existing information provided by Čingovski (1958), Jankovic (1971), Gogala et al. was used to analyze the fauna of Homoptera. (2005) and Muranyi (2018) while the analysis of hemiptera species diversity is based on the work of Goellner-Scheiding (1978) and Protič (2007, 2010).

Gunter (1980) describes the psocids (Psocoptera) in detail while the estimation of hymenoptera forms is based on the data of Koenigsmann (1969) and the diversity of plant wasps (Symphita) is analyzed according to the works of Zombi. 1974) and Cingovski (1985).

Chobanov (2002) and Chobanov and Mihajlova (2010) give a detailed overview of the fauna of orthoptera (Orthoptera), enriched with the knowledge of Matvejev (1967) and the doctoral dissertation of Cvetkovska-Gjorgjievska (2015).

The diversity of the beetle fauna (Coleoptera) is based on 28 references from older and newer date, and to assess the species diversity of the other groups (Gastropoda, Chilopoda, Isoptera, Blattodea, Dermaptera, Mantodea and Scorpiones without P. N. Macedonia (Hristovski et al. 2015), the doctoral dissertation of Cvetkovska-Gjorgjievska (2015) and others.

During the valorization of the diversity of the terrestrial invertebrate fauna the species list attached to the project report for valorization of the diversity of Lake Dojran by Petkovski (1999) supplemented by the more recent findings attached to the Study for valorization of the Dojran Nature (2016). Additional literature used for the needs of the report are the Biodiversity Strategy for the Restoration of Lake Dojran, the Report on Biodiversity Analysis and Valorization at the National Level (2009), the Catalog of Species for the Republic of North Macedonia (Petkovski 2009), the Fifth National Report to the Convention Biodiversity (2014), Biodiversity Assessment in N.Macedonia (2001), Biodiversity Convention (2014), National Biodiversity Strategy with Action Plan (2017-2027), etc.

The taxonomic classification of the species is mostly done according to the criteria of the European Species Diversity Database (http://www.faunaeur.org) and the list of species is prepared based on the above-mentioned literary data. The list also includes those data on species diversity that do not correspond to the modern classification of species (de Jong, Y. et al. 2014). The assessment of diversity at the national level was performed in accordance with the national lists for determining strictly protected (I) and protected (II) wild species in the Republic of N. Macedonia (Official Gazette no. 139 (7.10.2011), and the degree of endemism was determined based on the national list of Macedonian and Balkan endemics. The identification of the species of international and European importance was performed according to the criteria of the World, European and Mediterranean Red List of IUCN and the lists of species of international agreements in the field of nature protection ratified by the Republic of North Macedonia. North Macedonia (EU Directive 92/43 / EEC on the Conservation of Natural Habitats of Wildlife II and IV, Berne Convention for the Protection of European Wildlife and Natural Habitats II and III). The European Red List of Saproxial Beetles, the Red List of Macedonian Plecoptera and the Mediterranean Red List of Butterflies were also used in the assessment of conservation species. Valorization also includes the rare species, Corine and Emerald species, species that are new to North Macedonia as well as potentially new species for science, which are registered in the project region.

Literary review of prevous research on terrestrial invertebrates from waters of the "South East Plannig Region"

With some exceptions, the species diversity in the South-East Region is undoubtedly rich but insufficiently researched with a small number of published literary data relating to their taxonomy and fauna, as well as with difficult access to older literature. A detailed analysis of the published data on the diversity of terrestrial invertebrate fauna showed the presence of a total of 1956 taxa belonging to a total of 16 groups of invertebrates (Figure 1).

The order Lepidoptera (896) stands out with the largest number of taxa, followed by Coleoptera (434), the order Aranea (214) and Hemiptera (156) due to their great species diversity and appropriate available literature. The other groups: Hymenoptera (75), Orthoptera (73), Homoptera (42), Gastropoda (34) and Psocoptera (17) occur with a relatively smaller number of taxa, while from the groups Chilopoda, Mantodea, Dermaptera, Opiliones, Blattodea, Isoptera. The presence of Scorpiones has been recorded in only 1 to 4 species.

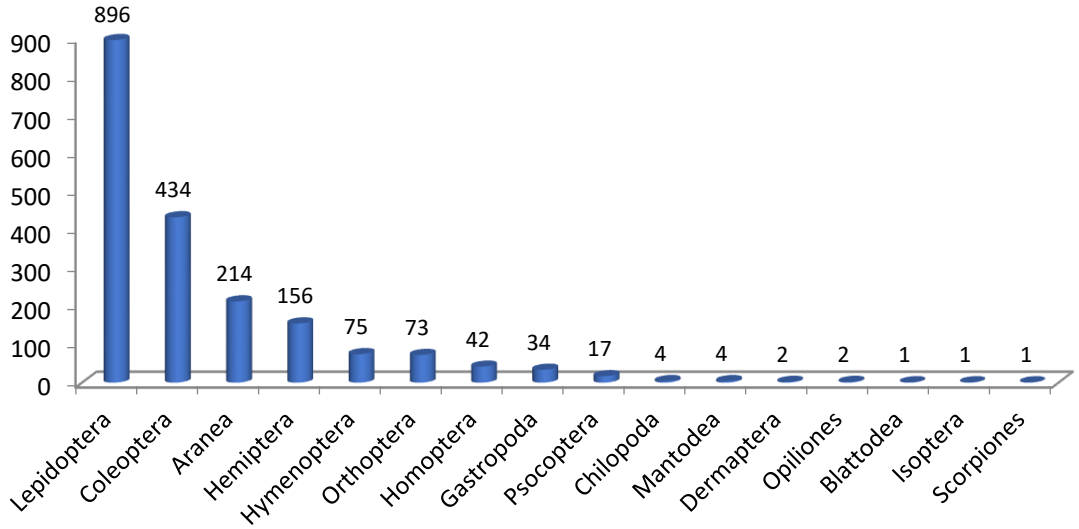


Figure 23. Species diversity of the terrestrial invertebrate fauna in the South East Planning Region

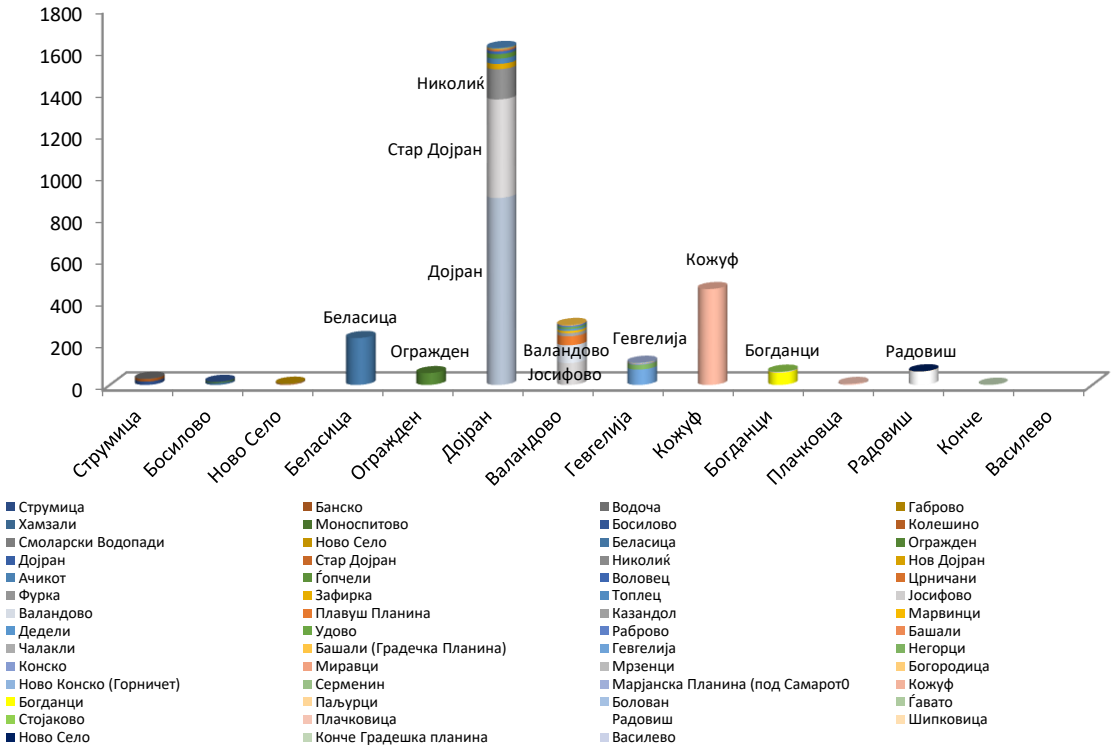


Figure 24. Species diversity of the terrestrial invertebrate fauna in the South East Planning Region

- **Municipality of Gevgelija**

The review of the faunistic literature for the municipality of Gevgelija includes 30 references that refer to 7 (Gevgelija, Bogorodica, Konsko, Novo Konsko formerly known as Gornichet, Miravci, Mrzenci, Negorci and Sermenin) from a total of 17 villages or localities.

Most of the faunal data refer to the fauna of spiders, butterflies and stoneflies. Regarding the other groups, Dedov and Hristovski (2010) found the presence of 16 species of snails (Pulmonata) on the mountain Kozuf, including the species *Helix pomatia* recorded on the move between the sites Asan Cesma, Adzibarica and the peak Dvete Ushi.

The fauna of spiders (Araneae) in the municipality of Gevgelija is relatively well studied from a faunal point of view. Initial data are provided by Nikolić (1981) and Drenski (1928) with the presence of 3 and 1 species, respectively, as well as Schönhofer and Martens (2009) - 1 species for the locality Smrdliva Voda (Kozuf). And exactly for this mountain which is included in the areas of Emerald and the Balkan Green Belt, there are researches from a more recent date (Matevski 2018), which enrich the faunal base of spiders with an additional 182 species belonging to 99 genera and 24 families. In fact, during his research, which covers a wide range of habitats, Matevski (2018) found the presence of:

12 Balkan endemics of which: 2 species from the families Nemesiidae (*Brachytele denier* and *Brachytele langourovi*), Agelenidae (*Histopona vignai* and *Inermocoelotes karlinskii*), Dysderidae (*Harpactea prope krumi* and *Harpactea samuili*), *linyphina* and *Linyphium* a species of the families Lycosidae (*Pardosa drenskii*), Thomisidae (*Ozyptila balcanica*) and Zodariidae (*Zodarion epirense* and *Zodarion konradi*).

Furthermore, **27 species that are new to the N. Macedonian fauna** among them: five species from the family Linyphiidae (*Agyneta ramosa, Drapetisca socialis, Metopobacturus orbelicus, Palliduphantes alutacius* and *Tenuiphantes mengei*), 4 species from Gnaphoschulas, *Aphantaulax cincta*, *Trachyzelotes holosericeus*, *Trachyzelotes lyonetti* и *Zelotes gallicus*), 3 species of Salticidae (*Pellenes allegrii, Sibianor tantulus* and *Sittiflor rupicola*) and Zodariidae (*Zodarion epirense, Zodarion konradi* and *Zodarion prope epirense*), 2 species each of the families Nemesiidae (*Brachytele langourovi* и *Nemesia prope pannonica*) and one species from the families Agelenidae (*Histopona vignai*), Araneidae (*Araneus sturmi*), Dysderidae (*Harpactea prope krumi*), Mimetidae (*Ero furcata*), Sparassidae (*Olius argelasius*), Theridiidae (*Epridusidae)* Thomisidae (*Diaea livens*) и Uloboridae (*Hyptiotes paradoxus*).

Additional **4 new genera for the fauna of N. Macedonia** as follows: one genus from the families Gnaphosidae (*Aphantaulax*), Linyphiidae (*Drapetisca*), Uloboridae (*Hyptiotes*) and Sparassidae (*Olius*), as well as **3 possible new species for science**, of which: one species from the families Nemesiidae (*Nemesia prope pannonica*), Dysderidae (*Harpactea prope krumi*) and Zodariidae (*Zodarion prope epirense*).

A total of 9 scientific studies refer to the stoneflies (Coleoptera) which inhabits the villages and localities in the municipality of Gevgelija, with special emphasis on the mountain Kozuf.

The beginnings of the study of the hard-winged fauna date back to 1939 when Heyrovsky for the mountain Kozuf ascertained the presence of 6 species of Cerambycidae, and later by Mikšić (1955) that number was supplemented with 17 more species of the family *Scarabaeidae*, around the city of Gevgelija. Of great importance are the findings of Karaman (1967, 1971) describing the presence of 15 species of Platypodidae and 31 species of Scolytidae respectively.

Recent research is aimed at studying the fauna of runners, enriching the list of species with 43 other species of the family Carabidae, including the presence of the Balkan endemic and protected species *Carabus violaceus azurescens* Dejean, 1826 and the species Corine - *Calosoma sycophausa* (Linnaeus, 1758).

Of great importance to the fauna of butterflies are the monographs by Doflain (1921) Thurner (1964), Daniel (1964), Pinker (1968), Schaider & Jakčić (1989) which announce a list of 65 species which includes rare, endemic, as well as species with conservation significance: *Lycaena dispar* (Haworth, 1803) *Polyommatus* (Polyommatus) *escheri* (Hübner, 1823), *Epiblema graphana* (Treitschke, 1835), *Parnassius apollo* (Linnaeus, 1758), etc. all for the surroundings of Konsko, Negorci, Gevgelija and Kozuf. During 2012 the list was supplemented with the conservation important species *Zerynthia polyxena* (Denis & Schiffermüller, 1775) registered in the sites Mrzenci (along the Sermeninska river near the village Mrzenci) and Novo Konsko (Gornichet) by Verovnik.

Within stoneflies fauna, Matvejev (1967) reports the presence of the species *Asiotmethis obtusus* (Fieber, 1853) which is considered near threatened species (NT) on the World and European Red List of Affected Species. Later on Chobanov and Mihajlova (2010) indicate the presence of 6 more species, mainly for the area of Negorci (Negorska Banja), but also for Sermenin all with the status of least affected species (LC) on the N.Macedonian Red List stoneflies.

For the fauna of hemiptera (Hemiptera) and termites (Isoptera) there is only one data - for Reduviidae (Protic 2010) and Rhinotermitidae (Weidner 1955) in the vicinity of Gevgelija, while for the same municipality, Günther (1980) lists 5 types of book lice from the family Psocidae (Psocoptera).

Nine species of Homoptera were published by Čingovski (1958), and during 2005 that number was enriched with an additional 5 species of Cicadidae, by Gogala et al.

Some time later, Čingovski (1985) published a list of cypresses containing a total of 5 species of Tenthredinidae, thus supplementing the already existing faunal list of 6 species (mainly from the family Vespidae), compiled by Konigsmann (1969).

- **Municipality of Radovish**

A total of 8 literary sources refer to the faunal composition of the beetles, homoptera and orthoptera that inhabit the municipality of Radovis, and cover only 2 localities / villages (around the town of Radovish and the village Shipkovica) out of a total of 35 villages.

The literature on the beetles fauna (Coleoptera) includes 57 species belonging to 10 families, and the first faunal research in this municipality dates back to 1955, when Mikšić (1955) published 4 species of Scarabaeidae and 3 species of the family Cetoniidae. Among them, two species (*Oxythyrea funesta* (Poda, 1761) and *Cetonia aurata aurata* (Linnaeus 1761)) are recorded in the vicinity of the village Shipkovica. Later Zora Karaman (1971) noted the presence of 1 species of the family Scolytidae. Further research in this area is performed by Istvan and Gyorgy (2008) with a record of a total of 31 species of the family Chrysomelidae, Rozner and Rozner (2009) publishing a list consisting of 15 species belonging to 7 families of Coleoptera, enrich the list with an additional 3 species of the family Carabidae.

Muranyi (2018) publishes 3 species of Aphididae (Homoptera) for the mountain Plachkovica and the locality Lomija, while Gogala (2005) announces the presence of only 1 species of family Cicadidae for the vicinity of the town of Radovis.

The fauna of orthoptera (Orthoptera) that inhabits the municipality of Radovis is poorly explored. The only data is provided by the work of Chobanov and Mihajlova (2010) where the presence of 3 species with conservation significance is stated.

- **Municipality of Konce**

The detailed review of the literature regarding land invertebrates showed a deficit of faunal data for the territory of the municipality of Konce which includes a total of 13 villages. The only data contained in the scientific study of Chobanov and Mihajlova (2010) which lists the species *Chorthippus vagans dissimilis* from the order of orthoptera (Orthoptera) and refers to the territory of the municipality of Konce. To enrich the knowledge about the biodiversity of this municipality, thorough faunistic research in it is necessary.

- **Municipality of Valandovo**

The literary review that refers to the municipality of Valandovo consists of a total of 20 references which include 10 (Valandovo, Josifovo - formerly known as Kaluchkovo, Dedeli, Kazandol, Marvinci, Rabrovo, Udovo, Chalakli, Bashali and Plavush with Plavush 29) villages i.e localities.

For this municipality, specifically for the village of Josifovo in the catalog of Matvejev (1967) the presence of the species *Iris oratoria* (Linnaeus, 1758) from the order Mantodea is stated. In the same catalog there are data on the presence of 5 species of stoneflies with conservation importance in the vicinity of Josifovo, Rabrovo and Plavush Mountain: the endemic *Poecilimon macedonicus* Ramme, 1926; *Callimenus oniscus* (Burmeister, 1838) and *Asiotmethis heldreichi* (Brunner von Wattenwyl, 1882) with almost affected status on the IUCN World and European Red List; *Metrioptera bispina* (Bolivar, 1899), as well as the endangered species in the world and Europe, *Callimenus pancici* Brunner von Wattenwyl, 1882, which on the N.Macedonian red list of stoneflies is listed under the category of critically endangered species (CR). This species is recorded on Mount Plavush without specific data on the place of identification. This faunal composition is followed by the species *Ameles decolor* (Charpentier, 1825), noted by Chobanov and Mihajlova (2010) in the vicinity of Josifovo, Raborvo, Dedeli and Plavush Mountain.

The fauna of spiders (Araneae) is processed by Drenski (1928) who found the presence of 6 species in the vicinity of the villages Dedeli and Josifovo.

During 2007, Liljana Protic published a list of Hemiptera consisting of 5 species of fam. Cydnidae from the vicinity of Marvinci (with Pupkov Rid) and Valandovo, and during 2010 it completes it with 4 more species of Reduviidae from the vicinity of Valandovo, Udovo and Marvinci (with the archeological site Isarot).

Konigsmann (1969) recorded 6 species of Hymenoptera of the family Eumenidae (Hymenoptera) from the vicinity of Josifovo and Dedeli while by Gogala (2005) only one species of Cicadidae in the vicinity of Valandovo has been published for the fauna of the unicorns (Homoptera).

The environmental impact assessment study: mining complex for production of cathode copper - "Kazandol", published by Empiria Ems (2015) includes data on the presence of 2 species of single-foot centipedes (Chilopoda, Myriapoda), 1 species of Scorpiones, Mesobuthus gibbosus, as well as 4 species of family Carabidae (Coleoptera), including the rare species *Pachycarus cyaneus*, all from the vicinity of Kazandol.

In addition to the faunal list of hardliners (Coleoptera) in the area of the municipality of Valandovo, the works of čurčić et al. (2003) which notes the presence of 2 types of cerambicides from the vicinity of Marvinci. Kovacs and Merkl (2013) for the vicinity of Rabrovo and Plavush Mountain publish 5 species of hardwoods, including species collected in oak holes: *Elater ferrugineus* Linnaeus, 1758 (Elateridae), *Rhaesus serricollis* (Motschulsky, 1838) from Cerambycidae and *Propomacrus bimucronatus* (Pallas, 1781) from Scarabaeidae, the first two with the status of the Nearly Threatened (NT) on the European Red List of Affected Species and the Red List of Saproxyl Coleoptera, and the third on the Mediterranean Red List of Affected Species.

A year later, Kovacs et al. (2014) note the presence of 2 more species for Plavush Mountain, and one of them is *Lacon punctatus* (Herbst, 1779) from Elateridae collected from the vicinity of the Monastery of St. George, also in a hole from Platanus.

With the work of Rozner and Rozner (2009) the list of stoneflies around Udovo and the town of Valandovo is enriched with 4 more species of Cetoniidae, and in the Catalog of Hristovski and Gueorguiev (2015) contains 8 species, including the Corine species *Calosoma sycophanta* (Linnaeus, 1758) for the surroundings of Valandovo, Marvinci, Udovo, Josifovo and Bashali (Gradechka Planina).

There is a wealth of literature on the faunal composition of butterflies (Lepidoptera). Some of them are contained in the above study prepared by Empiria Emma (2015) which lists 9 important conservation species of 4 families, for the area of Kazandol.

From the older literature, Daniel (1964) notes the presence of 22 species from 7 families in the vicinity of Valandovo, Dedeli, Rabrovo, Josifovo and Plavush Mountain. For the same sites Thurner (1964) describes 80 species belonging to 9 families. Additionally, Pinker (1968) made a great contribution by publishing a list of a total of 78 species from 8 families, which includes 9 rare species, 35 Balkan endemics, 12 local endemics and 1 subendemite.

- **Municipality of Bogdanci**

In 10 monographs, scientific papers and studies, faunistic data were found that refer to the territory of the municipality of Bogdanci (important area for plants - IPA), and include the stoneflies (Coleoptera) cipocrine (Hymenoptera) as well as the fauna of butterflies (Lepidoptera).

For the Hymenoptera fauna around the town of Bogdanci there is only one faunal data published by Konigsmann (1969) which records the presence of 2 species of the families Eumenidae and Vespidae.

For the vicinity of the town of Bogdanci, Daniel (1964) noted the presence of 7 species from 5 families, and the same year Thurner (1964) published a list of 18 species belonging to the families Erebidae, Hesperidae, Lycaenidae, Noctuidae and Satyridae.

Four years later, during his research Pinker (1968) registered: 1 Corine species, 3 Balkan, 4 local endemics as well as 4 rare species of the family Geometridae; 1 corine species - *Pyrausta aurata* (Scopoli, 1763), 2 Balkan (*Cynaeda gigantea* (Wocke, 1871) and *Paracorsia repandalis* (Denis & Schiffermüller, 1775) and 1 local endemic - *Pyrausta sanguinalis* (Linnaeus, 1767) from the Cramb family; 1 more Corine species - *Oegoconia quadripuncta* (Haworth, 1828) from the family Autostichidae, as well as 3 Balkan endemics (*Lamoria anella* (Denis & Schiffermüller, 1775) *Bradyrrhoa gilveolella* (Treitschke, 1832), *Scirpophaga praelata* (Scopi) 1 - *Pyralis regalis* Denis & Schiffermüller, 1775 from the family Pyralidae.

In recent research along the river Vardar northwest of the village Gjavato on rocky areas, pastures and bush slopes at an altitude of about 60 m Verovnik (2012) found the presence of another important conservation species - Zerynthia polyxena (Den & Schiffermüller, 1775).

Besides Gjavato, the territory of the municipality of Bogdanci includes the villages of Bolovan, Paljurci (as part of the Emerald area Curculum-Paljurci) and Stojakovo (as well as Selemli and Pobregovo for which there are no literary data). Within these villages, the presence of 1 species of Curculionidae (Mihajlova 1978) and 12 species of runners (Coleoptera, Carabidae) was ascertained. Most (7) of them can be found in the catalog of Hristovski and Gueorguiev (2015).

- **Municipality of Dojran**

Out of a total of 14 villages belonging to the Municipality of Dojran, the analysis of species diversity includes 7 villages (Nov and Star Dojran, Nikolic, Fourka, Gjopceli, Crnichani and Zafirka) and additionally the fauna that inhabits the areas around the springs Toplec and the resort "Achikot“.

Most of the literary data, otherwise taken from the Study for valorization of the Monument of Nature Dojran Lake (2016), refer to the fauna of butterflies (Lepidoptera) which in the Dojran Valley is represented by a total of 523 taxa from 47 families. Among them, the families Geometridae and Noctuidae with 89 taxa, Pyralidae (46), Tortricidae (37), Crambidae (32) and Nymphalidae (29) are represented with the largest species diversity. The group Bombyces and Sphinges includes 61 taxa of eleven families (Erebidae - 15, Zygaenidae - 14, Arctidae - 8, Lasiocampidae - 7, Nolidae - 5, Cossidae - 3, Sesiidae - 3, Hepialidae - 2, Notodontidae - 2, Lemoniidae , Thyrididae - 1), while the group of daily active butterflies Diurna is represented by a total of 58 taxa from four families: Lycaenidae - 20, Hesperiidae - 17, Pieridae - 16 and Papilionidae - 5. The list of butterflies in the Dojran Valley consists of 82 taxa of 26 families belonging to the Microlepidoptera order.

Based on the national list of N.Macedonian and Balkan endemics for the municipality of Dojran, the presence of seven endemic taxa was concluded. Among them, five are Dojran endemics *Euthrix potatoria* Linnaeus, 1758 - Lasiocampidae, *Cnephasia (Cnephasia) klimeschi* Razowski, 1956 - Tortricidae, *Zygaena (Mesembrynus) purpuralis dojranica* Burgeff, 1926, *Zygaena carniolica paeoniae* Burgeff, 1926, *Zygaena ramburii europensis* Daniel, 1957 from Zygaenidae. The species *Pieris balcana* Lorkovic, 1970 from fam. Pieridae is Balkan, while *Cosmia (Silva) confinis* Herrich-Schäffer, 184 from fam. Noctuidae is a national endemic. The possibility of a number of endemic forms is not ruled out, given that for most species there is a lack of literature data to assess their status.

According to the national lists for determination of strictly protected (I) and protected (II) wild species in R. N. Macedonia, one strictly protected wild species has been identified - *Lycaena dispar* (Haworth, 1802) and two protected wild species of butterflies: *Cnephasia (Cnephasia) klimeschi* Razowski, 1956 and Cosmia *(Silva) confinis* Herrich-Schäffer, 1849.

Following the identification of species of international and European importance, five species of Lepidoptera: *Proserpinus proserpina* (Pallas, 1772), *Callimorpha quadripunctaria* Linnaeus, 1758, *Lycaena dispar* (Haworth, 1802), *Zerynthia (Zerynthia) polyxena* (Denis & Schiff 1775), *Pieris balcana* Lorkovic, 1970 and *Euchloe (Euchloe) ausonia* (Hübner, 1804) are included in the international biodiversity conservation lists. According to the Habitats Directive, the species *Proserpinus proserpina* (Pallas, 1772) and *Zerynthia (Zerynthia) polyxena* (Denis & Schiffermüller, 1775) are included in Annex IV, but special attention is paid to the species *Callimorpha quadripunctaria* Linnaeus with protection in 1758. Additionally, the species *Lycaena dispar* (Haworth, 1802) is under legal protection with the Habitats Directive 92/43 / EEC (II IV) which again emphasizes the need for a high degree of protection of both the species and its habitat. This species is listed in Annex II of the Berne Convention, and also belongs to the group of Emerald species.

The IUCN Global Red List of Threatened Species lists three significant species of butterflies. *Pieris balcana* Lorkovic, 1970 and *Lycaena dispar* (Haworth, 1802) belong to the categories LC and LR / NT (on the limit of endangerment) respectively (IUCN 2016), while the species *Proserpinus proserpina* (Pallas, 1772) is classified under the category - DD (without enough data). Although this category does not apply to endangered species, it does emphasize the need for more taxonomic information in order to be included in the relevant category.

Some of the above species are also significant according to other international documents that treat invertebrates, ie butterflies. Thus, the species *Euchloe (Euchloe) ausonia* (Hübner, 1804), *Zerynthia (Zerynthia) polyxena* (Denis & Schiffermüller, 1775) and *Lycaena dispar* (Haworth, 1802) are cited in the list of CORINE biotopes. Unfortunately, R. N. Macedonia has not yet developed a National Red List and Red Book, but it is good to emphasize the inclusion of the species *Euchloe (Euchloe) ausonia* (Hübner, 1804), *Pieris balcana* Lorkovic, 1970 2010, *Lycaena dispar* (Haworth, 1802) and *Zerynthia (Zerynthia) polyxena* (Denis & Schiffermüller, 1775) in the Red Book of Butterflies in Europe under the category LC (less affected). The latter two species are included in the Red Book of Serbia 2003 under category V (vulnerable) and the Red Book of Croatia 2004 - category NT (unaffected), while the species Euchloe (Euchloe) ausonia (Hübner, 1804) in the Red Book of Serbia 2003 are leads as endangered.

Within the beetles fauna (Coleoptera) which includes 52 species from eight families, the analysis mainly covers the diversity of runners who are also one of the most researched and best-studied hard-winged fauna in the Republic of N. Macedonia. In the catalog of runners (Hristovski & Gueorguev, 2015), 37 types of runners are listed for the Dojran region, which is a relatively low number. Most species are registered in localities near Star Dojran. The data for the family Chrysomelidae are from an older date and include 3 species of the genus Chrysolina (Motschulsky, 1860) and 1 species each of the genera Colaphus (Dahl, 1823) and Gastrophysa (Chevrolat, 1837) registered in the vicinity of New Dojran. The family Cerambycidae is present with 4 species of the genera Stictoleptura (Casey, 1924) and Chlorophorus (Chevrolat, 1863), while the families Elateridae, Coccinelidae, Geotrupidae and Lucanidae are represented by 1 species each.

A total of 147 species of 16 families of true bugs (Heteroptera) mainly of Mediterranean and Eastern European origin inhabit the Dojran Valley. Most species belong to the families Lygaeidae (34), Miridae (30) and Pentatomidae (21).

The only data on the species diversity of Homoptera from the Dojran Region are given by Jankovic (1971) and refer to the order Auchenorrhyncha which includes a total of 23 species of the family Cicadiidae and one species of the family Delphacidae.

Within the hippocampus (Hymenoptera), thanks to the detailed work of Cingovski (1985), there is a rich list of species that includes only the order Symphyta (plant wasps). Their species diversity in the Dojran Valley is represented by 17 species of Apidae, 12 species of the family Vespidae and 21 species of Symphyta (15 species of Tenthregidae and 3 species of the families Argidae and Cephidae).

According to Gunther (1980) in the Dojran Valley is registered the presence of 16 species of vultures (Psocoptera). After the revision of the diversity of invertebrates (Hristovski et al. 2015), a total of 14 species were found for the Dojran Basin, for correction and exclusion of the species *Liposcelis simulans*, *Liposcelis terricollis* and *Liposcelis macedonicus* which are synonymous with the cholarctic species *Liposcelman decolor* (Pearman, 1925).

From the earwigs (Dermaptera) in the Dojran Valley by Muranyi (2013) the presence of only the species Labidura riparia (Pallas, 1773) along the shore of the lake in Nov Dojran has been ascertained. The only data on the mantodea in the Dojran region are given by Chobanov & Mihajlova (2010) where they state the presence of the species Empusa fasciata Brullé, 1836 and Ameles heldreichi Brunner von Wattenwyl, 1882, registered near the summer camp Achikot.

For the area around Lake Dojran, the same authors give a list of 18 species of orthoptera (Orthoptera) from six families, with the largest diversity of the family Tettigonidae (6 species). Some of the species are without data on the exact location, while for the others for which the place of collection is specified, the locality Achikot is mainly mentioned.

The knowledge about the diversity of spiders (Araneae) in R. N. Macedonia are significantly larger in the last ten years as a result of intensified archaeological research. However, there are few literary data on the Dojran Basin. Spider fauna is represented by a total of 11 species belonging to six families (Salticidae, Oxyopidae, Philodromidae, Agelenidae, Araneidae, Gnaphosidae). Thus Doflain (1921) in his research mentions the presence of a total of 6 species. Recently, Komnenov (2005) in the list of salticides (Araneae: Salticidae) adds 5 species of jumping spiders for the area of Dojran, among them two are new to the N.Macedonian fauna: *Euophrys herbigrada* (Simon, 1871) collected near the source of the river Toplec, at about 170 m asl and *Salticus propinquus* Lucas, 1846 collected in a pine forest in the Zafirka locality. For the Balkan Peninsula, the presence of this species is recorded only in N.Macedonia and Greece.

- **Municipality of Strumica**

Although there are about 11 references that refer to the invertebrate fauna from the municipality of Strumica and the villages of Bansko, Vodocha and Gabrovo (out of a total of 25 villages), they contain a small number of data on its species diversity. Thus, Drenski (1928) states the presence of 10 species of 6 families of spiders (Araneae) in the vicinity of Bansko and Strumica.

Furthermore, Klimesch (1968) registered the presence of only 2 Balkan endemics (*Scoparia arundineta* and *Anania hortulata*) from the family Crambidae (Lepidoptera).

In the article by Konigsmann (1969) can be found data on the presence of 3 species of the family Vespidae (Hymenoptera) in the vicinity of Bansko and Strumica and the only data on the fauna of the hemiptera (Hemiptera), which refers to the species Canthophorus dubius (Scopoli, 1763) was published by Protic (2007) on the surroundings of the city of Strumica.

Atanasova (2010) publishes 33 species of homoptera (Homoptera) from six families that inhabit vineyard fields from the region of Strumica and Atanasova et al. (2013) present new data on the species composition of Fulgoromorpha and Cicadomorpha in the Strumica region (Hristovski et al. 2015).

The authors Mikšić (1955), Karaman (1967), Ćurčić et al. (2003), Istvan and Gyorgy (2008) and Hristovski and Gueorguiev (2015) publishing a total of 11 species belonging to 5 families of Coleoptera.

The monograph of Chobanov and Mihajlova (2010) states the presence of 2 types of orthopedists while in the faunistic work of Cvetkovska-Gorgievska et al. (2015) the authors note the presence of additional 5 conservation significant species from the sites Pisana Skala and Groba on the mountain Belasica. Namely, the border position and specific features (specific macro-climatic and micro-climatic conditions, large and sharp leveling (400-2029 m) the presence of several altitude belts), indicate the abundance of habitats which in turn indicates a rich species diversity and existence of

unique soil communities, which is why **Belasica mountain** is part of the Emerald Network and the Balkan Green Belt and has been identified as a priority area for species diversity research.

In that regard, a total of 14 literary references refer to the species diversity of the terrestrial invertebrate fauna of Belasica. Thus, for the faunal composition of the butterflies (Lepidoptera) that inhabit Belasica, there is a solid number of references. The beginnings of the study of butterfly fauna date back to the time of Daniel et al. (1951) noting the conservation species Callimorpha quadripunctaria Linnaeus, 1758.

Later, Daniel (1964) reported the presence of 3 species from two families, and Thurner (1964) reported the presence of 18 species belonging to 5 families.

During 1968, the list was supplemented by research by Pinker (1968) who published 1 species of the family Tortricidae and 9 species of Geometridae for Belasica.

It is important to note the work of Schaider & Jakčić (1989) which resulted in the presence of 3 important conservation species of butterflies: *Polyommatus eroides* (Frivaldszky, 1835Parnassius mnemosyne (Linnaeus, 1758) and *Parnassius apollo* (Linnaeus 17).

Among the many references are the study for valorization of the diversity of Belasica (Micevski, 2010) and the doctoral dissertation of Cvetkovska-Gjorgjievska (2015). Within the dissertation of the same name, for the northern slopes of the mountain, the presence of a total of 146 taxa belonging to 8 classes, 23 rows and 97 families is stated. The species diversity of the Beetles (Coleoptera) is represented by 110 taxa belonging to 31 subfamilies of 27 families, and the valorization of species of conservation importance has shown the presence of four rare species: *Agaricophagus balcanicus* (Leiodidax), *Lyodium tuberculatus Nosodomodes tuberculatus* (Zopheridae) and *Cerambyx scopolii* (Cerambycidae).

Furthermore, the genus *Sternodea* Reitter 1875 and the species *Sternodea baudii* Reitter 1875 (Cryptophagidae), Catops neglectus Kraatz 1852 (Cholevinae), *Philorhizus notatus* (Stephens 1827) (Carabidae), the genus *Hymenalia* Mulsant 1856 and the species *Hymenalia graeca* Seidlitz 1896 are new for R.N.Macedonia.

Three subspecies are **endemic** of which *Cychrus semigranosus balcanicus* is Balkan, while the subspecies *Molops rufipes belasicensis* and *Tapinopterus balcanicus belasicensis* are local endemics and subendemites respectively. According to Gueorguev and Lobo (2006) the species *Myas chalybaeus*, which is a **tertiary relic** also has a subendemic origin.

Five species of Coleoptera are included in **international** biodiversity conservation lists.

The species *Carabus intricatus, Morimus asper funereus* and *Rosalia alpina* are listed in the IUCN Red List of Endangered Species under the categories LR / nt, VU A1c + 2c and VU A1c, respectively (IUCN 2010).

The species *Carabus intricatus* and *Carabus convexus dilatatus* are cited in the CORINE list while Annexes II and IV of European Habitats Directive 92/43 of Natura 2000 list the species *Lucanus cervus* and *Morimus asper funereus*.

The appearance of rare, endemic, further species with conservation importance as well as species that are new to Belasica and thus to the fauna of North Macedonia increases the conservation importance of Belasica and is an additional confirmation of the existence of a high degree of biodiversity.

In the paper Cvetkovska-Gorgievska et al. (2015) from a taxonomic point of view the species diversity of orthoptera (Orthoptera) was analyzed which includes a total of 16 species, among which there are species with the status of least affected (World and European Red List of IUCN - LC). The most common species is *Gryllomorpha dalmatina* with distribution up to an altitude of 847 m, while *Eupholidoptera chabrieri* is registered only in the Sessile Oak belt and *Troglophilus neglectus serbicus* in the beech belt.

In the same dissertation the order Araneae is represented by 29 families. If a more detailed analysis is performed at the level of the species, it is likely that there is a high species richness of spiders.

Although Belasica is a medium-high mountain, its role as a barrier has an insulating effect on the spread of some organisms, which contributes to the emergence of new species and subspecies.

However, despite the smaller species diversity and endemism the presence of the tertiary relic as well as endemic and subendemic species emphasizes its conservation importance and is a good enough indicator of the role of Belasica as a refuge center. Therefore, by R. Greece the mountain is proposed as a place under Natura 2000 and is considered as a special protected ornithological zone, according to the EC Birds Directive (79/409 / EC), and due to the abundance of natural habitats of great conservation importance Belasica is proposed for CORINE place with which creates an opportunity to become part of the European environmental network of Natura 2000.

- **Municipality of Novo Selo**

Out of a total of 15 villages belonging to the territory of the municipality of Novo Selo for only three of them (Novo Selo, Koleshino with Koleshino Waterfalls and Smolari with Smolar Waterfalls) there are a total of 7 literary records. Almost all records contain information about the invertebrate fauna that inhabits the northern side of Mount Belasica. Among them are the above-mentioned doctoral dissertation of Cvetkovska-Gjorgjievska (2015), as well as the faunistic work for orthopedists (Cvetkovska-Gorgievska et al. 2015).

That same year, Plewa et al. (2015) on the mountain Belasica near the village Koleshino, note the presence of the species Cerambyx (Microcerambyx) scopolii scopolii Fuessly, 1775 (Cerambycidae).

Of particular importance is the information contained in the catalog for the fauna of runners in North Macedonia (Hristovski and Gueorguiev 2015), which lists 17 species for Belasica near the locality Sharena Cesma and the villages Smolari and Koleshino.

One of the authors of the catalog during 2010 (Gueorguiev et al. 2010) registered the presence of 12 species of beetles from 10 families. Among them is the species *Pediacus dermestoides* (Fabricius, 1792) which on the European Red List of Endangered Species and the Red List of Saproxyl Beetles is listed under the category DD (data deficient).

The territory of the municipality of Novo Selo also includes parts of the mountain Ograzden for which Chobanov (2002) in his research on the move between the locality Suvi Laki - peak Ograzden as well as at the very top found the presence of 15 species of orthoptera. Of these, 3 species belong to the fam. Phaneropteridae, 4 species of Tettigoniidae, 7 species of Acrididae and 1 species of Tetrigidae and almost all have the status of least affected species (LC) on the IUCN World and European Red List.

- **Municipality of Bosilovo**

The faunal list for the invertebrate fauna of the municipality of Bosilovo is composed of only 4 references, counts a total of 15 species, and refers to only 3 (Bosilovo, Hamzali and Monospitovo) from a total of 17 villages belonging to the municipality.

Rozner and Rozner (2009) have contributed to the study of the beetles (Coleoptera) from the area of the village of Hamzali, Podazlija (Mount Obesenik) by publishing 4 species of fam. Scarabaeidae and the catalog of Hristovski and Gueorguiev (2015) which lists 2 species of the family Carabidae.

In the area of the villages of Hamzali and Gogala (2005) registered the presence of 3 species of Cicadidae and 1 species of the family Tibicinidae from the order Homoptera.

In the study for valorization of the diversity of Monospitovsko Blato (2004) where a large species diversity is stated, 4 species of spiders (Araneae) are listed. In the world (IUCN VU) the

vulnerable species *Dolomedes plantarius* and the three rare species that are recorded only in the area of the swamp of the same name: *Mendoza canestrinii, Clubiona phragmitis* and *Hypsosinga heri*.

The only data on butterfly fauna (Lepidoptera) published by Verovnik 2012, northwest of the Hamzali Monastery, recorded the presence of the conservation-important species *Zerynthia polyxena* (Denis & Schiffermüller, 1775).

The territory within the municipality of Bosilovo cover parts of the mountain Ograzden as well. From a faunistic point of view, the mountain is analyzed in only 4 references. The first beginnings date back to the time of Karaman (1967) which states the presence of 2 species of the family Scolytidae (Coleoptera). A little later, the same author (Karaman 1971) confirms the presence of the existing two and enriches the list with an additional 4 species of Scolytidae.

There is only one record of butterfly fauna (Lepidoptera) published by Schaider & Jakčić (1989), and it refers to the conservation species Lycaena dispar (Haworth, 1803).

After a while, Ograzden's faunal research continued, but this time with Chobanov (2002) studying owl fauna, resulting in 25 species from 8 families, almost all of which are on the World and European Red List of Endangered Species. species, as well as the N.Macedonian Red List of Orthoptera.

- **Municipality of Vasilevo**

After the analysis of the literature, not a single record was found that refers to the faunal composition of the invertebrate fauna on the territory of the municipality of Vasilevo (with a total number of villages 18), which emphasizes the need for intensive faunal research in it.

4.1.4.2. Fish species

- **Review of current data on the flora in the SEPR in Republic of N. Macedonia**

It is well known that in adopting specific measures for protection and conservation of ecosystems, among other things, knowledge of biodiversity and biology of each species in the country are invaluable. Unfortunately, in our country as a result of a small number of ichthyological researches not only in the past but also today, data on diversity and distribution of fish are missing. According to the National Strategy for Biological Diversity of North Macedonia (2014) the fish fauna in the country is represented by about 85 species (of which 19 are introduced), and the knowledge of their diversity is largely based on literary data from the past.

In that context, we would like to emphasize that according to the current literary data, the distribution of fish fauna in the South-East Region of the country is insufficiently researched. Literary data primarily refer to the composition of fish fauna along the main course of the river Vardar through the Valandovo-Gevgelija Valley, as well as the main course of the river Strumica, but not for other larger and smaller tributaries that gravitate to the mentioned watercourses. Modern research on the situation of the fish population from Lake Dojran, as well as some reservoirs entering the South-East Region, is also lacking. The following text provides a literary overview of the distribution of fish fauna in the waters that belong to the Vardar catchment area, as well as the Strumica river basin, and enter within the South-East Region. For greater visibility of the data, they are sorted by smaller regions / municipalities through which these watercourses pass. Based on the data, valorization of fish fauna was performed. The valorization of fish is carried out in accordance with international conventions and legislation. The naming of the species is according to Kottelat and Freyhoff (2007), with some additions explained either in the text or in the tables.

- **Valandovo-Gevgelija Valley**

According to the literary data from a total of 37 species of fish present along the river Vardar (Karaman, 1924, 1928, 1936; Berg, 1948; Ladiges, 1967; Vukovic & Ivanovic 1971; Dimovski and Grupce 1972; Grupce and Dimovski, 1973; Economidis et al., 1981; Economidis 1991, 1995; Economidis & Banarescu 1991; Nastova-Gjorgjioska et al., 1998; Soric 1999; Economou et al., 2007), about 35 species of fish have been registered for Vardar Basin - Downstream "(Fisheries Master Plan 2017-2022) which includes the Valandovo-Gevgelija Valley, as the last geomorphological unit through which Vardar flows on the territory of N. Macedonia.

The first complete research on the composition of the fish fauna of the river Vardar which passes through the territory of our country was performed by Grupce and Dimovski (1973). According to these researches, only on the river section that passes through the Valandovo-Gevgelija Valley 20 species of fish have been registered (Annex 4; Table 1).

In 1998, at two measuring points in the valley ichthyological research was performed by Nastova-Gjorgjioska et al., (1998) and the presence of 14 species of fish was ascertained. In 2006, thorough ichthyological researches were conducted by Kostov (2006) as part of the Project "Integrated Management of Transboundary Water Resources in Fyrom-RBMP Vardar River Basin" which showed that in the river Vardar on the move from Gradec to border, 16 species of fish are present (Appendix 4; Table 1). After ten years, in the period from 2016/17 in the part of Vardar around Gevgelija, enthusiastic ichthyological researches were conducted (by the team participating in the preparation of this study), where the presence of 15 species of fish was registered (unpublished data).

What can be noticed (Appendix 4; Table 1) is that the number of taxa is different in the mentioned studies which also depends on: (1) the applied methodology of collecting fish fauna, (2) number of points included in the surveys, (3) the time period in which the surveys were conducted. According to the research in Annex 4; Table 1, in the Valandovo-Gevgelija Valley along the main course of the Vardar, there are **24** species of fish from 10 families, out of which **20 autochthonous** and **4 allochthonous (non-native fish)** species (*Pseudorasbora parva, Carassius gibelio, Lepomis gibbosus* and *Oncorhynchus mykiss*).

Research conducted by Kostov (2006) indicates that in the composition of the fish community, the dominant species are *Barbus balcanicus, Squalius vardarensis, Alburnoides bipunctatus* at the measuring point near Gradec (as the closest measuring point to Udovo) and *Rhodeus meridionalis* and *Alburnoides bipunctatus* at the measuring point near the border. The other registered species are represented with insignificant density.

The ichthyological researches conducted in the same year show the absence of the species *Romanogobio*, as well as the streber (*Zingel balcanicus*) species that were previously detected by Grupce and Dimovski (1973) in this part of the riverbed of Vardar.

With insignificant number the presence of 3 non-native species of fish *Pseudorasbora parva, Carassius gibelio, Lepomis gibbosus* (Kostov, 2006) was registered at the same measuring points. Research conducted in the study of the same name does not confirm the presence of *Oncorhynchus mykiss* but the possibility of its existence is not ruled out, especially in those parts where there are fish farms for breeding California trout.

Unfortunately, literary data on the composition of fish fauna in the larger tributaries that gravitate towards Vardar in the mentioned valley such as Stara Reka, Anska Reka, Luda Mara, Sermeniska Reka, Kovanska Reka, Konjska Reka and Maminska Reka are missing. Data are also missing for most of the accumulations, such as "Bogorodica", "Topolec", "Dos" and "Kalica". According to data from fishermen in the reservoir "Kalica" there is a presence of carp.

It is probably a stock carp and according to the same sources this reservoir often runs out of water. For "Topolec" there are findings of the presence of carp, scarecrow and red fin (unverified sources).

Considering that the larger part of the downstream section of the Vardar River is potential for proclamation as Global KBAs - Mediterranean Basin Biodiversity Hotspots (2017), more detailed ichthyological surveys are needed to provide more recent data about the condition of the fish fauna in this part of the river including the larger tributaries.

Nowadays the part of the river Vardar which includes Stara Reka and Anska Reka belong to the Fishing area "Reka Vardar 6 - Demir Kapiski", while the flow of the river Vardar from the confluence of Kovanska Reka to the Macedonian-Greek border including Kovanska Reka, Luda Mara, enter the Fishing area "Reka Vardar 7 - Gevgelija". These areas are given on concession, whereby the Law on Waters (Official Gazette of RNM, no. 87/08) regulates the conditions for granting concessions for water in lakes and watercourses.

- **Municipality of Bogdanci**

The river Luda Mara (Stara Reka) is the main watercourse in the municipality of Bogdanci. Data that speak for the fish fauna in this watercourse are those from the “Fishing base for fishing on water reservoir “Paljurci” for the period 2017 - 2022” and refer only to the reservoir (Appendix 4; Table 2), but not to the river itself and its left tributaries: Polendere, Suva Reka, river Matorska and river Taljusnica, which flow directly into Paljurci and the right tributaries: Gabrovska River, Medurska, Gjokova, Kamilska and Gornoselska River.

Given that the fish fauna in an artificial lake is formed from the fauna found in the waters that fill the lake, we can only assume what was the composition of the fish fauna along the river in the past, because after the construction of the reservoir, the riverbed od river Luda Mara is usually dry. According to the data from the "Strategy for development of the rural environment that covers the territories of the municipality of Bogdanci, Valandovo, Gevgelija and Dojran" (2016), the other tributaries of Luda Mara are of torrential character, often dry up and during heavy rains cause problems with carrying sediment and flooding, hence are not expected to be suitable habitat for fish.

According to the data from the Fisheries Master Plan, the fish fauna in "Paljurci" consists of 11 species of fish which belong to 4 families. Out of these, two species *Lepomis gibbosus* and *Carassius gibelio* are non-native species of fish, while the other 9 species are indigenous species characteristic of the Vardar catchment area. According to the data obtained from sport fishermen, the pikeperch (*Cobitis vardarensis*) is present in the lake as well as the pike (*Esox lucius*) fish which belongs to the Strumica catchment area. Ichthyological research is needed to confirm this information.

Besides "Paljurci", in the Municipality of Bosilevo there is an reservoir "Selemli" built in the seventies on Selemliska River whose main purpose is irrigation of arable land, but it is not in operation for a long time due to problems with its ownership. According to the data from the recreational fishermen, in the reservoir today are found: carp, Prussian carp, pumpkinseed, common rude, tench, pike, catfish and perch. Ichthyological research is needed to determine the composition and condition of fish populations from this reservoir. Another reservoir "Chinarli" has been built on the river Luda Mara in the municipality of Dojran for which there is no data whether it is stocked and whether it has been in use in recent years.

- **Lake Dojran**

Ristovska and Kostov (2016) in the study "Study for valorization of the Monument of Nature Dojran Lake" give a detailed overview of the literary data (more than 30 literary data and reports from

studies) that speak of the type composition of the ichthyofauna of Lake Dojran throughout the past (Annex 4; Table 3).

According to these data, on the North Macedonian side of the lake 19 fish species are present belonging to 7 families. Out of these, 15 species are indigenous, and 4 species are non-native fish (*Gambusia holbrooki, Carassius gibelio, Hypophthamichthys molitrix, Hypophthamichthys nobilis*). The carp and gambusia as non-native species belong to the group of invasive species that negatively affect the native species of fish.

- **Strumica region**

The river Strumica (Strumeshnica) is the largest tributary of the river Struma/Strimon which flows through Bulgaria and Greece (Struma / Strymon sub-basin). It is a basin that passes through several important Natura 2000 protected areas in Bulgaria and Greece (Uzunova et al., 2019). According to the research of Vasilev and Pehlivanov (2002) 33 species of fish inhabit the part of the river that passes through the territory of Bulgaria, while 42 species of fish are detected in the part of the river that passes through the Greek territory (Economou et al., 2007).

Literary data on certain representatives of fish from the river Strumica which passes through our country can be found in several works from the last century (Karaman, 1955; Apostolski, 1956; Vukovic and Ivanovic, 1971; Dimovski and Grupce, 1971, 1972, 1977 1987; Grupche and Dimovski, 1973, 1976; Iliev and Dzinova, 1974; Naumovski, 1995), and researches on the distribution and composition of fish fauna in the river basin were first performed by Kostov (2016), as part of the study "Monitoring program for the Strumica river basin". The results are based on ichthyological research conducted at 15 measuring points in the watershed which includes both reservoirs "Vodocha" and "Turija". The measuring points include one point from the tributaries of the rivers that enter both the Radovish Region (Injevska River and Plavija) and the tributaries of the river Strumica, which pass through the Strumica Region (Koleshinska River near Smolarski Waterfalls), Begzastevska River and the river Vodocha).

During the research, 17 species of fish from 7 families were registered (Appendix 4; Table 4). During these researches, the presence of the sturgeon *Acipenser sturio* Linnaeus, 1758 a species mentioned by Naumovski (1995) has not been registered precisely for this catchment area. This species in the past was distributed in the waters of the basin but today it is not registered either in the part of Bulgaria (Vassilev and Pehlivanov, 2002) or in the waters of the same catchment area of Greece (Economou et al., 2007). To this list of species we would add the two introduced species of Eastern mosquitofish (*Gambusia holbrooki*) and stone morocco *Pseudorasbora parva* that are detected in the canals around Monospitovsko Blato [Monograph “Monospitovsko Blato, the last swamp in North Macedonia (Melovski et al., 2008)].

According to the above ichthyological researches in the part of the river that passes through the Strumica Region not including the reservoirs, 9 species of fish (barbel, chub, bleak, gudgeon, bitterling, spined loach and pike) live in the waters. Ichthyological examinations showed the absence of fish at the measuring points placed on Kolesinska River, Smolarski Waterfalls, Begzastevska River and Vodoca River.

Reservois ‘’Turija’’

The reservoir "Turija" located in the basin of the river Turija was built in the period from 1968 to 1972 and was put into operation in 1973. It is intended for water supply of the city of Strumica and industry, and irrigation of part of the Strumica Field.

The first literary data on the fish fauna of the Turija River as well as on the accumulation have existed since 1974 with research conducted by the Fisheries Institute of the Union of the Republic of N. Macedonia (Report, 1974), according to which the presence of 4 species is stated for the river and the reservoir: barbel (*Barbus strumicae*), chub (*Squalius orpheus*), gudgeon (*Gobio balcanicus*) and loach (*Cobitis strumicae*). After several decades follow the research conducted by Kostov (2016) as part of the already mentioned study "Monitoring program for the Strumica river basin". According to the results of this study, the fish fauna only on the lake consists of 8 species of fish (Appendix 4; Table 5) of which *Alburnus sp., Rutilus rutilus* and *Perca fluviatilis* are represented with higher density than the other species. However, it is not to be underestimated the abundance with which the two introduced types of pumpkinseed and Prussian carp are represented. As already mentioned above, in the same year ichthyological research was conducted only on the Begzastevska River before it entered the Turija River, a measuring point where no fish species were detected.

Reservois ''Vodoca''

The reservoir "Vodoca" is located in the basin of the river Vodocha (Vodocica), a tributary of the river Strumica. It was built in the period from 1962 to 1965, and is intended for water supply of the population of Strumica and irrigation of arable land in the Strumica Valley.

According to the Fishery Master Plan 11 species of fish from 5 families live in the reservoir (Appendix 4; Table 6). Recent ichthyological studies conducted by Kostov (2016) have shown that the populations of *Rutilus rutilus, Perca fluviatilis* and have an increased abundance compared to other fish species in the reservoir.

In the same year, ichthyological research was conducted on the Vodoca River (before the inflow into the Strumica River) and no presence of fish was ascertained at the same measuring point.

Smaller reservoirs have been built on the Strumica river basin, such as “Ilovica” and “Drvoska” (Municipality of Bosilovo), “Novoselska” (Municipality of Novo Selo) and “Markova Brana” (Municipality of Strumica), in which red-feathers most likely live (*Rutilus rutilus, Scardinius erythrophthalmus, Tinca tinca, Silurus glanis, Perca fluviatilis, Lepomis gibbosu*s and *Gambusia holbrooki*. In order to see what is the composition of fish fauna and the condition of the populations in these reservoirs, it is necessary to conduct ichthyological research.

We would like to emphasize that for the rivers Shtuka and Jazga there are no literary data on the composition of fish fauna. According to the study Environmental Impact Assessment (Non-Technical Summary), Euromax Resources - Copper and Gold Project "Ilovica" (2016) 9 species of fish live in these waters, and no list is given for the species in question. The composition of fish fauna in this part of the riverbed is of great importance given the fact that there is a tendency to start work on the mine "Ilovica".

As for Monospitovsko Blato, there are scarce data on the composition of fish fauna. According to the monograph "Monospitovo Swamp, the last swamp in Macedonia" (2008), the swamp is an important site for the spawning of some species of fish that live in the Strumica Valley. This is especially true for the pike (*Esox lucius*) which certainly enters the Monospitovo Swamp to spawn. According to the data from the monograph, it is not excluded that other species of fish enter the swamp during the spawning period. The presence of non-native species *Pseudorasbora parva, Gambusia holbrooki* and *Carassius gibelio* was also detected in the canals.

Data are also missing on the composition of the fish fauna of the rivers that originate from the mountain Belasica, and gravitate towards the swamp. Unique ichthyological data for the mountain

Belasica are found in the study "Valorization of the natural values of the mountain Belasica" (2010) according to which *Rhodeus amarus* and *Aspius aspius* live in the waters of the mountain, but from the Bulgarian and Greek side of the mountain, and not for the part that enters our country.

In addition to the Report, we would like to add that the part of the river Strumica on the move from the source part of the river Turija including the river Turija as well as all tributaries in that part of the course, together with the small accumulations ("Markova Dam", "Drvoska" and "Ilovica") belong to the Fishing area "Strumica 1". The rest of the Strumica river basin up to the Macedonian-Bulgarian border, including Monospitovsko Blato, all tributaries and small reservoirs ("Novoselska") belong to the Fishing area "Strumica 2". These areas are by concession granted, whereby the Law on Waters (Official Gazette of RM, no. 87/08) regulates the conditions for granting concessions for water in lakes and watercourses.

Radovish region

The Radovis Region includes waters belonging to two river basins: (1) Kriva Lakavica a tributary of the Bregalnica and (2) the upper course of the river Strumica (Stara Reka), as a larger tributary of the Struma / Strimon basin.

The only literary data that refer to the fish fauna from Kriva Lakavica are those from Apostolski et al. (1956) which indicate the presence of chub and trout in the river without giving a list of other fish species in the river. Only on the basis of literary data related to the ichthyofauna of Bregalnica, near Sofilari (Appendix 4; Table 7), where Kriva Lakavica flows into the river Bregalnica (Dimovski and Grupce, 1971; Kostov et al., 2010; Kostov, 2014), but also based on the data on the ichthyofauna of the reservoir “Mantovo” (Appendix 4; Table 9) one can only assume what was the composition of the fish fauna of the river in the past. According to data published in some of the media, the river is facing drying up, especially in 2017, when as a result of a defect in the door, which regulates the discharge of water from the dam, the river has dried up on several occasions, causing a death of fish.

As previously mentioned, out of 17 species of fish registered for the catchment area of the river Strumica (Kostov, 2016) 5 species inhabit the part of the river that passes through the Radovis Region (Appendix 4; Table 8). The chub, the crow and the pin are registered in Injevska Reka, while the chub and the barbell are registered in the river Plavaja. For the upper part of the Radovishka River only the barbel was detected in the part of the river before the catchment. According to the data from the mentioned study, in this part of the river due to the large number of obstacles smooth migration of the barbell is impossible. In the rest of the river, before continuing through the Strumica field live 5 species of fish. Ichthyological data for the other tributaries of Radovishka Reka and Stara Reka do not exist.

- ### Municipality of Konce

Within the Municipality of Konce enters the reservoirs "Mantovo" as part of the catchment area of the river Bregalnica. Data on fish fauna from the reservoir "Mantovo" can be found in the ichthyological research conducted by Kostov (2014) as part of the project "Ecological monitoring of the river Bregalnica" and in the fishing grounds for fishing water "Reservoir Mantovo" (2017-2022). According to these data, the fish fauna of the lake consists of 15 species of fish of which research conducted in 2014 showed that the non-native species *Lepomis gibbosus* and the perch (*Perca fluviatilis*) occur in the largest numbers.

4.1.4.3. AMPHIBIANS AND REPTILES

- **Review of current data on amphibians and reptiles in the SEPR in Republic of N. Macedonia**

The Balkan Peninsula along with the other two Mediterranean peninsulas is considered a hotspot for biodiversity in Europe (Médeali & Quézel 1999). This trend is particularly evident among reptiles (Speybroeck et al. 2016) and the Republic of North Macedonia with its central position in the Balkans is no exception to this trend. The first herpetological data from this territory date from the period between the two world wars (Doflein 1921, Buresch & Zonkow 1932, 1934, Karaman 1928, 1931, 1937, 1938-39, 1939) and continue sporadically until the beginning of the millennium (Radovanović 1951, Dimovski 1959a , b, 1963, 1964, 1966a, b, 1971, Džukić & Grubač 1988, Petrušev et al. 1990, Petkovski et al. 2000/2001). However, in the last decade there has been a significant improvement and refreshment of the data from this region (Jelić et al. 2012; Sterijovski et al. 2013; Uhrin et al. 2014). From their compilation we can conclude that to date, 46 species of reptiles (32) and amphibians (14) are nationally known, out of which as many as 41 (28 reptiles and 13 amphibians, Tables 1 and 2), i.e 89% of the total national herpetic diversity can be observed in the South-East Planning Region (SEPR).

Table 11. List of amphibia species present in SEPR

Scientific Name	Common Name
ANURA	
Bombina variegata	**Yellow-belied Toad**
Bufo bufo	**Common Toad**
Bufotes viridis	**Green Toad**
Hyla arborea	**Common Tree Frog**
Pelobates syriacus	**Eastern Spadefoot**
Pelophylax ridibundus	**Marsh Frog**
Rana dalmatina	**Agile Frog**
Rana graeca	**Greek Frog**
Rana temporaria	**Common Frog**
CAUDATA	
Salamandra salamandra	**Fire salamander**
Lissotriton vulgaris	**Smooth newt**
Triturus ivanbureschi	**Balkan crested newt**
Triturus macedonicus	**N.Macedonian crested newt**

Table 12. List of reptile species present in SEPR

Scientific Name	Common Name
TESTUDINES	
Testudo graeca	**Greek Tortoise**
Testudo hermanni	**Hermann's Tortoise**
Emys orbicularis	**European Pond Terrapin**
Mauremys rivulata	**Balkan pond turtle**
LACERTILIA	
Pseudopus apodus	**European glass lizard**
Anguis fragilis	**Slow worm**
Ablepharus kitaibelii	**European snake-eyed skink**
Lacerta trilineata	**Balkan Green Lizard**
Lacerta viridis	**Green Lizard**
Podarcis erhardii	**Erhard's Wall Lizard**
Podarcis muralis	**Common Wall Lizard**
Podarcus tauricus	**Balkan wall lizard**
Mediodactylus kotschyi	**Kotschy`s gecko**
OPHIDIA	
Xerotyphlops vermicularis	**European worm snake**
Eryx jaculus	**Javelin sand boa**
Vipera ammodytes	**Nose-horned Viper**
Vipera berus	**European adder**
Coronella austriaca	**Smooth snake**
Dolichophis caspius	**Large Whip Snake**
Elaphe quatuorlineata	**Four-lined Snake**
Hierophis gemonensis	**Balkan Whip Snake**
Malpolon insignitus	**Eastern Montpellier snake**
Platyceps najadum	**Slender whip snake**
Telescopus fallax	**European cat snake**

Zamenis longissimus	**Aesculapian snake**
Zamenis situla	**European rat snake**
Natrix natrix	**Grass Snake**
Natrix tessellata	**Dice Snake**

4.1.4.4. BIRDS

- **Review of current data on birds in SEPR in Republic of N. Macedonia**

Published data on birds in the area covered by the South-East Planning Region are scattered across multiple publications and are rarely focused on one locality or area. Probably the first data is given Viereck 1917 and they refer to 17 species of birds from Lake Dojran. A more significant source of data comes from the work of the N.Macedonian Natural Science Commission in which prof. Müller collected specimens of birds which were then published in the first major work on the birds of N.Macedonia "Avifauna Macedonica" (Stresemann 1920). Part of that commission was also prof. Doflein, who also in his masterpiece "Mazedonien" gives data on the fauna of birds (Doflein 1921) which are mainly the same as those contained in Stresemann.

Stresemann's masterpiece is preceded by several of his brief notes, including one on the discovery of the Masked Shrike *Lanius nubicus* near Valandovo and Mount Plavush as species recorded with most north distribution ot its kind in the Palearctic (Stresemann 1919). At the same time, from locality Kaluchkovo (above the village of Kalkovo) (Sachtleben 1919) describes a new subspecies of European Goldfinch *Carduelis carduelis balcanica*.

These first sources of data are joined by (Fehringer 1920, 1922) and (Henrici 1928, 1930) which provide data on the surroundings of Gevgelija and the foot of the mountain Kozuf (Ferringer) and Dojran Lake (Henrici).

A larger series of authors provides data on the ornithofauna of Lake Dojran (Makatsch 1943; Apostolski & Matvejev 1955; Dimovski & Matvejev 1955; Jovetić 1960; Apostolski & Jovetћ 1960; Apostolski & Jovetić 1967; Johnson & Hafner 1970; Dangel 1973; Geiger et al 1974; Schneider-Jacoby & Vasić 1989; Мицевски 1991, 2000, 2003; orkorpíková et al. 2006; Hanžel 2010; Velevski et al. 2010; Velevski & Saveljić 2010; Nikolov & Hristova-Nikolova 2015; Stefanov 2015; Vasić et al. . 2016) which are analyzed and supplemented in a thematic report on the ornithofauna of Lake Dojran (Velevski 2016). Thus, 94-96 species of waterfowl are listed for this important bird area identified primarily due to the presence of large numbers of *Pelecanus crispus* in the winter months (Velevski et al. 2010). At the same time Lake Dojran is the best studied area from an ornithological aspect in the South-East planning region.

Associations with Kermes oak around Dojran Lake were analyzed by Dimovski 1971 which registered a total of 68 species of birds.

Besides Dojran Lake, two other important bird areas enter the region: "Lower part of the river Vardar" and "Mantovo Lake and the river Kriva Lakavica" (Velevski et al. 2010). The region "Lower course of the river Vardar" is included primarily due to the presence of a significant population of white stork *Ciconia ciconia* (data also in (Heckenroth & Heins 2010), the nesting of the Little tern *Sternula albifrons* (Škorpíková et al. 2009) and the riparian Bank swallow *Riparia riparia.* Because it is on a migratory route, parts of the area are sometimes flooded and during migration there are many species

of birds (including some more interesting ones such as the flamingo *Phoenicopterus roseus* (Petrov 2015)) but there is also intense migration of songbirds, primarily swallows.

The area "Mantovo Lake and river Kriva Lakavica" is identified by the populations of the European Roler *Coracias garrulus* and the Masked shrike *Lanius nubicus* but there are other important species (Velevski et al. 2010). Data for this area can be found in (Škorpíková et al. 2006; Velevski et al. 2008), and given that it is part of the watershed of the river. Bregalnica was included in the studies of biodiversity in this area, for which a special thematic report on birds was prepared (Velevski 2015).

Another better researched area within the borders of the East Planning Region is Monospitovo Swamp. Due to the protection initiative, in 2007 and 2008 purposeful research of the ornithofauna was made, where 112 species of birds were registered (Ivanov et al. 2008). The authors then point out the small number of individuals of different species on this site. Data on the ornithofauna of the swamp and its surroundings are still found in Škorpíková et al. 2007; Heckenroth & Heins 2010).

From the more systematically collected data we will single out the results for the bird fauna on the mountain Ograzden (Velevski et al. 2002) where only a small part refer to the area of interest.

The remaining data are mainly for individual species or findings (Makatsch 1950; Vasić et al. 1985, 2016; Grubač 1998; Grubač et al. 2007, 2014; Velevski & Grubač 2008; Šere 2009; Hanžel 2012; orkorpíková et al. 2012; Petkov & Iliev 2017; Peshev et al. 2018) but still contribute to the knowledge of the whole picture of the ornithofauna. Additionally, in the study for impact assessment of energy projects - wind farm near Miravci (Decons-Emma 2009), the study for impact assessment of the gas pipeline Thessaloniki-Skopje, as well as in the study for impact assessment of the highway Demir Kapija - Gevgelija (Civil Engineering Institute N.Macedonia 2008) there are many data on the ornithofauna in this area.

The gaps that seem to exist for the mountains Belasica, Konechka and Kozuf are only apparent because although there are no published data, information can be found in the environmental assessment study for the ski resort "Kozuf" (Anonymus 2005) and the project "Development of a representative network of Protected Areas "(N.Macedonian Ecological Society 2009), while valorization of Mount Belasica (Oikos 2011) and the Smolar and Koleshino Waterfall Management Plan do not contain information from field research but include a potential list of species based on findings in Bulgaria and Greece, so the listed species were not considered. Additionally, there are many unpublished data of the author from this area, the student research action "Kozuf, Stinking Water 2004" (Research Society of Biology Students), unpublished data from the winter census of birds in N.Macedonia that refer to Dojran Lake, Zol - village Bogorodica and accumulation Paljurci (N.Macedonian Ecological Society) monitoring of bird migration (N.Macedonian Ecological Society) and Atlas of nesting birds in Europe. These data have not yet been processed and made publicly available, and were not used for this study.

A total of 262 bird species have been registered in the area out of a total of 318 confirmed for N.Macedonia (Velevski & Vasić 2017) which represents a huge 82% of the bird species diversity. This is as well due to the diversity of ecosystems and the relatively good degree of study of the area. Out of these species, 14 are extinct (some only from the area, some from the whole country). The remaining 248 species belong to 17 orders, 58 families and 155 genera (out of 18 orders, 63 families and 189 genera respectively, (Velevski & Vasić 2017) which of course speaks of the rich phylogenetic diversity of birds). 21 species are wintering animals, 44 are found only on migration, 67 are migratory nests, 90 are nesting nests, 8 are nesting nests and 18 are random.

The list of species, according to their systematic affiliation, as well as the status of the encounter are given in Annex 5.

4.1.4.5. MAMMALS

- **Review of current data on mammals in SEPR in Republic of Macedonia**

The first more serious studies of mammals (Mammalia) in N.Macedonia began during the First World War. During the supreme command of the German army a special commission for the study of N.Macedonia "Mazedonische Landeskundliche Kommision" was formed. The reason for that was the fact that before the war the territory of N. Macedonia was still one of the least studied areas in Europe. The world-famous zoologist Franz Theodor Doflein (1873-1924) was appointed head of the research team. The members of this "Commission for Macedonia" first arrived in Udovo during the month of May 1917 from where they began to study the sites along the river Vardar then to the mountain Plaush, Valandovo, Dojran, Kozuf and later in all directions of the territory which occupied the German army. After the end of the First World War, in 1921 Doflein published the results of the studies of N. Macedonia in his very poetically written epochal work "Macedonia".

In the period after the First World War, a significant pioneering contribution to the study of the mammal fauna (Mammalia) of N. Macedonia was given by Karaman (1929) in the study of Bats (Chiroptera) in Yugoslavia. Martino, V. (1933, 1934, 1935, 1936a, 1936b, 1937, 1939) reports on certain species of large mammals, mainly in terms of hunting game Martino, V. & E. Martino (1929, 1931, 1933, 1937, 1940) present the results of taxonomic studies of individual species of small mammals in N.Macedonia. Petrov (1939a, 1939b, 1940), provides new data in the field of taxonomy, ecology and distribution of mammals in N.Macedonia.

After the Second World War numerous works by authors from N. Macedonia, the former Yugoslavia and Europe, provide data on the taxonomy and distribution of certain species of mammals for certain areas of N.Macedonia: Vidinic (1963), Djulic & Mikuska (1966), Petrov (1969 ; 1971), Miric (1978), Hackethal & Peters (1987), Bogdanowicz (1990), Cirovic (2006), Krystufek (1993; 1994, 2013), Krystufek & Petkovski (1989; 1990a; 1990b), Donchev (1996), Krystufek et al. (1998), Stojanovski (1994; 1998), Zima et al. (1997), Breitenmoser-Würsten & Breitenmoser (2001), Polednik et al. (2008), Stojanov et al. (2010), Papadatou et al., (2011), Kaczensky et al. (2012), Karamanlidis et al. (2014), Micevski et al., (2014).

Summarized data for individual orders of mammal fauna are given by Petrov (1992) for the orders: *Erinaceomorpha* (Hedgehogs), *Soricomorpha* (Rodents and Mollusks) and *Rodentia* (Rodents); Krystufek et al. (1992) on the order Chiroptera (Bats).

Summarized data for the whole class of Mammals in N.Macedonia are given by Dulic & Miric (1967), Petkovski (1998), Krystufek & Petkovski (2003), Krystufek & Petkovski (2006).

For the territory of SEPR Petrov (1992) provides accurate data on the distribution of a species of the order Erinaceomorpha (Hedgehogs) for seven species of the order Soricomorpha (Rodents and moles) and for 19 species of the order Rodentia (Rodents).

Stojanovski (1998), completes the list of species of the order Soricomorpha, with a new finding for the species Etruscan shrew (Suncus etruscus) at the locality Mrdaja near Star Dojran.

Haberl et al., (2012) provide data with precise locations (GPS coordinates), for more than 50 locations where the presence of colonies of the European ground squirrel (*Spermophilus citellus*) has been registered in the vicinity of the settlements: Bogdanci, Gjavato, Gevgelija, Stojakovo, Bogorodica, Crnichani, Nikolic, Star Dojran, Udovo, Grciste, Brajkovci, Calakli, Pirava, Rabrovo, Sobri, Valandovo, Mrzenci, Miravci, Prdejci and Smokvica.

Petkovski in 2018, registered the presence of the species nutria (Myocastor coypus) at three sites in Lake Dojran (unpublished data), thus rounding out the list of representatives of the order Rodentia (Rodents) to 20 species.

For the territory of SEPR, the first accurate data for individual species of the bat (Chiroptera) are given by Martino (1939), for the mountain Kozuf and Djulic & Mikushka (1966), for Nov Dojran.

Krystufek et al., (1992) in the study of bats (Mammalia: Ciroptera) of N. Macedonia from a total of 36 surveyed sites in N.Macedonia, on the territory of SEPR study the fauna of bats in seven sites, where the presence of a total of 15 species. Of these, seven species are determined by visual determination in underground shelters, while the other eight species are collected by a network, usually set up by streams and rivers.

Micevski et al., (2014) for the territory of SEPR from a total of 12 surveyed sites, determine the presence of a total of 13 species. Of these, nine species have already been registered while four species have been registered for the first time, bringing the total number of registered bat species to the territory of SEPR to 19.

From the order of beetles (Carnivora), there are relatively scarce data on SEPR. Dulic & Miric (1967), state the presence of 13 species for the entire territory of N.Macedonia, without precise data on the distribution of species (Appendix 6).

Kaczensky et al. (2012), provide data on large carnivorous mammals (bear, lynx and wolf), of which the presence of the wolf is stated for JIPR, while the bear and lynx are given a potential opportunity for their presence on Mount Kozuf.

Polednik et al., (2008) provide data on the presence of otter (Lutra lutra) in N.Macedonia, out of which for SEPR they registered its presence at a total of six sites (Appendix 6).

Ivanov et al., (2016) provide a distribution map for jackal (Canis aureus) on the territory of N.Macedonia in which SEPR is included with the mountain Kozuf as a potential opportunity for the presence of jackal.

The order Artiodactyla within the territory of SEPR is represented by 2 species: wild boar (*Sus scrofa*) and roe deer (*Capreolus capreolus*). The wild boar is present both in the lowland part (shrubby vegetation of prnar) and in the hilly-mountainous areas, on the eastern slopes of Kozuf the western slopes of Belasica, the southern slopes of Ograzden and the southwestern slopes of Plachkovica (Petkovski, 1998). Roe deer (*Capreolus capreolus*) is confined to the terrains of the above-mentioned mountains (Petkovski, 1998).

The order Lagomorpha is represented by the wild rabbit (*Lepus europeus*) which is widespread throughout the SEPR from the lowlands to the highlands. The highest population density is registered on the eastern slopes of Mount Kozuf, between the villages of Negorci and Sermenin.

4.2. ECOSYSTEM DIVERSITY

The ecosystem diversity on the territory of SEPR is primarily due to the diverse and specific vegetation, i.e plant communities, which are a basic component of the structure of all terrestrial ecosystems. The map of the natural potential of the SEPR vegetation is a "mosaic of ecosystems" composed of forest, shrub, meadow, swamp, swamp and lake ecosystems. In Republic N. Macedonia so far over 260 plant communities have been registered many of them are found on the territory of SEPR or only in this region.

4.2.1. Habitat types

Habitats of wild plant and animal species are places with certain physical characteristics where specific communities of plants or animals normally live. Modern science and practice of biodiversity conservation believe that only by protecting habitats can the organisms that inhabit those habitats be preserved. Hence, the concept of habitats underlies many global documents related to nature protection: Convention on Biological Diversity (1992 - CBD), Pan-European Strategy for the Protection of

Biological and Landscape Diversity (Pan-European Strategy for the Protection of the Biological and Landscape Diversity, 1996 - PEBLDS), Directive 92/43 of the EEC on the conservation of habitats and wild flora and fauna, 1992 - HD), Berne Convention (Convention on the Conservation) of European Wildlife and Natural Habitats - Bern Convention and Resolution No 4 of the same Convention, 1996 - BC) and others.

The members of the European Union for the protection of habitats and in general for the protection of nature form a comprehensive network of habitats Natura 2000 based on the principles of the Habitats Directive. Natura 2000 sites are designated on the basis of conservation-important habitats under Annex I HD, as well as on the conservation-important species of HD and the Birds Directive.

The definition and recognition of habitats is based on knowledge of the vegetation of the area of interest which means that it is necessary to determine the phytocenological syntaxes of that area. The existing vegetation literature of the researched area has identified a number of non-forest vegetation types - vegetation related to water (aquatic, swamp vegetation), pioneer vegetation of wet and terrestrial habitats (riparian vegetation, vegetation of trampled habitats, eroded habitats, eroded habitats, eroded habitats), vegetation on hilly, mountainous and high mountain pastures, edge vegetation as well as ruderal vegetation.

The names of the registered syntaxes published in the works of the mentioned authors are in accordance with the latest classification of Mucina et al. (2016) presented in the synthetic work "Vegetation of Europe: hierarchical floristic classification system of vascular plant, bryophyte, lichen, and algal communities".

For a complete view of the habitats from a certain region, in addition to their listing it is necessary to determine the condition in which they are located (conservation level of the habitat). The determination of the conservation level is done according to a precisely prescribed methodology (European Commission 2011, Evans & Arvela 2011 and others). When assessing habitat conservation status, four parameters are considered: species distribution, area, structure and function (called habitat status) and future perspectives. Each of these parameters is evaluated according to one of the following conditions: favorable, unfavorable-inappropriate, unfavorable-bad or unknown (favorable, unfavorable-inadequate, unfavorable-bad or unknown).

4.2.1.1. Grass habitats

Review of relevant literature data on grass habitats in SEPR

The South-East Planning Region is characterized by great geographical, geological, pedological and climatic diversity which provide rich floral and vegetation diversity. Unfortunately, while a considerable amount of data is available on species richness, non-forest vegetation is much less studied.

Phytocenological data on the grass vegetation (steppe and other grass vegetation from the belt of hilly and mountain pastures as well as swamp and ruderal vegetation), which develops in the examined area (Serta, Plachkovica, Ограденден, Belasica, Kozufot, Bozotov, Monospovi on the river Strumica, part of the course of the river Vardar with its tributaries, artificial reservoirs, etc.) are found in the works of Micevski (1963, 1967, 1971, 1972, 1977), Matevski et al. (2008), Matevski (2013) and Matvejeva (1982, 1985) and others.

With special importance are the projects for important plant areas in R. N. Macedonia (Melovski et al., 2010) for the biodiversity of Bregalnica (Hristovski and Brajanoska, 2015), NATURA 2000 (2018), and the twinning project for NP Pelister, which have prepared serious studies for habitats in N.Macedonia.

A complete overview of the literature data is given in the Literature chapter.

List of grass habitats in South East Planing Region

Based on the consulted literary data as well as on the basis of personal knowledge, 25 non-forest habitats can be expected on the territory of the South-East Planning Region, five of which have the status of strictly protected habitats. A table with the list of habitats is given below.

Table. 1. List of non-forest habitats in the South-East Planning Region

3 : FRESHWATER HABITATS

A) Standing water

3110 : Oligotrophic waters containing very few minerals of sandy plains (Littorelletalia uniflorae)

3130 : Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or of the Isoeto-Nanojuncetea

3150 : Natural eutrophic lakes with Magnopotamion or Hydrocharition -type vegetation

Б) Runnig water

3260 :Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation

3270 : Rivers with muddy banks with Chenopodion rubri pp and Bidention p.p. vegetation

3280 : Constantly flowing Mediterranean rivers with Paspalo-Agrostidion species and hanging curtains of Salix and Populus alba

3290 : Intermittently flowing Mediterranean rivers of the Paspalo-Agrostidion

6 : NATURAL AND SEMINATURAL GRASSLAND

A) Natural Grasslands

6170 : Alpine and subalpine calcareous grasslands

Б) Seminatural dry grasslands and scrubland facies

6210 :Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) (* important orchid sites)

6220* : Pseudo-steppe with grasses and annuals of the Thero-Brachypodietea

6230* : Species-rich Nardus grasslands, on silicious substrates in mountain areas (and submountain areas in Continental Europe)

6260 * Pannonic sand steppes

62D0 : Oro-Moesian acidophilous grasslands

B) Mesophile grasslands

6430 : Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels

6520 : Mountain hay meadows

6540 : Sub-Mediterranean grasslands of the Molinio-Hordeion secalini

7 : RAISED BOGS AND MIRES AND FENS

7140 : Transition mires and quaking bogs

7160 : Mineral-rich springs and springfens

7210* : Calcareous fens with Cladium mariscus and species of the Caricion davallianae

7220* : Petrifying springs with tufa formation (Cratoneurion)

7230 : Alkaline fens

8 : ROCKY HABITATS AND CAVES

8150 : Medio-European upland siliceous screes

8210 : Calcareous rocky slopes with chasmophytic vegetation

8220 : (Siliceous rocky slopes with chasmophytic vegetation)

- **Description of habitats**

Description of habitats include an official description of the habitat, additional observations on its structural and ecological characteristics, a list of characteristic plant species and links to suitable habitats from the EUNIS classification. All descriptions are based on official habitat definitions (The Interpretation Manual of European Union Habitats, 2013) supplemented by specific (and specific) data on the respective habitat in N. Macedonia. In addition, an attempt was made for each of the habitats to give brief remarks on its distribution in the Region, its significance (ecosystem functions), review of pressures and threats and proposals for conservation measures. Unfortunately, the absence of data for considerable part of the habitats for the region does not allow for more detailed comments on each of these parameters.

3 : FRESHWATER HABITATS

A) Standing Waters

3110 : Oligotrophic waters containing very few minerals of sandy plains (Littorelletalia uniflorae)

Description. Shallow oligotrophic waters with few minerals and poor base, with low perennial vegetation, from aquatic to amphibious, belonging to the order *Littorelletalia uniflorae*, on oligotrophic soils on the shores of lakes and ponds (sometimes on peat). The vegetation consists of one or more zones, dominated by *Littorella, Lobelia dortmana* or Isoetes, although not all zones can be found in a given place. Characteristic plants are *Isoetes lacustris, I. echinospora, Littorella uniflora, Lobelia dortmanna, Deschampsia setacea, Subularia aquatica, Juncus bulbosus, Pilularia globulifera, #Luronium natans, Potamogeton polygonifolius;* in the boreal region and *Myriophyllum alterniflorum, Drepanocladus spp., Warnstorfia spp. and Fontinalis spp.*

Importance of the habitat. Provides fresh water and it habitat for aquatic organisms; participates in water and nutrient cycle; provides primary production of organic matter; participates in climate regulation.

Distribution in South East Planning Region. No reliable data. The presence of this habitat in N. Macedonia is considered suspicious (data from the NATURA 2000 project for N. Macedonia).

Pressures and threats. Threats are water scarcity, pollution, construction activities on the shore related to the development of tourism.

Conservation and management. Determining the real situation with the structure and functions, determining the current threats; establishing a monitoring plan; taking concrete steps to protect places where threats are strongest.

3130 : Oligotrophic to mesotrophic standing waters with vegetation of the Littorelletea uniflorae and/or of the Isoeto-Nanojuncetea

Description. The habitat is characterized by two forms - the first includes aquatic to amphibia supporting perennial oligotrophic to mesotrophic vegetation which belongs to the order Littorelletalia uniflorae which occurs along the shores of lakes, ponds and basins and transitions between water bodies and land. Characteristic species are *Littorella uniflora, #Luronium natans, Potamogeton polygonifolius, Pilularia globulifera, Juncus bulbosus ssp. bulbosus, Eleocharis acicularis, Sparganium minimum.* The second form involves amphibian supporting perennial vegetation, which occurs as a pioneer in transitional zones of lakes, basins, and ponds, on nutrient-poor soils, or that grows during periodic drying of stagnant water. Phytocenologically it belongs to the class Isoeto- Nanojuncetea. The species composition consists of *#Lindernia procumbens, Elatine spp., Eleocharis ovata, Juncus tenageia, Cyperus fuscus, C. flavescens, C.michelianus, Limosella aquatica, Schoenoplectus supinus, Scirpus setaceus, Juncus bufonius, Centaurium, Centaurium, Centaurium.*

Importance of the habitat. It is a habitat of aquatic organisms; participates in water and nutrient cycle cycles; provides primary production of organic matter.

Distribution in South East Planning Region. There is no reliable data, but it is thought to be probably present in SEPR as two of the characteristic species, *Limosella aquatic* and *Juncus buffonius*, are found in some phytocenoses. Also, indicative is the species *Lindernia procumbens* which so far is found only in Monospitovo Wetland.

Pressures and threats. The threats are water confiscation, pollution, construction activities on the shoreline related to the development of tourism.

Conservation and management. Determining the real situation with the structure and functions, determining the current threats; establishing a monitoring plan; taking concrete steps to protect places where threats are strongest.

3150 : Natural eutrophic lakes with Magnopotamion or Hydrocharition -type vegetation

Description. This habitat includes lakes and ponds usually with organically polluted, gray to blue-green and turbid waters, rich in dissolved salts and pH usually> 7. It is characterized by floating surface communities of the Hydrocharition alliance or deeper water communities of the Magnopotamion alliance. Characteristic plants of Hydrocharition are: *Lemna spp., Spirodela spp., Wolffia spp., Hydrocharis morsus-ranae, Utricularia vulgaris, Riccia spp., Ricciocarpus spp.* and others, while from Magnopotamion: *Potamogeton lucens, P. perfoliatus* and others. According to the EUNIS classification, this habitat corresponds to two habitats: C1.32: Free-floating vegetation of eutrophic waterbodies and C1.33: Rooted submerged vegetation of eutrophic waterbodies.

Importance of the habitat. Provides fresh water, is a habitat for aquatic organisms; participates in water and nutrient cycle cycles; provides primary production of organic matter; participates in climate regulation.

Distribution in South East Planning Region. On the territory of the region, the habitat 3150 can be recognized in Lake Dojran.

Pressures and threats. Intense anthropogenic pressure, especially from the Greek side. The threats are water confiscation, pollution, construction activities on the coast, related to the development of tourism.

Conservation and management. Determining the real situation with the structure and functions, determining the current threats; establishing a monitoring plan; taking precise measures to protect places where threats are strongest.

B) Running Water

3260 : Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation

Description. Habitat 3260 (Watercourses from plain to mountain levels with Ranunculion fluitantis and Callitricho-Batrachion vegetation) covers the grass vegetation along the watercourses, from lowland to mountainous altitude. Refers to slow or medium-flowing rivers or streams. It includes a large number of floating (floating) or submerged (submersible) aquatic plant communities from the Ranunculion fluitantis and Callitricho-Batrachion alliances. Plant species are characterized by *Ranunculus trichophyllus, R. fluitans, R. peltatus, R. aquatilis, Myriophyllum spp., Callitriche spp., Berula erecta, Mentha aquatica, Potamogeton spp., Fontinalis antipyretica* and others. Rivers and streams often line

up directly under this habitat, without being tied to specific plant communities. In R. N. Macedonia there are no phytocenological data for such communities, neither for the region of interest, nor beyond. The EUNIS classification is associated with three habitats: C2.1: Springs, spring brooks and geysers, C2.2: Permanent non-tidal, fast, turbulent watercourses and C2.3: Permanent non-tidal, smooth-flowing watercourses.

Importance of the habitat. The basis of the ecological functioning of the habitat are the macrophytic species. They provide habitat and shelter for benthic macro vertebrates and fish, modify the microclimate of watercourses and are an integral part of the nutrient cycle. It is an important conservation habitat because it points to preserved watercourses.

Distribution in South East Planning Region. There is no literature on habitat data, but communities of this type are known for the waterways that belong to the SEE on the mountains Kozuf, Belasica, Plachkovica and Ograzden.

Pressures and threats. Research at specific locations is required. This habitat is often exposed to serious threats, such as the construction of small reservoirs, fishponds and the like.

Conservation and management. mapping of places where the residence is present; determination of current threats; utilization of all legal possibilities for protection of potentially endangered representative places with this habitat; development of a monitoring plan; preparation of revitalization plans.

3270 : Rivers with muddy banks with Chenopodion rubri pp and Bidention pp vegetation

Description. The habitat includes nitrophilic communities of mainly annual ruderal plants from the *Chenopodion rubri p.p*. and *Bidention p.p*. and is characteristic of slow flowing, mostly plain, rivers on whose banks muddy soil accumulates after water withdrawal. The communities are extremely inconsistent in appearance and depend on the regime of flooding and changing the shoreline of rivers. If the conditions are not favorable, this vegetation is poorly developed or may not exist at all. Such communities can also develop in the quieter sections of otherwise fast hilly rivers or streams. According to the EU Habitats Manual (2013) the habitat range is associated with a 50-100 m muddy or sandy belt to the river even when no vegetation develops. The vegetation of this habitat in N. Macedonia was studied by Matvejev (1982, 1985). The plant species for the habitat are characteristic *Bidens spp., Cyperus spp., Persicaria spp., Rorippa spp., Chenopodium spp., Polygonum spp., Xanthium spp.* and others. The EUNIS classification corresponds to two more closely understood habitats - C3.5: Periodically inundated shores with pioneer and ephemeral vegetation and C3.53: Euro-Siberian annual river mud communities.

Distribution in South East Planning Region. There are no literary data, but according to the characteristic communities, on the territory of SEPR this habitat is present along all watercourses in the plain and mountainous part of the Region.

Importance of the habitat. A pioneering habitat that heals flooded shorelines.

Condition: Due to its unstable pioneering character, the structure and functions of the 3270 dwelling vary considerably from place to place and at different times. In general, it is preserved in relatively good condition, which depends mostly on the degree of preservation of the water body itself.

Pressures and threats. Residential and commercial development (development of urban, industrial or tourist zones) (potentially the whole area); construction of transport and service corridors (especially the river flows from the lowland parts of the Region); half; invasive species; ecosystem modifications (construction of dams, drainage, fires).

Conservation and management. Mapping of places where the residence is present; determination of current threats; preparation of a monitoring plan.

3280 : Constantly flowing Mediterranean rivers with *Paspalo-Agrostidion* species and hanging curtains of *Salix* and *Populus alba*

Description. Habitat 3280 includes nitrophilic annual and perennial formations of the Paspalo-Agrostidion alliance, with grasses and shrubs along the alluvial banks of large Mediterranean rivers with *Paspalum paspaloides, P. vaginatum, Polypogon viridis (= Agrostlatus semiveperic), Cyperus fuscus and Populus alba.* Corresponds to habitats E5.4: Moist or wet tall-herb and fern fringes and meadows and E5.44: Mediterranean grasslands on alluvial riverbanks from the EUNIS classification.

Distribution in South East Planning Region. The description of this habitat matches some communities from the lowland parts of most rivers in the region (Vardar, Strumica, Anska Reka and others). However, further research is needed to confirm this.

Importance of the habitat. Habitat for aquatic and swamp organisms; pollutant purifier; riverbank erosion control

Pressures and threats. Construction activities, sand extraction.

Conservation and management. Mapping of places where the residence is present; determination of current threats; preparation of a monitoring plan

3290 : Intermittently flowing Mediterranean rivers of the Paspalo-Agrostidion

Description. This habitat is similar to habitat 3280 but is characterized by intermittent flow and dry riverbed at one point in the year. The riverbed can be completely dry or with smaller ponds. Characteristic plant species are *Polygonum amphibium, Ranunculus fluitans, Potamogeton natans, P. nodosus, P. pectinatus* and others. Habitat 3290 to some extent coincides with EUNIS Habitat C2.5: Temporary running waters (narrower), in which, in addition to Paspalo-Agrostidion communities, Parvopotamion or Sparganio-Glycerion fluitantis communities can also be found. The dry phase according to the EUNIS classification is treated as a separate habitat (C3.5, C3.6 and C3.7).

Distribution in South East Planning Region. So far there is no direct confirmation of the presence of this habitat on the territory of the region. There is a possibility that he will be present in some localities, such as Kovanska Reka in the vicinity of Gevgelija.

Importance of the habitat. Habitat for aquatic and swamp organisms; pollutant purifier; riverbank erosion control

Pressures and threats. Construction activities, sand extraction.

Conservation and management. Mapping of places where the residence is present; determination of current threats; preparation of a monitoring plan.

6 : NATURAL AND SEMINATURAL GRASSLAND

Habitat habitats cover relatively large areas in the region and are important ecosystems that provide food (primary production) for domestic and wild herbivores. Some of them are characterized primarily by grassy physiognomy. However, quite large grasslands have a semi-natural character and are formed by healing abandoned arable land, or by digging former forests. The structure of the meadows is maintained thanks to the additional fertilization and mowing.

Significant threats to these types of habitats are overgrowth on the one hand, but also overgrazing on the other hand, land conversion, introduction of invasive species and more.

This is one of the most diverse groups, which includes 10 habitats.

A) Natural Grasslands

6170 : Alpine and subalpine calcareous grasslands

Description. Habitat 6170 includes alpine and subalpine grasslands on land-rich lands, on the massifs of almost all mountain ranges in Europe (Alps, Pyrenees, Carpathians, mountains of the Balkan and Apennine Peninsula, Scandinavia). Habitat includes several subtypes. Of the majority of plant species, *Dryas octopetala, Alchemilla hoppeana, Alchemilla flabellata, Anthyllis vulneraria, Aster alpinus, Draba aizoides, Helianthemum nummularium ssp. grandiflorum, Pulsatilla alpina ssp. alpina, Phyteuma orbiculare, Astrantia major, Oxytropis halleri* and others. Habitat 6170 completely matches habitat E4.4: Calcareous alpine and subalpine grassland from the EUNIS classification. In this classification there are several subtypes that are characteristic for the mountains of N.Macedonia (E4.4172: Rhodo-Pelagonian oligophile closed calcicolous grasslands; E4.41722: Pelagonide closed calcicolous feathergrass grasslands; E4.41723: Pelagonide closed calcicolous sesleria grasslands; E4.41724: Pelagonide closed calcicolous fescue grasslands).

Distribution in South East Planning Region. The habitat is present in the higher parts of the mountain Kozuf (Melovski et al. 2010; project NATURA2000). The other mountains in the region are not high enough, nor do they have a limestone base, two conditions that are essential for the appearance of this habitat.

Importance of the habitat. Habitat of mountain organisms; characterized by significant plant species; primary production; erosion control.

Pressures and threats. Research is needed. Today this habitat type can be exposed to two types of opposing threats - excessive grazing or lack of grazing, resulting in habitat healing. In addition, the construction of tourist or telecommunication facilities, roads and the like may have some significance. It should be borne in mind that this habitat, at least in the Region, has a limited distribution.

Conservation and management. It is necessary to conduct field research to confirm and more accurately locate locations with this habitat, mapping the places where the habitat is present; determination of current threats; preparation of a monitoring plan.

B) Seminatural dry grasslands and scrubland facies

6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) (* important orchid sites)

Description. Habitat 6210 consists of hilly pastures on more or less steep slopes, mostly on limestone and dolomite. Hemicryptophytes predominate in the composition of hill pastures as a life form, while other life forms (nanophanerophytes, hamephites, geophytes and therophytes) are presented in different ratios, so that from the north to the south the number of annual plants increases. Plant communities belonging to this habitat type are secondary phytocenoses that have occurred with long-term degradation of forest communities, especially from the oak belt. Thanks to the intensive phytocenological research of the communities from this habitat on the territory of R. N. Macedonia, several new associations and a new alliance for science are described, which enables its better recognition. Communities of this habitat type are dominated by numerous members of the families *Asteraceae, Apiaceae, Brassicaceae, Caryophyllaceae, Cistaceae, Dipsacaceae, Fabaceae, Lamiaceae, Rosaceae, Rubiaceae, Violaceae, Poaceae,* and others. Plants: *Anthyllis vulneraria, Arabis hirsuta, Brachypodium pinnatum, Bromus inermis, B. erectus, Campanula glomerata, Carex caryophyllea, Carlina vulgaris, Centaurea scabiosa, Dianthus carthusianorum, Eryngium campestre, Euphorbia proc, Glucose, Euphorbia, Koeleria pyramidata, Leontodon hispidus, Medicago sativa ssp. falcata, Ophrys apifera, O. insectifera, Orchis mascula, O. militaris, O. morio, O. purpurea, O. ustulata, O. mascula, Polygala comosa, Primula veris, Sanguisorba minor, Scabiosa columbaria, Silene otitis, Stipa capillata Veronica teucrium and others.* In the EUNIS classification this habitat to some extent corresponds to the habitat type E1.2: Perennial calcareous grassland and basic steppes. The list of suitable EUNIS habitats does not include E1.21: Helleno-Balkanic Satureja montana steppes, which is present in N. Macedonia.

Distribution in South East Planning Region. According to previous research on the territory of the region, the habitat is listed only for the zone of hilly pastures in the Plachkovica mountains (project "Improving the status of natural values in the Bregalnica region").

Importance of the habitat. Habitat of various organisms; characterized by significant plant species; primary production; erosion control.

Pressures and threats. Research is needed. The main threats arise from insufficient grazing, due to the reduction of the livestock on the territory of the Republic of N. Macedonia. With the abandonment of cattle breeding, there is a gradual succession of the communities from this habitat and their transformation into shrubby or forest phytocenosis.

Conservation and management. mapping of places where the residence is present; determination of current threats; development of a monitoring plan (for example, encouraging the development of livestock in open spaces.

6220* Pseudo-steppe with grasses and annuals of the Thero-Brachypodietea

Description. Habitat 6220 includes hilly pasture communities that develop on a silicate substrate, dominated by annuals. Habitat communities typically cover small areas and have a mosaic layout with adjacent vegetation types. Pastures of this type are considered to be the initial stage of succession that replaces the natural vegetation that is involved in certain anthropogenic degradation processes. Species: *Bromus fasciculatus, Bromus intermedius, Brachypodium distachyon, Aegilops neglecta, Ae. geniculata, Ae. triuncialis, Avena sterilis, A. barbata, Lagurus ovatus, Cynosurus echinatus, Stipa capensis, Andropogon distachyos, Cynodon dactylon,* as well as annual representatives of the genera *Euphorbia, Silene, Nigella, Adonis, Papaver, Fumaria, Altumva, Biscut Linum, Geranium, Astragalus, Ononis, Trigonella, Medicago, Melilotus, Trifolium, Lotus, Coronilla, Scorpiurus, Hedysarum, Onobrychis, Bupleurum, Daucus, Anagallis, Orobanche, Plantago, Centaurium, Galium, Evax, Paloxhem, Chila Tragopogon,* semi-shrubs *Teucrium, Thymus, Ballota, Phlomis, Micromeria, Salvia* and others, as well as geophytes (*Allium spp., Ornithogalum spp., Muscari spp., Romulea spp., Orchis spp., Ophrys spp., Anacisptis*) pyramid Habitat 6220 completely coincides with the habitat E1.3: Mediterranean xeric grassland from the EUNIS classification, to which the lower (fifth) level is joined by the habitat E1.332: Helleno-Balkanic short grass and therophyte communities, present in N.Macedonia.

Distribution in South East Planning Region. The habitat is stated for the mountain Plachkovica (project "Improvement of the status of natural values in the Bregalnica region"), as well as for the surroundings of Bogdanci and Valandovo (project NATURA2000). Meaning. These pastures are not considered very productive (oligotrophic pastures), but during the spring they can be quite important for the sheep, which breed during this period.

Pressures and threats. Quite a sensitive habitat type. In recent decades, there has been a significant disruption of the structure and reduction of its area, as a result of abandonment of traditional land use and extensive livestock. On the other hand, excessive grazing can be a serious threat.

Conservation and management. It is proposed to maintain, improve, and reintroduce traditional livestock practices, as well as to establish fire monitoring and control.

6230*: Species-rich Nardus grasslands, on silicious substrates in mountain areas (and submountain areas in Continental Europe)

Description. The habitat covers enclosed, dry or mesophilic, perennial grasslands with Nardus, developed on a silicate substrate in the Atlantic or subatlantic or boreal lowland, highland and mountainous regions. In general, habitats that are irreversibly degraded due to overgrazing should be excluded. Plants: *Antennaria dioica, Carex ericetorum, C. pallescens, C. panicea, Galium saxatile, Hypericum maculatum, Hypochoeris maculata, Meum athamanticum, Platanthera bifolia, Polygala vulgaris, Potentilla spp, Viola canina.* Habitat 6230 overlaps with habitat E4.3: Acid alpine and subalpine grassland from the EUNIS classification, in which, as a fourth level habitat is E4.39: Oro-Moesian acidophilous grassland.

Distribution in South East Planning Region. There is no literature on the presence of this habitat in the region. Not very large areas have been observed on Mount Ograzden. This habitat type is expected to be present on the mountains Kozuf, Belasica and Plachkovica.

Importance of the habitat. Grazing, erosion prevention.

Pressures and threats. The habitat may be under threat from tourism development, overgrazing, mining, road construction, ecosystem modifications and more.

Conservation and management. It is necessary to study the structure and distribution of the habitat in more detail, to determine the specific threats at each place where it occurs, to propose a conservation plan for protection.

6260 * Pannonic sand steppes

Description. Formations dominated by medium-sized or large perennial grasses or semi-arid grasses, with lacunar surface cover, together with accompanying therophytic communities that develop on mobile or immobile sands (alluvial sands, subphosilic dune systems) in the steppes of (Pal. 34.91), where the greatest impact is on these communities.

Distribution in South East Planning Region. On the territory of N. Macedonia, the habitat so far has been confirmed with certainty only for the shores of Lake Prespa. This leaves the possibility for its presence in the vicinity of Dojran Lake and perhaps in some places downstream of the river Vardar.
Importance of the habitat. Spawn, a pioneer habitat that participates in soil formation, erosion prevention.

Pressures and threats. The habitat may be under threat from tourism development, overgrazing, mining, road construction, ecosystem modifications and more.

Conservation and management. More detailed study of the structure and distribution of the habitat, identification of specific threats at each place where it occurs, proposal of a conservation plan for protection

62D0: Oro-Moesian acidophilous grasslands

Description. Acidophilic vegetation (union of *Poion violaceae* with the association *Thymo-Poetum violaceae*) occurs in a fragmentary state at an altitude of over 2000 m, on a silicate surface, in places exposed to wind erosion. The parent substrate is built of silicate rocks, most often of the type of granites, gneisses and others. The soils are moderately moist umbrisols, which if without vegetation, are quite susceptible to wind erosion. The vegetation period is short (approximately 4 months) so the plants are small, and their development is slow.

The communities are dominated by herbaceous species, primarily *Festuca paniculata, Bellardiochloa violacea, Festuca airoides, Calamagrostis arundinacea, Festuca nigrescens, Agrostis capillaris* and others, as well as a number of Balkan endemic species - *Festuca balcanida, F. r. peristerea, Sesleria comosa*, etc.

Distribution in South East Planning Region. This type of habitat is present on all higher mountains in the territory of R. N. Macedonia, on which silicate geological base is found on larger areas or a very deep layer of soil is formed. For SEPR it is pointed out for the mountain Plachkovica (project for Bregalnica 2018) can be found on the highest silicate regions of Kozuf and Belasica.

Importance of the habitat. Habitat for many organisms; primary production; prevents erosion. Areas with this habitat can be an important food source for domestic and wild herbivores.

Pressures and threats. Due to the sensitivity of the vegetation, overgrazing, construction of roads, antenna systems and various tourist facilities are a threat to this habitat. Intense pressure on alpine and subalpine vegetation gradually leads to the degradation of the habitats to which it is attached.

Conservation and management. Conservation should be aimed at preserving the structure of the habitat, by taking appropriate measures to maintain the lawns. Such measures may include the establishment of protected areas, the limitation of overgrazing, the improvement of legal protection, the proper management of habitat, etc.

C) Mesophile grasslands

6430 : Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels

Description. Habitat 6430 includes a large number of plant communities belonging to different vegetation syntaxes. These are moist and nitrophilic associations with tall herbaceous plants along watercourses or forest edge communities, belonging to the ranks *Glechometalia hederaceae* and Convolvuletalia sepium (alliances: Senecion fluviatilis, Aegopodion podagrariae, Convolvulion sepium, Filipendulion) as well as communities with hygrophilous perennial herbaceous plants from the mountain to alpine areas of the class Betulo-Adenostyletea. The habitat is characterized by many species: *Glechoma hederacea, Epilobium hirsutum, Senecio fluviatilis, Filipendula ulmaria, Angelica archangelica, Petasites hybridus, Cirsium oleraceum, Chaerophyllum hirsutum, Aegopodium podagraio, Allogia salicaria, Crepis paludosa; A. napellus, Geranium sylvaticum, Trollius europaeus, Adenostyles alliariae, Cicerbita alpina, Digitalis grandiflora, Calamagrostis arundinacea* and others. In N. Macedonia, this includes the communities of the unions Calthion, Cirsion appendiculati, Petasition, which develop along streams in the hilly, mountainous and alpine region. According to the EUNIS classification, this habitat overlaps with habitat types E5.4: Moist or wet tall-herb and fern fringes and meadows and E5.5: Subalpine moist or wet tall-herb and fern stands. Types E5.57: Eastern oro-Mediterranean and Balkan tall-herb communities and possibly E5.5B: Alpine and subalpine fern stands are listed for the Balkan Peninsula.

Distribution in South East Planning Region. The habitat is located on Plachkovica (project for Bregalnica). It is expected to be confirmed for the water flows from the higher parts of Kozuf and Belasica. Significance of habitat. Habitat and shelter for many organisms, primary production.

Pressures and threats. The existence of this habitat is related to the maintenance of the water bodies around which it develops. Hence, the pressures can arise from urbanization, tourism development, construction of different types of farms, artificial water bodies (closed reservoirs, concrete pools, etc.) and more. One of the most serious threats is the capture of these waters (unfortunately, a very common practice in our country), which results in fragmentation or complete disappearance of the habitat.

Conservation and management. Of particular importance is the accurate definition of threats. It is best for the habitat to be fully protected, or if possible, to be preserved to the extent that it will allow the basic structure and functions to be preserved.

6520 : Mountain hay meadows

Description. Mesophilic hay meadows rich in mountain and subalpine species (usually over 600 m) usually dominated by *Trisetum flavescens* and *Heracleum sphondylium, Viola cornuta, Astrantia major, Carum carvi, Crepis mollis, C. pyrenaica, Bistorta major, (Polygonum bista)*), *Silene dioica, S. vulgaris, Campanula glomerata, Salvia pratensis, Centaurea nemoralis, Anthoxanthum odoratum, Crocus albiflorus, Geranium phaeum, G. sylvaticum, Narcissus poeticus, Malva moschata, Valeriana repens, Trollius Musoparius L bulbiferum, Thlaspi caerulescens, Viola tricolor ssp. subalpine, Phyteuma halleri, P. orbiculare, Primula elatior, Chaerophyllum hirsutum* and many others. A suitable habitat type from the EUNIS classification is E2.31: Alpic mountain hay meadows, which is not listed for N.Macedonia. E2.33: Balkan mountain hay meadows is suitable for the region, but this habitat does not correspond to 6520. In the absence of more sound research, this issue will remain open for now.

Distribution in South East Planning Region. This type of habitat includes the mountain meadows in the region.

Importance of the habitat. In addition to biological functions (habitat, primary production), it has economic significance as a source of food for domestic animals.

Pressures and threats. The main threat is the modification of the habitat, which is due to the intensive abandonment of the village and the reduced interest of the local population for livestock. Abandoned meadows stop being fertilized and mowed, so they quickly heal into bushes (reforestation).

Conservation and management. The basic measure is to stimulate livestock.

6540 : Sub-Mediterranean grasslands of the Molinio-Hordeion secalini

Description. Wet grasslands with the Molinio-Hordeion secalini alliance along karst rivers and in the karst fields of the Dinaric Mountains. These wet meadows have traditionally been used as pastures and hay meadows and are flooded or particularly wet in winter and spring, and gradually dry up in summer. Due to the extreme differences in soil moisture, there is a combination of hygrophilous plants and plants that are more typical of dry habitats growing together. These wet grasslands occur in the usually arid Mediterranean landscape and often host endemic species including *Edraianthus dalmaticus, Succisella petteri* and *Chouardia litardierei*.

Characteristic plants are *Deschampsia media, Hordeum secalinum, Edraianthus dalmaticus, Succisella petteri, Chouardia litardierei, Ranunculus muricatus, R. sardous, Trifolium fragiferum, Trifolium resupinatum, Trifolium cinctum, Oenanthe media, Chrysopogon gryllus, Bromus erectus, Narcissus radiiflorus, N. tazetta.*

This habitat type includes lowland meadows that extend up to 1000 m above sea level, on flat surfaces or on areas with weak inclination. Often parts of the meadows are flooded during the winter and early spring. This habitat type on the territory of the Republic of North Macedonia is represented by the union *Trifolion resupinati,* while in the researched area they are found ass. *Hordeo-Caricetum distantis* and *Bromo-Alopecuretum.*

Distribution in South East Planning Region. The lowland meadows in the region belong to this type of habitat.

Importance of the habitat. In addition to biological functions (habitat, primary production), it has economic significance as a source of food for domestic animals.

Pressures and threats. The main threat is the modification of the habitat, which is due to the intensive abandonment of the village and the reduced interest of the local population for livestock. Abandoned meadows stop being fertilized and mowed, so they quickly heal into bushes (reforestation).

Conservation and management. The main measure is to stimulate livestock and avoid land reclamation measures that would cause disruption of the structure of the meadows.

7 : RAISED BOGS AND MIRES AND FENS

Marshes on calcareous substrates

7140 : Transition mires and quaking bogs

Description. Habitat includes peat-forming communities that develop on oligotrophic to mesotrophic water surfaces, adapting to the remaining soligenous and ombrogenic types. A number of different communities are involved here. Phytocenological turns for regular Scheuchzerietalia palustris (e.g. oligotrophic floating carpets) and *Caricetalia fuscae* (communities of reptiles). Characteristic plant species are *Eriophorum gracile, Carex lasiocarpa, C. diandra, C. rostrata, C. limosa, Scheuchzeria palustris, Rhynchospora alba, R. fusca, Menyanthes trifoliata, Epilobium palustre, Pedicularis palustris, Sphagnum sp.* and others.

Distribution in South East Planning Region. The relatively low pressure may have the latest planning plan of Kozuf and Monospitovski Blato (Melovski 2010). Necessary research in all places where it is expected to be present in this home. Significance of habitat. Habitat of important plant and animal species, primary production, regulation of water balance.

Pressures and threats: Exceptionally sensitive habitat which depends on the water availability. The threats are more intense considering the small distribution area of this habitat in R. N. Macedonia. In addition, as a serious threat can be any activity in the habitat or in the immediate vicinity which is related to urbanization of the area, develops tourism, agriculture, mining, construction of facilities and other buildings, pollution, introduction of invasive species, collection of plant and / or animal species, etc.

Conservation and management. It is necessary to determine the presence of the dwelling, to make a card and to determine the most appropriate measures for monitoring the condition and protection.

7160 : Mineral-rich springs and springfens

Description. The springs and spring fens are characterized by a continuous flow of water. The water is cold and rich in oxygen and minerals, due to the rapid percolation. The springs can be basins where water flows into the surrounding area, allowing the development of specific vegetation. Because the water comes from deeper layers, these springs often have liquid water during the winter, even if the surrounding areas are frozen and covered with snow. Invertebrate fauna is often very specific to this

habitat, and the flora is rich in "northern species". In N.Macedonia, the habitat is characterized by *Alchemilla indivisa, Angelica pancicii, Cardamine raphanifolia subsp. acris, Carex rigida var.macedonica, Carex echinata, Chrysosplenium alternifolium, Dactylorhiza cordigera, Equisetum arvense, Epilobium spp., Geum coccineum, Montia fontana, Parnassia palustris, Pedicularis limnogena, Pinguicula balcanca, Sax. alpigena, Silene asterias, Stellaria alsine and Brachythecium rivulare mosses, Bryum pseudotriquetrum, Chiloscyphus polyanthos, Marchantia aquatica, Philonotis spp., Pellia epiphylla, Plagiomnium undulatum, Pohlia wahlenstoria, The species Athyrium filix-femina, Caltha palustris, Cirsium appendiculatum, Deschampsia cespitosa, Doronicum austriacum, Myosotis scorpioides, Rumex alpinus, Veratrum album* and others usually develop around the swamp (Čarni & Matevski 2010). First described as Phenoscandinavian, this habitat is more widespread in Europe. On the Balkan Peninsula this habitat has a high conservation value, especially in the alpine zone. According to the latest research of the Finnish team in NP Pelister, the habitat is mainly found at about 2000 meters, and sporadically comes higher. The species Eriophorum latifolium, Blysmus rufus and Carex davalliana are found in the forest belt of this type of habitats, which indicate similarity with the type 7230 "Alkaline fens". Habitat 7160 matches habitat types C2.1 Springs, spring brooks and geysers and C2.111 Fennoscandian mineral-rich springs and spring fens, from the EUNIS classification.

Distribution in South East Planning Region. There is no official research, but this habitat type may be present in Kozuf. Significance of habitat. Ecosystem for important plant and animal species; importance for the water balance of the environment.

Pressures and threats. Concrete research is needed. Due to its sporadic distribution and small area it is one of the most vulnerable habitats. Particularly significant threats are water capture and the construction of roads or other facilities. Climate warming can also have a negative effect on this habitat type.

Conservation and management. Concrete research is needed. For proper preservation of this type of habitat it is necessary to study (saw composition, functions), to map and determine the most appropriate measures for monitoring the condition and protection. Activities for its restoration can be planned in places where there is a disruption of the structure and functions.

7210 * Calcareous fens with Cladium mariscus and species of the Caricion davallianae]

Description. Belts with *Cladium mariscus* in areas with elevated vegetation near lakes, fallows or successive stages of extensively cultivated wet meadows, in contact with vegetation of the *Caricion davallianae* or other species of the *Phragmition* [*Cladietum marisci* (Allorge 1935) Zob.] alliance. In contact with swamps on a limestone surface (7230), but also with acidic wetlands, wide wet meadows, other reedbeds and high-pitched communities. According to the EUNIS classification, the closest habitat types are D5.2: Beds of large sedges normally without free-standing water (narrower), and more precisely D5.24: Fen Cladium mariscus beds (wider).

Distribution in South East Planning Region. The Cladium mariscus community is known for its Negorski banji. It is an important phytocoenological and from conservation point of view important community, which has the status of a refugial residue of once far greater phytocenosis. In addition to C. mariscus, the relict fern Ophyoglossum vulgatum grows nearby.

Importance of the habitat. Ecosystem for important plant and animal species; importance for the water balance of the environment.

Pressures and threats. Concrete research is needed. It is a vulnerable habitat with limited distribution. Reclamation activities in the region in the past, and today the functioning of the spa, have contributed to a significant reduction of living space and disruption of the structure and functions.

Conservation and management. Concrete research and activities are needed for its protection and revitalization.

7220* : Petrifying springs with tufa formation (Cratoneurion)

Description. Hard water springs with active travertine or tuff formation. These formations can be found in a variety of environments such as forests or open areas. They are generally small (point or linear formations) dominated by bryophytes (*Cratoneurion commutati*). According to the original description, it is characterized by the plants Arabis soyeri, Cochlearia pyrenaica (in places with heavy metals), *Pinguicula vulgaris, Saxifraga aizoides and the mosses Catoscopium nigritum, Cratoneuron commutatum, C. commutatum var. falcatum, C. filicinum, Eucladium verticillatum, Gymnostomum recurvirostrum.* According to the EUNIS classification (Evans & Roekaerts2015), the appropriate habitat type is C2.121 Petrifying springs with tufa or travertine formations.

Distribution in South East Planning Region. The residence is confirmed for NP Pelister (data from the twinning project). The gorge of Raechka Reka was also ascertained, but with the construction of the road through the gorge, it is now probably destroyed. Potential areas should be expected on Mount Kozuf.

Importance of the habitat. Ecosystem for important plant and animal species; importance for the water balance of the environment. Pressures and threats. Concrete research is needed.

Conservation and management. In order to preserve this habitat with a significantly limited distribution in the area, it is crucial to protect its surroundings and the entire affected hydrological system. Concrete research and activities are needed for its protection and revitalization.

7230 : Alkaline fens

Description. Wet habitats heavily affected by peat or tuff, formed by communities of small blades and brown mosses that develop on constantly moistened soils, with soligenous or topogen-rich bases, often supplied with limestone water, below or just above the substrate. Peat formation, when present, is underwater. Swamp communities are usually dominated by small oysters and other Cyperaceae, belonging to the union *Caricion davallianae* which is characterized by a conspicuous carpet of "brown mosses", formed by *Campylium stellatum, Drepanocladus intermedius, D. revolvens, Cratoneuron commutatum, Acrocladium cuspidatum, Ctenidium molluscum, Fissidens adianthoides, Bryum pseudotriquetrum* и други, herbaceous plants - *Schoenus nigricans, S. ferrugineus, Eriophorum latifolium, Carex davalliana, C. flava, C. lepidocarpa, C. hostiana, C. panicea, Juncus subnodulosus, Scirpus cespitosus, Eleocharis quinqueflora,* as well as very rich grass flora with *Tofieldia calyculata,*

Dactylorhiza incarnata, D. traunsteineri, Epipactis palustris, Pinguicula vulgaris and others. This type of swamp with specialized, strictly limited species, is among the habitats that have undergone the most serious reduction and are considered the most endangered.

Distribution in South East Planning Region. This habitat type is known for Monospitovsko Blato (Melovski 2010) and Plachkovica - the vicinity of Turtel (project for Bregalnica) and can probably be found on other mountains in the region - Ograzden, Belasica and Kozuf.

Importance of the habitat. Ecosystem for important plant and animal species; importance for the water balance of the environment.

Pressures and threats. Concrete research is needed. There can be different types of threats, related to certain sectors, above all, urbanization, tourism development, opening of mines, construction of reservoirs, etc.

Conservation agronomic development, and management. As with most wetland habitats, which are sparse and cover relatively small areas, providing uninterrupted water supply is of particular importance. However, activities related to its protection and possible revitalization must rely on concrete research.

8 : ROCKY HABITATS AND CAVES

8150 Medio-European upland siliceous screes

Description. Silicate mounds of hills from Western and Central Europe, with *Epilobium collinum, Galeopsis segetum, Senecio viscosus, Anarrhinum bellidifolium, Cryptogramma crispa*. Upper silicate mounds, often formed by quarries and inhabited by impoverished forms of alpine communities, often rich in mosses, lichens, and sometimes ferns, especially *Cryptogramma crispa*, are included, but should not be considered. In the EUNIS classification, both habitats - 8110 Siliceous scree of the montane to snow levels (*Androsacetalia alpinae* and *Galeopsietalia ladani*) and 8150 Medio-European upland siliceous screes, from EU Habitats Directive Annex I, are included in habitat type H2.4. Probably the largest areas with this habitat in R. N. Macedonia are the famous "stone rivers" in NP Pelister.

Distribution in South East Planning Region. There are no specific data, but this habitat should be present at all sites with crushed silicate rocks (Plachkovica, Orgazden, Belasica, Kozuf).

Importance of the habitat. Pioneer communities of screeses which enable the primary accumulation of organic matter and begin the healing process of screeses. They also have a role to play in preventing erosion.

Pressures and threats. Concrete research is needed.

Conservation and management. More detailed research is needed.

8210: Calcareous rocky slopes with chasmophytic vegetation)

Description. Vegetation of cracks in limestone cliffs, in the Mediterranean region and in the Euro-Siberian plain to alpine levels, which mainly belongs to the ranks *Potentilletalia caulescentis* and

Asplenietalia glandulosi. Two levels can be identified: a) thermo- and meso-Mediterranean (*Onosmetalia frutescentis*) with *Campanula versicolor, C. rupestris, Inula attica, I. mixta, Odontites luskii*; b) mountain and Mediterranean (*Potentilletalia speciosae*, including *Silenion aurticulatae, Galion degenii* and *Ramondion nathaliae*). "This type of habitat has great regional diversity, with a large number of endemic plant species." On the territory of R. N. Macedonia habitat includes communities from the associations *Campanulion versicoloris* and *Ramondion nathaliae*. From the EUNIS classification it overlaps with the habitat type H3.2: Basic and ultra-basic inland cliffs.

Distribution in South East Planning Region. No specific data. It can be expected on the limestone rocks of Kozuf (Both Ears, Mala Rupa).

Importance of the habitat. Pioneer communities of limestone rocks.

Pressures and threats. Concrete research is needed.

Conservation and management. More detailed research is needed.

8220 : Siliceous rocky slopes with chasmophytic vegetation)

Description. "Vegetation in cracks of silicate cliffs, represented by a large number of subtypes, described by plant species." (The Interpretation Manual of European Union Habitats, 2013) This type of habitat includes vertical or very steep (65 ° -90 °) silicates (granite, gneiss, rhyolite) rock walls and cracks in them. The vegetation develops in extremely unfavorable conditions (large temperature differences during the day, differences in the humidity of the substrate, wind exposure, absence of snow cover, etc.), so the species composition is quite poor and with very little cover. This type of vegetation on the territory of R. N. Macedonia subordinate to the union *Silenion lerchenfeldianae*. According to the EUNIS classification, it overlaps with habitat type H3.153: Pelagonide campion siliceous cliffs.

Distribution in South East Planning Region. The habitat is stated for the mountains Plachkovica, Belasica and Kozuf (Melovski et al. 2010). With the project for research of the vegetation of the Bregalnica Basin, this habitat has been confirmed for several localities on the mountain Plachkovica (Lisec, around the village Gradec). Possible locations may also be on Mount Ograzden.

Importance of the habitat. Pioneer communities of silicate rocks.

Pressures and threats. Concrete research is needed.

Conservation and management. More detailed research is needed, especially in terms of more complete determination of the species composition.

- **Review of relevant iterature data on forest and shrub habitats in SEPR**

Forest and shrub vegetation for the South-East Planning Region (SEPR) has been explored since the beginning of the last century, but more intensively in the last 20 years). They are contained in the works of Em (1961, 1962, 1966, 1978, 1980, 1981) Stojanov (1921), Rudski (1943), Nikolovski and Cirimotic (1958), Rizovski (1974, 1983, 1992, etc.), Matevski et al. (2017), Mandzukovski et al. (2009).

- **List of forest and shrub habitats in the SEPR**

Based on the consulted literary data as well as on the basis of personal knowledge, 22 forest habitats can be expected on the territory of the South-East Planning Region, five of which have the status of strictly protected habitats. A table with the list of habitats is given below.

Table. 1. List of non-forest and shrub habitats in the South-East Planning Region

4 : TEMPERATE HEATH AND SCRUB

4060 : Alpine and Boreal heaths

4090 : Endemic oro-Mediterranean heaths with gorse

5 : SCLEROPHYLLOUS SCRUB (MATORRAL)

5110 : Stable xerothermophilous formations with Buxus sempervirens on rock slopes (Berberidion p.p.))

5130 : Juniperus communis formations on heaths or calcareous grasslands

9 :FORESTS

9110 : Acidophilous (Luzulo-Fagetum) beech forests

9150 : Medio-European limestone beech forests of the Cephalanthero-Fagion

9170 : Eastern (Galio-Carpinetum) oak-hornbeam forests

9180*: Tilio-Acerion forests of slopes, screes and ravines

91AA*: Quercus Pubescents Sub-Mediterranean Forests

91CA : Rhodopide and Balkan Range Scots pine forests

91E0*: Alluvial forests with Alnus glutinosa and Fraxinus excelsior (Alno-Padion, Alnion incanae, Salicion albae)

91F0 : 91F0 Riparian mixed forests of Quercus robur, Ulmus laevis and Ulmus minor, Fraxinus excelsior or Fraxinus angustifolia, along the great rivers (Ulmenion minoris))

91M0 : Pannonian-Balkanic turkey oak- sessile oak forests

91W0 : Moesian beech forests

92A0 : Salix alba and Populus alba galleries

92C0 : Platanus orientalis and Liquidambar orientalis woods (Platanion orientalis)

92D0 : Southern riparian galleries and thickets (Nerio-Tamaricetea and Securinegion tinctoriae)

9260 : Castanea sativa woods

9270 : Hellenic beech forests with Abies borisii-regis

9530*: *(Sub-) Mediterranean pine forests with endemic black pines

9560*: * Endemic forests with Juniperus spp.

Pseudomaccia scrubs on Cerris oak (Quercus coccifera)

- **Description of habitats**

4 : TEMPERATE HEATH AND SCRUB

4060: Alpine and Boreal heaths

Habitat description.
This habitat in South East Planning Region is represented by three subtypes:
- pre-mountain cries with blueberries, and
- pre-mountain screams with genists (rabbits);
- pre-mountain screams with stink

The first two subtypes are found in the highest parts of the mountains above the upper border of the forest, and instead are intertwined with each other.

The third subtype is characteristic of the limestone terrain of Kozuf in the subalpine belt.

Subtype 31.4A: -Ericoid communities and sub-Alpine belt of the mountain composed of blueberries

Subtype description.

The pre-mountain cries with blueberries are a secondary creation, spread in the subalpine belt of the high mountains in t. n. "Fighting zone" between high mountain pastures and the upper border of the forest and over time in successive processes, and in the absence of zooanthropogenic impact will be suppressed by the more dominant representatives of the vegetation.

They are found in the form of larger blemishes in the subalpine belt, which worsens the structure of the pastures. These are mostly steep sides of the colder exposures or surround parts around the rocky places. The geological base is mainly silicate, but can also be found on limestone, as is the case with the site Flora on Sq. Kozuf. These are dense ground formations with a mixed composition of blueberry (*Vaccinium myrtillus*) and red blueberry (*Vaccinium vitis-idaea*) which are present on the mountain Belasica and without the red blueberry of Kozuf (Appendix 7 - Figure 1). Apart from these two

species, *Juniperus communis subsp. nana, Bruckenthalia spiculifolia, Deshampsia flexuosa, Festuca sp., Hieracium hoppaeanum, Hieracium sparsum, Lilium albanicum, Euphrasia salisburgensis, Hypericum barbatum* and others.

Distribution in South East Planning Region. The border between North Macedonia, Bulgaria and Greece, further interrupted areas of the sites: Pole, Samar, Sechena Skala, Semer Kayasen, Visoka Chuka, Devil's Bridge and other smaller sites all on Mount Belasica, as well as sites between the Two Ears and Flora, and above The Sea and the Barn on Mount Kozuf (Appendix 7- Figure 2).

Pressures and threats. Although with reduced intensity, the main threats to this type of habitat come from livestock expressed through excessive grazing and trampling of livestock as well as burning of spruce by farmers which causes large-scale fires. These activities and fires contribute to the intensification of erosion processes and the settlement of more competitive grass species, on Belasica and with the shrub species Chamaecytisus absinthioides.

Conservation and management. Condition monitoring, fire prevention and control of gravity intensity are measures that can positively affect the preservation of this habitat subtype from further degradation and reduction of the areas on which it develops.

Subtype 31.4B: -High mountain greenweed heats with Genista

Subtype description.

This subtype is present on Mount Belasica in the form of a dense spruce spread in the subalpine belt above the upper border of the forest. The soils are acidic, shallow to medium deep that develop on a silicate geological substrate. They are registered mainly on colder exposures on terrains with different slopes. This subtype includes the following species: *Chamaecytisus absinthioides, Epilobium angustifolium, Verbascum longifolium subsp. pannosum, Hypericum perfoliatum, Calamagrostis varia* and other species (Appendix 7- Figure 3).

Distribution in South East Planning Region. In the subalpine belt of Belasica at the end of the triangle from the Macedonian - Bulgarian - Greek border through the locality Pole to Samar. Other sites are insignificantly small.

Pressures and threats. The habitat subtype *Chamaecytisetum absinthioidis* tends to conquer areas under the blueberry groves and pastures and is a transitional stage of re-establishment of forest habitats. Fires and possible construction activities pose a serious threat to this habitat.

Conservation and management. Condition monitoring and fire control are measures that can contribute to the preservation of this habitat subtype.

Подтип : submountain mountain heaths with *Juniperus sabina*

Subtype description: This subtype is present on the Kozuf mountain of isolated parts of the limestone parts in the subalpine belt. These are the steepest, often terrains with the advanced form of erosion that the stink heals and stabilizes. Warm, south-facing exposures with a shallow substrate, and we have often noticed developed specimens in the cracks of the rocks exclusively on limestone. The stinker lands on the terrain in the form of dense hard-to-pass low formations on the ridges that are hit by the wind. It is important to note that along the Kozuf massif, Kozjak (Mariovski) Nidze, passes one of the extreme parts of the southern area of the stinker. Isolated sites are found in several Greek

mountains. This subtype includes the following species: Juniperus sabina, Stachys horvaticii, Juniperus communis, Thymus sp. and other species.

Distribution in South East Planning Region. In the subalpine belt of Kozuf, isolated parts of Two Ears, Chichi Kaja and Mala Rupa on a small area of limestone.

Pressures and threats. The Juniperus sabina habitat subtype has suffered from fires in the past in the Two Ears, as evidenced by charred remains on the ground. Preserved specimens are in hard-to-reach areas. Fires are a serious threat to this habitat.

Conservation and management. Condition monitoring and fire control are measures that can contribute to the preservation of this habitat subtype.

4090 Endemic oro-Mediterranean heaths with gorse

Description. Primary cushion screams of high, dry mountains in the Mediterranean and Iran-Turanian regions with low and often prickly bushes that form "cushions. Characteristic plants. *Astragalus angustifolius, Acantholimon androsaceum, Astragalus lacteus, Convolvulus cochlearis, Rindera graeca, Aster alpinus, Globularia stygia, Minuartia stellata, Erysimum pusillum, Thymus teucrioides, Alyssum kionae, Alyssum kionae, Thymus boissieri, Sesleria caerulans.*

Importance of the habitat. Protects the terrain from erosive phenomena.

Distribution in South East Planning Region. The presence of this habitat in North Macedonia is known as Galicica, it is further fragmentarily developed on the limestone fields of Plachkovica. In the South-East Planning Region, this habitat develops fragmentarily on the sites of Dve Ushi, Chichi Kaja and Mala Rupa, all on the Eastern slopes of Mount Kozuv on a limestone geological base, and it is mainly dominated by Astragalus angustifolius.

Pressures and threats: Fires to which this dwelling is exposed, especially on the site Dve Ushi.

Conservation and management. Completion of data for distribution, vegetation-ecological research and mapping of the habitat.

5: SCLEROPHYLLOUS SCRUB (MATORRAL)

The following habitats are present in the sub-Mediterranean temperate areas:

5110: Stable xerothermophilous formations with Buxus sempervirens on rock slopes (Berberidion p.p.)

Description. The Common Box (Buxus sempervirens) usually builds the existing floor in the forest communities but with degradation, i.e. destruction of the forest it dominates and forms a scrub formation. It does not depend on the parent substrate, but more often we find it on terrains with limestone or serpentine geological substrate where the competition of other wood species is small. It has slow growth and produces quality wood. Characteristic plants: *Buxus sempervirens, Prunus spinosa,*

Prunus mahaleb, Cornus mas, Crataegus spp., Berberis vulgaris, Ligustrum vulgare, Viburnum lantana, Amelanchier ovalis, Geranium sanguineum, Dictamnus albus.

Importance of the habitat. Protects the terrain from erosive phenomena.

Distribution in South East Planning Region. The slopes of Serta towards the Demir Kapija gorge, also in sheltered places in the gorge of the river Javorica and other isolated shelter sites in the eastern parts of Kozuf.

Pressures and threats. Fire hazards to which this habitat is exposed and lately it suffers from the insect *Cydalima perspectalis* which cause the extinction of entire populations in the area.

Conservation and management. Completion of data for distribution, vegetation-ecological research and mapping of the habitat. Monitoring the situation with the insect *Cydalima perspectalis* with regular monitoring and reporting to the IDP service at the Faculty of Forestry in Skopje.

5130 Juniperus communis formations on heaths or calcareous grasslands

Description. The surfaces of this habitat are characterized by shallow soils and in some places the soil cover is washed so that the limestone geological substrate dominates in the form of larger and compact blocks. in which with greater cover are found: *Juniperus communis, Crataegus monogyna, Rosa mycrantha, Rosa canina,* in combination with grass species from nearby limestone pastures.

Significance of habitat. Protects the terrain from erosive phenomena.

Distribution in South East Planning Region. Fragmented components of this habitat are found in Kozuf.

Pressures and threats. Livestock is regularly grazed in these areas, and fires are also a danger.

Conservation and management. Completion of data for distribution, vegetation-ecological research and mapping of the habitat.

9: FORESTS

9110 Acidophilous (Luzulo-Fagetum) beech forests

Description. On the mountain Belasica, according to the current knowledge the beech forests of acidic habitats are present on limited areas in the high mountain belt. They grow on acidic soils at relatively shallow depths on a silicate geological substrate regardless of terrain exposure. According to the composition they are mainly pure beech forests represented by ass. *Luzulo luzuloidis-Fagetum sylvaticae* (Appendix 7- Figure 11).

The layer of herbaceous plants is well developed and as more important species in the composition of these forests are the following mainly acidophilic species: *Calamagrostis arundinacea, Hieracium murorum, Deschampsia flexuosa, Pteridium aquilinum, Galium pseudaristatum, G. rotundifolium, Lunulaus communion sylvatica, Physospermum cornubiense, Poa nemoralis, Veronica officinalis*, etc. These forests on Mount Belasica are characterized by moderately good biostructure and are of commercial interest.

Distribution in South East Planning Region. During the field research this habitat was observed on the sites above the places Ajdaro and Bolnica as well as on a smaller area in the upper course of Vodenicka Reka.

Pressures and threats. The most important threats are the following: improper and excessive use of forests in certain places, performance of construction activities for penetration of forest roads, settlements, gas pipelines, mines and other facilities. Further forest fires, introduction of invasive species. The mentioned threats can cause disturbance of the condition of this habitat in terms of change of the species composition, vitality and phenotypic characteristics of the species as well as fragmentation of the surfaces.

Conservation and management. It is necessary to monitor the conditions, proper management and protection of these forests by avoiding clean cuttings on large areas and steep terrain. Timely remediation of disturbed conditions of natural and anthropogenic character. Prevention of grazing of livestock during recovery phases, prevention of forest fires, etc.

9150 (Medio-European limestone beech forests of the Cephalanthero-Fagion

Description. This habitat is spread on terrains that are more inclined, shallower soil cover and the parent substrate instead comes out in the form of smaller and larger stones on the surface. The composition of the forest is rarer (0.7, instead of 0.5-0.6) which allows a larger amount of light to penetrate the ground. The thermophilic component can be observed in these forests in addition to the mesophilic character. From the vegetation can be found representatives of *Carex spp., Sesleria robusta, Brachypodium pinnatum, Cephalanthera spp*. The forests in this habitat are characterized by moderately good to poor bio structural characteristics and poor-quality timber that is not subject to use in the economy.

Distribution in South East Planning Region. The forests of this habitat mainly extend under the locality Dve Ushi on the eastern slopes of the mountain Kozuf from 1400 to 1650 m above sea level (Appendix 7- Figure 6).

Pressures and threats. There are anthropogenic disturbances in the forests of this habitat (cattle breeding, growing potatoes in the immediate vicinity and danger of fires). Beech forests on limestone are very difficult to restore after a fire.

9170: Eastern (Galio-Carpinetum) oak-hornbeam forests

Description. In this habitat there are forests in which the dominant role is played by the appearance of the European Hornbeam - *Carpinus betulus* but can also be found on the top - *Quercus petrea* and beech *Fagus sylvatica*. In terms of altitude, they develop lower than the *Tilio-Acerion* forests on slopes, screes and ravines, but almost regularly in the contact zone between the warm continental area and the montane area. On Belasica they develop on a silicate geological base along the sides of the valleys or in places where a large amount of soil has accumulated. On the floor of the trees are regularly found: *Acer campestre, A. hyrcanum, A. platanoides, Cerasus avium (= Prunus avium), Fraxinus excelsior, Sorbus torminalis, Tilia cordarta, T. platyphyllos rarely Quercus cerris and Q. frainetto. Cornus mas, Corylus avellana, Crataegus monogyna, Ligustrum vulgare* appear on the floor of the bushes. *Aegopodium podagraria, Convallaria majalis, Dentaria bulbifera, Festuca heterophylla, Galium odoratum, Melica uniflora* and *Mercurialis perennis* are species found on the ground floor.

Distribution in South East Planning Region. So far, a known site of this habitat is on the northern slopes of Belasica at about 600 to 750 meters above sea level.

Pressures and threats. Possible threats to this habitat are improper and excessive use of water hybrid forests in those places where it is more accessible.

Conservation and management. Mapping of these habitats as well as monitoring.

9180*: *Tilio-Acerion* forests of slopes, screes and ravines

Description. The forests of the Tilio-Acerion habitat on slopes, screes and ravines have not been sufficiently studied in N. Macedonia. On Mount Belasica the forests of this habitat correspond to *ass. Cotyledono-Juglandetum regiae* Matveeva et Micevski 1982. Habitat is a priority of the Habitat Directive. The habitats of the forests represented in this habitat are shaded valleys and sides of them in which there are colluvial deposits with rich nutrients. Most often dominated by representatives of the genera: *Acer sp., Tilia sp.* and *Fraxinus sp.* They can also occur on steep sides along valleys. The floristic composition is of mesophilic character. Noise as a species hardly succeeds in such conditions and leaves the role to other species that build polydominant communities. In Belasica, Kozuf and other sites the forests of the habitat Tilio-Acerion on slopes, screens and ravines are present on a silicate geological base. The following species are most often present on the ground floor: *Allium ursinum, Dryopteris spp., Galium aparine, Geranium robertianum, Geum urbanum, Mercurialis perennis, Phyllitis scolopendrium, Polystichum setiferum, Urtica dioica* and other species.

Distribution in South East Planning Region. On the territory of the region, the habitat 9180 of Belasica is found: along the sides around the Gabrovo waterfall, the steep sides and the valleys in front of the Kolesin waterfall, the gorge part of the Smolare waterfall (Appendix 7- Figure 4). Larger areas of this habitat are found above the village. Bansko, as well as areas along the Konska (Appendix 7- Figure 5) and Sermeninska River on the Eastern slopes of Kozuf.

Pressures and threats. As special threats to the habitat * 9180 Tilio-Acerion on slopes, screes and ravines can be mentioned the occurrence of breaking the branches of linden trees from the local population for collecting tea inflorescences as well as illegal cuttings to meet the needs of the local population with firewood . Fires are less common due to the moist substrate on which they develop.

Conservation and management. Because the forests of the habitat 9180 Tilio-Acerion on slopes, screes and ravines are not sufficiently studied in R. N. Macedonia needs additional vegetation research. Mapping of these habitats as well as monitoring is also necessary.

91AA *Eastern white oak woods

Description. The forests of this habitat are developed in the sub-Mediterranean area and mainly the Pubescent oak is mostly destroyed, and the white hornbeam dominates although there are plantations in which the participation of both editors is equal. Topographically, these are wavy - hilly terrains on which thermoxerophilic vegetation develops. The floristic composition is dominated by the following species: *Quercus pubescens, Carpinus orientalis, Fraxinus ornus, Acer monspessulanum, Cornus mas, Evonymus verrucosa, Silene viridiflora, Aristella bromoides, Saxifraga bulbifera, Symphytum bulbosum* and other species.

Distribution in South East Planning Region. Valley of the river Strumeshnica, towards Radovishko and above Demir Kapija and other localities.

Pressures and threats. Areas under this habitat often suffer from fires. Excessive exploitation can lead to degradation of this habitat.

Conservation and management. Monitoring the condition of blagon forests. Careful management of these forests.

91CA: Rhodopide and Balkan Range Scots pine forests

Description. This habitat, represented by white pine forests, is present in the eastern parts of Kozuf in the high mountain and sub-belt. Although the code in the EU Habitat Interpreter refers to descriptions of whitewood forests from the Rhodope Mountains and the Central Balkan Mountains - Stara Planina in Bulgaria, due to the lack of an appropriate code for forests we include them in code 91CA. It should be noted that in our country we are talking about whitewood forests that grow fragmentarily on limestone as a secondary habitats described in code 91CA. Additional research should give a clearer picture of the description of the relics, but also the white pine forests that develop in secondary habitats in the N.Macedonian mountains. There is a justification for white pine forests of limestone and dolomites to be described with a special code. More important plants that can be found in this habitat are *Pinus sylvestris, Fagus sylvatica, Pinus nigra, Calamagrostis arundinacea, Brachypodium pinnatum, Sesleria robusta, Luzula sylvatica* and *Pteridium aquilinum* and other species.

Distribution in South East Planning Region. Eastern parts of Kozuf (Appendix 7- Figure 12).

Pressures and threats. Areas under this habitat often suffer from fires.

Conservation and management. Monitoring the condition of white pine forests that develop on both primary and secondary origin.

91E0*: Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion, Alnion incanae, Salicion albae*)]

Description. This habitat is present along the lower course of the mountain rivers of Belasica in the form of a narrow belt not larger than 10 -15 m in width. They are less common in Kozuf where only in certain places wider localities appear where the topographic conditions allow it. These are usually dotted belts in the form of galleries along the rivers. They are characterized by high humidity. In the floristic composition, in addition to alders (*Alnus glutinosa*) can also appear narrow-leafed ash - *Fraxinus angustifolia*, single specimens of *Cornus mas, Euonymus europaeus, Viburnum opulus* and *Frangula alnus*. On the ground floor are found: *Angelica sylvestris, Carex remota, Circaea lutetiana, Leucojum aestivum, Ranunculus repens, Rubus caesius, Rumex sanguineus, Stellaria nemorum* and other species. Furthermore, *Berula erecta, Carex riparia, Iris pseudacorus, Lycopus europaeus, Oenanthe aquatica, Phragmites australis, Scirpus lacustris (= Schoenoplectus lacustris),* and others. Habitat is a priority of the Housing Directive.

Distribution in South East Planning Region. The most representative areas are above the village of Smolari.

Pressures and threats. Threats to this habitat can be seen that parts of this habitat, due to the fertility of the land are destroyed and turned into fields or gardens. It is also fragmented in many places due to the usurpation of land by the local population for the construction of weekend houses and orchards.

Conservation and management. Mapping of these habitats as well as monitoring. Prohibition of usurpation of places where forests develop on alluvial terrains with trunks. Additional phytocenological research is needed on these forests along the mountainous parts.

91F0: Riparian mixed forests of *Quercus robur, Ulmus laevis* and *Ulmus minor, Fraxinus excelsior* or *Fraxinus angustifolia*, along the great rivers (*Ulmenion minoris*)

Description. The habitat of riparian mixed forests in which *Quercus robur, Ulmus laevis* and *Ulmus minor, Fraxinus excelsior* or *Fraxinus angustifolia* grow along the large rivers has not been listed in the National Reference List of Habitats for the Republic of N. Macedonia. In neighboring countries: Bulgaria, Greece and further Croatia are represented in the list of habitats. The latest field research has confirmed its presence in SEPR which requires additional research in phytocenological terms to clarify the composition of these forests. Hans Em for Negorski Bani (Appendix 7- Figure 7) lists the community *Periploco - Fraxinetum angustifoliae -pallisae* which corresponds to the Interpreter's description of this habitat. The presence of this habitat is confirmed on the eastern slopes of Kozuf, but with a fragmentary character on the mv Dupene in SSE "Visoka Chuka" and near a place called Drtna at the ends of SSE "Sermeninska Suma".

Importance of the habitat. It is a relict habitat where a forest of clear ash grows on muddy terrains, mainly due to the appearance of thermal springs in the area of Negorski Bani, but in other localities it develops in similar conditions - in swampy places where streams flow or water makes small cracks. This phenomenon is unique in our country, and with such frequency is known only in Dolno Povardarie.

Distribution in South East Planning Region. Negorski Bani, mv Dupene in SSE "Visoka Chuka" and near a place called Drtna at the ends of SSE "Sermeninska Suma".

Pressures and threats. Execution of construction works in the area of Negorski Bani, which fragmentation of this habitat in the past and now. Planting of non-native species of the palm genus represented by the species Trachycarpus fortunei, which disturbs the natural environment of this habitat. Further on the site Construction of a hunting lodge and capture of the spring that moistened the entire site and provided pleasant conditions for the development of the Polish ash.

Conservation and management. Determining the real situation with the structure and functions, determining the current threats; establishing a monitoring plan; taking concrete steps to protect places where threats are strongest.

91M0 Pannonian-Balkanic turkey oak- sessile oak forests

Description. For forests dominated by oak it was difficult to find an appropriate code from the Habitats Interpreter, but at this point we think the 91M0 code is the closest. The monodominant forests of Italian Oak or instead of co-domination with white hornbeam are a special feature in the Lower Povardarie and the Strumica valley. N.Macedonian oak lacks with presence at this area. Mostly the

terrains on which these forests develop are flat on which deep soils of northern exposures have developed. The white hornbeam is found in warmer exposures but also at lower altitudes. Italian Oak forests are characterized by thermophilic characteristics, instead of xerophilic characteristics, but with less aridity. The most important species found in the forests of this habitat are the following: *Quercus frainetto, Carpinus orientalis, Pirus piraster, Malus florentina, Sorbus domestica, Rosa gallica, Rubus canescens, Lychnis coronaria, Danna cornubiensis, Asparagus tenuifolius,* and other species.

Distribution in South East Planning Region. Dolno Povardarie, Strumica valley.

Pressures and threats. Instead, the forests of this habitat are burned, and because they develop near settlements, a good part of them are dug up and turned into fields or vineyards and orchards.

Conservation and management. Forest monitoring of this habitat.

91W0: Moesian beech forests

Description. Widespread on the larger mountains in the region from Belasica (Appendix 7- Figure 8), to Kozuf between 450 to 1800 meters above sea level. It includes clean beech plantations as well as less common ones mixed with beech with other deciduous species dominated by beech. These forests develop in conditions where more humane conditions prevail in the air and soil. The soils are mostly cambisols, brown forest, with a neutral to acidic reaction formed on a silicate parent substrate, which are fresh, medium to deep and with a well-developed humus horizon. These are mostly quality forests of economic importance that have been actively managed for many decades. Plant species found in these forests are the following: *Acer platanoides, A. pseudoplatanus, Actaea spicata, Anemone ranunculoides, Aremonia agrimonoides, Asyneuma pichleri, Calamintha grandiflora, Campanula foliosa, Carpinus betulus, Crataegus monogyna, Dentaria bulbifera, Dentaria eneaphyllos, Dryopteris filix-mas, Elymus europaeus, Epilobium montanum, Euphorbia amygdaloides, Evonymus latifolia, Fagus sylvatica, Festuca heterophylla, Galium odoratum, G. pseudoaristatum, Hedera helix, Hieracium murorum, H. racemosum, Lamium galeobdolon, Lathyrus laxiflorus, L. niger, Luzula forsteri, Luzula sylvatica, Melica uniflora, Melissa officinalis, Milium effusum, Mycelis muralis, Neottia nidus-avis, Paris quadrifolia, Physospermum cornubiense, Polystichum aculeatum, Polystichum lonchitis, Potentilla micrantha, Primula acaulis, Prunus avium, Pulmonaria officinalis, Sanicula europaea, Scrophularia nodosa, Sorbus aucuparia, Stellaria hollostea, S. nemorum, Symphytum bulbosum, Ulmus glabra, Viola reichenbachiana.*

Depending on the altitude and exposure, three subtypes are differentiated represented by three different climazonal associations: *ass. Festuco heterophyllae-Fagetum*, *Calamintho grandiflorae - Fagetum* and *Fagetum pichleri* (Appendix 7- Figure 9). In these belts, the beech shows from thermophilic to mesophilic characteristics but also manifests differences in the physiognomy of the stems, especially expressed in the subalpine belt mainly due to the long lying of the snow, but also the influence of the wind.

Distribution in South East Planning Region. The habitat is widespread along the northern slopes of Belasica (Appendix 7- Figure 10) and Kozuf as well as other mountains Ograzden, Plachkovica, Serta.

Pressures and threats. The most important threats are the following: improper and excessive use of forests in certain places, performance of construction activities for penetration of forest roads, settlements, gas pipelines, mines and other facilities. Further forest fires, introduction of invasive species. The mentioned threats can cause disturbance of the condition of this habitat in terms of change

of the species composition, vitality and phenotypic characteristics of the species as well as fragmentation of the surfaces.

Conservation and management. It is necessary to monitor the conditions, proper management and protection of these forests by avoiding clean cuttings on large areas and steep terrain. Timely remediation of disturbed conditions of natural and anthropogenic character. Prevention of livestock grazing during recovery phases, prevention of forest fires, etc.

92A0: Salix alba and Populus alba galleries

Description. The habitat of riparian forests of willows and poplars ecologically develops in the immediate vicinity of the riverbed, i.e. on the shoreline but also beyond it, where the river meanders along its arches, and the vegetation follows them in the form of a narrow strip or extensions - depending on the topographic conditions on which the sediment material is accumulated. Often under the force of water movement and its volume in conditions of intense rainfall in spring and melting snow from the mountains in late spring and early summer months the shape of the riverbed is not constant, i.e. the shoreline is eroded and quite variable. Due to the strength of the transport mass, there are differences in the texture of the alluvial deposit which can be mixed except with sand and gravel and with the remains of branches and clay fractions, and the structure can be rougher. In the places farther from the shoreline, the water carries a finer structure of material that has better properties, i.e. we have the appearance of sandy-alluvial soils, which are layered and with better aeration. Several species occur in this habitat: *Salix alba, S. fragilis, Populus alba, P. nigra. Fraxinus angustifolia, Ulmus minor* and others.

Distribution in South East Planning Region. The course of the river Vardar and its tributaries.

Pressures and threats. The areas under this habitat of willows and poplars 92A0 in the past were subject to fragmentation for the purpose of obtaining agricultural land. Landscaping can be endangered by changing the water regime, as well as in dry conditions with the appearance of a natural succession that would go in the direction of higher vegetation units from the development of vegetation. The use of sand can also be a cause of deforestation in this habitat. The introduction of invasive and non-native species for the protection of the riverbed. Water pollution can also contribute to deforestation that develops in this habitat. Fires are rare.

Conservation and management. The purpose of these forests which are an integral part of the habitat of riparian forests of willows and poplars 92A0 is protective. Mapping and monitoring are also recommended for this type of habitat.

92C0: *Platanus orientalis* and *Liquidambar orientalis* woods (*Platanion orientalis*)
Subtype 44.71: [*Oriental plane woods* (*Platanion orientalis*)]

Description. The most common placement of the plane tree is the new deposits of sand and gravel along the banks of the rivers which it quickly connects. Often these are places where the river meanders, ie along the bends (arches) of the rivers, where the impact of running water is great, and in the spring months they are flooded, but it is not uncommon to see plane trees on the cones of rivers at their coming out in the plane. On the floor of the trees, besides the dominant plane tree, there are also alders *(Alnus glutinosa)*, white willow *(Salix alba),* walnut *(Junglas regia),* chestnut *(Castanea sativa),* beech *(Fagus sylvatica),* black ash *(Fraxinus ornus)* and black hornbeam *(Ostrya carpinifolia).* In the shrub floor and the ground floor as more characteristic can be distinguished: *Aegopodium podagraria, Alliaria*

petiolata, Aremonia agrimonoides, Asplenium adiantum-nigrum, Athyrium filix-femina, Cardamine graeca, Chaerophyllum temulentum, Circaea lutetiana, Cyclamen hederifolium, Dactylis glomerata, Dryopteris filix-mas, Euonymus latifolius, Euphorbia amygdaloides, Galium odoratum, Geranium robertianum, Hedera helix, Lamiastrum galeobdolon, Lapsana communis, Moehringia trinervia, Mycelis muralis, Parieteria officinalis, Polypodium vulgare, Salvia glutinosa, Urtica dioica, etc.

Distribution in South East Planning Region. Belasica - in the vicinity of the villages Smolari, Koleshino, Gabrovo, Bansko, further at the foot of Ograzden, Iberliska river around Demir Kapija gorge, further along the river Vardar, in the gorge of Javorica, Sermeninska, Kovanska and Konska Reka on the eastern slopes of Kozh and parts near Lake Dojran and other sites (Appendix 7- Figure 13).

Pressures and threats. Due to the location of these forests near settlements, for centuries they have been hit by various human activities that negatively affect their preservation in terms of form and quality.

Conservation and management. Within this type of habitat there are several species of vascular plants that are rare or of conservation interest such as: *Phylitis scolopentrium* and *Osmunda regalis*. These forests are also important for controlling erosion processes and preserving water quality. It is necessary to monitor the situation with these forests in terms of proper management (Appendix 7- Figure 14).

92D0: Southern riparian galleries and thickets (Nerio-Tamaricetea and Securinegion tinctoriae)

Description. The habitat is represented in formations from *Tamarix sp*. along the springs of the river Vardar and its tributaries. A community with Mediterranean characteristics is present in this habitat. Its habitats are the close springs of the rivers which are with sandy alluvial material and gravel, often completely sterile which in dry weather and sand drainage can be transported, i.e. carried by the wind (wind erosion). At high water levels, especially in the spring months, the habitats of this habitat are flooded, while later, in the summer months, the water level recedes. It is characterized by great dynamic strength and heals the springs quite quickly, and it is maintained, because the settlements are under constant impact from floods that bring new sand material.

Distribution in South East Planning Region. The springs along the river Vardar from Udovo, to Gjavato and other localities (Appendix 7- Figure 15).

Pressures and threats. Riparian erosion and behavior of scorpion populations.

Conservation and management. Monitoring of walnut populations.

9260: Castanea sativa woods

Description. This habitat covers forests in which chestnuts dominate or have a significant share. These are mesophilic and thermo mesophilic forests. Most often these are shady and sloping places with different slope in which there are no extremes in terms of heat and humidity regime. For the most part, these forests have a severely disturbed structure as a result of chestnut bark disease, so young plantations of shoot origin are more common and old trees are rare. These forests belong to the *ass.*

Castanetum sativae which is characterized by a rich floral composition. The following species are found with different frequency in the floor of the trees: *Acer campestre, A. pseudoplatanus, A. tataericum, Carpinus betulus, Fagus sylvatica, Platanus orientalis, Populus tremula, Quercus frinetto, Tilia tomentosa, T. platiphylos,* and other species.
The most common in the next layer: *Corylus avellana, Cornus mas, C. sanguinea, Crataegus monogyna, Euonymus europaeus, Ligustrum vulgare, Rubus hirtus* and other species. The floristic composition of the ground floor includes: *Colchicum autumnale, Corydalis solida, Cyclamen hederifolium, Euphorbia amygdaloides, Lathyrus laxiflorus, Luzula luzuloides, Melica uniflora, Mycelis muralis, Primula veris, P. vulgarolis, Pilla vulgaris, Pilla.*

Distribution in South East Planning Region. The forests of sweet chestnut in the foothills of Belasica are spread in the west from above the village of Bansko to the North Macedonian-Bulgarian border to the east. The lower limit of the chestnut belt reaches 300 meters above sea level and the upper limit reaches 900 meters above sea level. It occurs in the low belt around the villages of Gabrovo, further the villages of Drazevo, Koleshino up to Smolari.

Pressures and threats. There are natural threats regarding the condition of this habitat, but also threats of anthropogenic nature. In the first group, the threats come from the disease of chestnut bark cancer caused by the pathogenic fungus *Cryphonectria parasitica.* As serious threats should be mentioned those that arise from human activities such as: uncontrolled cutting and gathering, fires, introduction of invasive species and more.

Conservation and management. As measures for protection and improvement of the condition can be listed the following: monitoring the condition, control of the disease on the chestnut bark, prevention of uncontrolled cuttings, preventive fire protection and their control, controlled and proper fruit collection and more.

9270: Hellenic beech forests with *Abies borisii-regis*

Description. Forests of this type of fir are considered endemic to the southern parts of the Balkan Peninsula. In the area of interest is *ass. Abieti borisii regis - Fagetum*. Forests of this habitat develop on medium to deep soils on a silicate geological substrate from 900 to 1600 meters above sea level. It is noticeable that the forests with the Boris fir are expanding on Belasica and Kozuf in the higher belts. It has vital populations. The floristic composition is represented by the following species: *Abies alba subsp. borisii-regis* and *Fagus sylvatica* as species dominating the first floor. Further in the floor of the bushes we can find: *Clematis vitalba, Crataegus monogyna, Juniperus communis, Lonicera xylosteum, Ostrya carpinifolia.* On the ground floor are found: *Aremonia agrimonoides, Asplenium trichomanes, Brachypodium sylvaticum, Buglossoides purpurocaerulea, Campanula rapunculoides, Carlina vulgaris, Cephalanthera longifolia, C. rubra, Clinopodium vulgare, Dentures, Cruciata glurgata amygdaloides, E. cyparissias, Festuca nigrescens, Fragaria vesca, Hypericum perforatum, Luzula forsteri, Mycelis muralis, Primula elatior, Salvia glutinosa, Sanicula europaea, Stachys germanica, Stellaria nemorum, Veronica* and other species.

Distribution in South East Planning Region. The forests of this habitat are spread from the locality Secena Skala and the peak Pupolj to the upper course of the river Baba on the mountain Belasica while on Kozuf it has a more frequent occurrence in the basin of Konska Reka (upper part of the basin), further the locality Dve Ushi which gravitates towards SSE "Sermeninska uma". It is also found on smaller areas in other parts of the Eastern parts of Kozuf (Appendix 7- Figure 16).

Pressures and threats. Particular threats to this habitat that could occur are as a consequence of road construction, possible construction activities, invasive species, fires overuse, which would allow

fragmentation of forest complexes and disturbance of the species composition. Also, the introduction of exotic and invasive species.

Conservation and management. Forest monitoring of this habitat.

9530*: *(Sub-) Mediterranean pine forests with endemic black pines

Description. The endemic black pine forest in the region is found on two separate sites. One is in the gorge of the river Trkanja and the second is scattered on several sites on the eastern slopes of Kozuf. At the first site * (Sub) Mediterranean forests with endemic black pine develop on the right side of the gorge part of the river Trkanja which is part of the extreme western parts of the mountain Belasica. It is a thermophilic forest that grows on a silicate parent substrate and shallow soils with a steep slope in the range of about 250 (300) to 550-600 meters above sea level. It almost always develops in sheltered positions. Elements of the pseudomacia represented by the quince (*Quercus coccifera*) develop at the foot of this forest from the black pine. The appearance of the pine trees has bad phenotypic characteristics, i.e. it is characterized by umbrella crowns, grenades and low. The black pine community has many elements of pseudomacia and is therefore singled out as a subassociation: ass. *Querco cocciferae - Carpinetum orientalis macedonicum subass. pinetosum nigrae Em 62.* The more important species that occur in the sub-Mediterranean forest with endemic black pine are: *Pinus nigra subsp. pallasiana, Quercus petraea, Juniperus oxycedrus, Carpinus orinetalis, Quercus coccifera, Cistus incanus, Fraxinus ornus, Lonicera etrusca, Thymus tosevii, Genista carinalis, Aristella bromoides, Viscaria vulgaris subsp. atropurpurea, Hieracium pillosella, Aira capilaris, Luzula forsteri, Festucaa vallesiaca, F. callieri, Dicranum scoparium, Camptothecium lutescens, Hypnum cupressiforme* and others. The situation with the black pine forests in the eastern parts of Kozuf is completely different, where ass is developed on a limestone geological base, on the sites of Chichi Kaja and Mala Rupa*. Seslerio - Pinetum nigrae*, and on a base of gabbro *ass. Lathyro - Pinetum nigrae* with rich floral composition. Habitat is a priority of the Housing Directive.

Distribution in South East Planning Region. This habitat is found on the right sides of the gorge part of the river Trkanja and its tributaries and is part of the extreme western parts of the mountain Belasica, as well as several sites on the eastern slopes of Kozuf (Appendix 7- Figure 17).

Pressures and threats. The greatest danger is the threat of fires that are common in this habitat.

Conservation and management. Forest monitoring of this habitat. Prevention for fire protection. Additional scientific research and monitoring is required.

9560*: * Endemic forests with Juniperus spp.

Description. Greek juniper forest (*Juniperus excelsa*) are sparsely assembled (05-06) and develop most often on a steep limestone geological surface, although they are also found on serpentine. In sheltered places, gorges, but also on strongly insulated slopes. The soils are skeletal, and the parent rock often erupts on the surface making development conditions difficult. Therefore, in their development, these forests have no competition from other tree species. Trees that grow in such conditions rarely exceed 3-4 m (7m). Most of them are of vegetative origin, although they are also found in seeds. The most common plants found in this habitat are: *Asparagus acutifolius, Prunus webbii, Fraxinus ornus, Quercus pubescens, Carpinus orientalis, Pistacia terebinthus, Paliurus spina - christi, Juniperus oxycedrus, Osyris alba, Colyrus alba, Phyllis* and others.

Importance of the habitat. Habitat is a priority for the European Habitat Directive.

Distribution in South East Planning Region. The gorge of the river Javorica, the right side of the Sermeninska river in the upper parts, Valandovo, Anska Reka, the surroundings of Dojran Lake and the Demir Kapija gorge.

Pressures and threats. The juniper tree burns hard, ie it smolders and is a pyrophite. Fires do not cause much damage to this habitat although there are preconditions for that. But because of its good technical characteristics, the local population has used it in the past for vineyard piles, so the best specimens are mostly cut. In such conditions, a positive feature is that the foyer can be regenerated vegetatively.

Conservation and management. Foyer forests are rare and develop under specific conditions, such as the influence of the Mediterranean climate (sometimes altered or regulated by large water basins - lakes), deep gorges or stony insulated slopes. It is necessary to monitor and map the forests of this habitat.

Pseudomaccia scrubs in Cerris oak (*Quercus coccifera*)

For the habitats of the pseudomaccia scurbs from oak prnar that occupy large areas in Dolno Povardarie there is a difficulty to connect with the existing habitats from the Habitats Directive. Therefore, other classifications were used for this type of habitat (given below in the text) because it is an important element in the vegetation of the area of interest for the overall wildlife.

Relation to other classifications. EUNIS: F5.1162 [*Quercus coccifera*] and [*Quercus alnifolia*] low woods; PAL. CLASS .: 32. 1162 [*Quercus coccifera*] and [*Quercus alnifolia*] low woods;

Description. The appearance of pseudomaccia scrubs of oak, fluff and white hornbeam in the Lower Povardarie is associated with the impact of the changed Mediterranean climate which is characterized by higher temperatures, aridity, mild winter without snow, but with humid conditions and mild winter temperatures. It develops on all geological substrates that are present in the area. The terrains on which this spruce developed are often steep and warm sides where the soil layer is largely carried away by erosive processes, and it is not uncommon for the phenomenon to develop in stair places. Such ecological conditions are suitable for the development of prnar oak which is an evergreen species and adapted to life according to the orographic conditions that prevail in the field. The form we see in the field is extremely degraded, which is a result of the number of goats that the local population kept in the past, the frequent fires that occur in the region as well as the illegal cuttings that selectively removed the better and preserved specimens of oak that developed in sheltered places. The height of the pine trees does not exceed 3-4 m, in exceptional cases most of them are of vegetative origin. Climazonically ass which develops here is *Coccifero - Carpinetum orientalis*.

Characteristic species are: *Quercus coccifera, Quercus pubescens, Carpinus orientalis, Fraxinus ornus, Phillyrea media, Pistacia terebinthus, Coronilla emeroides, Colueta arborescens, Crataegus heldreichii, Lonicera etrusca, Arus spurs, Cornus mas, Pali Campanula crystalocalyx, Cardamine graeca, Dictamnus albus, Aristella bromoides, Clematis flammula, Asparagus acutifolius, Cistus incanus* and other species.

Distribution in South East Planning Region. South of the Demir Kapija gorge with a higher frequency on the right side along the river Vardar also in the gorge of the river Trkanja in front of the city of Strumica (Appendix 7- Figure 18).

Pressures and threats. Fires are the biggest threat to Curris oak populations. Also including illegal cuttings as well as digging of the plow on the terrains where the soil cover is preserved in order to obtain areas for vineyards and orchards.

Conservation and management. Monitoring and mapping of forests of this habitat, preventive measures for fire protection, as well as control of livestock grazing.

4.3. AGROBIOLOGICAL DIVERSITY

4.3.1. Plant agrobiological diversity

- **Status with preservation of plant agrobiological diversity in Republic of N. Macedonia**

Activities for preservation of plant agrobiological diversity in R. N. Macedonia started a long time ago, as part of the selection programs for creating new varieties. Activities intensified during 1969-71 within projects supported mainly by foreign donations, primarily from the United States. Most of the specimens collected at that time are still stored in gene banks in the United States and can be used to regenerate seeds. They are free for repatriation, but this means that the state will be responsible for their maintenance in the future. That activity requires missing funds, so repatriation is not considered a priority. Intensive activities for the conservation of plant genetic resources used for food and agriculture (RGRHZ) began in 2004 with the launch of the SEEDNet project, funded by the Swedish agency SIDA. In N.Macedonia, the activities are organized within the working groups for: cereals, fodder, industrial, horticultural, fruit and vine crops, as well as the group for medicinal and aromatic plants (MAR). In the period 2004-2011, numerous activities for conservation of RGHRZ were performed, both from the aspect of sample collection through collection missions, their characterization and evaluation, formation of a database for storage of documentary data, as well as from the aspect of infrastructure upgrade and the equipment in the Genbank at the Agricultural Institute in Skopje, which functions as a national genebank. In its work, the standards for gene banks set by the European Cooperative Program for Genetic Resources have been established.

In addition to the seed collection, the Institute, ie the Genbank also maintains Polish collections of fruit and vine crops. Seeds of medicinal and aromatic plants are stored in Genetic bank. The material preserved in Genbanka has different biological origins: indigenous populations, domestic and introduced varieties, different selection material and samples of spontaneous flora (wild relatives, weeds). All samples are registered with 34 passport data according to the inventory list of the European list of collections in which plant species are kept ex situ). This list currently provides data on 2158 copies from N.Macedonia (http://eurisco.ecpgr.org). In addition to these data, the Genbanka database records data from the characterization and evaluation of those samples where it was performed.

At the moment, a collection of 2666 specimens of 89 different species is kept in the Genetic bank. The largest percentage of this collection is occupied by fruit crops, which includes grapes, with a total of 1042 specimens whose collection is maintained as Polish. Most of the seed collection belongs to cereals (29%). According to the status of the material, the most numerous are the autochthonous or

local populations / varieties (1187). The Polish collection also includes local populations, but many of them are from other countries as well.

In 2008, a Department for National Genetic bank was established in the Seed and Planting Material Directorate at the MAFWE. Researchers from the Faculty of Agricultural Sciences and Food (FZNH) and the Agricultural Institute (ZI), members of the University "St. Cyril and Methodius ”Skopje. At the national level, activities for the preservation of RGHRZ, but to a lesser extent, take place in two more institutions:

-Tobacco Institute in Prilep at the University "St. Kliment Ohridski ”- Bitola, who is responsible for maintaining the tobacco collection, and

-Faculty of Agriculture at the University "Goce Delchev" - Stip, which maintains the collection primarily of rice and several industrial crops.

At the same time, activities for raising public awareness were conducted through various means (media campaign, radio and television appearances, distribution of brochures, leaflets, etc.) as well as education on the importance of RHRHZ.

- **Legislative framework for protection of agrobiological diversity in the Republic of N. Macedonia**

Significant progress has been made on the legal framework for the protection of genetic resources. Article 78 of the Law on Agriculture and Rural Development provides assistance for the conservation of the genetic diversity of indigenous agricultural plants and indigenous livestock breeds. It can be granted in the form of direct payments per acre of cultivated agricultural land on which indigenous agricultural plants are grown and propagated. For the implementation of this assistance in 2011 a list of indigenous agricultural plants was published (Official Gazette of RM no. 71/11). Based on the list, the Minister prescribes a way to monitor and analyze the situation with indigenous agricultural plants based on the degree of their endangerment and prescribes additional measures for conservation, collection and storage of mandatory genetic resources and their use for agricultural production. This article also prohibits the extinction of indigenous agricultural plants. The financing of these activities is done according to Article 7, which refers to the national program for agricultural development and rural development.

The work of the seed bank is covered by the Law on Seeds and Planting Material (Official Gazette of RM no. 55/11), where Article 54 stipulates that the reference samples of the seed material are stored in the seed bank. Within this Law, a Rulebook on the quantities, conditions and manner of storage of reference samples of species and varieties of agricultural plants, as well as the manner of operation of the gene bank (Official Gazette no. 144/11) has been prepared. Several articles of this Law are currently being revised in order to define the indigenous varieties, their status, and the possibility of their inclusion in the National List of Varieties. It is planned to develop special regulations related to this area.

- **South East Planning Region – agriculture and land use**

Due to the specific geographical and topographic position, the South-East Planning Region is characterized by long hot summers with high average daily temperatures and reduced annual rainfall, reduced winter temperatures and winds from all directions. With about 230 sunny days a year, this

region is the sunniest in the country. Such climatic conditions are favorable for the development of agriculture.

Most or 46% of the arable land in the South-East region belong to the plain relief part which is located from 250 to 300 meters above sea level. and are of primary importance for agriculture in the region. These are the areas along the riverbed of the rivers Vardar, Strumica, Trkanja and Kriva Reka. The remaining 52% of the areas belong to the slopes, and 2% to the hilly relief part. The altitude ranges from 64 to 2157 meters above sea level. (The highest peak is the Green Coast of Kozuf Mountain).

The region has 120,583 ha of agricultural land with a total arable land of 56,907 ha. The agricultural area in the South-East region is 9.5% of the total agricultural area in R. N. Macedonia. According to the areas under vineyards, the South-East region with 4,408 ha, i.e 20.7%, is on the second place after the Vardar region (SSO of RM, 2018). Vegetable production, especially early vegetables, is one of the most significant potentials of agriculture in the region. The production is located in the Stumica micro region and the Gevgelija region, on approximately 52,000 ha. About 300 ha belong to greenhouses and greenhouses that are equipped with heating systems in the Gevgelija region and the Municipality of Bogdanci. Dominant crops are: tomatoes, peppers, cucumbers, cabbage, onions, melons and watermelons that are traditionally produced in this area, along with crops grown in smaller areas such as: peas, garlic, leeks, lettuce, eggplant, carrots, cauliflower, and recently began to be planted non-traditional products such as: broccoli, Brussels sprouts, asparagus, Chinese cabbage and so on. The largest production of potatoes, garlic and peas is in the municipality of Strumica. The largest production of onions is in the municipality of Bogdanci, while in the municipalities of Bosilovo and Strumica is the largest production of beans. Cabbage production is 72.2% of the total production at the national level, of which almost 20 thousand tons are produced in the municipality of Strumica. The production of tomatoes with 56% of the total production in N.Macedonia as well as the production of peppers and cucumbers is again dominant in the municipality of Strumica, while in the municipality of Novo Selo is recorded the largest production of watermelon. The South-East region is a net exporter of vegetables because it has a surplus of 60 percent of the country's needs. Products that dominate exports are: tomatoes, peppers, melons and cucumbers, and the main destinations are the EU markets (Czech Republic, Slovakia, Poland, Greece, Germany, Slovenia), but also neighboring countries (mainly from the former Yugoslavia).

From the fruit production, the production of quinces with 26.1% and apricots with 23.3% of the total national production is the most noticeable. Of the other fruit species, significant areas are planted with peaches, plums, cherries, pears, cherries and apples, and on smaller areas there are walnuts and almonds. Local varieties that can be found are in quince, cherry, pear and apple. The rest are exclusively commercial varieties. A characteristic product of this region is the Japanese apple and pomegranate with dominance in the Valandovo region. The main market for these fruit products is the Russian Federation.

It is the same with the vineyards, where only a small part of agricultural producers in small areas (0.5 - 1.0 dk) grow autochthonous populations. Everything else is commercial varieties. Of the cereals and tubers, the largest areas are traditionally sown with corn, wheat and potatoes. The production of alfalfa covers almost 18.0% of the total production at the national level, located mainly in the municipality of Vasilevo. If we compare the production of industrial plants, we can see an increase in the area only with tobacco (the largest production was observed in the Municipality of Radovis), while the production of poppy and sunflower decreased.

- **Agrobiodiversity plant agrobiological diversity in South East Planning region**

The plant agrobiological diversity in the South-East Planning Region consists of indigenous populations as well as registered varieties and hybrids of agricultural crops. The production of larger

areas is mainly based on commercial varieties many of which are foreign imported varieties. A number of small producers still grow local and indigenous varieties, especially in horticultural production, on small areas, which production is mainly intended for the personal needs of the local population, and some for the local markets. The greatest variety of local varieties is maintained in beans in which several subspecies are present. Within the cereals the highest dominance of old local varieties is in corn, lower in rye, oats and sorghum, while wheat and barley maintain old or new commercial varieties. The largest variety of horticultural species with many different populations are found in peppers and pumpkins. Tomatoes, melons, okra and green beans are also present, but with less variety as well as garlic, watermelon, cucumber, cabbage, pumpkin, lettuce and eggplant, which are present in 1-3 different varieties. In industrial crops, old varieties can be found from opium poppy, tobacco, sesame, flax and sunflower, and with the exception of opium poppy and tobacco, the rest are represented by 1 to 2 representatives each. Old varieties of fodder crops are maintained only by broad bean, alfalfa and bitter vetch. On the other hand, the agricultural species that have been found to be most endangered, which are almost not grown at all and whose seed material is found very rarely are the corn for cooking with different colors of grain, pumpkin, bean, sesame flax (Appendix 8-Table 1) .

4.3.2. Biodiversity in domestic animals

According to the literary data, in the South-East planning region there are several species of local domestic animals. Some of them are autochthonous only for R. N. Macedonia (Ovce Pole sheep), and some of them are widespread in the surrounding countries (cattle bush, domestic Balkan goat, Karakachan sheep, Sharplanin dog).

Буша. The short-horn cattle ‘’brachicer type” is widespread throughout the Balkan Peninsula as well as in Small Asia and the countries of the Middle East. It is a monochromatic breed with variants of black, gray, blue, red, yellow and white which is a feature of all populations of cattle that originate from brachyceres. Adult cattle have a small height at the withers (90-115 cm). Body weight ranges from 150-300 kg. In good conditions, the average live weight of cows is 280-320 kg and in bulls 429 kg. According to indicative locations of the system for identification and registration of domestic animals, in the South-East region the size of the herds ranges from 1-5 heads. Based on the phenotypic characterization, it can be concluded that the described types of bush by color are still found in the region in its indigenous form, but in smaller herds and often mixed with bush mongrels with other breeds.

Within the ***local sheep breeds*** in the region the most common breed is Pramenka, of which only the Ovchepolje breed can be found as inventoried while for the Sharplanin and Karakachan breeds there are only indicative locations. The term pramenka means a primitive sheep that survives in very modest conditions of care and nutrition. It is a low-yielding breed with triple production characteristics: meat, milk and wool, resistant and well adapted to breeding conditions. It was once spread all over Europe, and in its central part it was known as Zackel, from Poland to Romania as Tzurzana, in Greece as Vlachian, and on the territory of the former Yugoslav Republic as Pramenka (represented by about 20 strains). The morphological and physiological characteristics depend on the geo-ecological conditions of the area where the strain belongs. It is characteristic that there are great variations between the strains, as well as in them themselves, both in morphological (size, height, wool color, tail length), and in production characteristics. Of special importance for the region is the sheep from Ovce Pole which is the only exclusively N.Macedonian species of Pramenka with a parent breeding area in this region.

Compared to the other species of pramenka, the size of the body of the *Ovchepolska pramenka* to the group of medium-sized. The live weight of adult rams/sheep is 45 kg (34-58) / 36 kg (25-48), and the height at the withers is 64.5 / 61.0 cm. Characteristic of the strain is that the head is partially or completely black pigmented. The dark areas are spread on both sides of the head from the eardrums and the base of the horns to the snout, so that along the forehead-nose a white line is formed with an irregular shape and size ("lisa"). "Karabashi" heads with a completely black or dark colored head are

often found. The horns of rams are well developed, but specimens without horns are also found, while sheep are usually without horns, but there are also horned individuals.

Due to the lack of inventory farms in the South-East region, the inventory and phenotypic characterization of the Ovchepolje sheep is from the neighboring Eastern region. The morphological racial characteristics of the Ovchepolska pramenka still present in several types such as "Karabasha", "Lisa", or with another form of pigmentation on the head. It can be concluded that despite the great variability, the most common are sheep with colored dark fields of irregular shape.

Until the Second World War, the ***domestic Balkan goat*** was the most common breed in the hilly and mountainous areas of the Balkan region. Its main feature is a long, thick and shiny fur which can be white, black, chestnut or colorful. Goats are often horned but there are also shoots. It is easily mobile and is therefore found in difficult terrain. Live weight is small and ranges from 30 to 40 kg, gives one goat per year, and in better herds up to 1.5 goats on average per goat. Milk is low in the range of 100-300 l for 7 months of lactation. It is most numerous in the region in Radovish and Valandovo. Data from the inventory farms in the South-East region, obtained through characterization of fifteen morphological characteristics of domestic goats, indicate color variations with the most frequent presenc of black in goats and goats (48% and 59.18 %%). Variations are observed in the profile line of the head, with the highest prevalence of a straight profile line. Most of the controlled animals, of both sexes, have pigmented ears that are placed horizontally, are predominantly horned (85.63% in goats and 79.04% in goats) and with curled horns. Animals of both sexes are predominantly with long fur, dark skin pigmentation and are characterized by the presence of earrings (70%).

The population of buffaloes in R. N. Macedonia is marked as eradicated. In the South-East region in 2018 it was reduced to 19 heads in Strumica Gradsko Baldovci which indicates the low importance of buffaloes in the total biodiversity of domestic animals.

Losses of biodiversity in domestic animals, in the region and beyond, is evident and is due not only to the neglected interest in the protection of indigenous breeds, but also to the long process of land reclamation and melting accompanied by permanent depopulation of rural areas. The extinction of the domestic primitive pig, the Karakachan, the Sharplanin sheep and the buffalo are the best examples of this. The intensification of animal husbandry completely suppressed the local bush, which remained only in the hilly and mountainous areas and in extremely extensive production conditions.

The protection of biodiversity in domestic animals is a planned, coordinated and long-term activity contained in the Program for protection of biodiversity in animal husbandry, hence the need for its consistent application.

- **Distribution and number of domestic animals in SEPR**

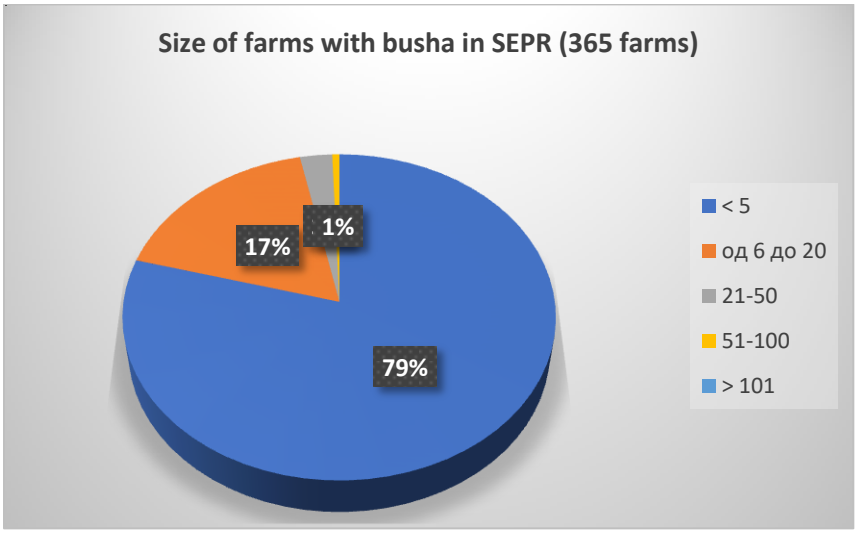
- **Busha**

In the municipalities of the region, the bush is characterized by different representation, which can be seen in the following graph.

Figure. 25 Distribution of cattle busha in SEPR (processed data by AFV 2018)

These locations were BUSHA is found in the analysis are taken as indicative given that only the inventoried and characterized herds can be claimed to belong to the indigenous bush. Therefore, it can be seen that most individuals of this species are found in Valandovo.

Figure. 26 Size of farms with busha cattle in South East Planning region (Processed data by the AFV)



The total number of inventory bush heads, according to the existing records in the database in the region is shown in the following table.

Table 13. Inventory of BUSH farms in SEPR

	Village	Municipality	РБО (Identification Number)	Total cows

1	Gopceli	Dojran	244300175	13
2	Gopceli	Dojran	244300078	9
3	Gopceli	Dojran	244300263	9
4	Gopceli	Dojran	244300014	26
5	Barbarevo	Novo Selo	201200142	15
6	Gopceli	Dojran	244300087	16
7	Asanli	Dojran	274900024	28
8	Kazandol	Valandovo	239700140	10
9	Kazandol	Valandovo	239700061	12
10	Kazandol	Valandovo	300013731	10
11	Kazandol	Valandovo	239700104	16
12	Kazandol	Valandovo	239700344	10
13	Kalauzlija	Radovish	181300535	4
14	Kalauzlija	Radovish	181300128	14
15	Kalauzlija	Radovish	181303602	5
16	Dolni Lipovikj	Radovish	203300552	7
17	Sushica	Novo Selo	207701209	121
TOTAL				**325**

- **Morphological characterization of busha**

The linear measures at the inventoried locations in the region are shown in Table 2.

Table 14. Morphological features of different strains of bush

Feature	Сив сој	Кафеав сој	Црн сој
Number of cows	34	28	25
Height of withers, sm	108 (104-113)	105 (97-114)	106 (98-1015)
Height of the back of the body, sm	107 (101-114)	105 (95-113)	105 (99-111)
Height of rump, sm	109 (100-116)	108 (100-118)	107 (102-119)
Length of head, sm	38 (32-44)	37 (31-46)	37 (34-48)
Length of horns, sm	16 (11-25)	16 (12-24)	15 (11-23)
Calf weight, kg	15 (12-19)	14 (10-18)	15 (11-19)

From the data shown, it can be seen that the bush population has retained its original strains according to color. The obtained values are within the racial characteristics of the breed and have not changed significantly, compared to the bush tests conducted by Tashkovski M. (1959), Smilevski S. (1985) and Bunevski Gj. (1994), which means that it is still retained in its indigenous form. (Appendix 9).

- **Domestic buffalo**

Table 15. Number of registered buffalos in the area of the region

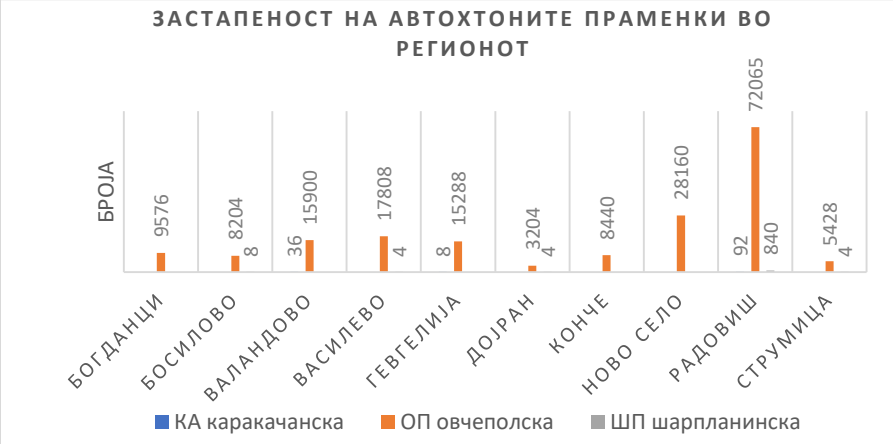
No.	Location	Total number of buffalos
1	Gradsko Baldovci, Strumica	19

The population of buffaloes in R. N. Macedonia is marked as critical-eradicated so this species of domestic animals from 39,950 heads in 1939 was reduced to 50 heads in 2013. In the region it is inventoried only in 1 location with 19 animals, so it is of little importance for the total biodiversity in animal husbandry.

- **Sheep (Ovcepolska Sheep)**

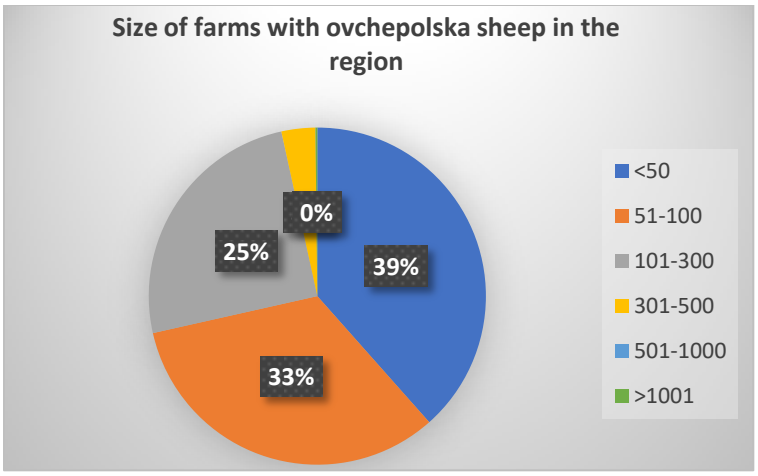
The distribution of the indicative locations of the autochthonous locks in the region, through the operating records of the FVA is shown in the following graph. Table 4. Numerical status of domestic indigenous locks in the South-East region (Processed data from the FVA database)

Figure 27. Numerical status of domestic autochthonous species ,,pramenka'' in the South-East region (Processed data from the FVA database)



From the presented data it can be seen that the largest population of Ovce Pole sheep is located in Radovish, while the Sharplaninska and the Karakachanska sheep are insignificantly present in the region. It is in line with the literary data sources on the distribution of domestic strains of Pramenka in the Republic of N. Macedonia, according to which, the border line of the main breeding areas of Sharplanin and Ovchepolje strait south of the N.Macedonian-Greek border between Bitola and Prespa, north of direction of Veles and Skopje and the eastern slopes of the mountains from Western Macedonia to Kumanovo. The boundaries are not strictly defined and therefore there was mutual mixing of the two strains, especially due to the semi-nomadic breeding system and the uncontrolled crossbreeding with noble breeds.

In addition to the data on the distribution of farms with indigenous tracks, their structure was determined according to their size, based on data from the FVA for the South-East region. Again, in this case, it should be noted that the analysis also refers to indicative locations, where the inventory and characterization of the domestic strain species has not been fully performed.



Picture. 28 Size of Ovchepolje sheep farms in the South-East region

From the presented data it can be seen that in the South-East region, from the total number of Ovchepolje sheep farms, small farms with a size of up to 50 sheep (39%) dominate. In the IAB database, there are inventory and characterization of Ovchepolje sheep farms, but not in the South-East region, but in the neighboring Eastern region (2051 in total). These Ovchepolje sheep farms are members of a recognized breeders' organization of Ovcepolje rs. For what purpose are they characterized in detail by the Institute of Animal Biotechnology at FZNH, and for the needs of MAFWE.

- **Morphological characterization of Ovcepolska Sheep *Pramenka***

The results obtained on the basis of the geographical distribution of the Ovce Pole sheep and the interviews conducted through a checklist for phenotypic characterization, confirm the literary data. Thus, the phenotypic racial characteristics of the Ovchepolka pramena are present in several types such as "Karabasha", "lisa", or with another form of pigmentation of the head. The frequency distribution for head color on some of the processed farms is shown in Appendix 9-Table 4. Based on the processed data from Annex 9, for the pigmentation of the head in the visited farms, it can be concluded that despite the great variability, the most common are the sheep with colored dark fields with irregular shape.

Table 16. Exterior measures for Ovce Pole sheep (Source: Faculty of Agricultural Sciences and Food - Skopje, Institute of Animal Biotechnology, Report on home bookkeeping, selection and monitoring of livestock conditions 2018)

Breed	Ovcepolka							
Parameter	Height of withers/sm		Length of body/sm		Depth of chest/sm		Height of the back of the body, sm	
	Пол							
	♀	♂	♀	♂	♀	♂	♀	♂

max	75	76.00	83	77.00	73	32.00	77	75.00
min	60	69.00	59	65.00	20	26.00	26	65.00
avg	70.77	73.61	68.19	72.18	28.00	29.93	70.46	73.00
std	2.85	1.62	4.35	3.28	4.35	1.44	4.92	2.26
cv	4.03	2.20	6.38	4.54	15.52	4.81	6.99	3.10

- **Domestic Balkan Goat**

Nowadays, the domestic Balkan goat in the South-East region according to the indicative locations (Fig. 5) is represented by over 90% of the total goat population.

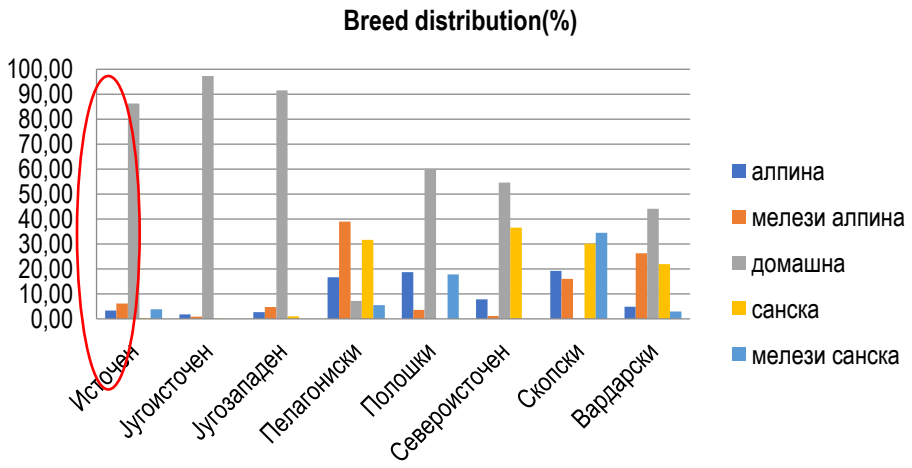


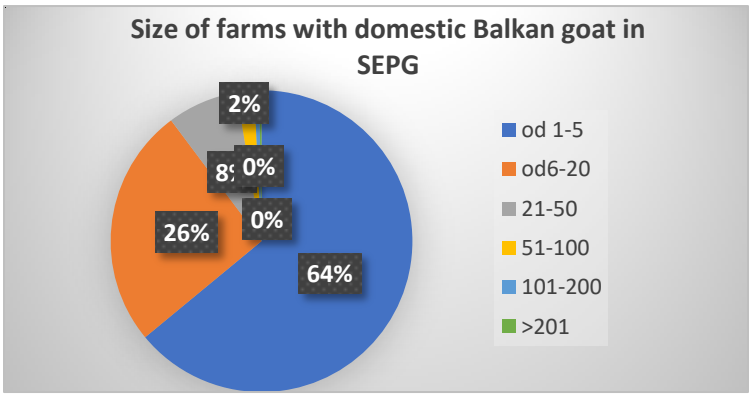
Figure. 29. Distribution of goat breeds per regions (Source: processed data from 2018, AFV)

The number of domestic Balkan goat is shown in Figure 30.

Figure 30. Number of domestic Balkan goat in South-East planning region (Source: processed data by AFV 2018)

In the settlements that belong to the South-East Planning Region, according to the available data, there are 16,000 heads of the domestic Balkan goat, most represented in the municipality of Radovis.

Figure 31. Size of the domestic Balkan goat farms in South-East planning region (Source: processed data by AFV)



From the graph shown it can be seen that most farms of the domestic Balkan goat are in the category of 1-5 goats (64%).

Morphological characterization of the domestic Balkan goat

The history of the goat sector in R. N. Macedonia, through the ban on goat breeding for a period of 40 years, has made a huge impact on the population of domestic Balkan goats. Hence the importance of research on its morphological characteristics, in order to determine whether its typical racial

characteristics were maintained or lost during long-term prohibition. Data from the inventory farms in the South-East region obtained through characterization of fifteen morphological characteristics of domestic goats (Appendix 9-Table 6) indicate color variations with the most frequent presence of black in goats and goats (48% and 59.2%, respectively). %). Variations are observed in the profile line of the head, with the highest prevalence of a straight profile line. Most of the controlled animals of both sexes have pigmented ears that are placed horizontally, are predominantly horned (85.63% in goats and 79.04% in goats) and with curled horns. Animals of both sexes are predominantly with long fur, dark skin pigmentation and are characterized by the presence of earrings (70%)

In order to assess the level of diversity in the examined ecotypes (1129 animals from 10 analyzed farms / locations in the South-East region, on 18 qualitative traits), the frequency of each analyzed trait within each individual ecotype was determined using PCA and cluster analysis.The results showed that two basic clusters were identified based on morphological features.

The exterior characteristics of the domestic Balkan goat on the inventory farms are shown in the following table.

Table 17. External characteristics for the domestic Balkan goat

Breed	Domestic Balkan Goat							
Parameter	Height of withers/sm		Length of body/sm		Chest depth/sm		Height of the back of the body, sm	
	Sex							
	♀	♂	♀	♂	♀	♂	♀	♂
max	83.00	89.00	95.00	84.00	70.00	40.00	90.00	88.00
min	45.00	56.00	25.00	54.00	24.00	24.00	55.00	56.00
avg	66.92	76.93	69.15	74.44	29.81	32.37	66.88	75.67
std	6.05	8.51	6.47	7.48	4.21	3.93	5.80	7.43
cv	9.05	11.07	9.35	10.05	14.13	12.15		

- **Hoofed animals (Ungulates)**

Based on the phenotypic characteristics of domestic ungulates, an inventory of several locations in the South-East region was performed, which are given in the following table. Table 7 Locations of inventory ungulates in the southeast region (2017)

- **Sharplanin dog**

There are several Sharplanin dog kennels in the region registered in KSM for which genealogical data are kept. Samples without data on the origin or reintroduced dogs from kennels are found on farms (Appendix 9-Table 8).

LOSS OF BIOLOGICAL DIVERSITY

Environmental conditions, global change and anthropogenic impact are key factors affecting biodiversity in N. Macedonia and beyond.

5.1. Major threats to biodiversity and recommendations for biodiversity protection

The main threats affecting the biodiversity of different groups of organisms in the area of SEPR are highlighted below. Recommendations aimed at preserving certain landscapes, sites or areas are also listed; measures or guidelines that will help the various sectors in the region better plan for development and contribute to better management of natural resources, habitats and ecosystems. It should be emphasized that the improvement of the situation with the species and their habitats can be realized through cooperation with the local population and cross-sectoral cooperation at the institutional level.

5.1.1 Algae

- **Threats**

Threats to the biodiversity of algal populations mainly stem from threats to the ecosystems to which certain algal communities belong. If these ecosystems are subjected to intense pressures on quantity (water abstraction) or quality (physico-chemical pressures), then changes in the composition of algal communities are evident and drastic. The threats are multiple, but most of them are uncontrolled discharge of wastewater, disposal of solid municipal waste, pollution from agriculture and the use of chemicals for cultivation and plant protection, as well as uncontrolled use of river and lake waters in order to irrigation or electricity generation.

- **Recommendations**

Given the size of the study area and the diversity of the terrain, the previous chapter describes the main identified threats. Therefore, it is necessary to highlight some recommendations aimed at preserving certain landscapes, sites or areas; measures or guidelines that will help the various sectors in the region better plan for development and contribute to better management of natural resources, habitats and ecosystems. According to the identified threats, the recommendations refer to proposals that would contribute to their mitigation or complete eradication.

Establishment of protected areas. Changes and negative impacts on landscapes and certain habitats and species as a result of human activities can be mitigated by declaring new protected areas in the region. In the Bregalnica river basin there are seven declared protected areas (nature monument

category) declared in the 60s and 80s of the XX century that have not been passed through the process of re-declaration. During the implementation of this project activity, a detailed analysis of the proposed areas for protection according to the Spatial Plan of the Republic of N. Macedonia, other strategic documents and reports was made, and the recommendations of the expert team for protection of certain important sites were taken into account. Therefore, the study was prepared (see Report on the situation with protected areas) in which new areas for protection of different categories are proposed (mainly lower categories of protection) which in the future should be taken into account in the preparation of development plans for the region. Particular attention should be paid to endangered and rare components of biodiversity (according to various international agreements and European legislation) and those species and habitats should be a priority in taking measures for their protection. One such example is the areas with halophytic vegetation, which can still be found in fragmentary condition on small areas in Ovchepolje, water habitats and some of the forest components, such as old beech forests or riparian forest belts.

Species protection. In addition to establishing a network of protected areas, the Bregalnica watershed also recommends the development of action plans for the protection of certain important species. There is a presence of species in the area that are important not only nationally but also internationally. With their protection and effective implementation of the prescribed measures with the prepared action plans, not only one species is protected, but also its entire habitat, and through that other species. Mammals and birds are especially favorable for this type of protection, because they usually appear as sheltered species. . Suppression of pollution from industry, mining and utilities. One of the biggest problems that drastically affects the ecological status of water bodies in the watershed is the discharge of municipal wastewater from urban centers. The basic precondition for improving the situation is the construction and proper functioning of a communal system that would include all major settlements in the watershed. An additional problem is the water that flows from the tailings from the mines. It is necessary to build a system that would capture these waters and they will be chemically treated in order to remove heavy metals from their composition. Regarding the use of agrochemicals (pesticides and mineral fertilizers), especially when growing rice in the catchment area of Bregalnica, it is necessary to conduct detailed analyzes of the need for application of appropriate pesticides and the amount of applied pesticides and mineral fertilizers.

Regarding algae, regular seasonal monitoring of various ecosystems in the region will allow detailed study of the algal component of hydrobiocenoses, as well as data on their natural or anthropogenic succession. On the other hand, the monitoring thus established enables accurate assessment of the ecological condition of the aquatic ecosystems as well as monitoring of the success of the undertaken protection activities.

5.1.2 Fungi

- **Threats**

Threats to fungi in the area of the South-East Planning Region generally refer to the various influences (anthropogenic and climatic) on the microdiversity and habitats in which the fungi develop, as well as the insufficient knowledge of the species composition of macromycetes. Fungi are susceptible to various climatic and anthropogenic influences such as forest fires, air pollution (acid rain) and degradation or change in the vegetation composition of forest communities. Climate change is an important factor in reducing mycodiversity and the quantity of macromycetes in general, so a negative impact on certain species can be expected. The most vulnerable to these pressures are fungi used in the diet, mycorrhizal fungi, saprobi of organic residues, as well as strictly acidophilic species. However, the

main factor endangering the fungi in the surveyed area is the fragmentation and destruction of their habitats. This refers mainly to the areas with intensive deforestation and removal of old and fallen trees and branches on which a large number of rare and specific types of fungi develop (Belasica and Kozuf). In some places, near the settlements, intensive collection of commercial species of fungi has been ascertained, which, if performed unprofessionally, may reduce the vitality of certain species. Other factors that generally endanger the fungi (climate effects, pollution, acid rain) have very little impact and their effect can not be registered during the short period of project activities.

In terms of knowledge of fungi in the area of interest it can be concluded that the available information on macromycetes is relatively well researched. Namely, there are data for all municipalities in the area from different periods of the year. There is also ample data on the species composition and distribution of fungi used in the diet. However in some parts of this region there are drawbacks, especially in terms of rare species.

- **Recommendations**

The main factor endangering the fungi is the fragmentation and destruction of their habitats. This applies mainly to areas with intensive deforestation and removal of old and fallen trees and branches. Preservation of fungal habitats will provide direct in situ protection of the species.

In order to prevent fragmentation and destruction of fungal habitats it is necessary to do the following:

- Providing adequate fire protection, especially in locations where rare and endangered species are registered.
- In the selected sites there should be no intervention on the forest, as well as a ban on the removal of old and fallen trees and branches on which a large number of rare and specific types of fungi develop.

In terms of knowledge of fungi in the area of interest it can be concluded that the available information on macromycetes is quite scarce. In order to overcome these obstacles, mycological research in the region must be intensified and the facts about the species composition and distribution of macromycetes must be established. If there is interest in commercial collection of fungi, it is necessary to take the following protection measures:

- Establishment of a system for recording quantities of each commercial type in order to provide relevant data for determining the quantity of the same in different parts of the area.
- Introducing collector education courses in order to identify the species and a sustainable way of collecting them.
- Monitoring of fungi in areas under strict protection. It will be carried out through a pre-established Monitoring Protocol which will provide the monitoring methods, time frame, monitored types and the goal to be achieved.

5.1.3 Plants

- **Threats**

This chapter takes into account some of the most important sites in this area, which are characterized by special flora-vegetation values and which are simultaneously exposed to various types of anthropogenic and other influences. The present threats and measures for overcoming them are listed.

With the large reclamation works, which were undertaken after the end of the Second World War, in order to obtain arable land, a large number of wetlands in N.Macedonia were destroyed, so that it led to the impoverishment of the swamp flora and vegetation. In the researched area there are several wetlands and swamps, which from the flora-vegetation aspect are very important (Monospitovsko Blato, the swamp in the area of Negorski Bani near Gevgelija, as well as the swamps around Dojran Lake), which should have special treatment in the protection .

Within the boundaries of the surveyed area is the only site of the endangered species *Astragalus physocalyx* from the vicinity of Bogdanci, for which special measures should be taken for its protection.

- **Swamp in the vicinity of Negorski Banji -Gevgeija**

This swamp is a unique case where swamp recent vegetation develops on the same habitat, together with fragments of relic swamp vegetation dominated by the relict species *Cladium mariscus*. Other relict species such as *Ophioglossum vulgatum, Molinia coerulea, Juncus maritimus* and others are present at higher elevations around the swamp. This interesting vegetation fragment of this area can serve to explain the genesis of swamp and meadow vegetation in this part of the Balkan Peninsula (Micevski, 1982). These fragments are maintained thanks to the constant flow of hot mineral water coming from the old bath, which today is almost non-functional. The community with *Cladium mariscus* develops in a very small space, so that by possibly digging a drainage canal near it, the whole *Cladium mariscus* community can be destroyed.

The Strategy and Action Plan for Biological Diversity of the Republic of N. Macedonia (2004) envisaged an action for declaring a protected area in this area.

The latest inspection of the swamp made in 2014 indicates that the condition of the swamp is deteriorating. By diverting the hot water coming out of the old bath, part of the population of the relict community *Mariscetum* has a reduced inflow of hot water and is about to dry out (advanced overgrowth with *Rubus sanguineus* on one side and *Fraxinus angustifolia* on the other) (Matevski, 2014).

The mineral water from the old bath is channeled to the other part of the swamp where the reed belt dominates and where the fragments of *Cladium mariscus* are rarer, but they are well maintained so far.

Recommendations: Initiate a procedure for protection of this swamp. The local self-government and the local non-governmental organizations from Negorci and Gevgelija should take care to remove *Rubus sanguineus*, which gradually suppresses the population of *Cladium mariscus* and to start with at least one flyer or information board to inform about the existence of natural rarity in their area. 2014).

- **Monospitovo swamp – Swamp associations with *Osmunda regalis* и *Isoetes phrygia* (Bansko-Gabrovo)**

Regarding Monospitovo swamp there are institutional and other proposed measures for protection: Decision for declaring the royal fern (Osmunda regalis) a natural rarity, the Assembly of the City of Strumica (1987); Emerald Site (2006); ZRP Strumica-Monospitovsko Blato (part of this important plant area) (2010);

Monospitovo Swamp together with the swamp near the village Bansko has been the subject of interest among botanists for more than 60 years. It is a place where the most representative compositions of the royal fern (*Osmunda regalis*) develop on the Balkan Peninsula, but several other relict marsh communities (*Scirpeto - Alopecuretum cretici, Osmundo-Thelipteretum*), as well as other groups of biodiversity.

Significant floristic species: *Alopecurus creticus, Anthemis meteorica, Cladium mariscus, Elatine alsinastrum, Elatine triandra, Equisetum sylvaticum, Glinus lotoides, Hippuris vulgaris, Hydrocharis morsus-ranae, Isoeta phrygia, Nesogatia phrygia, Neos, Ranunculus lingua, Romulea bulbocodium, Tamarix smyrnensis, Thelypteris confluens, Trapa natans*.

In 1986, the Republic Institute for Natural Rarities submitted an initiative for protection of the Monospitovo Swamp in the category of Natural Monument. In 1987, the Assembly of the City of Strumica adopted a Decision for declaring the royal fern (*Osmunda regalis*) a natural rarity (Official Gazette of the Municipality of Strumica 7/1987). In the Spatial Plan of the Republic of N. Macedonia (valid until 2020) Monospitovo Swamp is included in the system of protected areas. In 2004, the Strategy and Action Plan for the Protection of Biodiversity in the Republic of N.Macedonia envisages revitalization of the Monospitovo Swamp. In 2008, MES conducted a study on Monospitovo Swamp, supported by the Municipality of Bosilovo, with recommendations and measures to improve the protection of the Swamp

Despite the undertaken institutional measures for protection, the real protection of the Monospitovo Swamp complex together with the swamp near the village. Bansko does not work. In addition, a number of illegal activities appeared in its vicinity:

- Usurpation of areas where the species Osmunda regalis develops, by burning its rhizomes, usurp areas on which greenhouses with early vegetable crops sprout;
- Construction of facilities near the swamp;
- Reduced inflow of water to the wetland and lowering of the groundwater level;
- Depositing shot near it;
- Drying of surfaces with Osmunda regalis in the upper part of the swamp;
- Mass development of the alochton species Amorpha fruticosa along the edges of the Monospitovo Swamp;

- **Locality with *Astragalus physocalyx* in the vicinity of Bogdanci**

Institutional and other proposed protection measures: Emerald Site - Bogdanci (Churchulum-Paljurci) (2008): - CAG Bogdanci (Churchulum-Paljurci) (part of this important plant area) (2010)

This southern Balkan endemic species is known only for a few sites in Greece, Bulgaria and R. N. Macedonia. It is on the World Red List of Endangered Species (1998), in the category Extremely Endangered (Ex / En). It is known for only one locality in the southern parts of N.Macedonia, in the vicinity of Bogdanci (Churchulum). It develops in the macchia belt, one of the most thermophilic forest phytocenoses in our country.

The species habitat is located in a very sensitive zone, where a variety of forestry, construction and other anthropogenic activities are undertaken. The water supply pipeline on Lake Dojran from the locality Gjavato was built near its population. From the Environmental Impact Assessment Study it can be noticed that it did not take into account the condition of the population and the importance of this

species, so that the pipeline passed a few tens of meters from the only population of this species in N.Macedonia, but fortunately the population was not damaged. Illegal activities in its vicinity are:

- The first windmills in N.Macedonia were built right above its site.
- At the foot of the locality Churchulum we have afforestation with non-native species of pine and cypress.
- The wider area of Bogdanci, including the locality Churchuchum is susceptible to fires.

Recommendations: The MoEPP or the local self-government should take the initiative to declare this site a natural monument or to declare the species *Astragalus physocalyx* a natural rarity.

- **Dojran Lake**

The hydrological changes that occurred with the lowering of the lake level, ie the reduction of its depth, from 1988 until today, contributed to the disturbance of the biological balance, so that the large deficit of water in the lake led to a change in environmental conditions in all parts. of the lake, which resulted in significant changes to all plant communities from the macrophytic vegetation of the lake.

The most significant changes that occurred with the withdrawal of water from the lake are manifested in the reed belt. Namely, the entire belt of reeds remained almost completely dry and at different distances from the shore of the lake (from 50-450 m). where the water is withdrawn. This belt has a very important role in the ecology of the lake. Its continuous presence along the entire length of the lake shore and in the lake itself, ensured the existence of floating aquatic communities, which developed behind the reed belt. This led to some floating species and communities (*Salvinia natans, Trapa natans, Nymphaea alba, Lemno-Spirodelletum polyrhizae* W. Koch 1954 *subass. Salvinetosum natantis* W. Koch 1954 and the association *Hydrochari-Nymphoidetum peltatae* Slav. 1956, in sheltered places, protected from the impact of the waves to be almost completely destroyed. The current favorable hydrological condition of the lake has led to favorable trends, to the revitalization of certain plant communities and species (*Salvinia natans, Nymphaea alba*).

In places where the lake was quite withdrawn and where the terrain configuration is favorable, anthropogenically conditioned mining communities settled, as well as communities with C - 4 plants, which develop on trampled habitats.

5.1.4 Invertebrates

5.1.4.1 Aquatic Invertebrates

- **Threats**

Threat analysis is crucial in detecting the causes of biodiversity loss and planning measures to protect it. Based on numerous researches, findings and literary data, the main threats to the survival of water invertebrates from the waters in the South-East Planning Region have been identified, arising from the use of water for communal purposes, discharge of municipal wastewater, agriculture, industry, mining and energy. This situation significantly affects the reduction of biodiversity, through modification or complete destruction of part of the aquatic habitats. The following threats have been identified in the area of interest:

- *Modification of the current in the standing aquatic ecosystem through construction of artificial reservoirs.* In this way there is a loss of habitat and consequently the extinction of species related to the river ecosystem;
- *Fragmentation of the habitat due to construction of small hydro power plants* on the mountain watercourses. Such rivers are characterized by high diversity of aquatic species, which are largely rare or endangered, and with the construction of hydropower plants are at high risk of extinction;
- *Capturing the springs of the rivers for the use of water* by the local population. Drainage of springs poses a serious threat to the conservation of populations of important aquatic invertebrate species;
- *Erosion and deforestation affect* the quantity and quality of water potentials, leading to changes in the species composition of aquatic invertebrates. The number of sensitive species decreases, while tolerant and eutrophic representatives occur in high numbers;
- *Pollution of watercourses with wastewater from households, livestock farms and textile industry.* In many cases, untreated wastewater is discharged directly into watercourses from the country's South-East Planning Region. Numerous studies indicate that in such cases, there is a drastic reduction in biodiversity in river ecosystems;
- *Pollution of watercourses with agrochemicals* (fertilizers, pesticides, herbicides, fungicides) applied in agriculture, which occupies the most important place in the development of the overall economy of SEPR. Some of these agents are highly toxic which can lead to significantly reduced diversity in aquatic ecosystems near agricultural areas;
- *Pollution of water with heavy metals in the vicinity of mining facilities.* One of the biggest impacts on aquatic ecosystems is the discharge of wastewater from ore flotation without prior treatment. Such waters are characterized by low pH and contain high concentrations of toxic heavy metals that can cause significant changes in the composition and densities of aquatic invertebrates, and in some cases complete extinction of the species;
- *Pollution of watercourses with wastewater from fishponds*. Numerous studies indicate that in such cases, there is a drastic reduction in biodiversity in river ecosystems;
- *Lack of wastewaters treatment plants*. The situation in the South-East Planning Region in terms of wastewater treatment is quite poor, due to which the quality of much of the surface water is extremely worrying;
- *Uncontrolled use of water* for the needs of intensive agriculture can cause major environmental disasters for aquatic biocenoses and degradation of extremely important habitats for the survival of the rich diversity of aquatic fauna, and thus to the loss of natural values of aquatic ecosystems;
- *Presence of invasive species.* The spread of invasive species is one of the main biological factors that threaten global biodiversity and reduce the uniqueness of regional flora and fauna;
- *Climate change.* The South-East region is considered one of the most vulnerable regions in terms of climate change. In addition to the annual increase in temperature, there is a decrease in rainfall days and the amount of the same. This means that certain species in the region may become permanently extinct, and thus change the natural chain of biodiversity regulation. One of the most important nature reserves in N. Macedonia, the Monospitovo swamp, in addition to the human factor, also faces the challenges that come with climate change and will be one of the most affected by these changes;
- *Low level of public awareness.* There is little awareness of the importance of aquatic habitats and the wildlife that inhabits them. People are not sufficiently aware of what they could lose if degradation and disruption of habitats and wildlife within the region continues.

- **Recommendations**

In the area of interest, the following measures are proposed for prevention, elimination and mitigation of the consequences of the negative impacts regarding the identified threats:

- *Construction of new and reconstruction of existing treatment plants for wastewater treatment* from the municipalities in SEPR;
- *Wastewater treatment of wastewaters from industry and mining;*
- *Control of water pollution sources arising from agriculture (agrochemicals)* and mining activities;
- *Control of the quantities of water* used for the needs of agriculture;
- *Implementation of the Strumica River Basin Management Plan,* funded by the Swiss Agency for Development and Cooperation, implemented by UNDP in partnership with the Ministry of Environment and Physical Planning. The plan envisages a series of measures at the catchment area level to improve water quality in the catchment area, but also to minimize the risks of floods, droughts and other harmful effects of climate change on water resources;
- *Raising public awareness* among the local population and their timely response to inappropriate activities can make a major contribution to reducing threats to habitats and diversity of aquatic invertebrates.

    - **Terrestrial invertebrates**

- **Threats**

Based on previous knowledge and experiences, the text below presents the possible, but also identified threats to land invertebrates that refer to the territory of the South-East Planning Region:

- *Collection of endemic, rare and species with conservation significance.* This type of threat does not pose a major threat to all species. Exceptions are some rare species, as well as species of conservation importance, which are impressive and interesting for collection (*Rosalia alpina, Cerambyx scopolii, Morimus funereus, Lucanus cervus*, etc.) in the forest ecosystems of Belasica, Kozuf, Plachkovica, and Ogra butterflies (*Zerynthia polyxena, Lycaena dispar, Parnassius apollo, Parnassius mnemosyne*, etc.) especially in the area of Lake Dojran (village Nikolic) which due to their color and attractiveness are interesting for collection.
- *Degradation and destruction of habitats*. One of the biggest threats to the diversity of terrestrial invertebrate fauna is the degradation of habitats.
- *Uncontrolled felling*. Uncontrolled felling and complete removal of dead organic wood is a threat that especially affects the saproxyl fauna (representatives of *Coleoptera, Hemipera, Hymenoptera, Lepidoptera*).
- *Afforestation with non-native tree plants*. Plantations (plantations with aloe vera woody plants have a lower species diversity compared to well-preserved forest ecosystems (mountain and Podgorica beech forest, gourd forests, blagun-hornbeam forests, etc.);
- *Drying of wetlands.* Research has shown that wet meadows and peatlands are extremely important for the diversity of terrestrial invertebrate fauna (Coleopera, Lepidoptera). Drying of wet meadows, which is a trend throughout N.Macedonia, leads to their healing and loss of these semi-natural habitats;

- *Changes in hydrology.* Changes in the hydrological regime in natural ecosystems and, accordingly, changes in air and soil humidity pose a serious threat to the diversity of invertebrate riparian fauna. The construction of dams and reservoirs negatively affects many species that inhabit riparian habitats. At the same time, new zoocenoses may appear on the banks of reservoirs and reservoirs;
- *Increased human activity (contained in all threats)*. Uncontrolled exploitation of land and their transformation into arable land. The level of diversity recorded in agroecosystems is similar to the level of diversity recorded in degraded habitats;
- *Intensified urbanization.* The infrastructure and construction of residential buildings near sites of high species diversity, as well as in places that are natural habitats for many conservation important species, pose a serious threat to diversity and distribution of terrestrial invertebrate fauna;
- *Impact of climate change.* The impact of this threat on the diversity of fauna in the South-East region cannot be accurately addressed. However, it can be assumed that the most affected by climate change would be the locations of the high mountain zone (Kozuf, Belasica, Plachkovica), Lake Dojran, as well as wet habitats (especially Monospitovo Swamp). Changes in humidity and temperature (as well as other abiotic factors) would affect population dynamics and be a potential hazard to some vulnerable species. Vulnerable species are considered to be stenotopic species, with low abundance and small range and they can be used as bioindicators of the impact of climate change. Based on the degree of rarity and their environmental preferences for the vulnerable can be considered rare, endemic and species of conservation importance.
- *Occurrence of allochthons, invasive and harmful species.* As a result of climate change, which is most pronounced in the southern parts of N.Macedonia, the likelihood of occupying natural ecological niches, suppressing indigenous fauna and replacing them with non-native species in both lowland and mountainous areas, as well as pests in forest ecosystems has increased; Climate change (and especially expressed in mountain ecosystems) is expected to change the range of distribution of organisms and their movement to higher parts of the mountains, as well as the possible extinction of species that will not adapt to climate change.

Recommendations

Recommendations for future research and conservation measures stem from the analysis of species diversity, the valorisation of conservation-important species, and the identification of identified and potential diversity threats. Among them, the most important are:

- Maintaining the diversity of landscapes and ecosystems, and hence biodiversity;
- Reducing the intensity of human activity;
- Regulation of tourism;
- Controlled land exploitation;
- Afforestation and controlled felling (with 15% minimum of preserved dead organic wood);
- Regulated hydrological regime;
- Prevention of activities related to uncontrolled collection of some species;
- Introduction of monitoring programs for the presence and distribution of invasive, non-native and harmful species.

5.1.5 Fish species

- **Threats**

It is well known that habitat modification, habitat fragmentation, water pollution and the presence of non-native species are the four main classes of direct anthropogenic drivers of biodiversity and ecosystem change (Millennium Ecosystem Assessment, 2005 // Assessment, 2005) and the same fish biodiversity to varying degrees (Carpenter et al., 2011; Vörösmarty et al., 2010). Climate change is an additional accelerator of these modifications.

Pressures related to water abstraction (water supply, electricity generation and irrigation) contrary to good practice, gravel extraction, inadequate flow regulation and morphological changes of the riverbeds in order to prevent floods, erosive deposits, water pollution, as threats recorded in certain watercourses from the South-East Region [“Strategic Environmental Assessment Report on Water Strategy of the Republic of N.Macedonia” (2011); "Strategic Environmental Assessment Report for the Program for water supply, drainage, collection and purification of urban wastewater for Aglomeration Strumica" (2014); “Strumica River Basin District River Masin Management Plan 2016 - 2027” (2016)]. We are far from knowing the effect of the individual or combined impact of these threats on fish from all over the region, but the literary data, listed in the text that follows, indicate the existence of disturbances in the natural state of populations in certain watercourses.

Thus, based on the results obtained from the analysis of several biological components from the study "Monitoring program for the Strumica River Basin" (2016), it was concluded that the Strumica Valley is under intense anthropogenic pressure, expressed through discharges of wastewater from settlements. industry and agriculture. Only on the basis of the fish component (from the same study), Vodochnica was assessed with poor ecological status, while moderate status was found on Begzastevska River (before the confluence with the river Turija), the part of the river Strumica after the confluence of the river Turija and the part of the river Strumica , after the confluence of the river Vodochnica. Both accumulations "Turija" and "Водочаа" were assessed with moderate environmental potential. Based on the fish component, only the part of the river Strumica, which is close to the border, is assessed with good ecological status.

Only on the basis of the fish component, Radovishka Reka and Stara Reka, after the inflow of Radovishka, are assessed with poor ecological status. Moderate status has been established on Injevska Reka, while the river Plavija and the part of Stara Reka before continuing through the Strumica Valley are assessed with good ecological status.

As for the Monospitivsko Blato, the main threats to the fish are changes in the hydrological regime, drying of the swampy areas, cutting and burning of the reeds, eutrophication and water pollution. According to the literary data, most of the pollutants enter through the continuous discharge of fecal wastewater into the Vodochica which carries the communal wastewater from the city of Strumica. The continuous and uncontrolled use of chemicals (natural and artificial fertilizers, pesticides) in the surrounding agricultural areas, significantly intensify the eutrophication of water in the swamp. This condition only contributes to the dispersion of non-native species, which also pose a danger to native fish species.

The effect that the reservoirs themselves have is not to be underestimated. In the South-East Region there are a number of reservoirs, whose main activity is water supply. In many of them, in addition to the native species, live non-native fish species which are one of the main threats to the populations of native fish species (Chapter Non-native fish species). But we should not forget the fact that the construction of reservoirs creates strongly modified riverbeds, with unnatural seasonal hydrological and hydrochemical regimes, which degrade river habitats and biotic quality. According to the report "Strategic Environmental Assessment for Water Strategy for the Republic of N.Macedonia"

(2011), N.Macedonia is one of the countries with the most active erosion processes in Europe. The sediments in the reservoirs of the reservoirs also contribute especially to the production of sediment. In the text above, it is emphasized that near some of the reservoirs a fish plague or lack of water has been observed. Thus, the implementation of the requirements for ecological flow downstream of the accumulations is urgently needed.

The absence of endemic fish species such as the spindle and the thin-tailed deer from the river Vardar that passes through the Valandovo-Gevgelija Valley is also an indicator of disturbance of the environmental conditions (Ristovska et al., 2011; Kostov et al., 2011; Arsovska et al. ., 2014). It is well known that these species are sensitive to anthropogenic factor (Lusk et al., 2005; Telcean et al., 2006; Telcean and Cupşa, 2012; Freyhof and Brooks, 2011), so their absence from this part of the riverbed does not is surprising, because in this part of the river, among other things, a high organic load and a high concentration of insecticides have been registered, including lindane (Konstantinou et al., 2006; Skoulikidis, 2009).

As a result of the anthropogenic factor the largest dramatic changes in the composition of fish fauna were observed in Lake Dojran. It is well known that Lake Dojran in the past was one of the most productive lakes in Europe. As a result, 50% of the total fish catch in N.Macedonia came from Dojran. However, the lowering of the water level and the destruction of its quality significantly affected the quantity of fish, primarily due to the fact that some hatcheries ended up out of the water. Withdrawal of the shoreline leads to the complete loss of the littoral zone and its associated biological communities, including the fish community. It should be noted that the retreat of the lake level and the decrease of the water level are due to the excessive and uncontrolled depletion of water for agricultural needs [“Study for valorization of the Monument of Nature Dojran Lake” (2016)].

Given that stronger economic growth is expected in the South-East Region in the future, there is a high probability of demands for further development of hydropower and construction of hydropower plants, which are also one of the major threats to biodiversity. According to the information from the "Feasibility study for justification of granting a concession for the use of water for electricity production with the construction of small hydro power plants", the construction of about 24 hydro power plants is planned only for the Strumica catchment area.

Negative impact on water habitats is expected in the future if the proposed gold and copper mine" Ilovica "starts operating, which according to the project will cover the waters of the river Shtuka and Jazga, tributaries of the Strumica River, as well as the mine." Kazandol ”, which with its work would have a negative effect on the wildlife of Anska Reka (Municipality of Valandovo).

Widespread deforestation and forest fires increase erosion, contributing to frequent flooding of unregulated riverbeds, endangering the survival of fish and humans.

The difficult implementation of the existing legislative measures and the insufficient coordination between the relevant institutions also contribute to the deepening of the problems with the protection of water habitats.

- **Recommendations**

Over the past decades, in many Balkan countries, environmental protection has often been neglected in favor of development projects, even in protected areas. That is why today it is necessary to establish operational monitoring networks. Unfortunately, in our country, although monitoring is a legal obligation, there is still no continuous monitoring of water quality, especially in the South-East Region, and the fish component should be included.

But before setting up a monitoring network, ichthyological research is needed to gain a complete understanding of fish diversity in the South-East Region. In addition to the inventory, research that will map the threats to fish fauna in all water bodies in the region is extremely important. In this way, the basic data will be obtained, necessary to determine the indicator fish species - determining the

sensitivity of important fish species to changes in the environment, which in turn is a prerequisite for the implementation of monitoring programs.

Monitoring becomes even more complex in cross-border watersheds (present in the South-East Region) where the establishment of an appropriate administrative and institutional scientific framework is essential. Despite the difficulties encountered in monitoring transboundary watersheds, efforts are needed to standardize and calibrate monitoring techniques among the countries that share watersheds. Only good cooperation between experts and all planned activities at the local level and the central government can enable the development of action plans for the protection of vulnerable fish species.
It is also necessary to monitor the condition of fish fauna in the reservoirs. The presence of invasive species in them poses a potential danger to native fish, which imposes the need for stricter measures. It has been pointed out on several occasions that fish plague or lack of water has been observed near the reservoirs. Thus, it is urgently necessary to implement the requirements for ecological flow downstream of the reservoirs, but also observance of the ecological minimum of the water flow is necessary when performing all water intakes.

Improving the condition of fish habitats in this region there will be the construction of treatment plants in a number of settlements which will reduce the negative effect of wastewater, namely the establishment of a wastewater treatment system to maintain river and lake ecosystems according to the categorization of water necessary for their survival.

Also, an important step in reducing the effect of threats is raising public awareness among the local population. Timely response by the local population to inappropriate activities can make a great contribution in reducing the side effects of threats to fish fauna.

Greater control over the work of the fishing water concessionaires from the region will also make a significant contribution to the uncontrolled fishing of fish, especially when it comes to controlling the reports on the annual quantities of fishing of economically important fish species from Lake Dojran.

5.1.6 Amphibians and reptiles

- **Threats**

There are several protected areas in SEPR: natural monuments Monospitovsko Blato, Koleshinski waterfall, Smolarski waterfall, Dojran Lake, Konce, Gol Chovek and Div Prnar-Gevgelija and the nature park Cham Chiflik. However, their management is not carried out responsibly - a phenomenon especially evident in Monospitovo Swamp, and probably reflected throughout the region.

Amphibians are the most seriously affected group of vertebrates globally (IUCN, 2019), as they are directly dependent on the existence of standing and flowing waters. The change of the hydrological regime and the ameliorative interventions in the Monospitovo swamp started after the Second World War (1947) when the open water areas covered as much as 500 hectares, and continued from 1963-2006 (Melovski et al. 2008). In the last 30 years, some canals have been neglected and buried, while others have been dug for the interests of farmers. Additionally, to increase the arable land, ameliorative activities are followed by felling and burning of the reeds. These activities lead to fragmentation of habitats, which probably leads to fragmentation of amphibian populations, and probably has a negative effect on their predators (white-tailed deer). Furthermore, the remaining water surfaces of the swamp face enormous pressure from the discharge of fecal wastewater as well as the uncontrolled use of pesticides and natural and artificial fertilizers that lead to uncontrolled eutrophication, which in addition

to the negative impact of amphibians, probably negatively affects females and frogs. which are directly dependent on water.

Reading et al. (2010) have shown that snake populations show a negative trend worldwide, which is particularly pronounced in those who practice a sedentary lifestyle with an ambush tradition, and are therefore particularly negatively affected by anthropogenic influences in their habitats. According to this, the most affected species in SEPR would probably be the hopper, which in addition to destroying habitats, along with other species of snakes suffers from huge road deaths, as well as deliberate persecution by humans.

5.1.7 Birds

- **Threats**

Threats to bird fauna in the SEPR are typical of the whole country, and fall into several main groups:

- *Drainage of water habitats* - the biggest negative effect is probably seen in the reclamation of Monospitovo Swamp and flood areas in the village. Bogorodica et al. Stojakovo. The latter region is still important for the migration of many bird species;
- *Pure deforestation* - is regularly present in the region, and means one hundred percent loss of habitats of forest species. In addition, the usual practices of deforestation are often sufficient to destroy the habitats of some priority species (flycatchers, woodpeckers, etc.);
- *Fires* - especially present in and around Monospitovo Swamp, but also in the areas with pnar, foja, black pine (the site Cham Chiflik above Strumica is completely destroyed) and other forest and shrub communities, leads to complete destruction of habitats, which, in cases of forest communities, are slowly recovering;
- *Energy and infrastructural development* - the effects of the construction of the wind park near the village of Bogdanci, although it does not seem to be on the migration route of the birds and the possible mortality is minimal. The construction of other wind farms (eg near the village of Miravci, at the site Dvete Ushi in Kozuf and probably above the village of Stojakovo) will further intensify this problem and it is necessary to analyze the cumulative negative impact of all wind farms on the ornithofauna in The region. The highway Stip-Radovish passes through ZPP "Mantovo Lake and river Kriva Lakavica", and at the locality Pilav Tepe will probably contribute to the loss of the local couple of golden eagles. Other energy or water management projects (Kojuf Konjsko Reservoir, access road to Kozuf Ski Resort also mean loss of some bird habitat;
- *Mining* - the opening of the new mine at the Buchim mine, the still unclear future of the planned Ilovica mine, as well as most of the quarries in the area also mean the loss of bird habitat.

We note that for all infrastructure, water management and energy projects there are Environmental Impact Assessment (SEA) Studies, which have found "acceptability" of the local loss of biodiversity. It is not in the purpose of the current analysis to make a deeper elaboration of the SEA findings in the region.

- *Disturbance* – The disturbance (and partial loss of nesting sites) of tourism at the Dojran Lake Nature Monument takes precedence. This issue should be addressed in the development of a management plan for this protected area;

- *Direct persecution and poaching* - This threat exists at least on Monospitovo Swamp, Dojran Lake, and is probably widespread in the region. Cases of targeted shooting of birds of prey, primarily gray falcons, have been reported. Theft of eggs and young from the nests of birds of prey is present. No cases of poisoning of necrophagous species (eagles, vultures) have been reported, but they are probably present.

- **Recommendations**

The priority species of birds for protection are marked in the valorization section, and their selection is based on their inclusion in the draft list of birds of importance for the European Union (Petkov & Ruiz 2017). We consider that the implementation of the existing legal solutions from the Law on Hunting and the Law on Nature Protection (observance of hunting dates and the imposition of a ban on hunting of permanently protected species), legal protection of areas already identified as significant (in the Spatial Plan of RM, in the project "Development of a national representative network for protected areas" and internationally identified important areas - for birds, plants and butterflies, as well as Emerald areas), with the development of appropriate management plans, are sufficient basis and sufficient measures for protection and enrichment of bird fauna in the Region. In the future, parts of the region will be protected according to the European directives for birds and habitats, ie as Natura 2000 areas.

5.1.8 Mammals

- **Threats**

A multitude of different types of threats affect the status of mammals in Europe and in our country. To better understand the main (leading) threats, a standardized list of major threats to each mammal species (IUCN Major Threat Authority File) was used.

Summarized results for all mammalian species show that: Habitat loss, transformation and degradation have by far the greatest negative impact on both endangered and non-endangered species, affecting 27 of the 29 species are under threat in Europe.

The number of species negatively affected by the loss of natural habitats and their degradation is three times higher than the next most common threat, which is pollution (including climate change).

Human harassment, accidental mortality (inadvertent capture or casualties from road traffic), invasive, non-native species and unsustainable use of natural resources are also threats to mammals. Out of a total of 29 mammal species included in the IUCN Red List of Endangered Species Globally and Europe, five species are registered in the Project Area, of which four species belong to the order Chiroptera and one species to the order of Rodentia.

- **Recommendations**

Chiroptera is the most affected mammalian taxonomic group in Europe, with 11 species included in the IUCN Red List of Endangered Species. Of these, four (4) species are registered within the territory of the Project Area.

In the underground shelter near the village of Rabrovo-Valandovo, the presence of two species of bats was registered, which are on the IUCN Red List of Endangered Species at the global level and three species of bats on the IUCN Red List of Endangered Species at European level, as and the presence of seven species of bats included in the list in Annex II to Directive 92/43/EEC.

In the cave Sveta Nedela (1.2 km north-west of the village Gjavato, near Gevgelija) is registered the presence of four species of bats that are included in the list of Annex II of Directive 92/43/EEC.

In addition, caves that are not open to the public as tourist destinations are included in the list in Annex I of Directive 92/43 / EEC, under code 8310 - Caves not open to the public.

As a result of the above, it is recommended that these two sites, as biodiversity hot spots, not be left out in future activities related to monitoring and protection of biodiversity in the Project area.

In addition to these two future monitoring points, as priority areas for monitoring and protection, there are swamp ecosystems along the shores of Lake Dojran, located on the stretch between the village of Nikolic and Nov Dojran.

5.1.9 Agrobiodiversity

- **Recommendations for protection of agrobiodiversity in SEPR**

According to the report of the World Organization "Right to Food" from the United Nations it is necessary to change the way of investments in agriculture, which should not be directed only to industrial production, but also to agro-ecology and agriculture based on the use of different plants to satisfy the quantity and quality of food including cultural values as a landmark of rural areas.

- Measure 1. To improve in - situ and ex - situ protection of the genetic resources of the autochthonous cultivated plants.

The distribution, number and diversity of indigenous crops in the South-East Plaska region has so far only been partially studied (in some villages or regions. Due to discontinuous financial support, there is a danger that existing collections may be lost.

Existing indigenous varieties today are usually maintained by older farmers, while the younger ones orient themselves towards production with new varieties or leave rural areas altogether. In order to ensure the maintenance of indigenous genetic resources, as well as to motivate the younger ones, it is necessary to organize on-farm conservation with binding agreements supported by subsidies. Numerous activities should be organized in rural areas to raise awareness among farmers about the importance of that material. This will contribute to the spread of these varieties and reduce the risk of their loss.

To achieve Measure 1, it is necessary to undertake the following activities:

- Promotion of the ex situ protection of the indigenous species and varieties of agricultural crops;
- Conducting an inventory of the representation of indigenous species and varieties of agricultural crops on the territory of SEPR;
- Collection of seeds and planting material of indigenous species and varieties;

- Characterization and evaluation of the collected material from the indigenous agricultural crops;
- Entering the data in the only database in the gene bank available to the general public;
- Establishment of a system for on - farm and on - garden (in - situ) conservation of agricultural crops and concluding agreements with interested farmers;
- Forming catalogs and seed exhibition collections from indigenous agricultural crops, for easier distribution and spread of certain indigenous varieties.

- Measure 2. Preservation and promotion of traditional knowledge, innovations and practices for protection and sustainable use of natural resources in the South-East Planning Region

Certain natural resources in the past and today have a special mark and special significance for the local population. That is why the population traditionally has a special attitude towards them. Their specific characteristics or purposes have contributed to their preservation and maintenance through the application of traditional knowledge and practices. From the aspect of agriculture, traditional knowledge usually refers to the application of special old ways of growing plants and livestock. In crop production it often refers to traditional methods of protecting plants from disease or fertilization, in which no chemicals are used. As this method of cultivation is the basis for organic farming, it is of particular importance to note and preserve those traditional practices. The population still uses numerous agricultural crops to produce medicinal potions or products according to specific recipes. This purpose is also very important to preserve and promote in line with the recent trend in the use of natural remedies.

Often the loss of resources or knowledge is a result of insufficient information of the population about their values. It is therefore necessary to promote them to the general public and to provide support for the preservation and maintenance of traditional knowledge and practices, which will achieve their sustainability. For this purpose, it is necessary to conduct certain research on the situation and trends with traditional practices for natural resources and to establish a database that will serve for their promotion. In this way they will be properly valued and preserved.

To achieve Measure 1 it is necessary to undertake the following activities:

- Encouraging research and documenting good practices for traditional use of biodiversity;
- Documenting the traditional ways of growing crops;
- Documenting the traditional ways of production of food and other products from agricultural crops;
- Documenting the use of biodiversity in traditional treatment and ethno pharmacy;
- Promoting and subsidizing the traditional use of biodiversity;

5.1.10 Biodiversity within domestic animals

- **Threats**

Losses of biodiversity in domestic animals are due not only to the neglected interest in the protection of indigenous breeds but also to the long process of land reclamation and melting. The extinction of the domestic pig, the Karakachan and Sharplanin sheep and the domestic buffalo are the

best examples of this. The intensification of animal husbandry completely suppressed the local bush, which remained only in the hilly-mountainous areas and in extremely extensive production conditions. Even there, it is dominated by montafonic, obrental and other breeds. Unfortunately, this unstoppable process is advancing not only in this region but also on a global scale. An important factor contributing to the erosion of biodiversity in the region is the long-term depopulation of rural areas. As a result, their status by effective population size (FAO) looks like the following table.

Table 9. Degree of endangerment of the indigenous populations of domestic animals in the Republic of North Macedonia (Program for protection of biodiversity in animal husbandry 2011-2017)

Table 18. Degree of endangerment of the indigenous animal populations in the Republic of North Macedonia (Biodiversity Protection Program in Livestock 2011-2017)

Species	**Breed**	**State of the populations**
Cattle	Busha	Stabile/non-assessed
Sheep	Karakachan Ovchepol	Critical Stabile Stable/non-assessed
Goat	Balkan goat (local)	Stabile/non-assessed
Pig	Local breed	Non-assesseda/eradicated
Bee	*Apis mellifera macedonica*	Stable
Buffalo	Local breed	Non-assesseda/critical
Dog	Sharplanin dog	Non-assesseda/stable
Horse	Local breed	Non-assessed
Donkey	Local breed	Non-assessed
Other species	Domestic chicken	Non-assessed

- **Recommendations**

The process of improving the production traits of local breeds through their crossbreeding with noble breeds, especially in the second half of the last century, caused significant erosion of indigenous genetic resources in domestic animals in R. N. Macedonia. Although well documented in the past by many authors, many of the local breeds and strains of these domestic animals are facing complete extinction and thus their value as genetic resources.

Hence, recently, with the application of the methodology of the Program for the Protection of Genetic Resources in Domestic Animals (DAD) promoted in the early nineties of the last century by the

FAO, there is an increased interest of the professional public to determine the real situation with their own genetic resources. For that purpose, the indicated indicative locations are inspected where phenotypic characterization is performed and a database of inventory farms is formed.

The protection of biodiversity in farm animals is a planned, coordinated and long-term activity.

At the state level, it can be summarized with one paragraph from the Biodiversity Program in Animal Husbandry 2018-2023.

"General goal of the protection of the biological diversity of domestic animals in R. N. Macedonia, and accordingly the program for protection of biodiversity in animal husbandry, is to determine the national directions (priorities) in this area in accordance with the four internationally accepted priority areas, established within the framework of the Global Action Plan adopted on the first International Technical Conference on Animal Genetic Resources held in 2007 in Interlaken - Switzerland and the Law on Animal Husbandry of the Republic of N.Macedonia (2008).

The mentioned priority areas are the basis for defining the program for protection of biodiversity in animal husbandry and determining the future program activities, and in accordance with the identified gaps and weaknesses in the inventory, installation, characterization, sustainable use, development and conservation of genetic resources in animal husbandry. The Declaration from the First International Technical Conference on Animal Genetic Resources, held in 2007 in Interlaken - Switzerland under the auspices of FAO, which is a cornerstone of the area for protection, development and sustainable use of genetic resources in animal husbandry.

Having in mind the above, through system solutions such as the legal framework (Annex 9-Table 9) strategies, programs, together with an assessment of the current situation in the field of biodiversity protection, arise and the priorities related to the protection and utilization of genetic resources in animal husbandry are:

- establishment of a characterization and inventory system for all species and for all breeds / lines / breeds of domestic animals individually;
- establishment of a monitoring system for all species and for all breeds / lines / breeds of domestic animals individually;
- establishment of a system of sustainable use and development of genetic resources in animal husbandry;
- establishment of a conservation system, gene banks, in situ and ex situ conservation;
- establishing a system of measures to support the protection of genetic resources in livestock in ex situ or in vivo forms of conservation within national parks, agricultural holdings, educational or research centers;
- Institutional strengthening, research and monitoring, education, legislation;
- Raising public awareness for all listed areas.

In addition, for each protected indigenous breed of cattle, the recognized organizations that breed commercial herds, in order to enter the system of financial support of indigenous breeds, develop a special breeding program, which must be accepted and approved, in accordance with the protection objectives.

5.2. Key sectors affecting the biological diversity

5.2.1. Hunting

There is no official information on the impact of hunting on biodiversity, information based on expert knowledge indicates that poaching (especially of birds) is one of the most important factors in endangering biodiversity.

On the territory of R. N. Macedonia total of 256 hunting grounds have been established of which 112 are large game hunting grounds and 144 are small game hunting grounds. In R. N. Macedonia from the non-native species of game are mainly successfully introduced the fallow deer and the mouflon, and unsuccessfully the Nubian goat. Out of a total of 11 hunting areas on the territory of N.Macedonia, the hunting grounds in SEPR belong to two - Strumica hunting area, with the municipalities: Radovish, Konce, Podares; Strumica, Novo Selo, Vasilevo, Bosilovo, Kuklish and Murtino. and Dolno-Vardar hunting area, with the municipalities: Valandovo; and Gevgelija, Miravci, Bogdanci and Star Dojran.

Below are available data on shot wolves and other large beasts.

Donchev (1996), gives data on a total of 11,604 wolves shot on the territory of N.Macedonia for a period of 40 years (1947-1987). In the period 1980-1987, the number of wolves shot ranged between 101 and 164 (Donchev, 1996).

Petkovski (1998), states the presence of nine species of beasts for the territory of SEPR, all included in the category of hunting game, according to the Law on Hunting (2009).

Krystufek & Petkovski (2003), give an accurate map of the distribution of the wolf, according to data on locations where wolves were shot in the period 1980-1987 (Figure 1). However, the fact that the wolf in N.Macedonia inhabits mountainous areas should be taken into account, except for the central valley, where it occurs only during the winter, when wolves enter villages and sheep herds (Salvatori & Linnell, 2005).

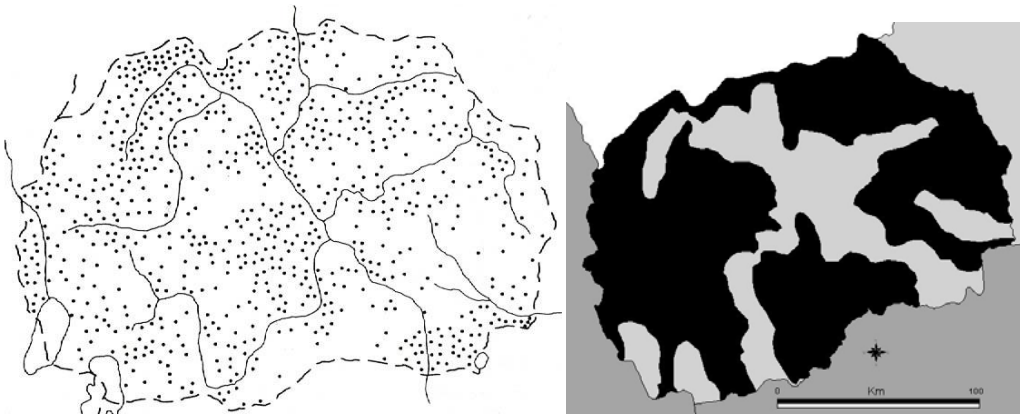


Figure 32: Sites in N.Macedonia where wolves were shot in the period 1980-1987. Source: Krystufek & Petkovski (2003); B. Distribution of the wolf in N.Macedonia. Source: Salvatori & Linnell (2005). Sidorovska (2010), for the period 1993-2007, provides data on the number of wolves shot throughout the territory of N.Macedonia, which ranges from 320 to 480 wolves shot during a year. For the period 1952-1977 an average of 6,200 foxes were killed annually on the territory of N.Macedonia.

5.2.2. Invasive, allochthonous and genetic modified organisms

Non-native and invasive plant and animal species exert significant biological influence on indigenous species and ecosystems. Non-native species are more competitive than indigenous ones in

terms of resources (water, food, pollinators, etc.), change the diet cycle (e.g. nitrogen fixation, may affect certain species), and alter disorders (e.g., invasive spread of many non-native grass species are associated with the frequency, intensity, and magnitude of fires).

Exotic species also have negative consequences for the economy, especially in the agricultural sector, but also in the fisheries, forestry and hunting sectors.

Although invasive species are a significant factor in endangering biodiversity, they are not uniform in the region. Invasive plant species are a greater threat where there is already significant ecosystem disruption. However, there are exceptions found in many ecosystems, such as some species of fish (American catfish and silver carp), or plants (eg acacia, ragweed, sturgeon, sage, and spider). Invasive animal species are more likely to be a threat to preserved ecosystems due to their mobility.

There is growing evidence that genetically modified plants (GMOs) may be a threat to indigenous biodiversity if found intentionally or accidentally in the environment. In endangered species, such cases can be a serious threat.

The following is an overview of the non-native and invasive species present in different groups of organisms on the territory of SEPR.

5.2.2.1. Algae– allochthonous and invasive species

Microcystis protocystis W.B.Crow from the group of blue-green algae, which until its establishment in Lake Dojran was only registered in the tropical and sub-tropical regions of the world, has been identified as an alochton species within the algae for the studied area of JIPR. For now, there are no data on invasive algal species in the area of R. N. Macedonia.

5.2.2.2. Fungi – allochthonous and invasive species

5.2.2.3. Plants – allochthonous and invasive species

Amorpha fruticosa and *Ailanthus altissima* stand out as particularly invasive non-native species in the studied area. The invasive species *Amorpha fruticosa* is especially widespread in Monospitovsko Blato, where in certain parts of the swamp it covers large areas, thus suppressing the autochthonous swamp vegetation and becoming competitive with the black donkey (*Alnus glutinosa*). Afforestation with various non-native woody species originating from other parts of the Mediterranean (*Pinus halepensis, Cupressus sempervirens* and others) is common in the researched area and thus influences the botanical depersonalization of the area. Such is the case with the vicinity of Bogdanci, at the Curculum site in the pseudomacia belt near the only site of the species *Astragalus physocalyx*, where plantations of this species are present which spontaneously begin to spread to the wider area.

5.2.2.4. Aquatic invertebrates - allochthonous and invasive species

Aquatic biotopes are one of the most susceptible ecosystems to biological invasions (Paunović et al., 2007). Flowing and stagnant waters in the area of the South-East Planning Region are no exception, although the presence of only 4 invasive species of water invertebrates has been recorded (Appendix 3; Table 15). These are the aquatic snails *Ferrissia fragilis* (Tryon, 1863) and *Physella acuta* (Draparnaud, 1805) (Gastropoda) and the amphipod shrimp *Gammarus roeseli* Gervais, 1835 and the *Orchestia cavimana* Heller, 1865 (Crustacea).

According to Tomović et al. (2010) The invasive aquatic snail Physella acuta from North America has been introduced into freshwater worldwide as a result of ornamental trade. Its spread started from the Mediterranean region to the northern borders of Europe (Semenchenko et al., 2008), settling with R. N. Macedonia (Stanković-Jovanović and Stojkoska, 2001). In the area of SEPR, this invasive species has been observed so far in the fauna of Gastropoda from Dojran Lake (municipality of Dojran) and from the accumulation Mantovo (municipality of Konce). The aquatic snail *Ferrissia fragilis* is widespread in North American waters from Florida and Texas to southern Canada and is now introduced into many countries in Europe (Marrone et al., 2011). This invasive species was recently established in the waters of Stara Reka in the municipality of Radovis ("Monitoring of the catchment area of the river Strumica", 2017-2018), and thus for the first time in the waters of R.N.Macedonia.

The invasive amphipod shrimp *Gammarus roeseli* originates from the freshwaters of South-East Europe and Asia Minor, while the *Orchestia cavimana* is a Mediterranean faunal element of marine origin (Karaman, G., 2013). The presence of *Gammarus roeseli* is determined in the rivers Plavaja (municipality of Radovish), Trkanja (municipality of Strumica), Strumica near the village. Novo Konjarevo (municipality of Novo Selo) and in the liturgy on Lake Dojran (municipality of Dojran). On the territory of SEPR, the invasive species Orchestia cavimana is observed only in the municipality of Dojran in the littoral of Dojran Lake.

Because the spread of invasive species is one of the major biological factors threatening global biodiversity and reducing the uniqueness of regional flora and fauna in the future, detailed population studies of the amphipod shrimp *Gammarus roeseli* and *Orchestia cavimana* (Crustacea pol acuta (Gastropoda) in the country.

5.2.2.5. Terrestrial invertebrates – allochthonous and invasive species

It is very important to follow the paths of distribution and introduction of alochtons, invasive and harmful species, to avoid vector diseases and to prevent in time the negative impact and destruction of habitats. One of the steps to overcome this problem in N.Macedonia is to enrich the knowledge of the existing non-native fauna and to develop monitoring programs for their distribution.

In general, the data on the presence and distribution of invasive species in N.Macedonia are far from satisfactory. The research of Cvetkovska-Gjorgjievska et al. (2018) contributes to the enrichment of the knowledge about 11 invasive species in N.Macedonia, 4 of which are recorded on the territory of the South-East region. These are: 1 species of the order of butterflies (Lepidoptera, Gelechiidae) - *Tuta absoluta* (Meyrick, 1917); and 3 species of the order Hemiptera: *Corythucha ciliata* (Say, 1832) by Tingidae, *Ceroplastes japonicus* (Green, 1921) by Coccidae and *Pseudaulacaspis pentagona* (Targioni Tozzetti, 1886) by MacGillivray, 1921 by Diaspididae.

The list also is not complete and further research is needed in order to develop a database that will contain data on the presence and distribution of invasive, non-native and harmful species in N. Macedonia.

Table. 19. Review of invasive species registered in the South-East region

Order	Family	Species	Identified presence	Species origin
Lepidoptera	Gelechiidae	*Tuta absoluta*	Gevgelija, Bogdanci, Valandovo, on eggplant plantations;	South America (Peru, Brazil)

			collection. M. postolovski, S. Лазаревска, C. Banjo	
Hemiptera	Tingidae	*Corythucha ciliata*	Gevgelija, 65 m. n.v. of Platanus orientalis; Strumica, 230 m above sea level of Platanus orientalis; collection. H. Simov	America and South Canada
Hemiptera	Coccidae	*Ceroplastes japonicus*	Valandovo, on persimmon - Chinese apple (Diospyros kaki); Marvinci; New Dojran; collection. C. Lazarevska	East Asiaa (China, Japan, Korea)
Hemiptera	Diaspididae	*Pseudaulacaspis pentagona*	Gevgelija on mulberry; collection. Bekirov, 1958	East Asia (China, Japan)

5.2.2.6. Fish species - allochthonous and invasive species

Out of a total of 40 species of fish, registered in SEPR, 10 species are non-native, namely 8 species of non-native fish are registered for the Vardar, and 5 for the Strumica catchment area. The pike (Esox lucius), which is native to the Strumica basin, is also included in the non-native species that are attributed to the Vardar catchment area. *Oxynoemacheilus bureschi* is excluded from the analysis (reasons highlighted in Table. 20).

Table 20. Allochthons fish species identified in the waters of South East Planning Region

REGISTERED SPECIES	Local name	Vardar river watershed	Strumica River watershed

Pseudorasbora parva	Stone morocco	+	+
Carassius gibelio	Prussian carp	+	+
Lepomis gibbosus	Pumpkin seed	+	+
Gambusia holbrooki	Eastern mosquitofish	+	+
Hypophthamichthys molitrix	Silver carp	+	-
Hypophthamichthys nobilis	Bighead carp	+	-
Ctenopharingodon idella	Grass carp	+	-
Ameiurus nebulosus	Brown bullhead	-	+
Esox lucius	Pike	+	Native
Number of allochthonous fish species according to literature data		8	5

The presence of non-native species of fish is most often registered in artificial lakes and rivers in their immediate vicinity. Along the lower course of the river Vardar, the presence of non-native species of fish has also been registered, including the invasive species of silver carp (*Carassius gibelio*). Although perhaps in small numbers, they still pose a great danger to the indigenous fish fauna of the river, because their dispersion, and thus the number of their populations, is always correlated with the reduction of the diversity of the indigenous fish species, which in turn depends on the increased anthropogenic pressure (Copp et al., 2005).

It is the carp, along with the American catfish, amur and gambusia that are considered invasive species, which pose a major threat to biodiversity and ecosystem integrity and cause significant economic damage as a result of their rapid adaptation (Pimentel et al., 2000; Copp and et al., 2005).

Over the years, the rapid adaptation and growth of the population of Karas in Lake Dojran is evident. In the period 2005-2006 Carassius gibelio became the dominant species in the lake catch (Kostov and Van Der Knaap, 2009). It is an allochton species of fish, introduced into the lake in the period from 1988 to 1990. This species was first recorded in the commercial catch in 1993, with a negligible share. Obviously, the drastic reduction of the volume of the lake, as well as the presence of oxygen-free layers from the bottom to the surface of the water, especially in the summer months, are the main reasons for the decrease of fish fauna in the lake, especially sensitive fish species, and a prerequisite for population growth. on the carcass.

No less dangerous is the invasive species *Ameiurus nebulosus*. Unlike many countries in Europe where there is a great deal of knowledge about the negative impact of the species, its distribution and negative effect on fish fauna in the waters of our country have not been sufficiently studied. Considering that its related species *Ameiurus melas* (Ristovska et al., 2017) has recently been registered in the country, it is necessary to conduct research on the distribution of both listed species.

There is a reasonable suspicion that in the future the distribution of aloe species in many countries around the world will significantly intensify as a result of **global warming** (Britton et al., 2010),

but also due to the existing populations of such species, especially in reservoirs (Piria et al. ., 2017), where non-native species, in recent years, have been intentionally or unintentionally introduced. The climate in our country (Mediterranean and continental) is favorable for natural reproduction of some of the introduced species, especially invasive species, and in the future, as a result of global warming (study "Scenarios for climate change in R.N.Macedonia" 2012) temperature changes are expected to go even further in favor of their adaptation to more waters across our country. Therefore, more research is needed on the dispersion and the negative effect caused by the presence of non-native fish species in the region.

5.2.2.7. Amphibia and reptiles – allochthonous and invasive species

Non-native amphibians and reptiles are not yet considered a serious threat in R.N. Macedonia. However, there are already several findings from the American red-eared turtle (Trachemys scripta; in Skopje, Katlanovo and the Bregalnica basin) which means that their spread to SEPR is probably inevitable. The red-eared turtle is a highly competitive species that can expel marsh and Balkan turtles from local ecosystems (e.g. Cadi & Joly, 2003).

5.2.2.8. Mammals – allochthonous and invasive species

Out of the 60 mammal species recorded so far in the territory of SEPR two species are in the category of non-native species: Bizamus meadow (*Ondatra zibethicus*) and Nutria (*Myocastor coypus*).

Muskrat (Ondatra zibethicus). The species is described from Eastern Canada, native to most of North America. It is a semi-aquatic rodent of medium size, which plays a significant role in the ecology of wetland ecosystems. Man inhabited it in numerous parts of Europe, Asia and South America. The population that inhabits N. Macedonia comes from the colony of Count Colloredo-Mennsfeld. In 1905, he brought 5 specimens from Ohio, USA for fur breeding to Dobrish, south of Prague. Only two years later did the fugitives settle in central Czech Republic. By 1932, the species had settled in Croatia. Today, it is relatively frequent along the rivers: Sava, Drava, Danube, Morava and Vardar. In N. Macedonia, the population is most numerous along the valley of the river Vardar, especially Katlanovsko Blato and the canal of Petrovec, as well as the river Bregalnica with Kochansko Pole, but also the swampy terrains along Lake Prespa and Dojran (Petkovski, 1998).

Nutria (Myocastor coypus). Nutria originates in the tropics and temperate regions of South America. By fur-bearing farmers, the species has spread to North America, Europe, Asia and Africa. Nutrients often escaped from farms, or were deliberately released into the wild where they were used as game prey or to destroy aquatic vegetation. The first farms in Europe appeared in the late 19th century. In N.Macedonia, nutria is registered in the valley of the river Vardar, Bregalnica, on the shores of Lake Prespa (Petkovski, 1998). During 2018, Petkovski (unpublished data) has registered the type of three sites on Lake Dojran. The population in N.Macedonia originates from fugitives from farms in Northern Greece (Petkovski, 1998). Nutrition is the best example of a high degree of harmful effects that can be caused by an invasive species of terrestrial vertebrate fauna: it damages crops, greatly destroys coastal, river and lake vegetation, undermines river banks by underground rushing shelters and transmits the bacterial infection "leptospirosis" to humans (Bertolino & Genovesi, 2007). So far, the species has been

successfully eradicated in the United Kingdom (Baker, 2006), while in other European countries millions of euros are spent on extinction efforts.

Nyctereutes procyonoides. The raccoon dog got its name because in appearance it resembles a raccoon (Procyon lotor), with which they are not close relatives. It is the size of a fox, but with shorter legs and a tail. The natural range of the species is in the temperate zone of East Asia, including Japan. Towards the middle of the 20th century, the species was introduced to the European part of the former Soviet Union, and then spread throughout Northern and Eastern Europe. The raccoon dog is most commonly found near aquatic biotopes. It is an omnivorous carnivore, which enters into strong competition with the native species of fox (Vulpes vulpes) and badger (Meles meles). In swamp ecosystems, it can pose a serious threat to amphibians and waterfowl colonies. Cirovic (2006), points out the type for Central Macedonia; at that time the southernmost point of the distribution area in Europe. Within the territory of SEPR, the raccoon dog has not been registered so far, but there is a high probability of forming a stable population around Dojran Lake and along the banks of the river Strumica.

American Mink (Neovison vison). The American mink is a semi-aquatic species of mammal, from the Coon family (Mustelidae), originally from North America, which with human intervention has spread to many parts of Europe, Asia and South America. It is a small beast with a body weight of 0.5-1 kg. It is grown on farms for the fur, the quality of which exceeds the fur of the silver fox and the marten. It feeds on rodents, fish, crabs, frogs and waterfowl. In the parts of Europe where it is present, it is included in the category of "invasive species". In N. Macedonia and on the territory of SEPR this species has not been registered yet. In Greece, however, wild populations have formed as a result of unintentional or deliberate release of individuals from farms. During 2010, 52,000 US mink units were released from breeding farms in Kostur and Kozani by animal rights activists (Adamopoulou & Legakis, 2016). Meanwhile, US wild mink were recorded in Mala Prespa and 150 km northeast of these farms in the Vardar River basin in Greece, which is relatively close to the SEPR.

5.2.2.9. Agrobiological diversity – disappearance of autochthonous varieties

Intensive production, the conversion of large areas into monoculture areas, as well as the excessive use of chemicals have the greatest impact on agricultural activities. The disappearance of mosaic agricultural land is putting a lot of pressure on biodiversity, including agrobiodiversity.

Loss of genetic variability in domestic animals is also another threat to biodiversity conservation. The pronounced negative socio-economic changes in rural areas, production systems with large investments in one-way selection in domestic livestock lead to a reduction of genetic variability. For example, the introduction of new methods of selection, crossbreeding and giving preference to uniformity in poultry due to the use of meat and egg production, has led to a reduction in genetic diversity in domestic poultry breeds. The 1951 law banning goat breeding in the country proved to be extremely harmful, as it led to the permanent loss of the Balkan goat's significant genetic wealth. A complex consequence has occurred due to the obligatory merinization, ie cross-breeding with the merino sheep, in order to obtain more wool. Due to that, the agrarian policy led to a serious decline in the populations of the indigenous races. Comprehensive policies and measures are lacking, which will prevent further decline and will support the preservation of agro-biodiversity in the Republic of N.Macedonia and thus in SEPR.

5.2.3. Climate change and desertification

Climate change is also a priority threat, which refers to the expected increase in temperature and decrease in the amount of precipitation, which will result in the disappearance or reduction of areas of more alpine and / or high mountain species and habitats, as well as the expansion of arid areas. increased risk of fires and increased erosion.

At the 1992 World Summit on Sustainable Development in Rio de Janeiro in 1992, biodiversity loss, climate change, and desertification and land degradation were identified as the biggest challenges to achieving sustainable development. Climate change affects all levels of biodiversity. They pose a serious threat to biodiversity because species and ecosystems have adapted to living in a particular climate and often cannot adapt to higher temperatures, more frequent droughts, and more extreme weather events.

Due to its location, the South-East region is considered one of the most vulnerable regions in terms of climate change.

6. VALORISATION OF BIOLOGICAL DIVERSITY

In the chapter Valorization, ie assessment of the state of natural values / biodiversity in the protected areas and outside them on the territory of SEPR, different groups of organisms were assessed in order to establish a balance between the ecological and economic processes in the region.

Biodiversity valorization is done in accordance with the EU Habitats Directive (Directive 92/43 / EEC), the EU Birds Directive (Directive 2009/147 / EC) (formerly Directive 79/409 / EEC), the IUCN Red List of Threatened Species Globally (2011), the existing IUCN European Red List of Endangered Species for Specific Taxonomic Groups, Species Richness, and Geographical Distribution / Endemism.

There are a number of international conventions and agreements in Europe for the protection of endangered species. Their implementation, in particular the establishment of Natura 2000 under the Birds Directive and the Habitats Directive, is of great importance for the development of the Pan-European Ecological Network (PEEN), as these instruments enable the preservation of very important sites throughout Europe.

- Habitats Directive (Directive 92/43/EEC) is a Council of Europe Directive adopted in 1992 on the protection of natural habitats and of wild fauna and flora. Contains the following annexes:
    - Annex I. refers to natural and semi-natural habitats that are important to the Union and whose protection requires the designation of specific areas of protection.
    - Annex II. refers to plant and animal species which are important to the Union and whose protection requires the designation of specific areas of protection.
    - Annex IV. refers to plant and animal species which are important to the Union and which require strict protection.
    - Annex V. relates to plant and animal species which are important to the Union and whose removal from the wild or their exploitation may be the subject of management measures.
- The Birds Directive (Directive 79/409/EEC) was adopted in 1979 and is the first European Directive on the protection of natural values. It is a vital legal instrument for the protection of birds and has been applied in all European Union countries since 2004. Contains the following annexes:

- Annex I: Designation of Special Protection Areas (SPAs) necessary for the survival of the species listed in Annex I, as protection of their natural habitat is required.
- Annex II: Regulation of hunting for the species listed in Annex II.
- Annex III: Regulation of trade in species listed in Annex III.

These two directives regulate the protection of habitats and types of habitats which are considered to have an unfavorable status. All EU Member States must ensure the introduction of protection measures for habitats and types of habitats listed in the directives, which may to be found in their territory. These conservation measures should result in the preservation or restoration of the favorable conservation status of the species and habitats subject to conservation. Both directives have several annexes listing the types and types of habitats to which the directives refer. These annexes also list illegal methods of capturing and killing species.

- Bern Convention - Convention on the Conservation of European Wildlife and Natural Habitats, 1979
  - Annex I: Strictly protected plant species
  - Annex II: Strictly protected animal species
  - Annex III: Protected animal species.
- Bonn Convention - Convention on the Conservation of Migratory Species
  - Annex I: Endangered migratory species;
  - Annex II: Migratory species requiring international cooperation.
- CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) - Convention on International Trade in Endangered Species of Wild Fauna and Flora.
  - Annex I: Contains a list of endangered and endangered species. Trafficking in wildlife is illegal
  - Annex II: Contains a list of species that are not yet threatened with extinction, but may become extinct if their trade is not under strict control
  - Annex III: Species included in the list of one Member State but cooperation from other CITES member states is required to establish control and prevent trade in these species.
- IUCN (International Union for Conservation of Nature) Red List of Global Threatened Species - A Global Approach to Valorizing the Endangered Status of Plant and Animal Species. The criteria and categories of this list provide a clear and objective framework for classifying the widest distribution area of the species according to the degree of risk for its extinction (IUCN, 2012). The red list distinguishes nine categories that are hierarchically related and are based on an estimate of the rate of decline of species populations.
  - Extinct species (EX). The taxon is considered extinct when the last individual of the species is suspected to be extinct. The taxon is thought to be extinct when comprehensive surveys of known and / or expected habitats, at appropriate times (daily, seasonal, annual) over its historical range, failed to identify an individual. Research should be in a time frame appropriate to the life cycle and life form of the taxon.
  - Extinct in the wild (EW). The taxon is considered extinct in the wild when it survives only by captive breeding, or as a naturalized population outside its past range.
  - Critically endangered (CR). The taxon is considered critically endangered when the best available evidence shows that it meets any of the criteria A to E for critical endangerment, which is why it is considered to be at an extremely high risk of extinction in the wild.

- Endangered (EN). The taxon is considered endangered when the best available evidence shows that it meets any of the criteria from A to E for critical endangerment, which is why it is considered to face a very high risk of extinction in the wild.
- Vulnerable (VU). The taxon is considered vulnerable when the best available evidence shows that it meets any of the A to E criteria for critical endangerment, which is why it is considered to be at high risk of extinction in the wild.
- Near Threatened (NT). The taxon is almost threatened when it is judged by the criteria but does not qualify as critically endangered, threatened or vulnerable at the moment, but is close to qualifying, or is likely to qualify as threatened in the near future.
- Least Concerned (LC). The taxon is considered the least endangered when assessed according to the criteria, but does not qualify as critically endangered, endangered, vulnerable or almost threatened. Widespread and abundant taxa are included in this category.
- Data Deficient (DD). There is a lack of data on the taxon when there is insufficient information to make a direct or indirect extinction risk assessment based on its prevalence and / or population status. The taxon in this category may be well studied and its biology well known, but it lacks adequate data on its prevalence and / or distribution. The category "lack of data" is not a category of threat. The list of species in this category indicates the need for more information, confirming the possibility of future research to show the appropriateness of categorization as endangered. It is important to use all available data. In many cases he has to choose very carefully between the category of "insufficient data" on the status of the endangered. If there is a suspicion of limitation of the taxon, and a considerable period has elapsed since its last detection, it may be justified to designate it as endangered.
- Invaluable (NE). The taxon is considered invaluable when it has not yet been evaluated according to the criteria.

- **IUCN European Red List of Endangered Species** - Extinction risk and rarity are restricted to European species populations. Valued at European level are: Status and distribution of European mammals (2007), European Red List of Amphibians (2009), European Red List of reptiles (2009), European Red List of Fairy Horses (2010), European Red List of Butterflies (2010) and the European Red List of Saproxyl Hard-Tailed Insects (2010)

- **IUCN National Red List of Endangered Species**. Nationally valued are National Red List of Fungi (2013), National Red List of Amphibians (2019), National Red List of Reptiles (2019), Preliminary Red List of Plants (2019)

- **National list of protected species** - in N.Macedonia a list has been prepared for the identification of strictly protected wild species and a national catalog of species from all animal groups, including endemics.

- **Geographical distribution / Endemism** - species whose geographical distribution is limited to a certain area are included in the category of endemic species. Endemism is defined at the local (local area), national (R.N.Macedonia) and regional level (Balkan Peninsula).

6.1 Endemic, rare, threatened and extinct species

6.1.1. Algae – endemic, rare, threatened and extinct species

Within the algological associations, the species composition of the populations directly depends on the ecological conditions of the ecosystem and the so-called 'Total capacity' which dictates the emergence and development of a particular group of algae or individual species. As a general principle, there is a tendency for the richness of algae species to be greatest in pure, unpolluted, natural exosomes that are characterized by a large number of algal forms, none of which have a dominant position. With the increase of eutrophic parameters, the number of species decreases drastically, and individual species of the most resistant forms begin to dominate the eos ecosystem, often creating a large biomass or 'water flower'. In this regard, the occurrence of endemic, rare or endangered species is a relative condition for algae because they often change their species community within an annual cycle or depending on the intensity of external influences on it. It is a common case to establish a new algae for the science of a certain ecosystem and to assume that the algae is endemic to that ecosystem (for example with Lake Ohrid or Lake Prespa), and that the same algae would later be found in other ecosystems.

Regarding the SEPR and the subject of this study, only Lake Dojran was the subject of continuous research for a long time and for that ecosystem are associated numerous extinctions of species (as presented in this report), but also the emergence of new species first listed for Europe (*Microcystis protocystis* WBCrow) or described by that ecosystem (*Gomphonema dojranense* Levkov et al., *Gomphonema italicum var. tumidum* Levkov et al., *Gomphonema jadwigiae* Lange-Bertalot & E.Reichardt, *Gomphonema lelicova* et al. and *Amphora macedoniensis* Nagumo). However, their survival and subsequent existence in the lake ecosystem depends on many parameters. Therefore, it is much more practical to present the species richness of algae in the research area and the dominance of certain species (if any) due to the need to determine the ecological condition for which algae are excellent bioindicators.

In international conventions there are no designated freshwater algal species (except for Charophyta-hari species for which there is also insufficient data) according to the endangerment.

6.1.2. Fungi - endemic, rare, threatened and extinct species

From the performed valorization of the fungi present in the area of SEPR (Appendix 10 - Table 1) the following can be concluded: a total of 73 species of fungi have been valorized, of which 70 species are part of the National Red List of fungi of N.Macedonia (Karadelev & Rusevska, 2013). Of these, 11 species are in the category of critically endangered (CR), 9 species are endangered (EN), and 24 are vulnerable (VU).

Four species are part of the official document of the MoEPP (2011) "Lists of determination of strictly protected and protected wild species". The most important of these are the species Pleurotus eryngii which is less common and is generally endangered due to gathering for food, as well as the species Boletus aereus which is a commercial species and Agaricus macrosporus which is collected for eating. The parasitic species Phellinus robustus is rare on very old oak trees.

Eight species (*Aleurodiscus disciformis, Boletus aereus, Butyriboletus regius, Disciseda candida, Hericium erinaceus, Onnia tomentosa, Poronia punctata* and *Rubroboletus satanas*) are part of the

European Red List of fungi. The species *Amanita caesarea, Hericium erinaceus, Myriostoma coliforme* and *Skeletocutis odora* are part of a group of 33 species proposed for protection by the European Council for the Conservation of Fungi (ECCF).

Twenty-five species (*Amanita boudierii, A. curtipes, Antrodia juniperina, Battarraea phalloides, Clavaria falcata, Clavulinopsis laeticolor, Cortinarius caerulescens, C. rufo-olivaceus, Cotylidia diaphana, Epithele typhae heliaca, Hygrocy H. Lactarius azonites, Microstoma protracta, Peniophora erikssonii, P. Narymica, Poronia punctata, Ramariopsis clavuligera, Rhodophyllus whiteae, Steccherinum bourdotii, S. subcrinale, Trametes ljubarskyi, Tulostoma caesomphalosin* and *Xeromphalina junipericola*) are rare species, known from a small number of sites in R.N.Macedonia.There is very little data on some of the rare species and their distribution is not well known.

A vulnerable species (*Xeromphalina junipericola*) from the Global Endangered Species Red List (IUCN) is being registered in the target area and is being published.

Data on localities and communities in which valorized species are known, as well as coordinates are given in Annex Table 2.

The list of endemic, rare, endangered and extinct species of fungi in the territory of SEPR is given in Annex 10-Table 2.

6.1.3. Plants - endemic, rare, threatened and extinct species

For the purpose of floristic valorization of the area of interest analyze has been conducted according the importance of separate species, Annex 11 – Table 1-6.

6.1.4. Aquatic invertebrates - endemic, rare, threatened and extinct species

Valorization of the biodiversity is based on several criteria that include national and international conventions and directives, as well as red lists of endangered species. Additionally, endemic species were identified, rare species with a narrow range of distribution in the country as well as species included in the National Lists for identification of strictly protected and protected wild species in the Republic of N.Macedonia.

Valorization which takes into account the published literary data as well as the results of the research conducted so far on the territory of SEPR in the Republic of N.Macedonia showed the presence of a total of 108 species of aquatic invertebrates of international and national importance for conservation (Annex 3; Table 12). The analysis of the species of high conservation importance detected in the project area showed that the aquatic ecosystems of the South-East Planning Region are characterized by high diversity of aquatic invertebrates, the presence of numerous Macedonian and Balkan endemics, as well as rare species for R. N. Macedonia. Additionally, the affected species and species under legal protection have been identified, which emphasizes the importance of the region in terms of biodiversity.

During all previous research conducted in the area of interest, the presence of the river shell *Unio crassus* Philipson, 1788, the crayfish *Austropotamobius torrentium* (Schrank, 1803) and the three dragonflies: *Coenagrion ornatum* (Selys, 1850), Corduch, 1979 and *Ophiogomphus cecilia* (Fourcroy, 1785) which are species of special interest to the Union, listed in Annex II to Habitats Directive 92/43 / EEC (Annex 3; Table 12). In order to maintain their favorable conservation status, it is necessary to determine Special Areas of Conservation (SACs) of these species within the Natura 2000 ecological network.

With their inclusion in Annex V of the Habitats Directive 92/43/EEC, the more common crayfish *Austropotamobius torrentium* (Schrank, 1803), the river crab *Astacus astacus* (Linnaeus, 1758) and the

leech *Hirudo medicinalis* Linnaeus, 1758 are important species for their removal from natural habitat or exploitation may be subject to management measures (Annex 3; Table 12).

Out of the species listed in Annex IV to the Habitats Directive 92/43 / EEC which require a strict protection regime covering the whole range of their distribution within and outside the Natura 2000 ecological network, in the area of interest *Unio crassus* Philipson, 1788, and three species of dragonflies (*Lindenia tetraphylla* (Vander Linden, 1825, *Cordulegaster heros* Theischinger, 1979; and *Ophiogomphus cecilia* (Fourcroy, 1785)) are found (Appendix 3; Table 12).

Some of the aforementioned species, in addition to Habitats Directive 92/43 / EEC, are also part of Annex II (*Lindenia tetraphylla* and *Ophiogomphus cecilia*) and Annex III (*Astacus astacus, Austropotamobius torrentium* and *Hirudo medicinalis*) to the Berne Convention for the Protection of Wildlife and fauna and their natural habitats in Europe (Appendix 3; Table 12).

Species found in the IUCN Red List of Global Threatened Species (2019) have been detected in the area (Appendix 3; Table 12). The greatest attention is paid to the river shell *U. crassus*, the river crab *A. astacus* and the dragonfly *Lestes macrostigma* (Eversmann 1836) which are evaluated as vulnerable (VU) species, as well as the freshwater snail *Graecoanatolica macedonica* Radoman & Stankranov, 1979 by has the status of an extinct (EH) species. In addition, the species *Dreissena presbensis* (Kobelt, 1915), *Potamon ibericum* (Bieberstein, 1809), *Hirudo medicinalis, Cordulegaster bidentata* Selys, 1843 and *Cordulegaster heros* Theischinger, 1979 have the status of Nearly Affected (NT) species. The shells *Anodonta anatina* (Linnaeus, 1758), *Anodonta cygnea* (Linnaeus, 1758), the goat *Atyaephyra stankoi* Karaman, 1972, as well as 7 species of freshwater snails (*Gastropoda*) and 47 species of dragonflies (*Odonata*) according to the IUCN Black List globally (2019) represent the least affected (LC) species (Appendix 3; Table 12). This list also includes species for whose populations there is a great lack of data (*A. torrentium, Pseudamnicola virescens* (Küster, 1853) and *Viviparus mamillatus* (Kuster, 1852)) due to which they are in the category "data deficient" (DD) (Appendix 3; Table 12).

According to the IUCN European Red List of Endangered Freshwater Mollusks, *G. macedonica* has an extinct (EH) status, and the river shell *U. crassus* is considered a vulnerable (VU) species (Cuttelod et al., 2011). In addition, *A. sygnea* and *Dreissena presbensis* (Kobelt, 1915) have the status of near-affected (NT) species, and *A. anatina* is the least affected (LC) species (Appendix 3; Table 12).

The IUCN European Red List of Endangered Dragonflies (Kalkman et al., 2010) also contains species that inhabit freshwater habitats in the area of interest, categorizing 2 species (*Lindenia tetraphylla* and *Sympetrum depressiusculum*) as vulnerable (VU), 5 species with Nearly Affected (NT) status, as well as 40 species in the “least affected” (LC) category (Kalkman et al., 2010) (Appendix 3; Table 12).

The IUCN Mediterranean Red List of Endangered Species (Riservato et al., 2009) includes 50 dragonfly species (Appendix 3; Table 12), of which *Cordulegaster heros* and *Sympetrum depressiusculum* are characterized by VU status. Most of the other species (40) are classified in the category "least affected" (LC), and 8 have the status of near affected (NT).

In our country 18 species of aquatic invertebrates are valorized as protected wild species (Official Gazette of the Republic of N.Macedonia, No. 139/2011), included in the National List 2 of Protected Wild Species in R. N.Macedonia (Appendix 3; Table 12).

From Table 12 given in Appendix 3 it can be concluded that 2 stenoendemites live in the area (*Niphargus pancici dojranensis* G. Karaman, 1960 and *Rhyacophila liutika* Oláh, 2010) as well as 8 species (*Balkanostenasellus skopljensis meridionalis* Karaman, S., 1954, Haber). *Isochaeta dojranensis* (Hrabe, 1958), *Baetis kozufensis* Ikonomov, 1962, *Brachyptera macedonica* Ikonomov, 1983, *Capnioneura valandovi* Ikonomov, 1978, *Rhabdiopteryx doiranensis* Ikonomov, 1983, *Taeniopteryx stankovitchi* Ikonomov, 1978 and *Eunapius carteri dojranensis* Hadzisce, 1953) are endemic for R. N. Macedonia. The area is also home to 25 Balkan endemics and 3 subendemics.

The shell *Dreissena presbensis* (Kobelt, 1915), the goat *Atyaephyra stankoi* Karaman, 1972, the Dojran crab *Potamon ibericum* (Bieberstein, 1809), the water hardy *Hygrotus (Coelambus) confluens* (Fabricius, 1787), the aquatic snail *Pseudamnicola virescens* (Küster, 1853), mayfly *Paraleptophlebia lacustris* Ikonomov, 1962 and the spring *Capnioneura balkanica* Baumann & Kacanski, 1975, *Isoperla pesici* Muranyi, 2011, *Leuctra metsovonica* Aubert, 1956 and *Protonemura rauschi* Theischinger, 1975 are rare species, while 19 species are very rare in R. N. Macedonia and are identified at 1 to 2 localities (Appendix 3; Table 12).

6.1.5. Terrestrial invertebrates - endemic, rare, threatened and extinct species

The overview of the conservation status of the terrestrial invertebrate fauna by municipalities, as well as the overview of the total number of species with the conservation status by categories is shown in Annex 12 - Table 1-3.

The high species diversity, the records of new species, the presence of endemic, rare, protected, as well as species included in the international lists for biodiversity protection, emphasize the conservation importance of SEPR and are a good enough indicator of its importance as a center of high diversity .

6.1.6. Amphibians and reptiles - endemic, rare, threatened and extinct species

Out of 28 species of reptiles, four representatives of the order Testudines (turtles) are present in SEPR, which are also all representatives of this order in the Republic of N. Macedonia and 15 species of snakes (group Ophidia) and nine species of lizards (group Lacertilia). Consequently, the identification of the region around Lake Dojran as one of the hotspots for reptiles in the country (Sterijovski et al. 2013) is not surprising. A detailed analysis of the distribution, as well as the hotspots for amphibians at the national level, does not exist yet, but it is necessary to note that in SEPR you can actually find almost all known species of amphibians for R. N. Macedonia (13 of 14), of which nine are frogs (Anura) and four are tailed amphibians (Caudata). Undoubtedly, more detailed analyzes would single out this region as a national hotspot for amphibian biodiversity. Wielstra et al. (2014) showed that in R. There are two species of murmurs of the genus Triturus in N.Macedonia, namely the N.Macedonian newt (*Triturus macedonicus*) and the Balkan newt (*Triturus ivanbureschi*). Additionally, it is interesting that both hybridize on the territory of SEPR namely Nov Dojran and Visoka Chuka, Kozuf. This is significant because these two species have in the past been treated either as one species (*T. cristatus*) or as other species (e.g. *T. karelinii*), but given that all of these murmur taxa enjoy the same conservation status according to various directives and red lists, their valorization is not disputed.

As many as 23 species of amphibians and reptiles are included in at least one extension of the European Birds and Habitats Directive. The green frog is the only species of Annex V. It is of commercial use while as many as 23 are located on Annex IV out of which six are on Annex II, in addition to enjoying strict protection, they also withdraw protection of habitats that inhabit them (they are also Emerald species). On the other hand, nine species of amphibians and reptiles are protected under the Bern Convention (Appendix II), and 15 species deserve strict protection (Appendix III). According to the Global Red List of Endangered Species (IUCN, 2019), 24 are Least Concern, while the draw, the German tortoise and the marsh turtle are affected (Near Threatened) and the Greek tortoise is endangered (Vulnerable). For more detailed information on the valorization of N.Macedonian species of amphibians and reptiles, an overview is given in Annex 13 - Table 1. Additionally, it is worth mentioning that JIPR with its

pronounced Mediterranean influences (Lazarevski 1969, 1972) is especially important for the representatives of the Iranian-Mediterranean horotype (read about the horotypes in the republic in Sterijovski et al, 2013), especially the blavor that actually in R. N. Macedonia can be seen only within the borders of SEPR and in its immediate vicinity. On the other hand, despite the fact that the spread of steppe drowning is wider than SEPR, the only site where it has been observed in the last 30 years is near the village of Nikolic.

6.1.7. Birds- endemic, rare, threatened and extinct species

The bird valorization is done according to the World (IUCN 2019) and European (BirdLife International 2015) red list, the European Union Wildlife Directive (The European Parliament & The Council of the European Union 2009), the Convention on the Conservation of European Wildlife and The Council of the European Union (1979), the Convention on the Conservation of Migratory Species (UNEP / CMS Secretariat 1979), the Convention on International Trade in Wildlife (The CITES Secretariat 1973), Lists of Protected and Strictly Protected Species in accordance with The Law on Nature Protection and the Law on Hunting. However, we take the national draft list of species of importance for the European Union as the most authoritative (Petkov & Ruiz 2017), because it takes into account the current status and trend of the species in the country, inclusion in the red lists and biomass characteristics of the species. Valorization shows (Appendix 14) the presence of a globally endangered species, but only during migration (Egyptian vulture, *Neophron percnopterus*, former nest in the area), three regularly present sensitive species, one of which (royal eagle, *Aquila heloniaca*) one (the throat, *Streptopelia turtur*) is a migratory nest and one (the red-headed skinhead *Aythia ferina*) is a winter guest. Three sensitive species are also regularly found, of which the partridge *Alectoris graeca* and the nun *Vanellus vanellus* are nests, the cod-headed pelican *Pelecanus crispus* is a nesting resident (on Lake Dojran), two are winter guests (the black-skinned Ayth) two more are found only during migration (the large crested hummingbird Numenius arquata and the blue kestrel *Falco vespertinus*). According to the European Red List of Birds, only the mountain falcon is a European endangered nest, and the Egyptian vulture and the little swan *Cygnus columbianus* (occasionally) meet on migration. The fisherman *Alcedo atthis*, the nun and the vulture are sensitive nests, the red-headed skull and the large lanius *Lanius excubitor* are regularly found in winter, and occasionally the great crickets whistle on migration. Appendix 1 of the Birds Directive lists as many as 91 species, 44 of which are nesting or non-nesting tenants, indicating the region's great potential for establishing a Natura 2000 network. Another 26 species regularly hibernate or migrate. In relation to this Directive, the steps for its transposition propose as many as 105 species found in the region to be the basis for identification of Natura 2000, of which 66 nest and 28 are found during migration or wintering. As many as 187 species are on Appendix 2 of the Bern Convention, of which 123 are nesting or non-nesting housewives and 36 regular winter or migratory species. Three species are housewives included in Appendix 1 to the Bonn Convention, along with three other migratory or wintering species. Finally, under national law, 73 species are strictly protected (42 nests and non-nesting tenants, 17 migratory or wintering) and 24 are protected species. According to the law on hunting, permanent protection is provided for 72 species, and another 25 are protected by hunting.

6.1.8. Mammals - endemic, rare, threatened and extinct species

Mammal valorization is performed in accordance with: IUCN Global Endangered Species Red List (2019), IUCN Red List of Endangered Species in Europe (2019), EU Habitats Directive (Directive 92/43 / EEC), Bern Convention, the Bonn Convention, the National Law on Nature Conservation (2004), the

National Law on Hunting (2009) and according to the Geographical distribution / endemism of the species.

Species under threats on Global and European level, species under legal protection

- **IUCN Red List on Threatened Species**

A total of three mammal species are included in the IUCN Global Endangered Species Red List, all in the lowest VU-Vulnerable category:

1. Rhinolophus mehelyi,
2. Myotis capaccinnii,
3. Dojran stump (Spermophilus citellus gradojevici).

The IUCN Red List of Threatened Species in Europe includes five species, all in the lowest category of endangered species (VU-Vulnerable):

1. Blasiev horseshoe (Rhinolophus blasii)
2. Southern horseshoe (Rhinolophus euryale)
3. Rhinolophus mehelyi,
4. Long-tailed night owl (Myotis capaccinnii),
5. Dojran stump (Spermophilus citellus gradojevici).

Legal protection

- **Habitats Directive (Directive 92/43/EEC)**

The Habitats Directive provides legal protection for a total of 25 species of mammals, of which 13 species are included in the list of Annex II, in addition, another 12 species are included in the list of Annex IV.

- **Convention on the conservation of European Wildlife and Natural Habitats (Bern, 1979)**

The Berne Convention provides legal protection for a total of 39 species of mammals registered in the territory of SEPR of which 22 species are included in the list of Appendix II (strictly protected species), 17 species in the list of Appendix III (protected species), while the remaining 21 species of mammals are not protected by the Berne Convention.

- **Convention on the conservation of migratory species and wild animals (CMS)**

Out of the 60 registered mammal species in the territory of SEPR none is included in the list of Appendix I. (endangered migratory species).

The list of Appendix II (migratory species with unfavorable protection status) includes 19 species of mammals, all from the order of Bats (Chiroptera).

- **National Law on Nature Protection (2004)**

3 mammal species in total are listed on the list I of the Strict Protected Species:

1. Wild cat (*Felis silvestris*);
2. Otter (*Lutra lutra*);
3. European ground squirrel (*Spermophilus citellus*).

6 mammal species in total are listed on the list II of protected species:

1. Blasius` horseshoe bat (*Rhinolophus blasii*);
2. Mediterranean horseshoe bat (*Rhinolophus euryale*);
3. Mehely`s horseshoe bat (*Rhinolophus mehelyi*);
4. Long fingered bath (*Myotis capaccinii*);
5. European badger (*Meles meles*);
6. Red squirrel (*Sciurus vulgaris*).

- **National Law on Hunting (2009)**

Article 5 of the Law on Hunting provides a list of 133 species of hunting game, of which 23 species of mammals and 110 species of birds. Of these, nine (9) species of mammals and 76 species of birds are included in the category of "game under permanent protection". Seven (7) species of mammals and 26 species of birds are under seasonal protection (hunting), while the other seven (7) species of mammals and eight (8) species of birds are included in the category of "game without protection".

Out of a total of 60 registered mammal species in the territory of SEPR, 17 species are included in the category of "hunting game". The following seven species are included in the category "game under permanent protection":

1. Golden jackal (*Canis aureus*)
2. Wild cat (*Felis silvestris*);
3. Otter (*Lutra lutra*);
4. European badger (*Meles meles*);
5. Red squirrel (*Sciurus vulgaris*);
6. European ground squirrel (*Spermophilus citellus*);
7. Red squirrel (*Sciurus vulgaris*).

Три видови се вклучени во категоријата на дивеч под сезонска заштита („ловостој“):

1. Дива свиња (*Sus scrofa*);
2. Срна (*Capreolus capreolus*);
3. Див зајак (*Lepus europeus*).

The other seven species of mammals are included in the category of "unprotected game".

For valorization of species according to their geographical distribution, the most important criterion is the degree to which the species are characteristic at the Local and National level. Species whose geographical distribution is limited to a certain area are included in the category "Endemic species". Hence, the definition of endemism depends on the size of the area. Within this report, endemism is defined at the Local (Local Area), National (N.Macedonia) and Regional (Balkan Peninsula) level. Most endemic species are locally, nationally and regionally endangered as a result of their limited distribution area.

Endemism in the mammal class (Mammalia) is relatively poor, especially for the category of steno-endemics (= local endemics) if we take into account the size of JIPR, as well as the total territory of R. N. Macedonia. At the species level, at the national level, there are four (4) regional (Balkan) endemic species, of which the species Western broad-toothed filed mouse (*Apodemus epimelas*) is registered at four localities within the SEPR.

Figure 33. Rocky Mouse (Apodemus epimelas) distribution area. Source: IUCN Red List of Threatened Species (2019).

The species European ground squirrel (Spermophilus citellus) in R. N. Macedonia is represented by two subspecies:

1. *Spermophilus citellus karamani* (Martino & Martino, 1940), with an area of distribution limited to the high mountain belt of the mountain Jakupica (local and N.Macedonian endemic); and
2. *Spermophilus citellus gradojevici* (Martino & Martino, 1929), with a distribution area limited to the Southeastern part of N.Macedonia (ie completely within the territory of SEPR) and the adjacent cross-border area in Greece.

The second subspecies the Dojran Spermophilus citellus gradojevici (Martino & Martino, 1929) appears as a regional (Balkan) endemic, whose distribution area is limited to the territory of SEPR, but partly continues in Greece.

6.2. Protected Areas

6.2.1. National Network on Protected Areas

The proclamation of protected areas in R. N. Macedonia dates back to 1948 when the first national park "Pelister" was declared. Most protected areas were declared during the 1960s, 1970s, and 1980s and include a variety of larger and smaller habitats that include different habitat types (predominantly forests) but also a variety of rare, endemic, and relict species. Currently, the network of protected areas in N.Macedonia is not a coherent system - it includes areas declared at different times, according to different categorizations and with different purposes. The Law on Nature Protection provides a good legal basis for creating a representative and efficient system of protected areas, and its purpose is to protect biodiversity within natural habitats, processes occurring in nature, as well as abiotic characteristics and landscape diversity (Article 65). The Law also encourages cross-border connection with the protected areas in the territories of neighboring countries (Article 67).

The following categories of protected areas and their respective management objectives are prescribed in Articles 66-90 of the Law on Nature Protection:

1) Category I - (Ia) strict nature reserve and (Ib) area in the wild;
2) Category II - national park;
3) Category III - monument of nature;
4) Category IV - nature park;
5) Category V - protected area and

6) Category VI - multipurpose area.

On the territory of SEPR so far the only functional governing bodies are the public institutions Municipality of Novo Selo for management of the natural monument "Smolar Waterfall", Municipality of Dojran for management of the natural monument "Dojran Lake"). For the other protected areas by different categories, appropriate management bodies have not been established and they face real problems regarding the implementation of the nature protection legislation.

Distribution of protected areas on the territory of R. N. Macedonia is given in Figure 34. On the territory of SEPR are located: from the category of Monument of Nature - Dojran Lake; Smolar Waterfall; Koleshinski Waterfall; Naked Man; High Chuka (wild boar) and Konce; from the category of Special Reserve - Iberlian River and Nature Park - Cham Chiflik.

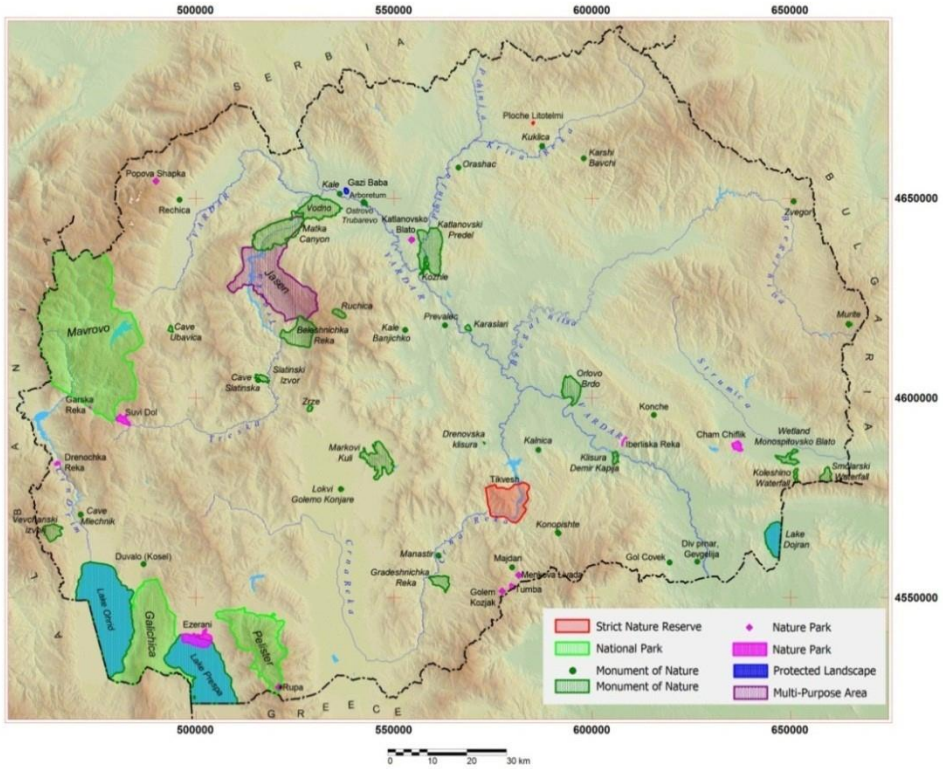


Figure 34. Distribution of protected areas in the Republic of N.Macedonia (Source: National Strategy for Nature Protection with Action Plan (2017-2027) (MoEPP, 2018))

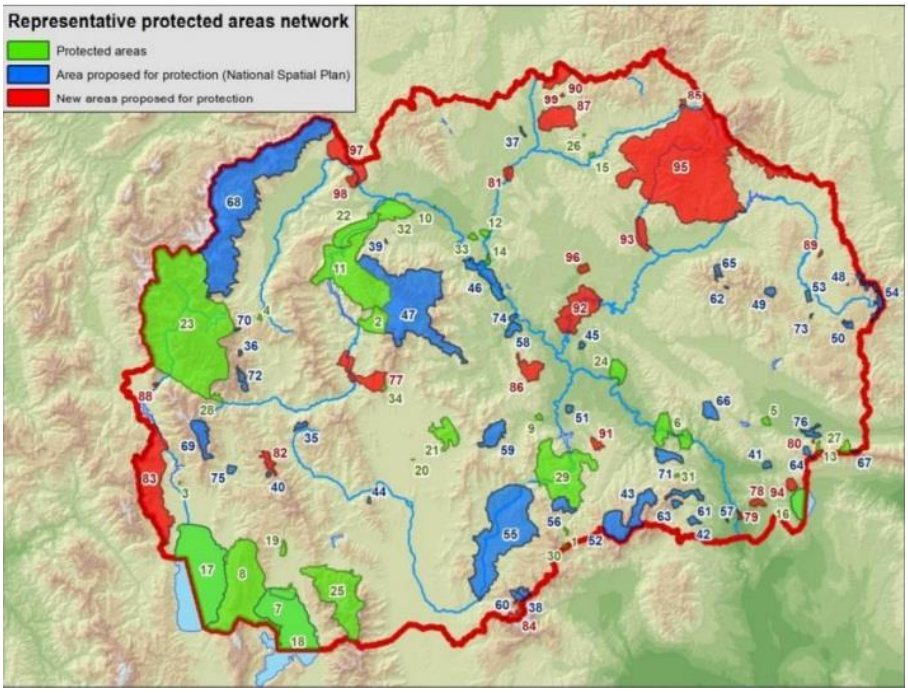


Figure 35. Map of a representative network of protected areas (green - protected areas, blue - areas proposed for protection according to the Spatial Plan of the Republic of N.Macedonia, red - newly proposed areas for protection)

On the territory of SEPR (figure 35 From the category of **protected areas** are: Special Reserve and Nature Park - Cham Chiflik; The Monument of Nature - Koleshinski Waterfall; Monument of Nature (2011) and Ramsar region (2007) - Dojran Lake; Monument of Nature - Smolar Waterfall (200); Monument of Nature - Visoka Chuka (1997); **Areas proposed for protection** according to the Spatial Plan of the Republic of N.Macedonia: Chalakli; Deep Dol; Negorska Banja; Kovanska River; Sermeninska River; Vodenisnica River; Salandzak; Cold Head; Samar; Monospitovsko Blato; **newly proposed areas for protection**: Churchulum; Aeolian sands; Gabrovski Vodopadi i Nikolic.

In order to effectively implement the Law on Nature Protection, quality management of PA, reduce the impact of external factors and achieve the goals of the Program of Protected Areas (PoWPA) of the Convention on Biological Diversity (CBD), it is necessary to overcome the following identified challenges:

- Lack of capacities for planning, establishment and management of protected areas at central and local level;
- Lack of financial resources for conservation and management of protected areas;
- Lack of efficiency in protected area management (protected area management bodies and draft management plans);
- Lack of bylaws regulating the management of protected areas;
- Insufficient involvement of local communities and relevant stakeholders in the management of protected areas;
- The overlap of competencies between state bodies (Ministry of Environment and Physical Planning and the Ministry of Agriculture, Forestry and Water Economy, in the management of forests and pastures in protected areas) and
- Lack of public awareness of ecosystem services in a protected area.

6.2.2. International protected and proclaimed areas

The protected area or natural rarity can be nominated for acquiring internationally recognized natural heritage status according to Article 91 of the Law on Nature Protection in accordance with the international agreements ratified by the Republic of N. Macedonia. Several areas in R. N. Macedonia have an international protection status and a number of areas important for the protection of birds, plants and butterflies have been identified and designated in accordance with international criteria.

- **Important Bird Areas (IBA)**

According to the proposal for IBA from 2008, 21 areas on an area of 6538 km^2 (about 25.4% of the territory of the Republic of N.Macedonia) have been proposed. In the EU member states and candidate countries, great success has been achieved with the adoption of SPAs (Specially Protected Areas) under the Birds Directive. Significant ornithological sites (IBA) on the territory of SEPR are: Mantovo with 5729.8ha 57,298km^2, which is 0.22% of the total area of IBA and Lake Dojran with 2376.5ha 23.765km^2 0.09% of the total area of IBA in R. N. Macedonia.

Figure 36. Important Bird Areas (IBA) in R. N. Macedonia (Hristovski, S. 2009, Development of the National Ecological Network in the Republic of N.Macedonia (MAK-NEN))

- **Prime Butterfly Areas (PBA)**

Criteria for designating significant butterfly habitat (SBA) areas are: presence of European species, species of the Bern Convention - Annex II and species from the Red List of Butterflies in Europe In R. N. Macedonia has five species of daily butterflies that are included according to the criteria for

selection of LPP. Important areas for butterflies (LPP) on the territory of SEPR are: the mountains Ograzden and Kozuf.

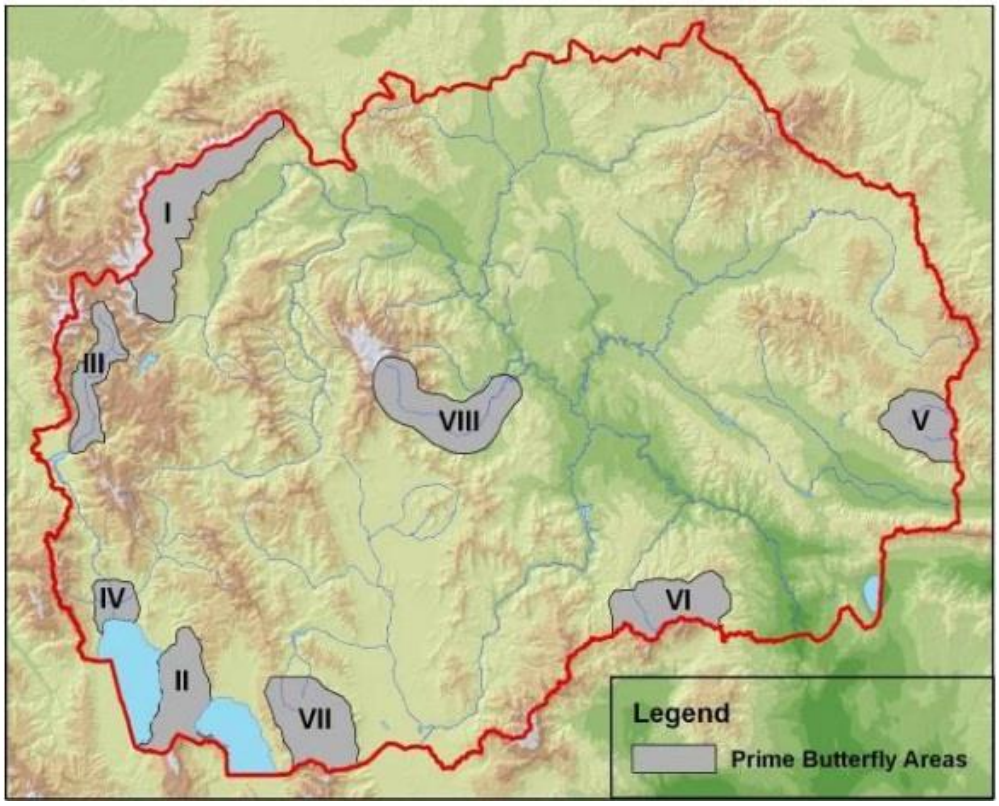


Figure 37. Prime Butterflies Areas (PBA) in R. N. Macedonia (Hristovski, S. 2009, Development of the National Ecological Network in the Republic of N.Macedonia (MAK-NEN))

- **Important Plant Areas (IPA)**

A total of 42 IPAs have been identified in N. Macedonia. The total area of all IPAs in N.Macedonia is 459,425 ha, which is 17.9% of the total territory of the country. All or part of 13 IPAs (31%) are located in protected areas in N.Macedonia (three National Parks, two strict nature reserves and seven nature monuments). All or part of the 31 IPAs overlap with the EMERALD areas in N. Macedonia, one area overlaps with the Ramsar area, 18 with the IBA areas and 10 with the PBA areas.

On the territory of SEPR from the important plant areas there are 3 cross-border IPAs: Kozuf, Dojran Lake and Belasica and 3 IPAs in the interior of R. N. Macedonia: Negorski Bani, Bogdanci (Churchulu-Paljurci) and Monospitovsko Blato.

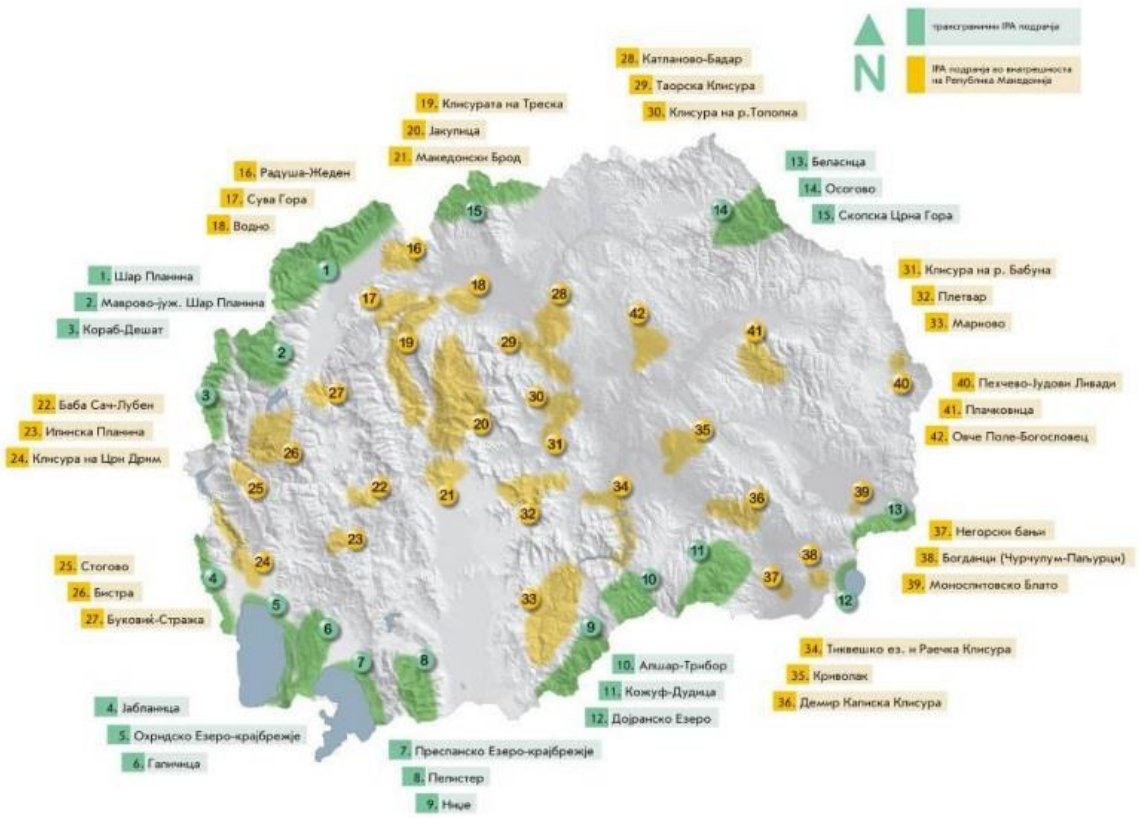


Figure 38. Significant Plant Areas (SAPs) in R. N. Macedonia (Hristovski, S. 2009, Development of the National Ecological Network in the Republic of N.Macedonia (MAK-NEN))

6.3. Ecological Networks

The creation of a national ecological network is prescribed in several national strategic documents: The Spatial Plan of the Republic of N.Macedonia (2004) (the basic elements are defined in the Study for protection of the natural heritage from 1999, the Second NEAP (2006) and the First NSBRAP (2004). networks enable a system of interconnected or spatially close ecologically important areas related to natural or artificial corridors, which with a balanced biogeographical distribution significantly contribute to the protection of natural balance and biodiversity.

- **Emerald Network/NATURA 2000**

The Emerald Network is a network of areas of special interest for conservation designated for the conservation of natural habitats and is developed in the territory of the member states of the Berne Convention. The main motive for the development of this network is to contribute to the ecological network Natura 2000 in countries that are not members of the European Union, using as similar a methodological approach as possible. The activities for development of the National Emerald Network in the Republic of N.Macedonia started in 2002, and the full identification was completed in 2008. The National Emerald Network includes 35 areas, covering a total area of 752,223 ha, which is about 29% of the territory of the Republic of N.Macedonia (MoEPP 2008). The following Emerald areas are located on the territory of SEPR: Kozuf, Belasica, Dojran Lake, Smolar Waterfalls, Curculum, Negorska Banja and Monospitovsko Blato (figure 39).

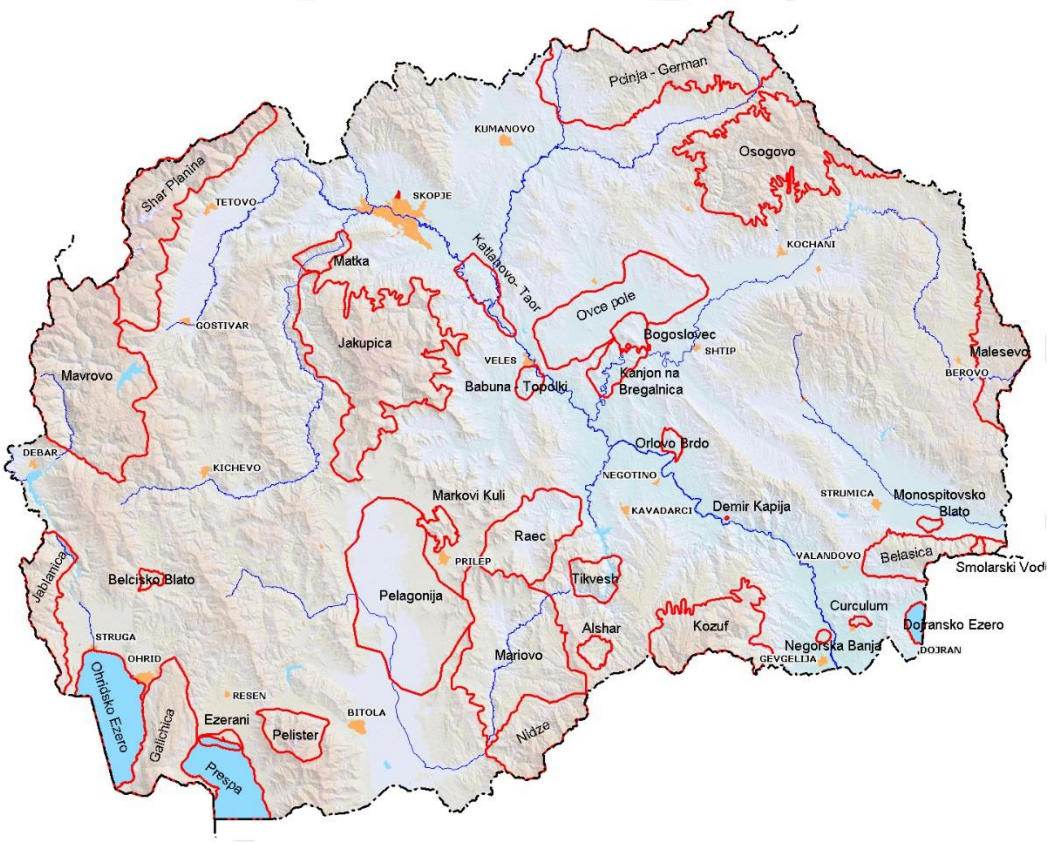


Figure 39. National Emerald Network in R. N.

7. MONITORING

7.1. Biodiversity monitoring

Biodiversity monitoring is an essential process that should provide data on specific threats / impacts as a result of human activities and changes in the state of the environment and thus help solve problems and improve the management of a particular area.

To protect a species or area requires systematic research and monitoring of the state of the environment in general and biodiversity. In this regard, SERP is not very researched. An exception to this is Lake Dojran, where several years of research on the state of biodiversity have been conducted through projects. Then, there is almost no research on the effects of pollution from various sources on nature and the environment.

In addition, proposed monitoring measures will be reviewed, in order to continuously monitor the state of biodiversity.

Agriculture. Given that agriculture is one of the most common activities in this region, it is recommended to start a study that will directly calculate the effects of the use of chemicals, mosquito spraying, the effects of tailings from mines and other similar activities such as the environment. , as well as on biodiversity.

Affected species. Continuous monitoring series are also recommended to monitor the situation with the populations and the number of affected and rare species of plants, fungi and animals and their

habitats, which will initiate the implementation of appropriate measures for the protection of the species and their habitats.

Physico-chemical parameters of water bodies. The analysis of physico-chemical parameters informs about the water quality, type and concentration of the pollutant at the moment of collection, but not about its effect on aquatic organisms, while the structure of aquatic invertebrates and macrophytes provides a clear picture of the long-term impact of factors the middle. Thus, given that the waters of the SEPR are under the influence of numerous pressures, continuous monitoring of watercourses and assessment of ecological status based on the composition and structure of aquatic invertebrate communities and macrophytes is recommended;

Monitoring the situation with the populations of invasive species and their distribution on the territory of SEPR in order to determine the possible negative impact on the local flora and fauna.

Monitoring of the ornithofauna of the Region, on several bases and at several localities:

- Continuous monitoring of Lake Dojran, every two weeks (one day);
- Continuous monitoring of Monospitovo Swamp, once a month;
- Continuous monitoring of LPP "Dolen Vardar", once a month;
- Continuous monitoring of the LPP "Mantovo Lake and River Kriva Lakavica", once a month;
- Locating and continuous monitoring of the nests of the priority species of birds for protection (small eagle clicker, small eagle, black stork, Mediterranean falcon, imperial eagle), once a year;
- Transects for monitoring the common bird species, in order to determine the trend of their populations, in different habitats (arable land, oak belt, oak blagon belt, oak grove belt, beech forests, coniferous forests and old plantations, mountain pastures), on ten semi-randomly selected test areas for each type of habitat, in the size of 500x500 (for forest) and 1x1 km (for open habitats), with rotation every 3 to 5 years (ie, 14-23 quadrants per year). This activity requires the involvement of extremely experienced ornithologists, who know how to collect and analyze quantitative data on bird fauna.
- It is expected that parts of SEPR will be identified as Natura 2000 sites. In these areas, it is necessary to conduct regular monitoring, in order to be able in the future to fulfill the obligation of the state to report to the European Commission on the situation with these areas.

The implementation of the monitoring activities "Development of a long-term monitoring program for mammals on the territory of SEPR" should take place in two phases, as follows:

1. Intensive field studies on the distribution, frequency and abundance of populations of endangered mammal species, species included in Annex II to Directive 92/43 / EEC and non-native invasive species; construction of local human capacities and adoption of Standard Operating Procedures (SOPs) for Mammal Monitoring.

2. Implementation of the Mammalian Monitoring Program.

Implementation of the Biodiversity Monitoring Program is envisaged by the National Legislation. It is also regulated by EU Directives 92/43 / EEC and 2009 / 147EEC, which are the basic legal instruments for the protection of nature and the development of the network of protected areas in Europe, NATURA 2000.

The main goal of the Monitoring Program is to ensure the long-term survival of the most valuable species and endangered natural habitats, listed in the EU Habitats Directive and the EU Birds Directive.

8. EDUCATION AND PUBLIC AWARENESS RAISING

Article 13a of the Convention on Biological Diversity, in its section on Education and Public Awareness, provides for all members to promote and foster an understanding of the importance of biodiversity conservation and the measures that are necessary. Also to place information through the media and to include this topic in the educational program.

Public information and communication are important in supporting biodiversity measures and strategies. All stakeholders should be involved in finding opportunities for nature conservation. It is necessary to establish an operational framework in education, information and public involvement.

8.1 Formal Education

In formal education, in order to improve the understanding of the importance of biodiversity and to develop the ability to study and protect biodiversity, it is necessary to include biodiversity information in the curriculum. The subjects that study the field of natural sciences are taught in the second development period (IV - VI grade) of the nine-year primary education, under the titles Nature (IV grade), Natural sciences (V grade) and Natural sciences and technology (VI grade). .), in order for the student to develop a connected, unique natural science understanding of the diversity of nature and the world in a broader sense. For that purpose it is necessary:

- Development of an educational program for biodiversity conservation in preschool institutions (kindergartens);
- Inclusion of information on biodiversity - origin, status, importance and protection in the curricula for primary and secondary education;
- To develop and promote academic programs and courses on biodiversity, agrobiodiversity and biological safety;
- To develop programs for professional development of biodiversity teachers.

8.2 Informal Education

The level of awareness of the environment and especially of biodiversity and nature protection is very low in SEPR. There is a clear need to improve communication and information on the value of biodiversity and the impact of biodiversity loss on the environment and humans. Biodiversity information management is assessed as particularly important for SEPR. By efficiently sharing and using existing information, time, money and energy are saved, to which insufficient attention has been paid in the past. Positive steps need to be taken in terms of information sharing, local institutions to organize campaigns at internationally recognized festivals, for example, World Water Day, World Earth Day, International Biodiversity Day, World Environment Day, etc. , which are important tools for improving communication and information. Unfortunately, the number of such activities held on the territory of SEPR is small. In addition to published information and brochures, this sector should be present on local radio and television stations. But the information is transmitted only once (in case of natural disasters, such as fires, floods, etc.), and not in terms of regular and preventive information. Public participation in decision-making will improve the quality and implementation of environmental decisions.

9. BODIVERSITY ACTION PLAN

As a result of the assessed state of the environment, primarily biodiversity for SEPR, an action plan has been developed that should provide direction for dealing with the most pressing environmental problems in the region in the next 10 years. The action plan includes specific programs and sub-

programs that through the mentioned activities will be realized with a stated priority and an indicator for their realization.

This action plan includes the following basic programs of measures to be realized in the territory of SEPR:

1. Protection of biological diversity
   1.1. In-situ protection
   1.2. 1.2 Ex-situ protection
2. Sustainable use of biological diversity
3. Monitoring activities
4. Public awareness raising

10. ANEXESS

ANEX 1 – Overview of the population dynamics through the censuses from 1948-2002. and households in 2002 by settlements and municipalities in the South-East Planning Region
ANEX 2 –Overview of algae in South East Planning Region
ANEX 3 –Overview of aquatic invertebrates in South East Planning Region
ANEX 4 –Fish fauna in South East Planning Region
ANEX 5 –Birds valorization in South East Planning Region
ANEX 6 –List of mammals in South East Planning Region
ANEX 7 – Photos of various shrub and forest association and habitat types in South East Planning Region
ANEX 8 – Plant agrobiodiversity in South East Planning Region
ANEX 9 –Photos of biological diversity within domestic animals
ANEX 10 – Valorization of fungi in South East Planning Region
ANEX 11 – Valorization in plants in South East Planning Region
ANEX 12 –Valorization in terrestrial invertebrate fauna in South East Planning Region
ANEX 13 – Valorization in amphibian and reptiles fauna South East Planning Region
ANEX 14 – Valorization of birds fauna in South East Planning Region
ANEX 15 – Action Plan for South East Planning Region

11. REFERENCES

Агенција за храна и ветринарство. База на податоци за индентификација и регистрација на говеда,овци и кози.

АКН, (2007). Топографска карта на Република Македонија, Р =1).25000, Скопје

Александар, С. (2002). Физичка географија на Република Македонија, ПМФ, Скопје.

Апостолски К, Јоветић Р. (1960). Утицај орнитофауне на густину популације риба у Дојранском Језеру. Издања Завода за рибарство НР Македоније 3:169–175.

Арсовска, Ј. (2018). Таксономска ревизија и редескрипција на родовите Gobio и Romanogobio од Р. Македонија, врз основа на компаративна морфолошка и остеолошка анализа. Магистерска работа. Природно-математички факултет, Уноверзитет „Св. Кирил и Методиј“, Скопје.

Арсовски, М. (1997). Тектоника на Македонија, РГФ Штип.

Бисерков, В и др. (ред.) (2015). Червена книга на Република България. Том 3 Природни местообитания, София.

Буневски Ѓ., Палашевски, Б. (2017) Факултет за земјоделски науки и храна - Скопје, Институт за анимална биотехнологија, Извештај биолошка разновидност во говедарството.

Василески, Д. (1999). Типови на водопади во Република Македонија според начинот на нивниот постанок. Годишен зборник на Институтот за географија, ПМФ, Скопје, 39-46

Велевски М, Поп-Трајков М, Андевски Ј, Фајдига Б. (2002). Први податоци за орнитофауната на планината Огражден. Билтен на Истражувачкото друштво на студенти биолози 2:171–177.

Горин, С. (2012). Географски анализи базирани на дигитално картографски основи на просторот на Гевгелиско-валандовската Котлина, (Докторска дисертација одбранета на Институтот за географија на Природно математичкиот факултет во Скопје), Скопје.

Градежен институт Македонија. 2008. Надградба на автопат Е – 75, делница Демир Капија – Смоквица, Студија за проценка на влијанието врз животната средина. Скопје.

Група автори, (1999). Географски лексикон на Република Македонија, ПМФ, ИГ, Скопје. (ракопис).

Групче, Р. и Димовски, А. (1973). Ихтиофауна на реката Вардар. Ann.fak. Scienc., Скопје, 25 (1972): 59-99.

Деконс-Ема. (2009). Студија за оцена на влијание врз животната средина од поставување на ветерни електрани во Гевгелија - југ. Page 165. Деконс-Ема, Скопје.

Димовски, А. и Групче, Р. (1974). Морфолошко- систематски проучувања врз родот Gobio (Pisces, Cyprinidae) во Македонија I. Gobio kessleri banarescui n.spp. од системот на реката Вардар. Acta Mus. Mac. Sc. Nat., XIV, 4 (122): 69-92.

Димовски, А. (1959b). Прилог кон распространувањето и начинот на живеење на Typhlops vermicularis Merr. во Македонија. Fragmenta Balcanica 3: 13-17.

Димовски, А. (1963). Херпетофауна на скопска котлина. I – зоогеографски и еколошки преглед. Годишен Зборник Природо-Математичког Факултета, Универзитета у Скопље, Књига 14, Биологија 2: 189-221.

Димовски, А. (1964). II Прилог кон херпетофауната на Макеоднија (II Beitrag zur herpetofauna Mazedoniens). Fragmenta Balcanica 5: 19-22.

Димовски, А. (1966a). Херпетофауна на скопска котлина. II – фаунистички дел. Годишен Зборник Природно-Математичког Факултета, Универзитета у Скопљу, Скопље, Књига 16, Биологија 4: 179-188.

Димовски, А. и Групче, Р. (1976). Морфолошко систематски проучувања врз родот Gobio (Pisces, Cyprinidae) во Македонија. III. Gobio uranoscopus stankoi n.ssp. од системот на реката Вардар. Год.зборник на Прир.мат.фак. 29:73-92.

Димовски, А., Групче, Р., (1977). Морфолошко систематски проулувања врз родот Gobio (Pisces, Cyprinidae) во Македонија. III. Gobio gobio balcanicus n.ssp. од реката Вардар. Год. Зборник на Прир.мат.фак. 30: 79-102.

Димовски, А.С. (1971). Сезонски измени на орнитофауната во состоината од прнар (Quercus coccifera) во Македонија. Годишен зборник, Биологија 23:45–54.

Државен завод за статистика на Република Македонија, (2002). Пописи на населението во Република Македонија, (1948, 1953, 1961, 1971, 1981, 1991, 1994, Кн. IX, Скопје

Државен завод за статистика на Република Македонија, (2004). Попис на населението, домаќинствата и становите во Република Македонија, 2002, Книга X, Скопје.

Државен завод за статистика, (2015). Регионите во Република Македонија, Скопје.

Ем, Х. (1956-57). *Fraxinus angustifolia* Vahl. var. pallisae (Wilm.) Fuk. распространет во НР Македонија. - Годишен зборник на Земјоделско-шумарскиот факултет - Скопје, 10: 305-306.

Ем, Х. (1974). *Arbutus andrachne* L. редок вид дрво во дендрофлората на Македонија. Годиш. зборн. Земј. Шум. фак., посеб.изд., 279-287, Скопје.

Ем, Х. (1984). Заедница полскиот јасен во долното Повардарје *Periploco Fraxinetum angustifoliae - pallisae* ass. nov. - Шумарски преглед, Скопје, 32(1-4): 3-17.

Ем, Х., (1957).Мочуришни врбак од Мавровско Поле. Шумарски преглед, 5(3-4): 13-19. Скопје.

Ем, Х., (1957-58). О шумама смрче у НР Македонији. - Годишен зборник на Земјоделско-шумарскиот факултет - Скопје, 11: 37-42;

Ем, Х., (1960). За костеновите шумски заедиици на планината Беласица. - Acta Musei macedonici scientiarum naturalium - Скопје, 5 (65), стр. 89-103.

Ем, Х., (1960-61). Платанот (*Platanus orientalis* L.) во НР Македонија / С. Џеков. - Годишен зборник на Земјоделско-шумарскиот факултет, 14: 5-34- Скопје

Ем, Х., (1961). Распространетоста на елата (*Abies alba* Mill.) во НР Македонија.- Шумарски преглед – 9(6): 3-8. Скопје.

Ем, Х., (1963-64). Шумата на плоскачот и на церот во СР Македонија - *Quercetum farnetto - cerris macedonicum* Oberd, 1948 emd. Ht - Годишен зборник на Земјоделско-шумарскиот факултет – 17: 235-253 Скопје.

Ем, Х., (1964). За Заедницата на евлата *Alnus glutinosa* во Македонија Годишен Зборник на ЗШФ-шумарство

Ем, Х., Џеков, С., (1969). Моликата и моликовата шума на Пелистер. - Зборник на Симпозиумот за моликата, 10: 49-62. Пелистер – Битола.

Ем, Х., (1974). За шумите на елата во Македонија. Fago-Abietetum meridionale ass. nov. - Годишен зборник на Земјоделско-шумарскиот факултет. 26: 41-58 Скопје.

Ем, Х., (1977). Олиготрофна букова шума со брукенталија и боровинки. - Годишен зборник на Земјоделско-шумарскиот факултет: шумарство, 27: 6-12.

Ем, Х., (1984). Na južnoj granici areala smrče: šuma smrče na Šarplanini u Makedoniji - Прилози - МАНУ: одделение за биолошки и медицински науки, 5 (1): 11-29 Скопје.

Ем, Х., (1986). За две заедници на македонскиот даб (*Quercus trojana* Webb.) во Македонија. - Годишен зборник на Шумарскиот факултет – 31: 5-18. Скопје.

Ем, Х., Џеков, С. Ризовски, Р., (1983). За рефугијалната шумска вегетација во СР Македонија. - Прилози МАНУ; Одделение за биолошки и медицински науки – 6(1-2): 5-20. Скопје.

Закон за сточарство сл. Весник на РМ бр. 7 од 15.01.2008.

Закон за измена и дополнување на законот за сточарство сл. Весник на РМ бр. 23 од 14.02.2013

Земјоделски институт - Универзитет „Св. Кирил и Методиј“ - Скопје, (2015). Почвена карта на Република Македонија, Размер 1:200000, Скопје.

Иванов, Ѓ. и др. (2008). Моноспитовско Блато, последното мочуриште во Македонија. Македонско еколошко друштво, Скопје.

Игеографија, (26.1.2015). Акумулација Мантово – неискористени туристички потенцијали.

Извештај (1974). Лимнолошки истражувања на акумулацијата Турија. Завршен извештај. Завод за рибарство на СР Македонија-Скопје.

Извештај (2011). Стратегиска оцена на животна средина за стратегија за води за Република Македонија.

Извештај за стратегиска оцена на животната средина за Програма за водоснабдување, одведување, собирање и прочистување на урбани отпадни води за Агломерација Струмица (2014) EuropeAid/133257/D/SER/MK

Измајлов, Н. (1963). Кретања у котлинама Македоније за време терциера и почетком квартара. Труд на ГЗ на СРМ, Св.10, Скопје, стр. 77-94.

Икономов, П. (1961). Еднодневките (Ephemeroptera) на Македонија (Ephemerelidae). Acta. Mus. Mac. Sci. Nat., Skopje. 7(3): 53-74.

Икономов, П. (1963). Еднодневките (Ephemeroptera) на Македонија род Heptagenia (Ecdyonuridae). Год. Збор. Прир. Мат. Фак. Биол. Скопје. 14(7): 155-163.

Икономов, П. (1978). Нови видови на плекоптери (Insecta: Plecoptera) од Македонија. Fragm. Balc. (Skopje), 10: 83-97.

Икономов, П. (1982). Плекоптера (Insecta) од јужните предели на СР Македонија. Год. Збор. Прир. Мат. Фак. Биол. Скопје. 35: 29-51.

Јуришић, Ж. (1923). Прилог флори Јужне Србије. Спом. СКА, 1-45.

Кавръкова, В., Димова, Д., Димитров, М., Цонев, Р. & Белев, Т. (Eds.) (2005). Ръководство за определяне на местообитания от европейска значимост в България. Автори на текстовете: Ганева, А., Русакова, В., Гогушев, Г., Димитров, М., Желев, П., Иванов, П., Цонев, Р., Иванова, Т., Белев, Т. & Гусев, Ч. Световен фонд за дивата природа – Дунавско-Карпатска програма и федерација „Зелени Балкани“, Софија.

Караделев, М, Русевска, К. & Н. Маркова. (2008f). Дистрибуција и екологија на видови од родот Tricholoma (Tricholomataceae) во Република Македонија. Екол. Зашт. Живот. Сред. Том 11, Број 1-2, стр. 27-42.

Караделев, М. & Д. Стојановска. (2002-2003). Диверзитет на ѕвездовидните гастеромицети во Република Македонија. Год. зб. Биол. 55/56:29-41.

Караделев, М. (1995b). Лигниколни габи на планината Кожуф. Училиштен центар „Јосиф Јосифовски", 1-45, Гевгелија.

Караделев, М., Настов, З. & К. Русевска. (2002). Квалитативно-квантитативни истражувања на макромицетите на планината Огражден. Билт. Истраж. друш. студ. биол., Скопје, 2:89-92.

Киприjановска, Х. & Узунов, А. (2014) Биолошка разновидност на медоносните пчели во Република Македонија извештај.

Китанов, Б. (1948). Флористични материјали од Македонија и Бугарија. Год. Зборн. Филозо.фак., 1:215-222.

Костов (2006). Report: "Integrated Management of Transboundary Water Resources in Fyrom-RBMP Vardar River Basin".

Костов (2014). Report: Study of Ecological Monitoring of River Bregalnica. Bregalnica River Basin Management Project.

Костов (2016). Студија: "Мониторинг програма за сливот на реката Струмица".

Костов, В. (2015). Риболовна основа за риболовна вода „Акумулација Мантово" за период 2017-2023 година: (PDF). Институт за сточарство Универзитет „Св. Кирил и Методиј" – Скопје. (македонски).

Кошанин, Н. (1921). Географија балканских рамондија. Глас. СКА, 101 (43)). 44-49.

Кошанин, Н. (1926). Нове врсте у флори Јужне Србије. Глас СКА, 69(54): 19-29, Београд.

Крстиќ, С. (1992). Промените на алгалната микрофлора како индикатор на полуцијата на Анска Река. Магистерски труд, Универзитет "Св.Кирил и Методиј" Скопје, 155 стр.

Крстиќ, С. (1995). Сапробиолошки карактеристики на микрофлората на Река Вардар како показател на интензитетот на антропогеното влијание. Доктроска дисертација, "Св.Кирил и Методиј" Скопје, 347 стр.

Лазаревски, А. (1969) Климата на Македонија – температурата на воздухот. Во: Географски разгледи, кн. 7, Култура, Скопје, 1969.

Лазаревски, А. (1972) Климата на Македонија – врнежите во СР Македонија. Во: Географски разгледи, кн. 8-9, Култура, Скопје, 1972.

Лазаревски, А. (1993). Климата во Македонија, Култура, Скопје, 253.

Листи на утврдување на строгозаштитени и заштитени диви видови. Службен весник на РМ, бр. 139 од 7.10.2011: МЖСПП, Скопје.

Македонско еколошко друштво. (2009). Развој на национална репрезентативна мрежа на заштитени подрачја. Скопје.

Манаковиќ, Д. (1968). Средно Вардарско Езеро. Зборник на VIII конгрес на географите од СФРЈ, Скопје, 155-164

Манаковиќ, Д. (1979). Геоморфологија на поречието на Коњска Река. Годишен зборник на ПМФ, кн. 25 Скопје, 43-72

Манаковиќ, Д. (1980). Оазни тип карстне хидрографије Македоније. Седми југословенски спелеолошки конгрес, Титоград, 293-309.

Манаковиќ, Д., Андоновски, Т. (1979б). Релјефни карактеристики на Источна Македонија. Геог. раз. Кн. 17, Скопје, стр. 5-32.

Манџуковски, Д. (2014). Фитоценолошки карактеристики на шумата од бел бор (*Pinus sylvestris* L.) на доломитски мермер под локалитетот Бело Гротло на планинскиот масив Ниџе – магистерски труд, ракопис.

Манџуковски, Д., Ацевски, Ј., Јованов, Т. (2009). Проширување на ареалот на моликата (*Pinus peuce* Grisb.) во Р. Македонија Шумарски преглед год. 42, стр . 155-162. Скопје

Маркоски, Б. (1992). *Картографско картометриски проучувања на хипсометриската струкрура на просторот и разместеноста на населението во Република Македонија*, докторска дисертација одбранета на институтот за географија при ПМФ, Скопје. (ракопис).

Маркоски, Б. (2004). Картогрсфско дефинирање и диференцирање на планинските просторни целини во Република Македонија, Билтен за физичка географија, бр.1. ПМФ, Институт за географија, Скопје.

Маркоски, Б. (2006). Картогрсфско дефинирање и диференцирање на котлинските просторни целини во Република Македонија, Билтен за физичка географија, бр.2. ПМФ-Институт за географија, Скопје.

Маркоски, Бл. (1995). *Хипсометрија на просторот и населеноста во Република Македонија - картографски метод*. Македонска ризница – Куманово, 1-315;

Маркоски, Бл., Чепреганов Т., Гроздаиоски Р., Николовски Д. Д. (2013). *МАКЕДОНИЈА – ТУРИСТИЧКИ БИСЕР, туристички потенцијали и културно-историски знаменитости*, Информативно-деловен бизнис центар-ИДБЦ, Скопје. стр. 1-592 (македонски, англиски). ISBN 978-9989-2631-3-2, COBIS.MK-ID 93211914.

Матвејева, Ј. (1982). Рудералната вегетација на СР Македонија. МАНУ, Оддел. за биол. и медиц. науки, 5-79.

Матвејева, Ј. (1985). Асоцијација Leersio-Bidentetum (W. Koch 1926) Poli et Tüxen 1960 во Македонија. Прилози, Одд. за биолошки и медицински науки, МАНУ, 6(1-2): 33-36.

Матевски, В. (2010). Флора на Република Македонија. МАНУ, 2 (1): 1-190.

Матевски, В. (2013). Разновидност и потекло на флората на Република Македонија. Пристапни предавања, прилози и библиографија на новите членови на Македонската академија на науките и уметностите, МАНУ, 125-186.

Матевски, В., Костадиновски, М., Ќуштеревска, Р. (2017). Селектирани живеалишта (хабитати) од Annex 1 од директивата за живеалишта во Република Македонија. – Selected Habitats from Annex I of Habitat Directives from The Republic of N.Macedonia. Skopje 2017.

Матевски, В., Костадиновски, М. (1997). Прилог за флората на Македонија II. Год.зб., Биол. 50:25-39, Скопје.

Матевски, Д. (2018). Структура и дистрибуција на аранеоценозата (Araneae) вдолж височински градиент на планината Кожуф. Магистерска работа, Скопје

Меловски Љ., Матевски В., Костадиновски М., Караделев М., Ангелова, Н., Радфорд, Е.А. (2010). Значајни растителни подрачја во Република Македонија. Посебно издание на Македонското еколошко друштво. Скопје.

Меловски, Љ., Иванов , Ѓ., Ангелова, Н., Велевски, М., Христовски, С., уред. (2008). Моноспитовско Блато. Последното мочуриште во Македонија. Општина „Босилово", 56 стр.

МЗШВ. Програма за заштита на биолошката разновидност во сточарството 2011-2017,2018/22.

Мијалов, Р. (1994). Природни одлики, аграрно-просторни обележја и функционална класификација на населбите во сливот на Р. Струмица, (Докторска дисертација одбранета на Институтот за географија на ПМФ - Скопје), Скопје.

Мијалов, Р. (2004). Аграрно-географски потенцијали како фактор за трансформација на руралниот простор во Криво-лакавичката Котлина, Скопје.

Милевски, И. (2011). 10-те можеби најубави високи врвови во Република Македонија. Објавено на ИГЕО-портал: www.portal.igeografija.mk (18.11.2011).

Милевски, И. (2012в). Плачковица - планина која треба да се посети и доживее. www.portal.igeografija.mk (24.03.2012).

Милевски, И. (2014б). Македонија има 13 „вистински" острови! Објавено на ИГЕО-портал: www.portal.igeografija.mk (13.10.2014).

Мицевски, Б. (1991). Анализа на фаунистичкиот состав и структура на зимската орнитофауна на Дојранското Езеро. Годишен зборник, Биологија 43–44:65–73.

Мицевски, Б. (2000). Орнитофауна на трите природни езера во Македонија (Преспанско, Охридско, Дојранско). Page 144. Природно-математички факултет, Скопје, Скопје.

Мицевски, Б. (2003). Нови видови птици за орнитофауната на Република Македонија. Год. зб. Биол. 55/56:55–73.

Мицевски, К. (1956). Прилог за запознавање на флората на Македонија I. Год.зб. Филозоф.фак.-Природ.матем.оддел, Скопје, 9: 99-118.

Мицевски, К. (1962). Прилог за запознаванје на флората на Македонија. III. Chenopodium ambrosioides L. var. anthelminticicum (L.) Aellen во флората на Македонија. Год.зб. Филозоф.Фак.-Прир.матем.оддел, 14(2):183-184.

Мицевски, К. (1963). Водната и блатната вегетација на Дојранското Езеро. Acta Musei Macedonici Scientarum Naturalium, 8 (76): 175-192.

Мицевски, К. (1963). Типолошки истражувања на блатната вегетација во Македонија. Год.зб. ПМФ-биол., Скопје, 14: 79-130.

Мицевски, К. (1964). Типолошки истражувања на вегетацијата на низинските ливади во Македонија. Год.зб. ПМФ-биол., Скопје, 15: 121-174.

Мицевски, К. (1967). Блатната вегетација кај Негоречка Бања и нејзиното значење за сингенезата на блатната вегетација во Македонија. Год. зб. ПМФ-биол., Скопје, 19: 31-45.

Мицевски, К. (1969). Прилог за запознавање флората на Македонија, IV.. Год.зб. ПМФ-биол., Скопје, 21: 109-117.

Мицевски, К. (1970b). Нов ендемичен сојуз во вегетацијата на Македонија -Artemision maritimae Micevski fed. nov. God. zb. PMF-biol., Skopje, 22: 157-166.

Мицевски, К. (1970a). Astragalo-Potentilletalia, нов вегетациски ред на брдските пасишта во Македонија. Прилози, Одд. за прир. мат. науки, МАНУ, 2(2): 15-23.

Мицевски, К. (1971). Astragalus physocalyx и Astragalus ponticus Pall., нови видови за флората на Македонија и Југославија. Год.збор. ПМФ-биол., Скопје, 24: 67-72.

Мицевски, К. (1972). *Helianthemo-Euphorbietum thessalae* Micevski ass. nova во вегетацијата на брдските пасишта во Македонија. God. zb. PMF-biol., Skopje, 25: 149-155.

Мицевски, К. (1973). Прилог за запознавање на флората на Македонија, VI. Год.зб. ПМФ-биол. Скопје, 26: 125-129.

Мицевски, К. (1977). *Erysimo-Trifolietum* Micevski ass. nova во вегетацијата на Македонија. Прилози, Одд. за прир. мат. науки, МАНУ, 9(1): 75-82.

Мицевски, К. (1978). Типолошки истражувања на вегетацијата на ливадите и пасиштата во Малеш и Пијанец. МАНУ, посебни изд., 9-41.

Мицевски, К. (1982). Флората и вегетацијата на СР Македонија и проблемот на нивната заштита. Прилози, Одд. биол.мед.науки, МАНУ, 3(1): 77-92.

Мицевски, К. (1982). Преглед досадашњег рада на заштити флоре и вегетације Југославије. Прилози, Одд. биол.мед.науки, МАНУ, 3(1): 13-25.

Мицевски, К. (1983). Прилог за запознавање на флората на Македонија. VII. Год.зб. Биол., 36:127-134.

Мицевски, К. (1987). Прилог за запознавање флората на Македонија. VIII.. Год. зб. ПМФ-биол., Скопје, 39-40: 193-202.

Мицевски, К. (1991). *Sporobolus indicus* (L.) R.Br. нов вид во флората на Република Македонија. Год.Зб. Биол., 43-44:179-183.

Мицевски, К., (1985). Флора на Република Македонија. МАНУ, 1(1):1-152

Мицевски, К., (1994). Високопланинска вегетација на планината Бистра. МАНУ, 1-91.

Мицевски, К. (1993). Флора на Република Македонија. МАНУ, 1(2):153-391

Мицевски, К. (1995). Флора на Република Македонија. МАНУ, 1(3):503-548

Мицевски, К. (1998). Флора на Република Македонија. МАНУ, 1(4): 781-1113.

Мицевски, К. (2001). Флора на Република Македонија. МАНУ, 1(5): 1121-1430.

Мицевски, К., Матевски, В. (2005). Флора на Република Македонија. МАНУ, 1(6): 1433-1715.

Мицевски, К., Матевски, В. (1984). *Diantho-Cistetum incani* Micevski et Matevski ass. nov. во вегетацијата на СР Македонија. Прилози, Одд. биол.мед.науки, МАНУ, 5(2): 11-16.

Мицевски, К., Матевски, В.,(1983). Ретки и слабо познати растенија во флората на Македонија I. Год.зб. Биол., 36:149-153, Скопје.

Мицевски, К.,(1970). Прилог за запознавање флората на Македонија, V. Год.зб. ПМФ-биол., Скопје, 22:167-178.

Мицевски, Љ., (1986). Заедницата *Junipereto Bruckenthalietum* на планинскиот масив Јакупица, Шумарски Преглед 1-6, 45-50, Skopje

Мицевски, Љ., Матвејева, Ј., (1979). *Fraxino-Alnetum glutinosae* ass. nova во шумската вегетација на СР Македонија, ШП 1-2, 57-86

Мицевски, Љ., Ризовски, Р., (1981) Шумско-вегетациска карактеристика на Мариово. Зборник на трудови Мариово природни и социо-економски обележја и можности за развој-Друштво за наука и уметност –Прилеп-Битола.

Мониторинг на сливното подрачје на реката Струмица (2017-2018).

Настова-Ѓорѓиоска и сор. (1998). Квалитативен состав на компонентите на исхраната на рибите од реката Вардар како индикатор за одредување риболовни ревири од аспект на спортскорекреативниот риболов. Зборник од трудови на меѓународен научен собир „Перспективи и унапредување на планирањето и уредувањето на просторот“. Охрид, 4-7 март, 1998 год.

Националната стратегија за биолошка разновидност на Македонија (2014).

Николовски, Т., (1951). Придонес кон познавање на костеновите шуми, Годишник на Шумарскиот Институт, кн. 1, Скопје

Николовски, Т., Циримотиќ Ј., (1958). Карактеристика на крајбрежни растителни групации по средното и долното течение на р. Вардар. Год. Шум. Институт III Скопје

Оикос. (2011). Валоризација на природните вредности на Планината Беласица. Домжале.

Општина Богданци, (2014). Стратегија за климатски промени на општина Богданци за период 2014-2020 година, (на македонски).

Пенџерковски, Ј. (1958). Геолошко-петрографски карактеристики и тектоника на Република Македонија, Секторска студија, Институт за просторно планирање, Скопје.

Петковски, Р. (1998). Врска меѓу неотектонските движења и езерските стадиуми во Македонија. Зборник на трудови од I Конгрес на еколозите на Македонија со меѓународно учество, Охрид, 855-867.

Петковски, С., Сидоровска, В., Џукич, Г. (2000/2001). Биодиверзитетот на фауната на змиите (Reptilia: Serpentes) во Македонија (The Biodiversity of the Macedonian Snake Fauna (Reptilia: Serpentes)). Екологија и Заштита Животне Средине, Скопје 7: 41-54.

План за управување на речниот слив за реката Брегалница (2013-2014).

Познавање овчепољске овце. Годишен зборник на Земјоделско-шумарскиот факултет на Универзитетот во Скопје. Земјоделство, том XV, 1961/62.

Прирачник за хабитати на ЕУ (2013). Interpretation Manual of European Union Habitats - EUR28 (2013). Eeuropean Commission, DG Environment. Nature ENV B.3.

Радовановић, В.С. (1931). Холокарст хуме под Кожуфом. Глас. СНД, Књ IX. Св. 3, Скопље, стр. 108-159.

Радовановиќ, В., (1931). Холокарст Хуме под Кожуфом, Гласник Српског географског друштва, Скопје.

Ракиќевиќ Т., Пенџерковски Ј., Ковачевиќ. (1980). Основна геолошка карта (ОГК) на Република Македонија во размер 1:100000, Лист Струмица К 34-94 Геолошки завод на СРМ, Скопје.

РГУ, (1982). СР Македонија низ катастарска евиденција, Скопје.

Риболовни основи: Management plan (Fishing ground) for fishing waters in the Republic of Macedonia - Paljurci Reservoir, for the period of 2017– 2022.

Риболовни основи: Management Plan (Fishing grounds) for fishing waters in the Republic of Macedonia. Lower part of the River Vardar, for the period of 2017 – 2012.

Ризовски, Р., (1974): Ценози на дабот плоскач (Quercus farnetto Ten.) како засебен вегетациски појас во Долното Повардарје ГЗШФ (шумарство), 26, Скопје

Ризовски, Р., (1983). Фитоценозата на бука и ситнолисна липа (Tilio cordatae – Fagetum Ass. nov.) во Македонија, МАНУ, Прилози IV 1-2 Оделение за биолошки и медицински науки, Скопје

Ризовски, Р., (1992). Вегетациска карта на Македонија –ракопис (извештај)

Ризовски, Р., Групче, Љ., Ризовска -Атанасовска, Ј.,(1996) Рефугиуми во клисурите на р. Треска како простори за заштита на биолошката разновидност во Р. Македонија. Симпозиум: Национални паркови и нивната улога во заштитата на биодиверзитетот на Балканскиот полуостров, Охрид.

Ризовски, Р., Ризовска Атанасовска, Ј., (1998) Заедницата на македонскиот даб (*Quercus trojana* Webb.) во долината на реката Раец. I Конгрес на еколозите на Македонија со меѓународно учество-Зборник на трудови Том 1

Ризовски, Р., Џеков, С., (1990). Шумска вегетација на Бистра. Едиција Бистра, кн II, МАНУ, Скопје.

Ризовски, Р., Џеков, С., (1990). Бистра II. Шумската вегетација на планината Бистра, МАНУ, 1-72, Скопје.

Ристовска, М. и Костов, В., (2016). "Студија за валоризација на Спомениkот на природата Дојранско Езеро".

Рудски, И. (1943). Прилог за познавању флоре околине Струмице. Охридски зборник, 2 (136): 205-238.

Сошка, Т. (1953). Придонес кон познавањето флората на клисурите во Македонија. - Клисурите кај Струмица и Валандово. АСТА, Изд. Прир. Науч. Муз., Скопје, 1(3):61-77.

Стојанов, Н. (1921). Флористични материјали од Беласица. Годиш. СУ (ФМФ), 15-16: 1-133.

Стојмилов, А. (2003). Физичка географија на Република Македонија. ПМФ.Скопје. 1-316.

Стратегија за развој на руралната средина која ги опфаќа територииите на општина Богданци, Валандово, Гевгелија и Дојран" (2016).

Студија (2010). Валоризација на природните вредности на Планината Беласица".

Студија (2016)."Оцена на влијанието врз животната средина (Нетехничко резиме), Еуромакс Ресоурцес - Проект за бакар и злато „Иловица" (2016).

Студија за валоризација на Спомениkот на природата Дојранско Езеро (2016).

Темовски, М. (2012). Површинска распространетост на карстните карпи во Република Македонија. Географски разгледи, 46, 21-35

Темовски, М. (2013b). Карактеристики на хипогената карстификација и појава на хипоген карст во Република Македонија, Географски Разгледи, 47, 11-29.

Теофиловски, А. (2011). Прилози за флората на Република Македонија 1-142

Тодоровски, Н. (1972). Придонес кон разрешување на прашањето за постоењето на типови кај шарпланинскиот сој овци. Сточарство 26:39-50.

Ќуштеревска, Р., (2014). Фитоценолошки истражувања на вегетацијата на брдските и планинските пасишта на планината Галичица. Докторска дисертација, Природно-математички факултет, Скопје.

Факултет за земјоделски науки и храна - Скопје, Институт за анимална биотехнологија, Матично книговодство, селекција и следење на состојбите во сточарството, Извештај, 2017.

Хлебаров, Г., (1942). Каракачанска овца. Год. на Софискиот унив. Том. XX. Книга 1 Софија.

Христовски, С., Брајаноска, Р. (eds) (2015). Биолошка разновидност во сливот на реката Брегалница. Завршен извештај по проектот „ Анализа на недостатоци во еколошки податоци и изработка на карта на еколошка сензитивност за подрачјето на сливот на река Брегалница", Книга 2, Скопје.

Цветковска-Ѓорѓиевска, А. (2015). Екологија и дистрибуција на безрбетната фауна на планината Беласица со посебен осврт на тркачите (Coleoptera: Carabidae). Докторска дисертација, Скопје

Черњавски, П. (1943). Прилог за флористичко познавање шире околине Охридског Језера. Охрид. Зборн., 35(2): 11-88.

Џабирски, В., Порчу, К. Пациновски, Н. (2014). Факултет за земјоделски науки и храна - Скопје, Институт за анимална биотехнологија, Датотека на Програма за биолошка разновидност во козарството.

Џеков, С., Ризовски, Р.(1978). Шумската растителност во Малеш и Пијанец. МАНУ (посебно издание) Малеш и Пијанец I – Вегетација, Скопје

Шапкарев, Ј. (1981). Пијавиците (Annelida: Hirudinea) од блатата во Македонија. Македонска академија на науките и уметностите, Прилози 1-2: 43-61.

Латиница

Adamopoulou, C. & Legakis, A., (2016). First account on the occurrence of selected invasive alien vertebrates in Greece. BioInvasions Records, Volume 5, Issue 4: 189-196. DOI: http://dx.doi.org/10.3391/bir.2016.5.4.01.

Adamović, L. (1909). Die Vegetationsverhältnise der Balkanländern". Leipzig.

Adamović, Ž. (1990). Odonata collected in Strumička Kotlina, Macedonia, Yugoslavia. Bulletin of the Natural History Museum in Belgrade, B(45): 47-59.

Allan, J. D. & Flecker, A. S. (1993). Biodiversity conservation in running waters. BioScience 43: 32-43.

Anonymus. (2005). Environmental impact assessment study (notification) for the ski center Kozhuf. Skopje.

Apostolski K, Jovetić R. (1967). Vlijanie na ishranata na pticite močvarici vrz ribnite populacii od Dojranskoto Ezero. Page 23. Zavod za ribarstvo na SR Makedonija, Skopje.

Apostolski K, Matvejev S. (1955). Lov riba u ogradama pomoću ptica na Dojranskom jezeru. Izdanija Zavod za ribarstvo na NR Makedonija 1:29–65.

Apostolski, K., Petrovski, N., Popovska, O., & Sidorovski, M. (1956). Ribite na Makedonija. Zavod za ribarstvo na SRM, Skopje.

Arsovska, J., Ristovska, M., Kostov, V., Prelic, D., & Slavevska-Stamenkovic, V. (2014). Osteological description of Zingel balcanicus (Teleostei: Percidae). Biologia, 69(12), 1742-1756.

Assessment and Evaluation of Biodiversity on National Level – REPORT and National Catalogue (Check List) of Species (2010). MoEPP, 100 pp.

Assessment, M. E. (2005). Ecosystem and human well-being: biodiversity synthesis. World Resources Institute, Washington, DC.

Atanasova, B. (2010). Faunistic review of cicadas (Homoptera: Auchenorrhyncha) at grapevine in Republic of Macedonia. Masters thesis, Faculty of Agricultural Sciences and Food.

Atanasova, B., Spasov, D., Spasova, D., Dimitrov, Y. (2013). Cicada species on vine plantations in the Strumitza Region, Republic of Macedonia. Agrarni Nauki 4(12): 135-138.

Axel L. Schönhofer and Jochen Martens (2009). Revision of the genus Trogulus Latreille: the Trogulus hirtus species-group (Opiliones: Trogulidae). Contributions to Natural History No. 12: 1207–1251.

Baker, S., (2006). The eradication of coypus (Myocastor coypus) from Britain: the elements required for a successful campaign. In: Koike F, Clout MN, Kawamichi M, De Poorter M, Iwatsuki K (eds), Assessment and Control of Biological Invasion Risks. Shoukadoh Book Sellers, Kyoto, Japan and IUCN, Gland, Switzerland, pp 142–147.

Barbieri, R., Vukić, J., Šanda, R., Kapakos, Y., & Zogaris, S. (2017). Alburnoides economoui, a new species of spirlin from Central Greece and redescription of Alburnoides thessalicus (Actinopterygii: Cyprinidae). Biologia, 72(9), 1075-1088.

Bedjanič, M. & Bogdanović, T. (2006). Regional guide to dragonflies: Other states of former Yugoslavia. In: Dijkstra K-D.B. (Ed.), Lewington R. (Illustr.), Field guide to the Dragonflies of Britain and Europe. British Wildlife Publishing, Dorset, p. 57.

Bedjanic, M. & Vinko, D. (2012). New records of Epallage fatime (Charpentier, 1840) in Macedonia (Odonata: Euphaeidae). Natura Sloveniae, 14(1), 15.

Berg, L. S. (1948). Freshwater fishes of the USSR, and adjacent countries: 3 vols. Ak. Nauk.

Bertolino, S. & Genovesi, P., (2007). Semi aquatic mammals introduced in Italy: case studies in biological invasion. In: Gherardi, F. (ed.), Biological invaders in inland waters: profiles, distribution, and threats. Springer, Dordrecht, Netherlands, pp. 175-191. http://dx.doi.org/10.1007/978-1-4020-6029-8_9.

Bilek, A. (1966). Ergebnisse der Albanien-Expedition 1961 des Deutschen Entomologischen Institutes. 46. Beitrag. Odonata. Beitr. Entomol. 16(3/4): 327-346.

BirdLife International. (2015). European Red List of Birds. European Commission, Luxembourg: Office for Official Publications of the European Communities.

BirdLife International. (2017). European birds od conservation concern: populations, trends and national responsibilities. BirdLife International, Cambridge, UK.

Biserkov, V. et al. (Eds) (2015). Red Data Book of the Republic of Bulgaria. Volume 3. Natural habitats. BAS & MoEW, Sofia.

Blagoev, G. (2002). Check List of Macedonian Spiders (Araneae). - Acta zoologica bulgarica, 54 (3): 9-34.

Bogdanowicz, W., (1990). Geographic variation and taxonomy of Daubenton's bat, Myotis daubentoni in Europe. J. Mamm., 71: 205-218.

Bornmüller, J. (1925). Beiträge zur Flora Mazedoniens, I. Engl.Bot.Jahrb., 59: 294-504, Leipzig

Bornmüller, J. (1926 a). Beiträge zur Flora Mazedoniens, II. Engl.Bot.Jahrb., 60: 1-125, Leipzig.

Bornmüller, J. (1926 b). Bearbeitung der von H. Burgeff und Th. Herzog in den Kriegsjahren 1916/18 in Mazedonien gesammelten Pflanzen, I. ABZ, Jahrg., 32: 16 -37.

Bornmüller, J. (1927). Bearbeitung der von H.Burgeff und Th.Herzog in den Kriegsjahren 1916/18 in Mazedonien gesammelten Pflanzen, II. Allg.Bot. Zeit., Jahrg., 33: 25(249)-38(262).

Bornmüller, J. (1928). Beitrag zur Flora Mazedoniens III. Engler's Bot.Jahrbücher, 61: 1-195

Bornmüller, J. (1932). Bearbeitung der von H.Burgeff und Th.Herzog in den Kriegsjahren 1916/18 in Mazedonien gesammelten Pflanzen, III. Repert. Spec. Nov. Regni Veg., 30: 337-362.

Breitenmoser-Würsten, C. & Breitenmoser, U. (2001). The Balkan lynx population – History, recent knowledge on its status and conservation needs. KORA Report Nr. 7, 39 pp.

Britton, J. R., J. Cucherousset, G. D. Davies, M. J. Godard, and G. H. Copp. (2010)."Non-native fishes and climate change: predicting species responses to warming temperatures in a temperate region." Freshwater Biology 55, no. 5 (2010). 1130-1141.

Brody, J., Andersen, R., Kawachi, M. and Millar, A. (2009). Endangered algal species and how to protect them. Phycologia, 48(5), 423-438.

Bucholz, K. (1963). Odonaten aus Mazedonien. - Opusc. Zool. 70: 1-16.

Buresch, I., Zonkow, J. (1932) Die Verbreitung der Giftschlangen (Viperidae) in Bulgarien und auf der Balkanhalbinsel. Trudove na Balgarsko Prirodno Drushtvo, Sofia 15/16: 189-206.

Buresch, I., Zonkow, J. (1934). Untersuchungen über die Verbreitung der Reptilien und Amphibien in Bulgarien und auf der Balkanhalbinsel. 2. Schlangen (Serpentes). Mitteilungen aus den Königlich Naturwissenschaftlichen Instituten in Sofia 7: 106-188. [на Бугарски, со Германско резиме]

Byk, A. and Marczak, D. (2016). New Data on the Occurrence of Scarabaeoid Beetles (Coleoptera: Scarabaeoidea) in the Republic of Macedonia. Acta Zoologica Bulgarica, 68 (4): 491-496

Cadi, A., & Joly, P. (2003). Competition for basking places between the endangered European pond turtle (Emys orbicularis galloitalica) and the introduced red-eared slider (Trachemys scripta elegans). Canadian Journal of Zoology, 81(8), 1392–1398. https://doi.org/10.1139/z03-108

Čarni, A., Matevski, V., Kostadinovski, M., Ćušterevska, R. (2018). Scrub communities along a climatic gradient in the southern Balkans maquis pseudomaquis and shibljak. Plant Biosystems - An International Journal Dealing with all Aspects of Plant Biology, 2018

Čarni, A., Matevski, V., Šilc, U. (2010). Morphological, chorological and ecological plasticity of Cistus incanus in the southern Balkans. Plant biosystems, 144 (3):602-617, Roma.

Čarni, A., Matevski, V., Šilic, U., Ćušterevska, R. (2014). Early spring ephemeral therophytic non-nitrophilous grasslands as a habitat of various species of Romulea in the southern Balkans. Acta Bot. Croat. 73 (1):107-129.

Carpenter, S. R., Stanley, E. H., & Vander Zanden, M. J. (2011). State of the world's freshwater ecosystems: physical, chemical, and biological changes. Annual review of Environment and Resources, 36, 75-99.

Castroviejo, S. (2009). Zygophyllaceae. – In: Euro+Med Plantbase - the information resource for Euro-Mediterranean plant diversity.

Chavdarova, S., Kajevska, I., Rusevska, K., Grebenc, T. & Karadelev, M. (2011). Distribution and ecology of hypogeous fingi (excluding Tuber) in the Republic of Macedonia. (2011). Biol. Macedonica, 62: 37-48.

Chingovski, J. (1985). Rastitelni Osi [Symphyta: Tenthredinidae (Dolerinae, Selandrinae, Tenthredinidae)], [Insecta-Hymenoptera]. Fauna na Makedonija VI. Mac. Mus. Sci. Nat., Skopje, pp. 251.

Chobanov, D. P. & Mihajlova, B. (2010). Orthoptera and Mantodea in the collection of the Macedonian Museum of Natural History (Skopje) with an annotated check-list of the groups in Macedonia. Articulata, 25(1), 73-107.

Čingovski, J. (1958). Zweiter beitrag zur kenntnis der blattwes-penfauna von Mazedonien. Musei Macedonici Scientiarum Naturalium, Tom V, No.10 (51). Skopje.

Cirimotić, J. (1958). Prilog poznavanju flore planine Duba kod Dojranskog Jezera. Godišnik Šum.Inst. Skopje, 3:175-210.

Cirovic, D., (2006). First record of the raccoon dog (Nyctereutes procyonoides Gray, 1834) in the Former Yugoslav Republic of Macedonia. Eur. J. Wildl. Res., 52: 136-137.

Cook C., Vardaka E. and Lanaras T. (2004). Toxic cyanobacteria in Greek freshwaters, 1997–2000: Occurrence, toxicity and impacts in the Mediterranean region. Acta. Hydroch. Hydrob. 32:107–124.

Copp, G. H., Bianco, P. G., Bogutskaya, N. G., Erős, T., Falka, I., Ferreira, M. T., ... & Kováč, V. (2005). To be, or not to be, a non-native freshwater fish?. Journal of Applied Ichthyology, 21(4), 242-262.

Country study for biodiversity of the Republic of Macedonia – First National Report (2003). MoEPP, 213pp.

Cuttelod, A., Seddon, M. and Neubert, E. (2011). European Red List of Non-marine Molluscs. Luxembourg: Publications Office of the European Union.

Cvetkovska-Gjorgievska, A., Dedov, I., Hristovski, S., Langourov, M., Lazarevska, S., Prelik, D., Simov, N. (2019). New records of allochtonous, invasive and pest invertebrate species from the Republic of Macedonia. Ecologica Montenegrina 20: 56-70)

Cvetkovska-Gjorgjievska, A. (2015). Ecology and distribution of arthropod fauna on Belasitsa Mt. with emphasize on ground-beetles (Coleoptera: Carabidae). Faculty of Natural Sciences and Mathematics, Institute of Biology, Skopje. Doctoral thesis.

Cvetkovska-Gorgievska, A., Chobanov, D. P, Prelić, D., Hristovski, S., Slavevska-Stamenković, V. and Ristovska, M. (2015). Contribution to the knowledge of Orthoptera on Belasitsa Mountain, southeast Macedonia.CONTRIBUTIONS, Section of Natural, Mathematical and Biotechnical Sciences, MASA, Vol. 36, No. 2, pp. 121–133

Cvetkovska-Gorgievska, A., Chobanov, P. D., Prelić, D, Hristovski, S., Slavevska-Stamenković ,V., Ristovska, M. (2015). Contribution to the knowledge of Orthoptera on Belasitsa Mountain, South-east Macedonia. Contributions, Section of Natural, Mathematical and Biotechnical Sciences, MASA, Vol. 36, No. 2, pp. 121–133

Dangel M. (1973). Ornithologische Beobachtungen am Dojran-See. Ornithologische mitteilungen 25:73–75.

Daniel, F. (1964). Die Lepidopteren fauna Jugoslavisch mazedoniens II. Bombyces et Sphinges. Посебно издание No. 2, Природонаучен музеј, Скопје

Daniel, F. (1964). Die Lepidopteren fauna Jugoslawish Mazedoniens. II. Bombyces et Sphinges. Posebno Izdanie. Mus. Mac. Sci. Nat., Skopje. 2: 1-75.

Daniel, F., Forster, W., & Osthelder, L. (1951). Beiträge zur Lepeidopterenfauna Mezedoniens. Veröffentlichtungen der Zoologischen Staatssammlung München 2.

De Jong Y., M. Verbeek, V. Michelsen, P. Bjorn, W. Los, F. Steeman, N. Bailly, C. Basire, P. Chylarecki, E. Stloukal, G. Hagedorn, F. Wetzel, F. Glockler, A. Kroupa, G. Korb, A. Hoffmann, C. Hauser, A. Kohlbecker, A. Muller, A. Guntsch, P. Stoev. & L. Penev. (2014). Fauna Europaea - all European animal species on the web. Biodiversity Data Journal, 2: 1-35.

De Jong, Y. et al. (2014) Fauna Europaea - all European animal species on the web. Biodiversity Data Journal 2: e4034

Dedov I.K. (2012) Two new and rare mountain door-snails (Gastropoda, Pulmonata, Clausiliidae) from high mountain areas in Macedonia. ZooKeys 168: 45–53

Dedov, I., Hristovski, S. (2010). Contribution to the study of the gastropods (Mollusca, Gastropoda) of Kožuf Mt., Republic of Macedonia. Bull. Biol. Stud. Res. Soc 4: 35-40.

DG Environment. (2017). Reporting under Article 17 of the Habitats Directive: Explanatory notes and guidelines for the period 2013-2018. Brussels. Pp 187.

Dimovski A, Matvejev S. (1955). Ornithologische Forschungen in der VR Macedonien. Arhiv Bioloških nauka 1–2:121–138.

Dimovski A. (1966b). Pridones kon raspostranuvanjeto na Algyroides nigropunctatus D. B. na Balkanskiot poluostrov. Годишен Зборник Природно-Математичког Факултета, Универзитета у Скопљу, Скопље, Књига 17-18, Биологија 4: 149- 156.

Dimovski, A (1971). Zoocenološki istražuvanja na stepskite predeli vo Makedonija. Годишен Зборник Природно-Математичког Факултета, Универзитета у Скопљу, Скопље, Књига 23, Биологија 4: 25-54.

Dimovski, A. & Grupce, R. (1971). L'Ichtyofaune de la riviere Brégalnitsa. Izdanija, Institut de Pisciculture de la RS de Macedonie. Skopje IV (7), 1-37.

Dimovski, A. (1959a). I прилог кон херпетофауната на Македонија (Beitrag zur Herpetofauna Mazedoniens). Fragmenta Balcanica 3: 1-4.

Dimovski, A., & Grupce, R. (1971). L'Ichtyofaune de la riviere Brégalnitsa. Izdanija, Institut de Pisciculture de la RS de Macedonie. Skopje IV (7), 1-37.

Dimovski, A., & Grupce, R. (1972). L'Ichthyofaune de la riviere Treska. Acta Musei Macedonici Scientiarum Naturalium, 12, 185-205.

Dimovski, A. & R. Grupche, (1987). Contribution to taxonomy of Genus Barbus (Pisces, Cyprinide) in Macedonia. Fragm. Balc. Mus. Maced. Sci. Nat., 13 (10/288): 95-111

Djilvidjiev, G., Stojceski, D. (2015). Natural-geographic features of the upper basin of the river Bashiboska and tourist valorization of hidromorphological structures (waterfalls) on Bashiboska River. Proceedings of V-th Congress of geographers of the Republic of Macedonia; Skopje.

Doflein, F. (1921). Mazedonien, Erlebnisse und beobachtungen eines Naturforschers im gefolge des Deutschen heeres. Verlang von Gustav Fischer, Jena.

Donchev, I., (1996). Number of killed wolves in the Republic of Macedonia for the period 1947-1987. Publisher: author. Skopje. (in Macedonian).

Dragan P. Chobanov (2002). Results of the orthopterological investigations from Ograzden and Kozjak Mts., Republic of Macedonia. Bulletin Biology students Research Society, 2, 111-117.

Dragan P. Chobanov and Branislava Mihajlova (2010).Orthoptera and Mantodea in the collection of the Macedonian Museum of Natural History (Skopje) with an annotated check-list of the groups in Macedonia. Articulata, 25 (1): 73-107

Dulic, B. & Mikushka, J. (1966). Two new species of Bats (Mammalia, Chiroptera) from Macedonia with notes on some other Bats occurring in this Territory. Fragmenta balc. Mus. Maced. Sci. nat., Skopje, 61(1): 1-13.

Dulic, B. & Miric, D. (1967). Catalogus Fauna Jugoslavije. IV/4 Mammalia. Academia Scieniarium et Artium Slovenica, Ljubljana: 1-45.

Dzabirski, V. & Porcu., K. (2013). Regional distribution of cattle, sheep and goat farms in the Rebuplic of Macedonia, according to farm size and breed structure. Interantional Sympoziun for Agriculture and Food, Skopje, 2013 p649-664.

Dzabirski V. at al. (2015). Assessment of Genetic Diversity in Domestic Balkan Goat Ecotypes in the Republic of Macedonia.

Džukić, G., Grubač, B. (1988). New findings on the turkish sand boa Eryx jaculus turcicus (Olivier 1801) in Yugoslavia (Serpentes, Boidae). Archives of Biological Sciences 40: 11-12.

Eberhard Konigsmann (1969). Falten wespen aus Mazedonien (Hymenoptera, Vespoidea). Musei Macedonici Scientiarum Naturalium, Tom XI, No.8 (98), Skopje

Economidis, P. S. (1991). Check list of freshwater fishes of Greece: recent status of threats and protection. Hellenic Society for the Protection of Nature.

Economidis, P. S. (1995). Endangered freshwater fishes of Greece. Biological Conservation, 72(2), 201-211.

Economidis, P. S., & Banarescu, P. M. (1991). The distribution and origins of freshwater fishes in the Balkan Peninsula, especially in Greece. Internationale Revue der gesamten Hydrobiologie und Hydrographie, 76(2), 257-284.

Economidis, P. S., Kattoulas, M. E., & Stephanidis, A. (1981). Fish fauna of the Aliakmon river and the adjacent waters (Macedonia, Greece). Cybium, 5(1), 89-95.

Economou, A. N., Giakoumi, S., Vardakas, L., Barbieri, R., STOUMBOUDI, M. T., & Zogaris, S. (2007). The freshwater ichthyofauna of Greece-an update based on a hydrographic basin survey. Mediterranean Marine Science, 8(1), 91-166.

Em, H., (1961). Субалпска букова шума на македонските планини. - Шумарски преглед - 9 (5): 21-35: Скопје.

Em, H., (1962). Šumske zajednice četinara u NR Makedoniji. - Biološki glasnik, 15 (1): 1-38; Zagreb.

Em, H. (1966). Notizen zur Flora Mazedoniens. Fragm.balc., 5(24):177-185, Skopje.

Em, H., (1978). O nekim osobenostima borovih suma Makedonije. I. Reliktne crnoborove zajednice.- Mitt.Ostalp.-din.Ges.f.Veget.-Innsbruck.

Em, H., (1980). O nekim osobenostima borovih šuma Makedonije. I. Reliktne crnoborove zajednice. - Mitt. Ostalp.-din. Ges. f. Veget. - Innsbruck.

Em, H., Rizovski, R., Dzekov, S., (1988). Ein Beitrag zur Kenntnis refugialer Vegetation Mazedoniens. Bushen – Hopfenbushenmischwald im Treskakanon, Atti del simposio della societa estalpino – dinarica di fitosociologia: Feltre 29 giugno – 3 luglio

Em. H., (1981). O nekim osobenostima borovih šuma Makedonije. II. Prilozi MANU: Oddelenie za bioloski i medicinski nauki. 2(1-2): 5-16. Skopje.

EU Habitats directive/ COUNCIL DIRECTIVE 92/43/EECof 21 May 1992 on the conservation of natural habitats and of wild fauna and flora.

European commission (2013). The Interpretation Manual of European Union Habitats - EUR28. – European Commission DG Environment. Nature ENV B.3. 144 pp.

Evans, D.& Roekaerts, M. (2015). Interpretation manual of the habitats listed in Resolution No. 4 (1996) listing endangered natural habitats requiring specific conservation measures. Third draft version 2015 - Strasbourg, 31st August 2015 T-PVS/PA (2015) 9.

Fehringer, O. (1922). Die Vogelwelt Macedoniens. Forschungsreise auf dem macedonischen Kriegsschauplatz 1917 und 1918. Journal für Ornithologie 70:286–324.

Fehringer O. 1920. Vogelzug in Macedonien Frühjahr (1918). Ornithologische Monatsberichte 28:55–57.

Filipovski, Gj. (1959). Geneza, evolucija i naučne osnove melioracija slatina Ovčeg Polja. God. Zborn. Zem.-Šum. Fak., Zemjodelstvo. Kn. 12.

Formanek, E. (1890). Beitrag zur Flora von Serbien, Macedonien und Thessalien. Deutsche Bot. Monatsschr. 8(5-6): 65-72.

Formanek, E. (1890). Beitrag zur Flora von Serbien, Macedonien und Thessalien. Deutsche Bot. Monatsschr. 8(11-12): 161-175.

Formanek, E. (1891a). Beitrag zur Flora von Serbien, Macedonien und Thessalien. Deutsche Bot. Monatsschr. 9(2-3): 24-32.

Formanek, E. (1891b). Beitrag zur Flora von Serbien, Macedonien und Thessalien. Deutsche Bot. Monatsschr. 9(4-5): 63-76.

Formanek, E. (1891c). Beitrag zur Flora von Serbien, Macedonien und Thessalien. Deutsche Bot. Monatsschr. 9(6-7): 88-101.

Formanek, E. (1892). Beitrag zur Flora von Serbien und Macedonien. Verh. Naturf. Vereins Brünn, 30: 50-96.

Formanek, E. (1894a). Zweiter Beitrag zur Flora Serbien und Macedonien. Verh. Naturf. Vereins Brünn, 32: 146-210.

Formanek, E. (1894b). Zweiter Beitrag zur Flora Serbien, Macedonien und Thessalien. Verh. Naturf. Vereins Brünn, 34: 255-365.

Formanek, E. (1898). Vierter Beitrag zur Flora von Macedonien. Verh. Naturf. Vereins Brünn, 36.

Formanek, E. (1899a). Funfter Beitrag zur Flora von Macedonien. Verh. Naturf. Vereins Brünn, 37: 124-220.

Formanek, E. (1899b). Fünfter Beitrag zur Flora von Macedonien. Verh. Naturf. Vereins Brünn, 37: 124-220.

Formanek, E. (1900). Sechster Beitrag zur Flora von Macedonien. Verh. Naturf. Vereins Brünn, 38: 165-240.

Freyhof, J. & Brooks, E. (2011). European red list of freshwater fishes (p. 61). Luxembourg: Publications office of the European Union.

Geiger S, Kratzer R, Stopper H. (1974). Vogelkundlische Fruhjahrsbeobachtungen in Macedonien. Ornithologische Mitteilungen 26:133–141.

Geiger, M. F., Herder, F., Monaghan, M. T., Almada, V., Barbieri, R., Bariche, M., ... & Denys, G. P. (2014). Spatial heterogeneity in the Mediterranean Biodiversity Hotspot affects barcoding accuracy of its freshwater fishes. Molecular ecology resources, 14(6), 1210-1221.

Gkelis, S., Lanaras, T. and Sivonen, K. (2015). Cyanobacterial toxic and bioactive peptides in freshwater bodies of Greece: concentrations, occurrence patterns and implications for human health. Marine Drugs, 13:6319-6335.

Goellner-Scheiding, U. (1978). Beitrag zur kenntnis der Heteropterenfauna Mazedoniens. Acta. Mus. Mac. Sci. Nat., Skopje, 15: 145-150.

Gogala, M., Trilar, T., Krpac, V. T. (2005). Fauna of singing cicadas (Auchenorrhyncha: Cicadoidea) of Macedonia – A bioacoustic survey. Acta. Ent. Slov. 13(2): 113-126.

Göllner-Scheiding, U. (1978). Beitrag zu Kenntnis der Heteropterenfauna Mazedoniens. Acta Mus. Mac Scient. Nat., 15(6): (131), 145-149.

Griffin, J., S. Petkovski & Sidorovska, V. (2001). Biodiversity Assessment for Macedonia. Chemonics International Inc., Washington, D.C. & USAID/Macedonia. pp: 1-61.

Grubač, B, Velevski, M., Avukatov, V. (2014). Long-term population decline and recent breeding performance of the Egyptian Vulture Neophron percnopterus in Macedonia. North-Western Journal of Zoology 10:25–35.

Grubač, B. (2002). Le Statut de Gypaete barbu (Gypaetus barbatus) en Yougoslavie et Macedoine. Pages 53–60 in LPO Fir, editor. Proceedings of the International Conference “Conservation of Bearded Vulture populations.” LPO Fir, Tende-Mercantour National Park, France.

Grubač, B., Velevski, M. (2010). The Lanner Falcon Falco biarmicus in Macedonia. Falco 35:9–12.

Grubač, B., Velevski, M., Lisičanec, T., Lisičanec, E., Rolevski, D., Andevski, J. (2007). Decrease of population size of the Griffon vulture Gyps fulvus in Macedonia and assessment of conservation measures. Abstract Book of the 3rd Congress of Ecologists of Republic of Macedonia:101–102.

Grubač, BR. (1998). Population status and conservation of the Black Vulture (Aegypius monachus) in the Former Yugoslavian Republic of Macedonia (FYR Macedonia). Pages 63–72 Proceedings of the Conference The Black Vulture in South Eastern Europe. BVCF/FZS, Dadia, Greece.

Guéorguiev, B. (1960). Contribution a la connaissance des Coleopteres Hydrocanthares de Yougoslavie. Acta, Mus. Mac. Sci. Nat., 7(2/26): 19-39.

Guéorguiev, B. (2007). Annotated catalogue of the carabid beetles of Albania (Coleoptera: Carabidae). Pensoft, Sofia-Moscow, 243 pp.

Gueorguiev, B.(1998). Ground-beetles (Coleoptera: Carabidae) collected by Bulgarian zoologists in Republic of Macedonia. Historia naturalis bulgarica, 9, 1998: 35-51

Gueorguiev, B., Bekchiev, R., Chehlarov, E., Hristovski, S., Prelik, D., Cvetkovska-Gorgievska, A. (2010). New Coleoptera (Insecta) species from Republic of Macedonia. Acta Zoologica Bulgarica, 62 (3), pp 363-365

Gunther, K. (1980). Beitrage zur Kenntnis der Psocoptera-Fauna Mazedoniens. Acta Mac.Mus. Sci. Nat., 16 (1): 1-32. Skopje.

Haberl W., Petkovski S., Hoffmann I.E., (2012). Distribution and assessment of endangered European ground squirrel (Spermophilus citellus gradojevici) populations in south-eastern Macedonia (FYROM). IV. European Ground Squirrel Meeting. Polish Society for Nature Conservation Salamandra, Poland: 15.

Hackethal, H. & Peters, G.,(1987). Notizen über mazedonische Fledermäuse (Mammalia: Chiroptera). Acta Mus. maced. sci. nat., 18(6/152): 159-176.

Hanžel, J. (2010). From the ornithological notebook: Cattle Egret Bubulcus ibis. Acrocephalus 31:57–71.

Hanžel, J. (2012). Poročilo ornitološke skupine. Pages 45–51 in Š. Borko, editor. Ekosistemi Jadrana 2010 Makedonija. Društvo študentov biologije, Ljubljana.

Heckenroth, H, Heins J-U. (2010). Weißstorch (Ciconia ciconia) Brutbestand im östlichen Makedonien im Jahr 2010.

Henrici, P. (1928). An Brutplätzen der Beutelmaise, Remiz pendulinus pendulinus (L.). Beiträge zur Fortpflanzungsbiologie der Vögel 4:3–5.

Henrici, P. (1930). Brutvorkommen von Mergus albellus L. in Macedonien. Beiträge zur Fortpflanzungsbiologie der Vögel mit Berücksichtigung der Oologie 6:30.

Heyrovsky, L. (1939). Beitrag zur Kenntnis der Cerambyciden-Fauna der Kozuf-Planina und deren Vorgelande (Coleoptera, Cerambycidae). Annales Musei Serbiae Meridionalis. Tom 1, No 4, Skopje.

Hristovski, S. & Gueorguiev, B. (2015). Annotated catalogue of the carabid beetles of the Republic of Macedonia (Coleoptera: Carabidae). Zootaxa,4002(1), 1-190.

Hristovski, S., Slavevska-Stamenković, V., Hristovski, N., Arsovski, K., Bekchiev, R., Chobanov, D..& Komnenov, M. (2015). Diversity of invertebrates in the Republic of Macedonia. Macedonian Journal of Ecology and Environment, 17(1), 5-44.

http://ec.europa.eu/environment/nature/legislation/habitatsdirective/docs/Int_Manual_EU28.pdf.

http://investinseregion.mk/index.php/mk/2015-07-23-20-18-42/2016-01-18-13-09-56/77-jugoistocen-region/222-2016-01-20-11-27-22

http://www.artdata.slu.se/Bern_Fungi/ECCF%2033_TPVS%20%282001%29%2034%20rev_low%20resolution_p%201-14.pdf

https://commons.wikimedia.org/w/index.php?curid=26384496 , MacedonianBoy - сопствено дело, based on this map, CC BY-SA 3.0, (за карти на опсхтините)

https://rm.coe.int/16807469f9

Ikonomov, P. (1974). Distribution saisonnière des Plécoptères (Insectes) dans les eaux de Macédoine par rapport au facteur température.VI. Ruisseau de Karani (Montagne de Belassitsa). Contributions of the Macedonian Academy of Sciences and Arts. 6(2): 29-49.

Ikonomov, P. (1986). Plécoptères de Macédoine (Insecta, Plecoptera). Taxonomie et Distribution. Acta Musei macedonici scientiarum naturalium, 18(4): 81-124.

Ing, B., (1993). Towards a Red List of endangered European macrofungi. Royal Botanic Gardens, Kew, pp. 231-237.

Interpretation Manual of European Union Habitats - EUR28 (2013). Eeuropean Commission, DG Environment. Nature ENV B.3.

IUCN (2019). The IUCN Red List of Threatened Species. Version 2019-2. http://www.iucnredlist.org. Downloaded on 18 July 2019.

Ivanov, G., Karamanlidis, A., Stojanov, A., Melovski, D. & Avukatov, A. The reestablishment of the golden jackal (Canis aureus) in FYR Macedonia: Implications for conservation. Mammalian Biology 81 (2016) 326-330.

Jankovic, Lj. (1971). Homoptera: Auchenorrhyncha from Macedonia. Acta. Mus. Mac. Sci. Nat., Skopje, 12 (3): 42-59.

Jelić, D., Ajtić, R., Sterijovski, B., Crnobrnja-Isailović, J., Leto, S., Tomović, Lj. (2012) Distribution of the genus Vipera in the western and central Balkans (Squamata: Serpentes: Viperidae).

Johnson, AR, Hafner, H. (1970). I.W.R.B. Mission to South-eastern Europe. Winter 1969-1970. Biological Station at Tour du Valat, Tour du Valat.

Josifov, M. (1986). Verzaichnis der von der Balkanhalbinsel bekannten Heteropterenarten (Insecta, Heteroptera). Faunistische Abhandlungen Staatliches Museum füer Tierkunde in Dresden 14(6): 61-93.

Jovetić, R. (1960. Roda bijela, Ciconia ciconia, u Makedoniji. Larus 14:75–83.

Jović M. (2009). Report on Macedonia 2008 project - Odonata. IDF-Report 21: 1-23.

Jović, M. & Mihailova, B. (2009): Cataloque of the Odonata collection in the Macedonian Museum of Natural History. Acta entomologica serbica, 14(2): 133-146.

Kaczensky, P., Chapron, G., von Arx., Huber, Dj., Andrén, H. & J. Linnell, (eds.), (2012). Status, management and distribution of large carnivores – bear, lynx, wolf & wolverine – in Europe. Report to the EU Commission, Part 1 and Part 2, 2012.

Kajevska, I., Rusevska, K. & Karadelev, M. (2013a). The family Pyronemataceae (Pezizales, Ascomycota) in the Republic of Macedonia. Macedonian Journal of Ecology and Environment Vol. 15, 1: p. 11-22.

Kalkman, V.J., Boudot, J.-P., Bernard, R., Conze, De Knijf, K.-J. Dyatlova, G. E. Ferreira, S., Jović, M., Ott, J., Riservato, E. and Sahlén, G. (2010). European Red List of Dragonflies. Luxembourg: Publications Office of the European Union. Karaman, S. (1928) III Prilog herpetologiji Jugoslavije. Glasnik Skopskog Naučnog Društva, Skopje 4: 129-143. [in Serbian]

Karadelev, M. & Nastov Z. (1998). A check-list of ascomycete fungi from the Republic of Macedonia. God. zb., Biol.-Prir.-mat. fak. Univ. “Sv. Kiril i Metodij” Skopje, 51:17-21.

Karadelev, M. & Rusevska, K. (2004-2005). Ecology and distribution of genus Hymenochaete Lév. (Hymenochaetaceae) in the Republic of Macedonia. Biol. Macedonica, 57/58:39-53.

Karadelev, M. & Rusevska, K. (2008). Bern convention fungi candidates from Macedonia I (Boletus dupainii, Phylloporus rhodoxanthus and Suillus sibiricus ssp. helveticus). Biol. Macedonica, 61:7-14.

Karadelev, M. & Rusevska, K. (2013). Contribution to Macedonian red list of fungi. Proceedings of the 4th Congress of Ecologists of Macedonia with International Participation, Ohrid, 12-15 October 2012, Macedonian Ecological Society. pp. 68-73.

Karadelev, M. & Rusevska, K. (2016a). Distribution Maps of Critical Endangered Species from Macedonian Red List of Fungi. Hyla Vol. 2016., No.1, pp. 14- 18.

Karadelev, M. & Rusevska, K. (2016b). New data on macromycete species (Basidiomycota) in Macedonia. Contributions, Section of Natural, Mathematical and Biotechnical Sciences, MASA, Vol. 37, No. 2, pp. 167–172.

Karadelev, M. & Spasikova, S. (2009). Second contribution to hallucinogenic fungi in the Republic of Macedonia. – In: Ivanova, D. (ed.), Plant, fungal and habitat diversity investigation and conservation. Proceedings of IV Balkan Botanical Congress, Sofia, 20–26 June 2006. Pp. 441–449.

Karadelev, M. & Spasikova. S. (2004). First contribution to hallucinogenic fungi in the Republic of Macedonia: distribution and syndromes. Mycol. Monten. VII:35-46.

Karadelev, M. & Spasikova. S. (2004-2005). The genus Psilocybe (Agaricales, Strophariaceae) in the Republic of Macedonia: a revision of the known species and a first record of Psilocybe phyllogena. Biol. Macedonica, 57/58:55-66.

Karadelev, M. (1993). Contribution to the knowledge of wood – destroying fungi in the Republic of Macedonia. Young explorers of Macedonia, Fungi Macedonici I, 78 pp.

Karadelev, M. (1995a). Lignicolous Aphyllophorales (Basidiomycetes) on Greek Juniper (Juniperus excelsa) in the Republic of Macedonia. Mycotaxon, LVI: 467-472.

Karadelev, M. (1998). Fungal biodiversity in Macedonia I. With a special regard to substrates with a disjunct range and relict origin. Mycologia Montenegrina, I-n, 49-55.

Karadelev, M. (1999). New or rare species of lignicolous Aphyllophorales (Basidiomycotina) for the fungia of the Republic of Macedonia. God. zb., Biol.-Prir.-mat. fak. Univ. “Sv. Kiril i Metodij” Skopje, 52:97-101.

Karadelev, M. (2000). New and noteworthy species of Aphyllophorales (Basidiomycotina) from the Republic of Macedonia. Pagine di Micologia, A.M.B.Centro Studi Micologici, Vicenza, Italy, 14:62-67.

Karadelev, M. (2001a). Fungi Macedonici – Габите на Македонија. Македонско миколошко друштво. Скопје. 1-299.

Karadelev, M. (2001b). Distribution of lignicolous macromycetes, parasites and saprophytes on Juniperus spp. (J. excelsa, J. foetidissima, J. sabina, J. communis and J. oxycedrus) in the Balkan Peninsula. La Deuxième Colloque International "Le Genévrier thurifère et le forêts d'Altitude dans les Montagnes du Pourtour Méditeranéen", Marrakech, Morocco, 125-131.

Karadelev, M. (2001c). Lignicolous macromycetes, parasites and saprophytes on Juniperus spp. distributed in the Balkan Peninsula. Mycol. Monten. III (1):115-125.

Karadelev, M. Rusevska, K. & Stojkoska. K. (2008e). Distribution and ecology of the gasteromycete fungi - orders Phallales and Sclerodermatales in the Republic of Macedonia. Proceedings of III Congress of Ecologists of the Republic of Macedonia with International Participation. Struga, 06-09.10.2007. Macedonian Ecological Society, Skopje, 2008. pp. 208-216.

Karadelev, M., Kost, G., Rexer, K. H. (2007b). New macromycetes species (Ascomycetes and Basidiomycetes) for mycota of the Republic of Macedonia. Collection of papers Devoted to Academic Kiril Micevski. Maced. Acad. Sci. Arts. Skopje. 311-327.

Karadelev, M., Rusevska, K. & Kajevska, I. (2008c). Distribution and ecology of Genus Ganoderma (Ganodermataceae) in the Republic of Macedonia. Proceedings of International conference on Biological and Enveronmental Sciences, Tirana, Albania, 26.-29.09.2008. Tirana, pp. 320-326.

Karadelev, M., Rusevska, K. & Spasikova. S. (2006). Ecology and distribution of the genus Boletus L. (Boletaceae) in the Republic of Macedonia. Mycol. Monten., IX:7-23.

Karadelev, M., Rusevska, K. & Spasikova. S. (2007a). The Family Boletaceae s.l. (Excluding Boletus) in the Republic of Macedonia. Turk J Bot, 31:539-550.

Karadelev, M., Rusevska, K. & Taukcieva. L. (2008a). Diversity and ecology of fungi in Monospitovo Marsh, Republic of Macedonia. Biol. Macedonica, 61:15-28.

Karadelev, M., Rusevska, K. & Taukcieva. L. (2008b). Diversity and ecology of macromycetes on Ograzden Mountain, Republic of Macedonia. Biol. Macedonica, 61:29-45.

Karadelev, M. Rusevska, K. & Stojanovska. S. (2008d). Ecology and distribution of Genus Phellinus (Hymenochaetaceae) in the Republic of Macedonia. Proceedings of III Congress of Ecologists of the Republic of Macedonia with International Participation. Struga, 06-09.10.2007. Macedonian Ecological Society, Skopje, 2008. pp. 197-207.

Karadelev, M., Rusevska, K. & Cicimov, V. (2011). Distribution and ecology of genus Amanita (Amanitaceae) in the Republic of Macedonia. Glas. Rep. Zavoda Zašt. Prir. Podgorica. 31-32: 63-84.

Karadelev, M., Rusevska, K. & Pampurova, S. (2009). Ecology and distribution of Morels (Morchellaceae, Helvellaceae) in the Republic of Macedonia. Екологија и заштита на животната средина. 12 (1/2): 45-55.

Karaman S. (1928). Прилози Ихтиологији Југославије I. (Beiträge zur Ichthyologie von Jugoslavien I). Bulletin de la Société Scientifique de Skoplje 6: 147-176. [Караман, С. (1928): Прилози ихтиологија Југославије. I. Глас.Скоп.научн.друштва, 6. (2).

Karaman, B. (1969). Contribution a la connaissance des Odonatesen Macedoine. Fragenta Balcanica Musei macedonici scientiarum. Tom 7, 11 (169), pp. 93-102.

Karaman, B. (1979). Contribution a la connaissance de l' ecologie des larves d'Odonates dans l'ecosysteme du lac de Doiran. Ann. Fac. Biol. Univ. Skopje, 32: 191-199.

Karaman, B. (1981). Contribution a la connaissance de la faune des Odonates du lac de Doiran. God.zb.Biol., T.34, 45-53.

Karaman, B. (1981). Contribution a la connaissance de la faune des Odonates du lac de Doiran. Ann. Fac. Biol. Univ. Skopje, 34: 215-222.

Karaman, G. (2013). Invasive species of Amphipoda (Crustacea, Malacostraca) in Ohrid Lake basin (Contribution to the knowledge of the Amphipoda 265). Mac. J. Ecol. Env, 15(1): 5-10.

Karaman, S. (1924). Pisces macedoniae. Hrvatska Štamparija.

Karaman, S. (1931). Zoološke prilike Skopske kotline. Glasnik Skopskog Naučnog Društva, Skopje 10: 214-241. [in Serbian] Karaman, S. (1937): Fauna južne Srbije. Spomenica, Skoplje: 161-179. [in Serbian]

Karaman, S. (1937). Prilog poznavanju slatkovodnih riba Jugoslavije. Glasnik Skopskog Naučnog Društva, 18, 55-61.

Karaman, S. (1938-1939). Vipera ursinii Bonap., treća otrovnica iz južne Srbije (Vipera ursinii Bonap., die dritte Giftschlange Sudserbiens). Glasnik Skopskog Naučnog Društva, Skoplje 20: 165-166. [in Serbian, with German summary]

Karaman, S. (1939). Über die Verbreitung der Reptilien in Jugoslavien. Annales Musei Serbiae Meridionalis, Skoplje 1: 1- 20.

Karaman, S. L. (1955). Die fische der Strumica (Struma-system). Prirodonaučen muzej.

Karaman, S., (1929). O slepim misevima Jugoslavije. Glasn. Nauc. D-va, 9, Skopje.

Karamanlidis, A.A., Stojanov, A., Hernando, M.G., Ivanov, G., Kocijan, I., Melovski, D., Skrbinšek, T. & A. Zedrosser, (2014). Distribution and genetic status of brown bears in FYR Macedonia: implications for conservation. Acta Theriologica, 59:119–128.

Kekić, A. (1976). Prilog poznavanju karsta i karstne izdani na gornjem slivu reke Bošave (planina Kožuf). 8-mi Jugoslovanski geološki kongres, Ljubljana, 71-94.

Klimesch, J. (1968). Die Lepidopteren fauna Mazedoniens. IV. Microlepidoptera. Posebno Izdanie. Mus.Mac. Sci. Nat., Skopje. 5: 1-203.

Koenigsmann, E. (1969). Faltenwespen aus Mazedonien (Hymenoptera: Vespoidea). Acta. Mus. Mac. Sci. Nat., Skopje. 11 (8): 147-160.

Komnenov, M. (2005). New data on jumping spiders in the Republic of Macedonia with a complete checklist (Araneae: Salticidae). Acta. Zool. Bulg,1, 301-314.

Konstantinou, I.K., Hella, D., Albanis, T., (2006). The status of pesticide pollution in surface waters (rivers and lakes) of Greece. Part I. Review on occurrence and levels. Environ Pollut;141(3):555–70.

Koovács, T. & Murányi, D. (2013). Larval data of Caliaeschna microstigma (Schneider, 1845) from the Balkan Peninsula, with contributions to its biology (Odonata: Aeshnidae). Folia Historico Naturalia Musei Matraensis, 37: 21-28.

Kostov V. & M. Van Der Knaap, M. (2009). The collapse of Fisheries of Lake Dojran – Reasons, Actual situation and Perspectives. p. 239-246. Proceedings of the IV International Conference ”Fishery”, 27-29 May 2009. Faculty of Agriculture, University of Belgrade, Zemun-Belgrade.

Kostov, V., Rebok, K., Slavevska-Stamenković, V., & Ristovska, M. (2010). Fish Fauna of River Bregalnica (R. Macedonia)–Composition, Abundance and Longitudinal Distribution. In Conference on water observation and information system for decision support.

Kostov, V., Ristovska, M., Prelic, D. & Slavevska-Stamenkovic, V. (2011). Assessement of the ecological status of the Crna River based on the fish fauna – Contribution of the establishment of the monitoring system of rivers in R. Macedonia. Macedon. J. Anim. Sci. 1 (1): 261–270.

Kottelat, M., & Freyhof, J. (2007). Handbook of European freshwater fishes. Publications Kottelat.

Kozarov, Gj. (1958). Phytoplankton of Dojran Lake. God.Zb.Biol., T.2(6), Skopje, 103-123.

Kral, D., & Hillert, O. (2013). Three new Lethrus species close to L. raymondi (Coleoptera: Geotrupidae) from the Balkan Peninsula. Acta Entomologica Musei Nationalis Pragae, 53(1), 219-244.

Krstić S., Ristovska, M, Slavevska-Stamenković, V., Rebok, K., Aleksovski, B, Arsovska, J., Ivanova, L. & Klekovska, D. (2015). Report on detected state of flora and fauna in Dojran Lake. Development of sustainable capacities of Dojran Lake, Scientific Report, REC (in Macedonian) http://mk.rec.org/proekti/227/dojranlake

Krstić, S. (2011). First records of cyanobacterial blooms, mcy gene cluster presence and cyanotoxins in several freshwater ecosystems in Macedonia”. 16th Studenica Academy Scientific Meeting “Cyanobacteria and human health”, Novi Sad, Serbia, July 1-3, 2011.

Krstić, S. (2013). Report on performed first survelliace monitoring on River Bregalnica catchment. River Bregalnica Management Plan project, SECO-GTI, 180 pp.

Krstić, S. (2015). Ecological information on algae, phytoplankton and phytobenthos. Regional Environmental Center “Developing of capacities for sustainability of Dojran Lake” – Final Report, 12 pp. (in Macedonian)

Krstić, S. and Aleksovski, B. (2016). Microcystis spp. dominance in Dojran Lake – a consequence of 30 years accelerated eutrophication. Botanica Serbica, 40(2), 119-128.

Krstic, S. and Stojanovski, P. (1993). Comparative microflora analysis in mouth waters of rivers Bosava and Anska, Macedonia. God.zb.Biol., 46, 101-110.

Krstić, S., Aleksovski, B. and Komarek, J. (2017). Rare occurrence of nine Microcystis species (Chroococcales, Cyanobacteria) in a single lake – Lake Dojran, Macedonia. Advances in Oceanography and Limnology, Vol.8, No.1, 5-23.

Krstic, S., Levkov Z. and Nakov, T. (2006). Diatom diversity in Republic of Macedonia our present knowledge. In: Witkowski A. (ed.), Proceeding of 18th International Diatom Symposium. Międzyzdroje, Poland, 209-220.

Krstic, S., Levkov, Z. and Stojanovski P. (1998). Diatom communities as indicator of pollution in river Vardar, Macedonia. Proceeding of 15th Diatom Symposium, Perth, Australia, 103-112.

Krstic, S., Levkov, Z. and Stojanovski, P. (1997). Diatoms in monitoring of River Vardar, Macedonia. Ecologia, 32. (2): 1-16.

Krstic, S., Levkov, Z. and Stojanovski, P. (1999). Saprobiological characteristics of diatom microflora in river ecosystems in Macedonia as a parameter for determination of the intensity of anthropogenic influence. In: Prygiel, L., Whitton, B.A., Bukowska, J. (eds). Use of Algae for Monitoring Rivers III. 145-153.

Krstic, S., Melovski, Lj., Levkov, Z. and Stojanovski, P. (1994). Complex investigations on the river Vardar. II. The most polluted sites in the first 3 months. Ekol.zast.zivot.sred., Tome 2, No.2, 13-29.

Krstic, S., Stojanovski, P. and Levkov, Z. (1996). Comparative microflora analyses of Anska River, Nikolicka River and Doiran Lake- a possibility for lake's microflora revitalization. God. Zb. Biol., 49, 17-28.

Krystufek, B. & Petkovski, S. (1989). Distribution of water shrews (gen. Neomys Kaup 1829, Insectivora, Mammalia) in Macedonia. Fragm. balc. Mus. maced. sci. nat. Skopje, 14 (12/305):107-116.

Krystufek, B. & Petkovski, S. (1990a). New records of mammals from Macedonia (Mammalia) Fragmenta balc. Mus. maced. sci. nat., 14(13/306): 117-129.

Krystufek, B. & Petkovski, S. (1990b). New record of the jackal Canis aureus Linnaeus, 1758 in Macedonia (Mammalia, Carnivora). Fragmenta balc. Mus. maced. sci. nat., 14(14/307): 131-138.

Krystufek, B. & Petkovski, S. (2003). Annotated Checklist of the Mammals of the Republic of Macedonia. Bonner zoologische Beitrage, Bonn. 51 (4): 229-254.

Krystufek, B. & Petkovski, S. (2006). Mammals of Macedonia - Current State of Knowledge. Anniversary Proceedings (1926-2006). Mac. Mus. Sci. Nat., Skopje, 95-104.

Kryštufek, B. & Reed, J.M. (2004). Pattern and process in Balkan Biodiversity—an overview. In: Griffiths, H.I., Kryštufek & Reed, J.M. (Eds.), Balkan Biodiversity. Kluwer Academic Publishers, Dordrecht, pp. 1–8.

Krystufek, B. Glasnović, P. & Petkovski, S. (2012). The status of a rare phylogeographic lineage of the Vulnerable European souslik Spermophilus citellus, endemic to central Macedonia. Fauna & Flora International, Oryx. 1-4.

Krystufek, B., (1993). European Sousliks (Spermophilus citellus; Rodentia, Mammalia) of Macedonia. SCOPOLIA No. 30, 1-39.

Krystufek, B., (1994). The taxonomy of blind moles (Talpa caeca and T. stankovici, Insectivora, Mammalia) from south-eastern Europe. Bonn. zool. Beitr., 45: 1-16.

Krystufek, B., (2013). Valid name for the Balkan lynx: Lynx lynx martinoi Mirić, 1978, is a junior synonym of Lyx lyx balcanicus Bureš, 1941. Folia Zool. 62(2): 121-124 (2013).

Krystufek, B., Petkovski, S. & Koselj, K. (1998). Additions to bat fauna of Macedonia (Chiroptera, Mammalia). Folia Zoologica 47 (3): 237-239.

Kryštufek, B., Vohralík, V., Flousek, J. & Petkovski, S. (1992). Bats (Mammalia: Chiroptera) of Macedonia, Yugoslavia. In: Horáček, I.; Vohralík, V. (eds.) Prague Studies in Mammalogy. Charles Univ. Press, Praha, pp. 93-111.

Kulijer, D. (2016). Leptoglossus occidentalis (Heteroptera: Coreidae) and Harmonia axyridis (Coleoptera: Coccinellidae), two new invasive alien species for insect fauna of Macedonia. Ecologica Montenegrina, 5, 22-25.

Kurt K. Günther (1980). Beitrage zur Kenntnis der Psocoptera-Fauna Mazedoniens. Musei Macedonici Scientiarum Naturalium, Tom XVI, No.1 (134), Skopje

Ladiges, W. (1967). Pisces. Illies, J. Limnofauna Europaea. Verlag G. Fischer, Stuttgart, 427-439.

Lakušić, D., Blaženčić, J., Ranđelović, V., Butorac, B., Vukojičić, S., Zlatković, B., Jovanović, S., Šinžar-Sekulić, J., Žukovec, D., Ćalić, I., Pavićević, D. (2005). Staništa Srbije – Priručnik sa opisima i osnovnim podacima. - In: Lakušić, D. (ed.), Staništa Srbije, Rezultati projekta "Harmonizacija nacionalne nomenklature u klasifikaciji staništa sa standardima međunarodne zajednice", Institut za Botaniku i Botanička Bašta "Jevremovac", Biološki fakultet, Univerzitet u Beogradu, Ministarstvo za nauku i zaštitu životne sredine Republike Srbije. http://www.ekoserb.sr.gov.rs/projekti/ stanista/; http://habitat.bio.bg.ac.rs

Lemonnier-Darcemont, M. (2010). A short note on Orthoptera from the Republic of Macedonia (F.Y.R.O.M): new species for the country and new data. Articulata, 26: 67-70.

Lemonnier-Darcemont, M., Chobanov, D., & Krpac, V. T. (2014). Red list of Orthoptera of the Republic of Macedonia. Revue d'écologie, 69(2), 151-158.

Lemonnier-Darcemont, M., Dutrillaux, A. M., Dutrillaux, B., & Darcemont, C. (2008). Recherches sur la phylogénie du genre Saga (Orthoptera: Tettigoniidae): données chromosomiques. Annales de la Société entomologique de France 44(4): 477-485.

Levkov, Z., Tofilovska, S. and Mitić-Kopanja, D. (2016). Species of the diatom genus Craticula Grunow (Bacillariophyceae) from Macedonia. Contributions, Sec. Nat. Math. Biotech. Sci., MASA, V.37, 129-166.

Lusk, S., Halačka, K., Lusková, V., & Horák, V. (2005). Distribution of Gobio species in the Czech Republic. Folia Zool, 54(Suppl 1), 65-64.

Makatsch, W. (1943). Einige neue Brutvogel Macedoniens. Ornithologische Monatsberichte 51:21–31.

Makatsch, W. (1950). Die Vogelwelt Macedoniens. Akademische Verlagsgesellschaft Geest & Portig K.-G., Leipzig.

Management plan (Fishing ground) for fishing waters in the Republic of Macedonia - Mantovo Reservoir, for the period of 2017 – 2022.

Mandžukovski, D., Acevski, J. (2013). Relict forest of Macedonian pine (Pinus peuce Grisb.) on calcareous parent material in Macedonia, Book of apstract, 35-th Meeting of Eastern Alp. And Dinaric Society for Vegetation Ecology, 36-37, Ohrid

Mandžukovski, D., Ćušterevska, R., & Teofilovski, A., (2017). Alpine and subalpine heaths on Balkan Peninsula with emphasis on Macedonian mountains, 37-th Eastern Alpine and Dinaric Society for Vegetation Ecology. Book of Abstracts, 25, Priština (Kosovo).

Mandžukovski, D., Ćušterevska, R., & Teofilovski, A., (2017). Distribution and ecological conditions of heaths in Republic of Macedonia, 70 years Faculty of Forestry in Skopje – International Scientific Conference. Book of Abstracts 33, Skopje (Macedonia)

Mandžukovski, D., Ćušterevska., Teofilovski, A., Acevski, J. (2013). Comparison of ecological and vegetation characteristocs between Pinus peuce Grisb. forest communities

Marrone, F., Brutto, S. L. & Arculeo, M. (2011). Cryptic invasion in Southern Europe: the case of Ferrissia fragilis (Pulmonata: Ancylidae) Mediterranean populations. Biologia, 66(3): 484-490.

Martinčič, A. (2009). Contributions to The Bryophyte Flora of Republic of Macedonia. – Hacquetia 8(2): 97-114

Martino, V., (1933). O sistematskom polozaju jugoslovenskog vuka. Lovac, Beograd. 38(3-4): 73-76.

Martino, V., (1934). Prilog za sistematiku jugoslovenske divokoze. Ibid. 39(3-4): 59-65.

Martino, V., (1935). Gradja za sistematiku jugoslovenskih zeceva. Ibid. 40(11-12): 11-12.

Martino, V., (1936a). Gradja za sistematiku jugoslovenske lisice. Ibid. 41(1-2): 12-15.

Martino, V., (1936b). Prilozi za sistematiku jugoslovenskog medveda. Ibid. 41(7-10): 168-175.

Martino, V., (1937). Prilozi za sistematiku tvora. Ibid. 42(9-10): 1-5.

Martino, V., (1939). Jeleni u Juznoj Srbiji. Ibid. 44(1-2): 1-3.

Martino, V. & Martino, E. (1929). A new souslik from Macedonia. J. Mammal. 10: 76-77.

Martino, V. & Martino, E. (1931). A new form of mole from Yugoslavia. Ibid. 12: 53.

Martino, V. & Martino, E. (1933). Novi jez iz Vardarske Banovine. Prirodosl. Razpr., Ljubljana. 2: 56-57.

Martino, V. & Martino, E. (1937). Preliminary on four new rodents from Korab Mountains. Ann. & Mag. Nat. Hist. 10 (19): 514-518.

Martino, V. & Martino, E. (1940). Note on the Yugoslavian ground squirrels (sousliks). Idem. 11: 465-471.

Matevski, V. (2014). Flora and vegetation in the Republic of Macedonia and the problem of their protection – (Comparative analysis 1982-2014). Book of Abstracts, I Symposium-Research in the field of environment and materials, MASA, Skopje, p.2.

Matevski, V. (2016). New species for the Flora of the Republic of Macedonia. Contributions, Section of Natural Mathematical and Biotehnical Sciences, MASA 37(2):79-83.

Matevski, V., Čarni, A, Avramovski, O., Juvan, N., Kostadinovski, M., Košir, P., Marinšek, A., Paušič, A., Šilc, U., (2011). Forest vegetation of the Galičica mountain range in Macedonia. Zalozba ZRC, ZRC SAZU, 1-200, Ljubljana.

Matevski, V., Čarni, A. (2019). Moenchia erecta (L.) G. Gaertn., B. Mey & Scherb. and Catapodium marinum (L.) C.E. Hubb. two new species in the flora of the Republic of Macedonia. Contributions, Section of Natural, Mathematical and Biotechnical Sciences, MASA, 40 (1):33–37.

Matevski, V., Čarni, A., Kostadinovski, M. (2005). Novi podatci o flori Republike Makedonije. 8 th Symposium on Flora of Southeastern Serbia and Neighbouring Regions, Proceeding, 25-28, Niš, Serbia and Montenegro.

Matevski, V., Čarni, A., Kostadinovski, M., (2001). Contribution to the flora of trampled habitats on the territory of the Republic of Macedonia. 75 years Maced.Mus.Nat.Hist., 237-244, Skopje.

Matevski, V., Čarni, A., Kostadinovski, M., Košir, P., Šilc, U., Zelnik, I., (2008). Flora and vegetation of the Macedonian steppe. Biol. Inst. ZRC, SAZU, Ljubljana, Slovenija, 1-94

Matevski, V., Kostadinovski, M. (1998). Hymenocarpus circinatus (L.) Savi, a new species of the flora of Republic of Macedonia. Zbornik radova V Simpozijuma o flori jugoist. Srbije,41-44, Niš, SR Jugoslavija.

Médail, F., Quézel, P. (1999). Biodiversity hotspots in the Mediterranean Basin: Setting global conservation priorities. Conservation Biology 13: 1510-1513. [на Англиски].

Mediterranean Basin Biodiversity Hotspot (2017). BirdLife International

Melovski Lj., Hristovski S. (2015). First records for seven species and one hybrid for the Flora of the Republic of Macedonia. For. review 46: 36-42. Skopje.

Melovski, L., Ivanov, G., Angelova, N., Velevski, M., Hristovski, S., Daov, S., & Trajkova, F. (2008). Monospitovsko Blato: posledno močuriste vo Makedonija.

Mertlik, J., Šíma, A. and Németh, T. (2015). New distributional data on eleven click-beetles (Coleoptera: Elateridae) for Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Greece, Hungary, Macedonia, Montenegro, Romania and Turkey, Elateridarium 9: 171-181.

Micevski, B., Chobanov, D. & Pop-Stojanov, D. (2003). Orthoptera fauna of the National Park Pelister. Society for studying and protection of birds in Macedonia (SSPBM).

Micevski, K., (1957). Typologische Gliederung der Niederungswiesen-und Sumpfvegetation Mazedoniens. Folia Balcanica, Skopje,1(6): 29-33.

Micevski, K., (1959). Neue Wiesen- und Sumpfassoziationen und Subassoziationen in der Vegetation Mazedoniens. Fragmenta Balcanica, 2 (19): 159-163.

Micevski, K., (1961). Typologische Untersuchungen der Vegetation der Niederungssümpfe und -Wiesen Mazedoniens. Bulletin Scientifique, Zagreb, 4 (4): 106-107

Micevski, K. (1965). Halofitska vegetacija Ovčeg Polja. ACTA, Musei macedonici scientiarum nat., 10(3): 67-90.

Micevski, K. (1988). Osmunda regalis L. i njena pripadnost močvarnoj vegetaciji Jugoslavije. Zbor.referata nauč. skupa "Minerali, stijene, izumrli i živi svijet BiH", Sarajevo.

Micevski, N., Presetnik, P., Micevski, B. & Celuch, M. (2014). Contribution to the knowledge of the Macedonian bat fauna. Vespertilio 17: 103-114.

Michieli, S. (1963). Beitrag zur Kenntnis der Makrolepidopterenfauna Mazedoniens (S.R. Makedonija). Acta Musei Macedonici Scientiarum Naturalium IX, 2.

Mihajlova, B. (1978). Contribution to the study of fauna of snout beetles (Coleoptera, Curculionidae) of Macedonia. Fragmenta Balcanica, Musei Macedonici Scientiarum Naturalium, X, No.14 (234).

Miric, D., (1981). Lynx lynx martinoi ssp. nova (Carnivora, Mammalia) – neue Luchsunterart von der Balkanhalbinsel. Glasnik Prirodnjackog muzeja, Beograd, 33(B): 29-36.

Monospitovsko Blato, the last marsh in Macedonia (2003). Municipality of Bosilovo.

Moucha, J. (1959). Beitrag zur Kenntnis der Lepidopterenfauna Mazedoniens. Ac.Faun. Ent.Mus. Nat. Pragae, 5.

Mucina et al. (2016). Vegetation of Europe: hierarchical floristic classification system of vascular plant, bryophyte, lichen, and algal communities ....

Mucina, L., Bültmann, H., Dierßen, K., Theurillat, J.-P., Raus, T., Čarni, A., Šumberová, K., Willner, W., Dengler, J. , Gavilán García, R., Chytrý, M., Hájek, M., Di Pietro, R., Iakushenko, D., Pallas, J., Daniëls, F.J.A., Bergmeier, E., Santos Guerra, A., Ermakov, N., Valachovič, M., Schaminée, J.H.J., Lysenko, T., Didukh, Y.P., Pignatti, S., Rodwell, J.S., Capelo, J., Weber, H.E., Solomeshch, A., Dimopoulos, P., Aguiar, C., Hennekens S.M. & L. Tichý. (2016). Vegetation of Europe: hierarchical floristic classification system of vascular plant, bryophyte, lichen, and algal communities. Appl. Veg. Scien., Volume 19 (1): 3-264.

Murányi D. (2018). First records of four aphids (Hemiptera: Aphidoidea) from Macedonia. Ecologica Montenegrina 17: 20-25.

Murányi, D. (2013). Data to three insect orders (Embiidina, Dermaptera, Isoptera) from the Balkans. Opuscula Zoologica Budapest, 44(suppl 1), 167-186.

Murányi, D. (2013). Further contribution to the earwig and termite (Insecta: Dermaptera et Isoptera) fauna of Albania and Macedonia. Folia Historico Naturalia Musei Matraensis, 37, 43-46.

Murányi, D., Kovács, T. & Orci, K. M. (2014). New country records and further data to the stonefly (Plecoptera) fauna of southeast Macedonia. Ecologica Montenegrina, 1(2): 64-77.

Nacheski, N., Papazova –Anakieva, Ivanov, B., Lazarevska, S., Shurbevski, B. Occurrence of the new invasive insect cydalima perspectalis walker. on box tree in the Republic of Macedonia, Contributions, Sec. Nat. Math. Biotech. Sci., MASA,Vol. 39(2), 135–141(2018).Skopje

Naumovski, M. (1995). Ribite vo Makedonija: sistematska pripadnost, biologija i značenje. Žaki.Lambevska, A., Rusevska, K. & Karadelev. M. (2013b). New data on the taxonomy, distribution and ecology of the genus Peniophora Cooke (Basidiomycota, Fungi) in the Republic of Macedonia. Macedonian Journal of Ecology and Environment Vol. 15, issue 2, pp. 69-79, ISSN 1857 – 8330.

Nemeth, T., Dusanek, V., Mertlik, J., & Kundrata, R. (2014). New distributional data on Elateroidea (Coleoptera: Elateridae, Eucnemidae and Omalisidae) for Albania, Montenegro and Macedonia. Elateridarium, 8, 112-117.

Nikodinovski, B. (2000). Osnovi na voena geografija na Republika Makedonija. Niko Kompjuteri, Skopje.

Nikolić, F. (1981). Catalogus Faunae Jugoslaviae III/4 Aranea. Consilium Academiarum Scientiarum rei Publicae Socialisticae Foederativae Jugoslaviae, Ljubljana

Nikolov, BP, Hristova-Nikolova, IP. (2015). From the ornithological notebook: Spur-winged Lapwing Vanellus spinosus. Acrocephalus 36:96.

Oláh, J. (2010). New species and new records of Palearctic Trichoptera in the material of the Hungarian Natural History Museum. In Annales historico-naturales Musei nationalis hungarici, 102: 65-117.

Ordynets, A., Heilmann-Clausen, J., Savchenko, A., Bässler, C., Volobuev, S., Akulov, O., Karadelev, M., Kotiranta, H., Saitta, A., Ewald Langer, E. & Abrego, N. (2018). Do plant-based biogeographical regions shape aphyllophoroid fungal communities in Europe?. Journal of Biogeography, pp. 1–14.

Otto, P., (2002). Mapping and Monitoring of Threatened fungi in Europe, ECCF – European Council for Conservation of Fungi in Europe.

Papadatou, E., Gremillet, X., Bego, F., Petkovski, S., Stojkoska, E., Avramovski, O. & Y. Kazoglou, (2011). Status Survey and Conservation Action Plan for the Bats of Prespa. Society for the Protection of Prespa, Agios Germanos, pp.170.

Papp, B, Pantović, J., Szurdoki, E. & Sabovljević, M. S. 2015: New bryophyte records for the Republic of Macedonia. – Journal of Bryology January (2016). DOI: 10.1080/03736687.2015.1113628

Paunović, M., Csányi, B., Knežević, S., Simić, V., Nenadić, D., Jakovčev-Todorović, D., Stojanović, B. & Cakić, P. (2007). Distribution of Asian clams Corbicula fluminea (Müller, 1774) and C. fluminalis (Müller, 1774) in Serbia. Aquatic Invasions. 2(2): 99-106.

Peshev, H, Stoynov, E, Parvanov, D, Grozdanov, A. (2018). Seasonal and Spatial Dynamics of the Population of the Griffon Vulture Gyps fulvus (Hablizl, 1783) (Aves: Accipitridae) in Southwestern Bulgaria. Acta Zoologica Bulgarica Supplement 12:67–75.

Peters, G. & Hackethal, H. (1986). Notizen über die Libellen (Odonata) in Mazedonien. Acta musei macedonici scientiarum naturalium, 18(5/151): 125-158.

Petkov, N, Iliev, M. (2017). Final Report on Working Group Birds. Page 20. Strengthening the capacities for implementation of Natura 2000. Ministry of Environment and Physical Planning of the Republic of Macedonia, Skopje.

Petkov, N, Ruiz, E. (2017). Draft List of bird species from Annex I of the Birds Directive, migratory birds and other birds of importance regularly occurring in the Beneficiary country (DII.01). Page 17. Strengthening the capacities for implementation of NATURA 2000-EUROPEAID/136609/IH/SER/MK. Particip GmBH and its Consortium partners, Skopje.

Petkovski, S., (1998). Proekt Cicaci na Makedonija. Zavrsen izvestaj 1995-1997. Prirodonaucen muzej na Makedonija, Skopje 131 str.

Petkovski, S., (2003). Faunal diversity. In: Country Study for Biodiversity of the Republic of Macedonia (First National Report). Ministry of Environment and Phisical Planning. Skopje. pp. 217.

Petkovski, S., B. Micevski, T. Petkovski, V. Sidorovska, J. Sapkarev, S. Stankovic, V. Krpac, B. Mihajlova and S. Hristovski. (2003). Fauna. In: Country Study for Biodiversity of the Republic of Macedonia

(First National Report). Ministry of Environment and Spatial Planning, Skopje, Republic of Macedonia. 217 pp

Petrov, B.M., (1939a). New vole from South Serbia. Prirodosl. Razpr. Ljubljana. 3(16): 363-365.

Petrov, B.M., (1939b). Novye dannya o rasprostranenii mlekopitajuscih v Jugoslavii. Zapiski Russk. Naucn. Inst. Belgrad. 14: 77-83.

Petrov, B.M., (1940). Zamjatki po sistematiki ekologii mlekopitajuscih Juznoj Serbii. Ibid. 14: 85-106.

Petrov, I. (2015). From the ornithological notebook: Greater Flamingo Phoenicopterus roseus. Acrocephalus 36:95.

Petrov. B.M. (1992) Mammals of Yugoslavia. Insectivores and Rodents. Natural History Museum in Belgrade, Suppl. 37: 1-186.

Petrov. B.M., (1969). Neue daten uber die Verbreitung einiger Saugetierarten in Mazedonien. Fragmenta balc. Mus. Maced. Sci. Nat., 7(1/159): 1-4.

Petrov. B.M., (1971). Taxonomy and distribution of moles (genus Talpa, mammalia) in Macedonia. Acta Musie Macedonici Scientarium Naturalium, Skopje 12 (6/107): 117-138.

Petrušev, S., Džukić, G., Petkovski, S. (1990). Further reports on the morphological characters and distribution of Eryx jaculus turcicus (Olivier, 1801) in Yugoslavia. Fragmenta Balcanica 14: 139-150.

Pimentel, D., Lach, L., Zuniga, R., & Morrison, D. (2000). Environmental and economic costs of nonindigenous species in the United States. BioScience, 50(1), 53-66.

Pinker, R. (1968). Die Lepidopteren fauna Mazedoniens. III. Geometridae. Posebno Izdanie. Mac. Mus. Sci. Nat., Skopje. 4:1-72.

Piria, M., Simonović, P., Kalogianni, E., Vardakas, L., Koutsikos, N., Zanella, D., Ristovska, M., Apostolou, A., Adrović, A., Mrdak, D., Serhan Tarkan A., Milošević, D., Zanella, L., Bakiu, R., Ekmekçi, F. G., Povž, M., Korro, K., Nikolić, V., Škrijelj, R., Kostov, V., Gregori, A. and Joy, M. K., (2017). Alien freshwater fish species in the Balkans— Vectors and pathways of introduction. Fish and Fisheries. 2017:1–32.

Plewa, R., Marczak, D., Borowski, J., Mokrzycki, T., Jakubowski, M., & Górski, P. (2015). New data on the occurrence of longhorn beetles (Coleoptera: Cerambycidae) in the Republic of Macedonia. Acta zoologica bulgarica, 67(1): 43-50.

Poledník, L., Poledníková, K., Beran, V., Thelenová, J., Valášek, M., Prášek, V., Škorpíková, V. & M. Dostál, (2008). Distribution of the Eurasian otter (Lutra lutra) in the Republic of Macedonia in 2007. IUCN Otter Spec. Group Bull. 25(2) 2008, 8 pp.

Preliminary River basin Management Plan for Strumica River Basin District. (2015). PointPro, 160 pp.

Protic, Lj. (2007). Family Cydnidae (Insecta: Heteroptera) in the Natural History Museum in Belgrade. Polish Journal of Entomology. Vol76: 143-159

Protic, Lj. (2010). Assassin bugs (Insecta: Heteroptera: Reduviidae) in collections of the Natural History Museum in Belgrade. Bulletin of the Natural History Museum, 3: 141-159.

Pulević, V. (1981). O arealima vrsta Herniaria nigrimontium Hermann i Allium phthioticum Boiss. & Heldr. Glas. Republ. Zavoda Zašt. – Prirodnjačkoj Muzeja Titograd 14: 23–29.

Radoman, P. (1983). Hydrobioidea a superfamily of Prosobranchia (Gastropoda): systematics. Serbian academy of sciences and arts. 1-255.

Radovanović, M. (1951). Vodozemci i gmizavci naše zemlje. Naučna knjiga, Beograd.

Reading, C. J., Luiselli, L. M., Akani, G. C., Bonnet, X., Amori, G., Ballouard, J. M., … Rugiero, L. (2010). Are snake populations in widespread decline? Biology Letters, 6(6), 777–780. https://doi.org/10.1098/rsbl.2010.0373

Reference Lists (2016). Ordinance on Reference Lists, November 2016 (Draft). Project: Strengthening the capacities for implementation of NATURA 2000 - EUROPEAID/136609/IH/SER/MK. Ministry of Environment and Physical Plannina, Skopje.

Riservato, E. et al. (2009). The Status and Distribution of Dragonflies of the Mediterranean Basin. Gland, Switzerland and Malaga, Spain: IUCN. vii + 33 pp

Ristovska, M., Arsovska, J., Kostov, V., Georgievska, A. C., Prelik, D., & Radevska, K. (2017). First record of the black bullhead Ameiurus melas (Pisces, Ictaluridae) in the Republic of Macedonia. Macedonian Journal of Ecology and Environment, 19(1/2), 28-35.

Ristovska, M., Kostov, V., Prelic, D., Slavevska-Stamenkovic, V. & Arsovska, J. (2011). Fish community structure and water quality assessment of Babuna River. J. Int. Environ. Appl. Sci. 6 (4): 508–517.

Rizovski, R. (1978) Cenoze hrasta sladuna (*Quercus frainetto* Ten.) u submediteranskoj zoni donjeg Povardarja. Izvadak iz doktorske disertacije. Poroč. Vzhodno alp.-dinar. Preuč.veget. Tom 14, SAZU, Ljubljana.

Roding, G. M. (1966). Molluskenfunde während zwei Fahrten in Jugoslawien, insbesondere in Mazedonien. Fragm. Balc., Skopje, 5: 125-141.

Rodwell, J., Schaminee, J., Mucina, L., Pignatti, S., Dring, J. & Moss, D. (2002). The Diversity of European Vegetation. An overview of Phytosociological Alliances and their relationships to EUNIS Habitats. Landbouw, natuurbeheer en visserij, Wageningen.

Roubal, J. (1932). Fragmente zur Koleopterenfaunistik des balkanischen Festlandes. Entomologischer Anzeiger, Vienna, 12, 177-178.

Roug, S. (2009). EUNIS Biodiversity Database. European Environment Agency. Checklist dataset https://doi.org/10.15468/wgd298 accessed via GBIF.org on 2018-10-28.

Rozner, I. and Rozner, G. (2009). Data to the Lamellicornia fauna of the Republic of Macedonia (Coleoptera: Lamellicornia). Natura Somogyiensis 15: 57-68

Rusevska, K. & Karadelev, M. (2014-2015). Distribution of Bovista, Bovistella and Disciseda in the Republic of Macedonia. Biol. Macedonica, N° 64, pp. 55-64.

Rusevska, K., Karadelev, M., Phosri, C., Dueñas, M., Telleria, T. M., Watling, R. & Martín, M. P. (2015). DNA barcoding is an effective tool for differentiating Pisolithus species from Macedonia. Mycotaxon, Vol. 130, pp. 1007–1016.

Rusevska, K., Karadelev, M., Phosri, C., Dueñas, M., Watling, R. & Martín. M. P. (2014). Rechecking of the genus Scleroderma (Gasteromycetes) from Macedonia using barcoding approach. Turkish Journal of Botany, 38: 375-385.

Sachtleben, H. (1919). Carduelis carduelis balcanica subsp. n. Anzeiger der Ornithologischen Gesellschaft in Bayern 1:3–4.

Salvatori, V. & Linnell, J. (2005). Report on the conservation status and threats for wolf (Canis lupus) in Europe. Standing Committee of the Convention on Conservation of European Wildlife and Natural Habitats. Strasbourg, T-PVS/Inf (2005)16, pp. 24.

Schaider, P. & Jaksic. P. (1989). Die Tagfalter von Jugoslawisch Mazedonien Diurna (Rhopalocera und Hesperiidae). Selbsverlag Paul Schaider, Ratoldstrasse 36, Munchen. pp.: 1-82.

Schaminée J, Chytrý M, Hennekens SM, Mucina L, Rodwell JS & Tichý L. (2012). Development of vegetation syntaxa crosswalks to EUNIS habitat classification and related data sets. Unpublished report for the EEA.

Schneider-Jacoby, M, Vasić, V. (1989). The Red-crested Pochard Netta rufina breeding and wintering in Yugoslavia. Wildfowl 40:39–44.

Schröeder, B. (1921). Phytoplankton aus Seen von Mazedonien. Sitzungsber. Abt., I Bd. 4 und 5, 147-186.

Sedivá, A., Apostolou, A., Janko, K., Kohout, J., Kostov, V., & Sanda, R. (2008). Genetic structure and distribution of Oxynoemacheilus bureschi (Balitoridae, Teleostei), and its phylogenetic relationships with other European stone loaches. Folia Zoologica, 57(1/2), 111.

Semenchenko, V., Laenko, T. & Razlutskij, V. (2008). A new record of the North American gastropod Physella acuta (Draparnaud 1805) from the Neman River Basin, Belarus. Aquatic Invasions. 3(3): 359-360.

Šere D. 2009. The differences in wing length and weight concerning the Cetti's Warbler Cettia cetti from Slovenia and Macedonia. Scopolia Supp. 4:183–187.

Sidorovska, V., (2010). Wildlife Ecology of Game Species, crucial for Control and Eradication of Rabies in the Republic of Macedonia. In: Preparation of Control and Eradication of Rabies. Agriconsulting Europe, pp. 22.

Šilić, Č. (1979). Monografija rodova Satureja L., Calamintha Miller, Micromeria Bentham, Acinos Miller i Clinopodium L. u flori Jugoslavije. Zemaj. Muzej BiH, Posebno izdanje, Sarajevo, 1979, 440 p.

Škorpíková, V, Prášek, V, Beran, V., Dostál, M., Valášek, M., Thelenová, J., Polednik, L., Poledniková, K. (2007). Birds of prey in Macedonia: notes from an ornithological expedition in 2007. Ciconia 16:19–25.

Škorpíková, V., Čamlík, G., Prášek, V., Dostál, M. (2009). Little Tern Sterna albifrons - a new breeding species for Macedonia. Ciconia 18:223–224.

Škorpíková, V., Prášek, V., Dostál, M., Bělka, T., Čamlík, G., Hlaváč, V. (2012). The Sardinian Warbler Sylvia melanocephala in Macedonia. Ciconia 21:6–10.

Škorpíková, V., Prášek, V., Valášek, M. (2006). Ornithological notes from Macedonia in 2006. Ciconia 15:30–45.

Skoulikidis, N. T. (2009). The environmental state of rivers in the Balkans—a review within the DPSIR framework. Science of the Total Environment, 407(8), 2501-2516.

Sladen AGL. (1917). XXI.—Notes on Birds recently observed in Macedonia. Ibis 59:429–433.

Sladen AGL. (1918). XVI.—Further Notes on the Birds of Macedonia. Ibis 60:292–300.

Slavevska-Stamenković, V., Rimcheska, B., Stojkoska, E., Stefanovska, N., Hinić, J. & Kostov, V. (2016). The Catalogue of the freshwater Decapoda (Decapoda: Potamonidae, Astacidae, Atyidae) from

Republic of Macedonia in the collection of Macedonian Museum of Natural History. Section of Natural, Mathematical & Biotechnical Sciences, 37 (2): 173-183.

Smiljkov, S., Slavevska-Stamenković, V., Prelić, D. & Paunović, M. (2008). Distribution of benthic macroinvertebrates in Mantovo Reservoir (South-East part of the Republic of Macedonia). Balwois Ohrid, Republic of Macedonia. 1-25.

Soric, V. M. (1999). First finding of Orthrias brandti (Cobitidae) in the drainage area of the Vardar River (FYROM) and description of the subspecies Orthrias brandti macedonicus ssp. Nov. lchthyologia, 31, 83-87.Šopova, M., Sekovski, Ž. (1982). Chromosome atlas of some Macedonian Angiosperms. Maced. Acad. Sci. and Arts, Sec. of Biol. and Med. Sci., I-42.

Soška, Th. (1939). Beitrag zur Kenntnis der Schluchtenfloren von Südserbien, III. Glasnik SND, 20(7): 167-191.

Speybroeck, J., Beukema, W., Bok, B., Van Der Voort, J., & Velikov, I. (2016). Field Guide to the Amphibians and Reptiles of Britain and Europe.

Stanković-Jovanović, S.V. & Stojkoska, E. (2001). Diversity of aquatic snail fauna (Gastropoda, Mollusca) in the Republic of Macedonia from the bibliographic data of the hitherto taxonomic investigations. 75 years Macedonian Museum of Natural History. 125-136.

State of the art in the management of animal genetic resources.The state of theworld'S animal genetic resources for food and agriculture. Commission on Genetic Resources for Food and Agriculture, Food and Agriculture Organization of the United Nations ROME, Part 4. 2007.

Stefanov L. (2015). From the ornithological notebook: Sanderling Calidris alba. Acrocephalus 36:97.

Sterijovski, B., Tomović, L., & Ajtić, R. (2014). Contribution to the knowledge of the Reptile fauna and diversity in FYR of Macedonia. North-Western Journal of Zoology, 10, 83–92.

Stierandová, S., Vukić, J., Vasil'eva, E. D., Zogaris, S., Shumka, S., Halačka, K., ... & Koščo, J. (2016). A multilocus assessment of nuclear and mitochondrial sequence data elucidates phylogenetic relationships among European spirlins (Alburnoides, Cyprinidae). Molecular phylogenetics and evolution, 94, 479-491.

Stojanoff, N. (1928). Thracische und macedonische Herbarmaterialen des Verstorbenen prof. Dr. Theodor Nikoloff. Spis.BAN, 37(18): 49-209.

Stojanov A., Ivanov Gj., Melovski D., Hristovski S.& Velevski, M. (2010). Population Status of the Brown bear (Ursus arctos) in the Republic of Macedonia - Project : Development of the National Ecological Network in R. Macedonia (MAK-NEN),(Project report). MES, Skopje, pp. 51.

Stojanov, P. (1972). The characteristics of Dojran Lake phytoplankton and its seasonal oscillations. MSci thesis, University of Zagreb, 79 pp.

Stojanov, P. (1976). The periphyton of Dojran Lake – its composition and production. PhD thesis, "Ss. Cyril and Methodius" University, Skopje, 161 pp.

Stojanov, P. (1983). Algal flora in periphyton of Dojran Lake. God.Zb.Biol., 36, 95-109.

Stojanov, P. (1986). Periphyton production in Dojran Lake. Biosistematika, 12(2), 87-97.

Stojanovski, L., (1994). Prilog kon poznavanjeto na liljacite (Chiroptera, Mammalia) na Makedonija. Ekol. Zast. Zivot. Sred., Skopje, 2(1): 59-62. (In Macedonian with English Summary).

Stojanovski, L., (1998). The first record of Suncus etruscus (Mammalia, Soricide) in the Republic of Macedonia. Folia Zoologica 47: 235-236.

Stojanovski, P. and Krstić, S. (1995). Lake Dojran forced dystrophy as a direct consequence of the anthropogenic influence. God.Zb.Biol., T. 48, Skopje, 139-173.

Stojanovski, P., Krstic, S. and Levkov, Z. (1996). The phenomenon of microflora disbalance in Doiran Lake as direct consequence of the anthropogenous influence. God. Zb. Biol., 49, 5-16.

Stojanovski, P., Krstic, S. and Levkov, Z. (1997). Changes in Doiran Lake's microflora - a case of rapid turnover towards hypertrophy. God.zb.,Biol. 50, 13-24.

Stresemann, E. (1919). Lanius nubicus Licht. Anzeiger der Ornithologischen Gesellschaft in Bayern 1:4.

Stresemann, E. (1920). Avifauna Macedonica. Die ornithologischen Ergebnisse der Forschungsreisen, unternommen nach Mazedonien durch Prof. Dr. Doflein und Prof. L. Müller-Mainz in den Jahren 1917 und 1918. Dultz & Co., München.

Strumica River Basin District River Masin Management Plan 2016 – 2027 (2016). DRAFT FINAL REPORT (2016)

Telcean, I. C., & Cupşa, D. (2012). Threatened and rare fishes from Upper Tisa valley and its Romanian left shore tributaries (North-Western Romania). Pisces Hungarici, 6, 87-94.

Telcean, I., Cupşa, D., Covaciu-Marcov, S. D., & Sas, I. (2006). The fishfauna of the Crişul Repede River and its threatening major factors. Pisces Hungarici, 1, 13-19.

Temovski, M. (2016). Evolution of karst in the lower part of Crna Reka river basin. 1-265, Springer.

Teofilovski, A., Mandzukovski, D., Simovski, B., Acevski, J. (2012). Chorology and habitats of some plants in the Republic of Macedonia, For.review 43: 24-32, Skopje

The CITES Secretariat. (1973). Convention on International Trade in Endangered Species of Wild Fauna and Flora. Bonn.

The Council of the European Union. (1979). Convention on the conservation of European wildlife and natural habitats. Bern.

The European Parliament, The Council of the European Union. (2009). Directive 2009/147/EC of the European parliament and of the Council of 30 November 2009 on the conservation of wild birds. Official Journal of the European Union. Brussels.

Thurner, J. (1940). Die Schmetterlinge der Ochrid Gegend in Macedonien II. Teil Microlepidoptera. Mitt. Königl. nat.-wiss. Inst. Sofia 14.

Thurner, J. (1964). Die Lepidopterenfauna Jugoslawish Mazedoniens. I. Rhopalocera, Grypocera und Noctuidae. Posebni Izdanie. Mus. Mac. Sci. Nat., Skopje. 1: 1-159.

Thurner, J. (1957). Beitrag Zur Kenntnis der Insektenfauna Mazedoniens. Fragmenta Balcanica. Musei Macedonici Scientiarum Naturalium, tom II, No.2 (36), Skopje

Thurner, J. (1964). Die Lepidopteren fauna Jugoslavisch mazedoniens I. Rhopalocera, Grypocera und Noctuidae. Природонаучен музеј, посебно издание nr.1, Скопје

Tomović, J., Csanyi, B., Zorić, K., Atanacković, A., Tubić, B., Cakić, P. & Paunović M. (2010). Alien Mollusca in Serbian waters. Proceedings of BALWOIS 2010, Ohrid, Republic of Macedonia.

Tortić, M. & Karadelev M. (1986). *Lignicolous macromycetes* in the submediterranean part of Macedonia (Yugoslavia). Acta Bot. Croat., 45:109-117.

Uhrin, M., Havaš, P., Mina, M., Koleska, D., & Jablonski, D. (2014). Distribution updates to amphibian and reptile fauna for the Republic of Macedonia. 20.

UNEP/CMS Secretariat. (1979). Convention on the Conservation of Migratory Species of Wild Animals. Bonn.

Uzunova, E., Studenkov, S., & Dashinov, D. (2019). First records of largemouth bass Micropterus salmoides (Lacépède, 1802) from Bulgaria (Balkan Peninsula). BioInvasions Records, 8.

Vandas, C. (1909). Reliquiae Formanekianae, Brunnae.

Vargas, M. J., & De Sostoa, A. (1996). Life history of Gambusia holbrooki (Pisces, Poeciliidae) in the Ebro delta (NE Iberian peninsula). Hydrobiologia, 341(3), 215-224.

Vasić, V., Grubač, BR, Sušić, G., Marinković, S. (1985). The Status of Birds of Prey in Yugoslavia, with Particular Reference to Macedonia. Pages 45–53. International Council for Bird Preservation, Cambridge.

Vasić, V., Ivanovski, T., Velevski, M. (2016). Bird Collections from Macedonia. Pages 53–228 Anniversary Proceedings (1926-2016). Macedonian Museum of Natural History, Skopje.

Vassilev, M., & Pehlivanov, L. (2002). The ichthyofauna of the Bulgarian part of the Struma River. Historia naturalis bulgarica, Sofia, 14, 103-108.

Velevski, M, Grubač B. (2008). Distribution and estimation of the population size of the Short-toed Snake-eagle Circaetus gallicus in Macedonia. Pages 22–24 Proceedings of the 3rd Congress of Ecologists of the Republic of Macedonia with International Participation. Special Issues of the Macedonian Ecological Society 8. Macedonian Ecological Society, Struga.

Velevski, M,, Hallmann, B., Grubač, B., Lisičanec, T., Stoynov, E., Lisičanec, E., Avukatov, V., Božič, L., Stumberger, B. (2010). Important Bird Areas in Macedonia: Sites of Global and European Importance. Acrocephalus 31:181–282.

Velevski, M. (2015). The birds in the Bregalnica river cathment. Page 52. Gap analyses of the ecological data and development of a sensitivity map in the Bregalnica river catchment. Dekons-Ema and Macedonian Ecological Society, Skopje.

Velevski, M. (2016). Bird fauna of the Lake Dojran. Page 8. Regional Environmental Centre for South-eastern Europe, local office in Skopje, Skopje.

Velevski, M., Grubač, B., Hallmann, B. (2008). Distribution and estimation of the population size of the Black Stork Ciconia nigra in Macedonia. Ciconia 17:14–19.

Velevski, M., Saveljić. D. (2010). From the ornithological notebook: Great Black-headed Gull Larus ichthyaetus. Acrocephalus 31:57–71.

Velevski, M., Vasić, V. (2017). Annotated check-list of the birds of the Republic of Macedonia. Acta Musei Macedonici Scientiarum Naturalium 20:54–76.

Verovnik, R. (2012). Contribution to the knowledge of the spring butterfly fauna of the Republic of Macedonia (Lepidoptera: Papilionoidea & Hesperioidea). Natura Sloveniae, 14(2): 39-50.

VGI, (1977). Geoloska karta 1:500 000, Beograd.

Vidinic, Z., (1963). Micromys minutes brauneri Martino, new mammal from Macedonia. Fragmenta balc. Mus. Maced. Sci. Nat., 4(21/105): 167-169.

Viereck von M. (1917). Ornithologische Beobachtungen vom Kriegsschauplatz in Mazedonien. Ornithologische Monatsschrift 42:233–246.

Vinko, D., Kulijer, D., Dinova, D., Rimčeska, B., Brauner, O. & Olias, M. (2017). Faunistic results from the 5th Balkan odonatological meeting–boom 2015, Republic of Macedonia. Acta entomologica slovenica, 25(1): 89-114.

Vörösmarty, C. J., McIntyre, P. B., Gessner, M. O., Dudgeon, D., Prusevich, A., Green, P., ... & Davies, P. M. (2010). Global threats to human water security and river biodiversity. Nature, 467(7315), 555.

Vuković, T., & Ivanović, B. (1971). Slatkovodne ribe Jugoslavije. Zemaljski musej BiH-Prirodnjačko odjeljenje.

Weidner, H. (1955). Die Verbreitung der Isoptera in Sudosteuropa. Fragmenta Balcanica. Musei Macedonici Scientiarum Naturalium, Tom I, No. 18, pp 160

Wielstra, B., Sillero, N., Vörös, J., & Arntzen, J. W. (2014). The distribution of the crested and marbled newt species (Amphibia: Salamandridae: Triturus) – an addition to the New Atlas of Amphibians and Reptiles of Europe. Amphibia-Reptilia, 35(3), 376–381. https://doi.org/10.1163/15685381-00002960

Ziani, S., Bezděk, A., Branco, T., Hillert, O., Jákl, S., Král, D. & Sehnal, R. (2015). New country records of Scarabaeoidea (Coleoptera) from the Palaearctic Region.

Zima, J., Macholan, M., Krystufek, B. & Petkovski, S. (1997). Karyotypes of certain small mammals (Insectivora, Rodentia) from Macedonia. Scopolia, 38, 1-15.

Zombori, L. (1974). Data to the sawfly fauna of Yugoslavia (Hymenoptera: Symphyta) Fragmenta Balcanica, Mus. Mac. Sci. Nat., Skopje 9: 173-185.

Zupančič M., (1992). Zur Syntaxonomischen problematic des Verbandes Brukenthalion spiculifoliae Hr.1949 (nom. Nudum) und der Assoziation Junipereto Bruckenthalietum auf der Balkan-Halbinsel, Feddes Repertorium, 3-4, 243-268, Berlin

Links for EUNIS Fact Sheet:

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Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation	https://eunis.eea.europa.eu/habitats/10077
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Siliceous rocky slopes with chasmophytic vegetation	https://eunis.eea.europa.eu/habitats/10166

Корисни линкови:

Law on agriculture and rural development2017. http://zpis.gov.mk/Upload/Documents/Zakon%20za%20zemjodelstvo%20i%20ruralen%20razvoj%20mart%202017.pdf.

Integrated plan for local development of Municipality of Bosilovo (2019-2022). 2019. http://opstinabosilovo.gov.mk/wp-content/uploads/2019/05/%D0%98%D0%9F%D0%9B%D0%A0-%D0%91%D0%BE%D1%81%D0%B8%D0%BB%D0%BE%D0%B2%D0%BE-final-PDF.pdf.

Exploring the potential of the Osogovo Mountain for transboundary Biosphere Reserve 2007.http://www.fznh.ukim.edu.mk/images/stories/2016/proekt/FinalReport/update/final_compilation_mk_no_photos.pdf.

Колева Гудева, Љ., Ф. Трајкова. 2007. Генетски ресурси на Capsicum spp. Во генбанката на Земјоделскиот факултет при Универзитетот Гоце Делчев - Штип. http://www.mes.org.mk/PDFs/3rd%20Congress%20Proceedings/06_Koleva-Gudeva%20%20Trajkova.pdf.

National Biodiversity Strategy and Action Plan 2014. http://www.moepp.gov.mk/wp-content/uploads/2015/01/Nacrt-NBSAP-20.01.2015-za-MZSPP-so-tabela-2.pdf.

National Strategy for Agriculture and Rural Development for the period 2014-2020. 2014. http://www.mzsv.gov.mk/CMS/Upload/docs/NSZRR2014-2020.pdf

Fifth National Report on Convention on Biological Diversity. 2014. http://www.moepp.gov.mk/wp-content/uploads/2014/12/Petti-nacionalen-izvestaj_MK_designed.pdf.

Plan for development of South-East planning Region. 2008. http://www.rdc.mk/southeastregion/files/jugoistocen_region_-_strategiski_plan_-_4_revision.pdf.

Support on the preparation of National Strategy for Sustainable Development. 2009. http://www.moepp.gov.mk/wp-content/uploads/2014/12/Predlog-Nacionalna-Strategija-za-Odrzliv-Razvoj-vo-RM-DEL-I.pdf.

Program for development of South-East Planning Region 2015-2019. https://www.rdc.mk/southeastregion/images/JugoIstocenRegion_razvojnaPrograma%202015_2019.pdf
Студија за одржлив развој на органското земјоделско производство во Источниот плански регион. 2010. http://eprints.ugd.edu.mk/5428/1/Studija_mkd.pdf.

Study on the status of the biological diversity of Republic of N. Macedonia (first National Report). 2003. http://www.moepp.gov.mk/wp-content/uploads/2014/12/Studija-za-sostojba-so-bioloska-raznovidnost-vo-RM.pdf.

Third National Plan on Climate Change
http://www.unfccc.org.mk/content/Documents/ADAPTATION/Agriculture_final_MK%20so%20CIP.pdf

https://www.rdc.mk/southeastregion/index.php/mk/regionot/za-regionot

www.bogdanci.gov.mk

www.gevgelija.gov.mk

www.gtzredem.com.mk

www.ipardpa.gov.mk

www.mls.gov.mk

www.novoselo.gov.mk

www.opstinabosilovo.gov.mk

www.opstinadojran.gov.mk

www.opstinavasilevo.gov.mk

www.radovis.gov.mk

www.sep.gov.mk

www.strumica.gov.mk

www.undp.org.mk

www.usaid.org.mk

www.valandovo.gov.mk

www.zels.org.mk