Country Study for Biodiversity of the Republic of Macedonia

(First National Report)

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R. Darrell Smith, Ph.D., and Katherine A. Smith

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Zoran Spasovski

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- **Stojmirka Tasevska**, Economic Chamber of the Republic of Macedonia

Project Manager:

- **Vesela Lambevska Domazetova**

Members of the Working Groups Involved in the Preparation of the Country Study

I. Biodiversity assessment group

Coordinator for flora:

- Vlado Matevski, Ph.D., Professor - Institute of Biology, Faculty of Natural Sciences and Mathematics, Skopje

Members:

- Pance Stojanovski, Ph.D., Professor - Institute of Biology, Faculty of Natural Sciences and Mathematics, Skopje

Other Participants:

- Ljubica Petrovska, Ph.D., Professor, ret. - Institute of Biology, Faculty of Natural Sciences and Mathematics, Skopje
- Magdalena Cekova, Ph.D., Professor, ret. - Institute of Biology, Faculty of Natural Sciences and Mathematics, Skopje
- Radoslav Rizovski, Ph.D., Professor, ret. - Faculty of Forestry, Skopje
- Zivko Sekovski, Ph.D., Professor - Institute of Biology, Faculty of Natural Sciences and Mathematics, Skopje
- Mitko Karadelev, Ph.D., Assoc. Professor - Institute of Biology, Faculty of Natural Sciences and Mathematics, Skopje
- Mitko Kostadinovski, Ph.D., Assoc. Professor - Institute of Biology, Faculty of Natural Sciences and Mathematics, Skopje
- Zlatko Levkov, M.Sc., Assistant - Institute of Biology, Faculty of Natural Sciences and Mathematics, Skopje

Coordinator for fauna:

- Svetozar Petkovski, Ph.D., Museum advisor - Macedonian Museum of Natural History, Skopje

Members:

- Branko Micevski, Ph.D., Professor - Institute of Biology, Faculty for Natural Sciences and Mathematics, Skopje

Other Participants:

- Trajan Petkovski, Ph.D., Museum advisor, ret. - Macedonian Museum of Natural History, Skopje
- Vesna Sidorovska, Ph.D., Vice-president - Society for the Investigation and Conservation of Biodiversity and the Sustainable Development of Natural Ecosystems (BIOECO), Skopje
- Jonce Sapkarev, Ph.D., Professor, ret. - Institute of Biology, Faculty of Natural Sciences and Mathematics, Skopje
- Snezana Stankovic, M.Sc., Museum advisor - Macedonian Museum of Natural History, Skopje
- Vladimir Krpac, M.Sc., Senior museum custodian - Macedonian Museum of Natural History, Skopje

- Branislava Mihajlova, M.Sc., Museum advisor - Macedonian Museum of Natural History, Skopje
- Slavco Hristovski, Assistant - Institute of Biology, Faculty of Natural Sciences and Mathematics, Skopje

II. Use and valuation of biodiversity group

Coordinator:

- Sreten Andonov, Ph.D., Professor - Faculty of Agriculture, Skopje

Members:

- Vladimir Dzabirski, Ph.D., Professor - Faculty of Agriculture, Skopje
- Sonja Ivanovska, Ph.D., Assoc. Professor - Faculty of Agriculture, Skopje
- Vladimir Andonovski, Ph.D., Assoc. Professor – Faculty of Forestry, Skopje
- Dana Kolevska, Ph.D., Professor - Faculty of Forestry, Skopje
- Vasil Kostov, M.Sc. - Institute of Stockbreeding, Skopje
- Gose Stefkov, M.Sc., Assistant - Faculty of Pharmacology, Skopje
- Slavica Hristovska, Museum custodian/ethnologist - Museum of the City of Skopje

Other Participants:

- Vladimir Maletic, Ph.D., Professor - Faculty of Forestry, Skopje
- Nikola Nikolov, Ph.D., Asst. Professor - Faculty of Forestry, Skopje
- Mirce Naumovski, Ph.D., Professor - Faculty of Agriculture, Skopje

III. Socioeconomic context and sectoral analysis group

Coordinator:

- Ljupco Melovski, Ph.D., Asst. Professor - Institute of Biology, Faculty of Natural Sciences and Mathematics, Skopje

Members:

- Jorde Jakimovski, Ph.D., Professor - Institute for Sociological, Political and Juridical Research, Skopje
- Nikola Panov, Ph.D., Professor - Institute of Geography, Faculty of Natural Sciences and Mathematics, Skopje
- Pece Nedanovski, M.Sc., Assistant - Faculty of Economy, Skopje
- Goran Arsov, M.Sc.
- Pene Penev - Public Enterprise for Spatial and Urban Planning, Skopje

Other Participants:

- Dragan Kolcakovski, Ph.D., Asst. Professor - Institute of Geography, Faculty of Natural Sciences and Mathematics, Skopje
- Milto Mulev, Ph.D., Professor, ret. - Institute of Biology, Faculty of Natural Sciences and Mathematics, Skopje
- Zivka Meloska, Ph.D., Assoc. Professor - Faculty of Forestry, Skopje

IV. Institutions, legislation and existing conservation programs group

Coordinator:

- Svetislav Krstic, Ph.D., Asst. Professor - Institute of Biology, Faculty of Natural Sciences and Mathematics, Skopje

Members:

- Jovan Ristov, Ph.D., Director - Institute of Protection of Cultural Monuments of the Republic of Macedonia

Other Participants:

- Daniela Stefkova - Ministry of Environment and Physical Planning
- Sasko Jordanov, M.Sc. - Ministry of Environment and Physical Planning

FOREWORD

Over the period since achieving its independence, the Republic of Macedonia has been striving to build a stable political and economic community, with a legal system able to facilitate rapid integration into the European Union and the wider international community. This primary strategic goal has given rise to sectoral targets, one of which is the establishment of efficient environmental protection measures in order to provide a basis for an improved quality of life.

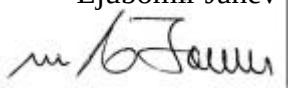
One component of this strategic goal is the conservation of biodiversity and habitats. In the process toward accomplishing this goal, the Republic of Macedonia has ratified: the *Convention on Biological Diversity* (Rio, 1992), *Convention on Wetlands of International Importance Particularly as Waterfowl Habitat* (Ramsar, 1971), *Convention on the Conservation of Migratory Species of Wild Animals* (Bonn, 1979), *Convention on the Conservation of European Wildlife and Natural Habitats* (Bern, 1982), *Convention on Protection of the World's Cultural and Natural Heritage* (Paris, 1972), *Convention on International Trade in Endangered Species of Wild Fauna and Flora* (Washington, 1973) and the *European Convention on the Protection of Vertebrate Animals Used for Experimental and Other Scientific Purposes* (Strasbourg, 1986), which together with the international agreements taken over from the former Socialist Federal Republic of Yugoslavia by means of succession, constitute part of the national legislation and represent a basis for biodiversity conservation.

In spite of the existence of legal bases for the regulation of biodiversity conservation (*Law on the Protection of Natural Rarities* [1973] and other sectoral laws), for a long period there has been a felt need to develop a national strategy for biodiversity conservation in order to establish a direction and identify priorities in this area, but also as an obligation arising from the *Convention on Biological Diversity.* The action begun in 1998, before the involvement of the Global Environmental Facility, was initiated with the signing of the agreement for funding the project, "Activities Related to Biodiversity and Capacity Assessment," which will result in a National Biodiversity Study, Strategy and Action Plan.

The study is the first step in this procedure and represents an overview of the situation in the State related to species distribution, dominance and level of endangerment, uses of biodiversity for commercial purposes and the impacts driving its alteration in both positive and negative senses. Supported by the scientific sphere and watched with vigilance by non-governmental organisations and the wider public, we have prepared a document which will not only be the first national report submitted to the Conference of the Parties to the *Convention on Biological Diversity*, but also a quality foundation for building the National Strategy and the Action Plan.

Minister of Environment and Physical Planning,

Ljubomir Janev



EXECUTIVE SUMMARY

The Republic of Macedonia is situated in the central part of the Balkan Peninsula. Today, as in the past, it is at the crossroads of important transport corridors in Europe. It occupies an area of 25,713 km^2 and has a population of 1,945,932 inhabitants (according to the census of 1994).

The territory of the Republic of Macedonia is hilly and mountainous, cut by river valleys. The climate is modified sub-Mediterranean, continental, and mountainous. It possesses some moderately significant water resources (a well developed hydrologic network and three major natural lakes).

Macedonia has been continuously settled since prehistory. From a demographic standpoint, the population was slowly increasing prior to World War II, and has been increasing more rapidly since then. A substantial migration from villages to towns has been occurring over the last 60 years.

For the past ten years the Republic of Macedonia has been undergoing a period of transition characterised by a significant economic recession, an increase in unemployment and a decrease in the standard of living. The State is politically unstable and there have been interethnic conflicts which resulted in a civil uprising in 2001.

In the areas of transportation, water management and energy infrastructure, the State has failed to keep pace with the developed European countries. Of the total land area, 40% is forested, 51% is in agriculture and 9% is non-productive.

The most impressive finding of the recent biodiversity study was Macedonia's heterogeneity and high level of relict and endemic species. In support of this, analyses of biodiversity richness for individual countries within the European continent rank the Republic of Macedonia at the very top of the list of countries considered to be "European Hot Spots."

The diversity of higher plant species and habitats is represented by a large variety of taxa and phytocoenoses (approximately 30 vegetative classes, 60 orders, 90 alliances and over 260 associations). Higher plant groups are represented by 3,700 species (most of them within flowering plants [*Angiospermae*] – 3,200 species, with 114 endemics). Mosses (*Bryopsida*) are represented by 350 species, with 2 endemics; ferns (*Filicinae*) – 42 species, with 1 endemic; *Gymnospermae* – 15 species; *Sphenopsida* – 7 species and *Lycopsida* – 6 species. According to available data, in the Republic of Macedonia lower plants are represented by 1,580 species of Algae (the best studied being diatoms [*Bacillariophyta*] – 512 species, with 62 endemics; Green algae [*Chlorophyta*] – 398 species, with 10 endemics and Blue-green algae [*Cyanophyta*] – 204 species, with 10 endemics). There are at least 1,250 species of Fungi and some 340 species of Lichens.

Regarding threats to lower plant groups, most of the available information concerns diatoms. Of this group, nine are considered to be extinct, whereas 107 species are threatened. Among the Fungi, the most threatened are 67 species of *Basidiomycota*, as well as 12 species of Lichens. As for the higher plant groups, Angiosperms are the most endangered group (280-300 endangered species, of which 5 are extinct), ferns (15), mosses (20) and Gymnosperms (7).

The diversity of fauna in the Republic of Macedonia is represented by 9,339 species and 228 subspecies, or a total of 9,567 taxa. Of these, 602 species and 72 subspecies, or a total of 674 taxa, are Macedonian endemics representing 7 % of the entire fauna.

Threatened status is defined only for vertebrates and is based upon the European Vertebrate Red List. Out of 506 vertebrate species, 113 are included on the list of

threatened species, which is 22.3% of the entire vertebrate fauna in the Republic of Macedonia. The most threatened group is fishes, with 30 out of 58 indigenous species included on the list, which is 51.7% of the entire ichthyofauna.

Biological resources in the Republic of Macedonia are utilised continuously. Usage includes agriculture, forestry, hunting, fishing and collection of wild plants. For some of these activities there are legal regulations, but they are not as effective as intended and do not ensure a high level of protection. Such a situation is particularly evident in the protection of autochthonous genetic material and the conservation of wild species and varieties. In everyday life, the economic benefits of the utilisation of biological resources often outweigh the protection measures for their maintenance.

The main economic factors affecting biodiversity show the same trends as the rest of the economy of the Republic of Macedonia during this period of transition. A significant decrease in production has been recorded in mining, civil engineering, tourism and fishing. In contrast, the agriculture, industry, forestry, energy and transport sectors, which suffered a significant decline in the beginning of the 1990s, are now stable. With regard to the significance of their individual impacts on biodiversity, the different sectors can be ranked from greatest to least as follows: agriculture, transport, energy, industry and mining, tourism, forestry, fishing and civil engineering.

Despite the existence of factors which provide limited protection to biological diversity within the Republic of Macedonia, experience with biological diversity management shows that there is a pressing need to prepare a strategy for biodiversity conservation, initiate reorganisation at the government level, harmonise legislation with that of the European Union, and apply the provisions of the international agreements related to biodiversity and the European and world methodologies and criteria in this field.

With this in mind, the following activities for biological diversity conservation are considered to be priorities: clarify and allocate responsibilities to relevant ministries, introduce continuous monitoring of biodiversity and those factors leading to its loss, establish relevant scientific data banks, intensify publishing activities in this field, intensify education at all levels, introduce efficient supervisory and penal policies, increase scientific accomplishments in practical conservation, strengthen and support non-governmental organisations in their activities to raise public awareness and promote the relationship “citizen-natural property.”

1. COUNTRY CONTEXT

1.1. Geographical location, borders and land area

The Republic of Macedonia is situated in the central part of the Balkan Peninsula and has a very favourable geographic position. It extends between 40°50' and 42°20' North Latitude, and between 20°27'30" and 23°05' East Longitude. Very important transportation routes pass through the country, which serve to connect central and eastern Europe with the southern and south-eastern parts of the continent, continuing towards the countries of the Near East and beyond. The most important among them is the main E-75 motorway, which connects the Morava and Vardar Valleys to neighbouring Greece. It also intersects with the western Macedonian motorway E-65, which connects the capital, Skopye, with parts of western Macedonia and on through the border crossing Kyafa-San to Albania. The main motorway is also connected with other major roads, such as the M-5, which starts at Skopye, passes through Veles, Shtip and Kochani, and ends at the Bulgarian border crossing Arnautski Grob near Delchevo. From Shtip, the road M-6 turns towards Strumitsa, connecting Macedonia again with Bulgaria through the border crossing at Novo Selo. The road M-2 begins at Kumanovo and passes through Kriva Palanka to the Bulgarian border crossing at Deve Bair.

Figure 1. General overview map of the Republic of Macedonia.

Macedonia borders Albania on the west, Greece on the south, Bulgaria on the east and Serbia and Montenegro on the north. The total length of the border is 849 km, of which the western border is 191 km, the southern, 262 km, the eastern, 165 km and the

northern, 231 km in length. The northern and southern borders are roughly parallel, while the western and eastern borders form opposing convex arcs. The total area of the country is 25,713 km^2.

1.2. Physical geography and topography

The landform of Macedonia, as part of the Balkan Peninsula, is characterised by complex geotectonic features, which produce developed relief, complex geology and, hence, a diversity of soil types. This is an important factor in explaining the rich biodiversity of the country.

The chief reason for the complex geotectonic evolution of the internal part of the Balkan Peninsula (Macedonia) is the large number of orogenic cycles, from the oldest yet known, to the youngest alpine orogenesis. These cycles led to multiple metamorphoses of the surface relief; there were rhythmic patterns of advancement and regression of the seas, allowing for the creation of a series of various sediments. Whenever the regime changed, the sediments were tectonically transformed by faulting, fissuring and metamorphosis.

The Rhodope massif is the oldest on the Balkan Peninsula and is part of the ancient foundation. Part of it extends within Macedonia, not as a solid formation, but broken into several blocks of differing forms and dimensions. The Pelagonian and Serbian-Macedonian massifs are products of the Grenville phase of the Baikal orogenesis. They were formed in the Precambrian Era during the strongest magmatic movements. At that time, there were intrusions (over large areas) of granite and granodiorite magma accompanied by regional and contact metamorphism. The separation of the two masses (Pelagonian and Serbian-Macedonian) from the mother Rhodope massif and from each other, which was connected with the creation of the Vardar zone, was made in conjunction with the Caledonian orogenesis during the early Paleozoic Era. The Hercynian orogenesis had an extreme influence in the western parts of Macedonia, where the sediment complex is folded and metamorphosed. The lateral pressure from the east transmitted by the Pelagonides created positive and negative structures with axes generally oriented in a northwest-southeast direction. The alpine orogenic cycle, which has been occurring from the Triassic Period to the present, has left fresh traces in the geotectonic structure of Macedonia. The youngest neotectonic phase, having started during the middle Miocene Epoch (Torton Stage) and continuing to the present, is characterised by block tectonics.

The territory of the Republic of Macedonia possesses a complex mosaic of various metamorphic, sedimentary and igneous rocks in all tectonic units. In general, the metamorphic complex is dominant in the western zone of Macedonia and Pelagonia, reduced in the Serbian-Macedonian massif and least likely to occur in the Vardar zone. In the Vardar zone, sedimentary rocks are dominant, while in the Serbian-Macedonian massif, igneous rocks are characteristic (but they are also present in the Vardar zone). Both types of rocks are lacking in the other tectonic units. Stratigraphically, metamorphic rocks belong to the Grenville, Baikal and Caledonian complexes and sedimentary rocks to the alpine complex, while igneous rocks are present in almost all periods, from the oldest to the Quaternary.

Relief

The relief structure of the Republic of Macedonia is very interesting and diverse, and is represented by mountains, valleys, ravines, narrow gorges, saddles and other forms. Further, the present relief structure is morphogenically diverse as well, with both older and younger relief forms.

"Mountains" are the most important among the large relief forms, and cover approximately two-thirds of the territory. They fall into two groups depending upon their time of formation, geological composition and size of extension; these are the Rhodope and Dinaric groups. The Rhodope group is considered to be older and was formed during the so-called Hercynian orogenesis phase. The mountains Osogovo (Ruen peak – 2,252 m), Plachkovitsa (Lisets – 1,754 m), Belasitsa (Tumba – 1,881 m) and Ograzhden (Ograzhden – 1,745 m), situated primarily in the eastern part of the country, are characteristic representatives. The Dinaric group extends through the western, south-western, southern and central portions of the country. These mountains were formed during the alpine orogenesis and are considered to be young mountains. These include the Shar Planina mountain group, Vardar zone and Pelagonian horst anticline. The Shar Planina mountain group includes Shar Planina Mountain (Titov Vrv peak – 2,748 m), Korab (Golem Korab, the highest peak in Macedonia – 2,764 m), Bistra (Medenica – 2,163 m), Stogovo (Golem Rid – 2,268 m), Yablanitsa (Strizhak – 2,233 m) and Galichitsa (Livada – 2,253 m). This is the highest group of mountains and extends into the western part of the country. The Vardar zone includes the mountains distributed along both banks of the Vardar river: Zheden, Vodno, Kitka, Mariovo, Nidze and Kozhuf on the right descending bank and Serta and Plavush on the left descending bank. The Pelagonian horst anticline includes the following mountains: Baba (Pelister – 2,601 m), Yakupitsa, Karadzitsa, Babuna, Goleshnitsa, Selechka Planina and others. With the exception of Baba Mountain, which is situated in the southwest, these mountains are located in the central portion of the country.

"Valleys and larger plains" are the second distinct morphological feature of the relief structure. They are distributed over approximately one-third of the country. Most distinct are the ones extending along the Vardar River. From the northwest to the southeast, they are situated as follows: Polog (373 km^2), Skopye (1,840 km^2), Tikvesh (604 km^2) and the Gevgeliya-Valandovo Valley (620 km^2). They are intersected by the respective gorges Zheden (Derven), Taor and Demir Kapiya. The Ciganska Klisura extends from the Gevgeliya-Valandovo Valley towards neighbouring Greece. The largest valley in the Republic of Macedonia is the Pelagonia Valley, which is situated in the south-western part of the country and occupies an area of 4,000 km^2. A portion of this valley extends into Greece, where it is called the Lerin (Florina) Plain. In western Macedonia, the following valleys and plains are most characteristic: Ohrid-Struga Valley (226 km^2) Prespa Valley (94 km^2) and Debarsko Pole Plain (73 km^2). In eastern Macedonia, the following valleys and plains extend along the course of the Bregalnitsa River: Berovo Valley (192 km^2), Piyanets, Kochani Valley (345 km^2) and Ovche Pole Plain (317 km^2). The most fertile valley in the country is the Strumitsa-Radovish Valley, situated in the south-eastern part of the country and occupying an area of 658 km^2. In the north, the Kumanovo Valley (628 km^2) and the Slavishko Pole Plain (320 km^2) extend along the watershed of the rivers Pchinya and Kriva, respectively.

Old, so-called "paleo-relief" is characterised by saddles, which are traces of former fluvial erosion. Today, they are the most common features through which neighbouring valleys are connected. The best known saddles are: Pletvar (990 m msl) and Prisad

(1,140 m) between the Pelagonia and Povardarje Valleys, Bukovo (1,180 m) between the Ohrid and Prespa Valleys, Gyavato (1,168 m) between the Prespa and Pelagonia Valleys, Strazha (1,212 m) between the Kichevo and Polog Valleys and Preseka (1,102 m) between the Kichevo and Ohrid Valleys.

Traces of "glacial relief" can also be found in Macedonia. There are remnants of both glaciers and cirques on some of the mountains, and of only cirques on others due to the small size of the glaciers. Such relief is characteristic mainly of the high mountains in western Macedonia, such as Yakupitsa, Bistra, Korab, Pelister, Shar Planina, Galichitsa and Stogovo; however, most of these traces occur on Shar Planina Mountain. So far, 50 are known, some of which are filled with water and represent glacial lakes.

"Karstic relief" is present on Paleozoic, Mesozoic, Palaeogenic and Neogenic limestones. Limestone is found mostly on the Suva Gora, Zheden, Yakupitsa, Galichitsa, Bistra, and higher parts of Shar Planina, mountains. All types of karstic forms are present, both on the surface and underground. The former includes depressions, crevices, fissures and karstic plains, while the latter includes caves as well as pits and sinkholes. The most distinctive karstic relief form is karstic plains, of which Tonivoda on Bistra Mountain is most representative. Underground karstic relief forms include about 164 caves and 12 pits and sinkholes. The most characteristic sinkhole is located on Solunska Glava, with a depth in excess of 500 m. One of the most beautiful caves is Ubavitsa (the Beauty), or Gyonovitsa, on Bukovik Mountain, whereas the longest is Bela Voda (White Water) near Demir Kapiya (996 m).

Other relief forms include "gypsum and younger fluvial relief" which also have economic relevance.

Soils

The Republic of Macedonia, although a small country, abounds in various soil types: Automorphous (*undeveloped* – rocky soil, serozem on loose substratum, aeolian sand and colluvial soil; *humus-accumulative* – limestone-dolomitic mould, rendzina, humic-silicate soil, chernozem, and smolnica (vertisol); *cambic* – eutric brown soil, acid brown soil, brown soil over limestone and dolomite, and red soil; *eluvial-illuvial* – luvic soil and brown podzolic soil; *anthropogenic* – regolithic soil, garden soil and landfill soil); Hydromorphic (*undeveloped* – alluvial soil; *pseudogley* – pseudogley; *meadow* – meadow soil; *gley* – pseudogley-gley, black wetland soil, gley soil and peat-gley soil; *peat* – high peat, intermediate peat and low peat; *anthropogenic* – regolithic peat soil, rice soil and irrigated soil); Halomorphic *(acute saline soils* – solonchak; *solonetz* – solonetz); Subaquatic *(undeveloped* – protopedon; *developed* – "gitja," "daj" and sapropel).

1.3. Water resources

The Republic of Macedonia contains a considerable number of water resources, both underground and surface. Underground waters include: phreatic, artesian, subartesian and well waters. They have great importance for the country, because it is estimated that nearly 60% of rural and 50% of urban drinking water supplies come from wells. A portion of these waters are used for industrial purposes, which is unpopular in light of the current situation with global water shortages. Artesian waters are common in the Pelagonian and Strumitsa-Radovish Valleys and can be found at depths of 60-80 m. Reserves in the Pelagonian Valley are estimated to be 170 million m^3, with about half

this amount in the Strumitsa-Radovish Valley. In some places, there are also high mineral constituents.

With respect to surface waters, 4,414 springs have been recorded, with a total capacity of 31.43 m^3/s or 991.90 × 10^6 m^3/year. A great number have not yet been measured, but are included on hydrologic maps. The capacity of about 800 of the springs ranges from 1-5 l/s, while the remaining springs exceed 5 l/s, totalling a considerable quantity of water. There are also 90 springs with capacity of more than 30 l/s, with 58 yielding 100 l/s. A great number of them are located in the various tributary watersheds of the Vardar River (80%), Crni Drim River (15%) and Strumitsa River (5%), especially in the mountainous areas of Yakupitsa, Pelister, Plachkovitsa, Osogovo, Shar Planina and others. Of the springs occurring only in karstic areas, the most characteristic are: Rasche, in the foothills of Zheden Mountain (4 m^3/s capacity); Ostrovo, near the monastery of St. Naum by Ohrid Lake and Bilyana Springs, near the town of Ohrid. The mineral springs most used for bathing and drinking are: Katlanovo Spa near Skopye (41-50°C); Kumanovo Spa near the village of Proevo, municipality of Kumanovo (30-35°C); Kezhovitsa near Shtip (57°C), also one of the most radioactive in the Balkans; Negortsi Spa near the village of Negortsi, municipality of Gevgeliya (36-40°C); Debar Spa in the village of Banjiste near Debar (36°C); Kosovrasti near Debar (48°C) and Bansko Spa near the village of Bansko, municipality of Strumitsa (72°C), which is one of the hottest in Europe and in the world.

The rivers of Macedonia are divided into three primary watersheds: one flowing to the Adriatic Sea and two to the Aegean Sea. Another very small watershed flows to the Black Sea. The Vardar River (Aegean watershed) is the largest river, containing 80% of the water flow leaving the Republic of Macedonia. Of the remaining 20%, 13% flows through the Crni Drim River (Adriatic watershed), with only 7% through the Strumitsa River, a tributary of the Bulgarian Struma River (Aegean watershed). The total length of the Vardar River is 388 km, of which 300 km are present in Macedonia and the remainder in neighbouring Greece. Its headwaters are the springs near the village of Vrutok, and it flows into the Aegean Sea near the Thessaloniki Gulf. At the point where it exits Macedonia near Gevgeliya, its flow is 174 m^3/s. Its major western tributaries are the Crna River (207 km in length with a 37 m^3/s flow at its mouth) and the Treska River (138 km and 30 m^3/s average flow at its mouth). The longest eastern tributary of the Vardar River is the Bregalnitsa River (225 km and 28 m^3/s average flow at its mouth). The second largest eastern tributary is the Pchinya River (135 km and 16 m^3/s average flow). The Crni Drim River flows only 48 km within the territory of Macedonia and, together with its tributary, the Radika River, one of Macedonia's most attractive rivers, encompasses 1,772 km^2 of watershed area. The flow rate at its entry point into Ohrid Lake is 21 m^3/s. The Strumitsa River's watershed is 1,465 km^2.

There are several natural and artificial lakes in the Republic of Macedonia. Of the natural ones, the most attractive are the tectonic lakes: Ohrid, Prespa and Doyran.

Ohrid Lake is the largest, occupying an area of 348.8 km^2, of which 229.9 are in the Republic of Macedonia and the remainder in Albania. It is 30.5 km long, 15 km wide and 287 m deep at its deepest point. The average depth is 144.8 m and the total length of the shore is 83.8 km. The temperature of the surface water in the summer period reaches 25°C. The lake is situated at 699 m msl. In addition to flow from the Crni Drim River, the lake receives water from 80 surface and underground springs and from Prespa Lake, which is located at a higher altitude.

Prespa Lake, with an area of 274 km^2, is the second largest in the country, 176.8 km^2 of which belong to Macedonia, 47.8 km^2 to Greece and 49.4 km^2 to Albania. Its length is 28.6 km and its width is 16.9 km. Its greatest depth is 54 m, its average depth is 18.8 m and the length of the shoreline is 100.1 km. Prespa Lake is situated at 853 m msl. Because the lake has no major tributaries and because a portion of the water migrates downward through the limestone into Ohrid Lake near the locality of Vragodupka, the level of the water fluctuates considerably. The highest summer temperature reaches more than 25°C.

Doyran Lake, unlike the other two lakes which are located in western Macedonia, is situated in the south of the country, occupying an area of 42.74 km^2; 27.1 km^2 of the area belong to the Republic of Macedonia and the rest to neighbouring Greece. Prior to the recent hydrologic perturbations caused by both climatic and human factors, the lake's maximum depth was 10 m and the average, 6.7 m. At that time, the maximum water volume of its basin was 202×10^6 m^3. The mean annual temperature of the water is 14.8°C, which contributes to its high level of fish production in comparison with other lakes of the world.

Among the other Macedonian water resources, discounting the glacial lakes which have limited hydrologic capacity, there are 110 major and minor artificial lakes, but only 20 with volumes larger than 1,000,000 m^3. They are used for irrigation, water supply and production of hydroelectric power. The largest is Shpilje on the Crni Drim and Radika Rivers, with a volume of 520×10^6 m^3, followed by Tikvesh Lake on the Crna River, with 475×10^6 m^3 and Mavrovo Lake on the Mavrovo River, with 357×10^6 m^3. Mavrovo Lake produces the most hydroelectric power, as much as 415×10^6 KWh. Other lakes important for their water capacity or ambient characteristics include Kalimantsi (Makedonska Kamenitsa), Gratche (Kochani), Mladost (Veles), Strezhevo (Bitola), Matka (Skopye), Globochitsa (Struga), Vodocha (Strumitsa), Ratevo (Berovo), Turiya (Strumitsa) etc.

1.4. Climate

Due to specific natural and geographic characteristics, there are two main types of climate in the Republic of Macedonia: Mediterranean and continental. Thus, two prominant seasons occur: cold, wet winters and dry, hot summers. In addition to these, in the high, mountainous areas there is also a mountainous climate characterised by short, cool summers and considerably cold and moderately wet winters, where precipitation is mainly in the form of snow. In spite of the fact that Macedonia lies relatively close to the Aegean and Adriatic Seas, the influence of the Mediterranean climate does not reach very deeply into the country, except within a few valleys. This is a result of the high mountains which rise up in the west and south of the country. The influence of the Aegean Sea can be felt along the valley of the Vardar River northward to Demir Kapiya, and slightly less so in the Skopye Valley. Some slight effect also reaches the valleys of the Strumitsa and Bregalnitsa Rivers, as well as the proximity of Doyran Lake. The influence of the Adriatic Sea on portions of western Macedonia extends primarily along the Crni Drim valley. The continental influence enters from the north and continues towards the south; therefore, the characteristics of this climate are felt deep within the country, especially in the northeast and eastern regions.

The average annual temperature is 11.3°C. The hottest towns are Valandovo and Gevgeliya, with temperatures of 14.5°C and 14.3°C, respectively. In the mountainous climatic areas, the mean annual temperatures are: on Popova Shapka, 4.7°C, in

Lazaropole, 6.8°C and in Krushevo, 8.2°C. The average precipitation within Macedonia is 683.7 mm/year. The areas of highest precipitation occur in Mavrovi Anovi and Resen, with 1,197 mm and 757.9 mm, respectively, and the least in Ovche Pole Plain with only 490.3 mm. Hail falls most often in the period from April to October, with the highest incidence in April and May. It is most frequent in the Ovche Pole, Tikvesh and Pelagonian areas and in the valleys of Gevgeliya-Valandovo and Skopye. Winds blow mainly from the northern quadrant but, in specific areas, their direction can changes according to the relief structure. Although the best known winds are the Vardarec and Jug, sometimes in valleys or ravines local winds occur, such as in Denik and Noknik. Annually, the quantity of sunlight present is about 2,100-2,450 hours, while the mean annual cloudiness is between 4.3 and 5.7 on a 10-point scale. The average number of clear days is 130 in the south and 73 days in the Skopye Valley. The average number of foggy days ranges from 4-72, mostly occurring in autumn and winter months. Fog is mainly present in the Skopye Valley (72 days) and in Polog (33 days), and occurs least often in the Strumitsa-Radovish Valley and in Malesheviya, where the average annual number of foggy days is 3-5.

2. SOCIO-ECONOMIC CONTEXT

2.1. History of the human settlements and archaeology

The territory of the Republic of Macedonia has been continuously inhabited since ancient times due to its favourable geographic location and climatic conditions (Section 1.4.). There are archaeological findings that indicate intensive human activity (settlements and other objects) dating from the Palaeolithic and Neolithic periods, Bronze Age, Iron Age, and from the Classical period (Archaeological Map of the Republic of Macedonia – Macedonian Academy of Science and Arts, 1994). The findings are most numerous in the areas of the Vardar River and Pelagonia, and in the valleys of some of the Vardar's tributaries. The current appearance and characteristics of many of the landscapes in Macedonia are the result of the distribution of settlements from prehistoric times to the present (e.g., degradation of the natural zonal vegetation in some regions, strong cultural characteristics within certain areas etc.).

Modern settlements within the Republic of Macedonia differ from each other in size, spatial organisation and social and cultural characteristics. Rural and urban social organisation varies mainly with demographic and economic indicators. The principal differences between villages and towns can be seen in the orientation of their communities. Villages are oriented towards agriculture, in contrast to towns' professional/industrial orientation in the secondary and tertiary sectors. There are also other rural-urban differences, such as the size of the community, level of dispersal of structures, social differentiation and stratification, mobility, ambient surroundings and systems of interaction.

The shape and spatial distribution of settlements have always been under the influence of demographic factors, but certain influences also come from socioeconomic, natural, geographic (e.g., relief, geological composition of the soil, climate and vegetation) and historical factors. These elements have been of major or minor significance in various time periods.

Unlike the current processes – urbanisation, industrialisation and modernisation – where people are fully separated from nature, in former times people cared for every centimetre of arable land and forest. Now, no care is taken in deciding which type of land is to be converted for urban use. These poor decisions manifest themselves by inhibiting the functioning of ecosystems, and lead towards degradation of the environment.

High population concentrations in the larger cities (Skopye – 444,760 inhabitants, Bitola – 86,174, Kumanovo – 94,589, Prilep – 71,899 and Tetovo – 65,318), the inappropriate siting of industrial capacities and an inadequate communal infrastructure create serious problems in ensuring a quality environment. Demographic, economic, social and environmental characteristics within the population demonstrate significant rural-urban differences.

The number of abandoned villages, as well as the number of small settlements, indicate both an absolute and a relative increase in migration. According to the census of 1994, 121 rural settlements have been completely abandoned. While the processes of industrialisation and urbanisation have had a positive influence on the development of towns and their nearby villages, they have negatively impacted distant hill and mountain villages. Those persons who are able to find jobs in urban or suburban settings are usually forced to migrate permanently to be near their workplace because poor transportation systems prevent them from commuting from the village to town each day. In many cases, a shortage of funds for the purchase of housing in town forces them to stay in unauthorised (illegal) settlements. In these illegally inhabited areas, even though the residents do not generally have the ability to raise cattle, they are usually forced to abandon their arable land in the village. Such a trend of migration can be seen on Table 1.

Table 1. Inhabited areas – Dynamics of population, number of settlements and structure.

Population	1948		1994	
	Number	Structure (% of Total)	Number	Structure (% of Total)
Up to 99	117	6.7	573	35.1
100-299	566	32.5	387	23.7
300-499	411	23.6	184	11.3
500-799	356	20.4	149	9.1
800-991	102	5.9	84	5.1
1000-4999	176	10.1	217	13.3
5000-19999	9	0.5	25	1.5
20000-49999	3	0.2	8	0.5
50000-99999	-	-	4	0.2
over 100000	1	0.1	1	0.1
Total	1,741	100.0	1632	100.0

Source: "Spatial Distribution of the Population as a Factor of Change in the Network of Inhabited Places in the Republic of Macedonia," Prikaz i Studii (Review and Studies), No. 86, Skopje, 1997

The official territorial limits of Macedonian villages encompass 86.7% of the nation's land area and include 40.2% of the total population (records from 1994). Villages having less than 50 inhabitants represent a specific problem (360 villages – 20.6% of the total number of villages). It is expected that the villages of this subgroup, especially the ones having 10 or less inhabitants, will eventually be totally abandoned (104 villages). The situation is especially serious in the regions of Prilep, Kavadartsi, Shtip, Veles, Ohrid, Demir Hisar and Bitola.

Of 1,715 rural settlements, 508 (29.6%) are located in hilly or mountainous areas (over 800 m msl) (According to the *Law on Support for the Development of Less Developed Areas*, Official Gazette of Socialist Republic of Macedonia 39/89).

2.2. Current human population and demography

The population of Macedonia and its dynamics over the past 50 years are presented in Table 2.

Table 2. Population dynamics in the Republic of Macedonia (according to census data).

Census	Population		
	Total Number	Number of Males (%)	Number of Females (%)
1948	1,152,986	584,002 (50.7)	568,984 (49.3)
1953	1,304,514	659,861 (50.6)	644,653 (49.4)
1961	1,406,003	710,074 (50.5)	605,929 (49.5)
1971	1,647,308	834,692 (50.7)	812,616 (49.3)
1981	1,909,136	968,143 (50.7)	940,993 (49.3)
1994	1,945,932	974,255 (50.1)	971,677 (49.1)

Source: Calculations using data from the Statistic Yearbook of the Republic of Macedonia 2001, p.48, Skopje 2001

The demographic development of the Republic of Macedonia deserves special attention, especially with respect to the natural population growth. From 1948 to 1994, a period of 46 years, the total population grew by 729,946 inhabitants or 69%.

Table 3. Dynamics of the birth rate and population growth, 1953-1994.

Census	(Per 1000 Inhabitants)		
	Live births	Deaths	Population Growth
1953	37.9	14.8	23.1
1961	29.9	9.3	20.6
1971	22.9	7.5	15.4
1981	20.6	7.0	13.6
1994	16.1	7.6	8.5

Source: Calculations using data from the Statistic Yearbook of the Republic of Macedonia 2001, p.48, Skopje 2001

Table 3 shows a continuous tendency for a decrease in birth rate, death rate and general natural growth rate. Such trends unfavourably transform the age structure of the population (the continual aging process). The process of demographic aging (i.e., that the average age of the population is tending to increase), is subject to both the natural and mechanical components of population growth. The level of spatial mobility within the country conforms, to a great extent, with the size and distribution of ethnic and migrant populations. The number of migrants included within the total population figures increased from 12% to 36% during the period 1948-1994. According to the census of 1994, 46% of the migration was of local origin, 42% was between municipalities and 12% was from abroad. “Village to town” migration recorded the greatest growth during the period, 1961-1971. These migratory movements contributed greatly to the enlarging of regional differences in the age and educational structure of the population, primarily in the villages.

Table 4. Structure and characteristics of the population by location and education level (1994).

Age Structure	Macedonia	City of Skopye	Other Towns	Villages
0-19	33.2	30.2	32.2	36.0
20-30	30.8	30.5	30.3	30.5
40-59	22.8	26.7	34.5	18.9
60 and older	13.0	12.6	12.0	14.1
Unknown	0.2	0.0	0.0	0.3
Educational Structure				
Illiterate*	5.4	2.9	3.6	8.6
Without school education †	6.6	3.5	4.4	10.5
Not completed primary school †	18.4	9.2	14.8	27.4
Primary school †	33.4	25.2	30.6	41.1
Secondary school †	32.3	46.7	38.4	17.7
Advanced and university †	8.7	15.1	11.3	2.5
Unknown †	0.6	0.3	0.5	0.8

* age 10 and older; † age 15 and older

Source: Calculations using data from the Census of 1994, Population, housing and agricultural businesses, Book V, Skopje 1996

In relation to the national average, the age structure of cities and towns is more diverse than that of rural areas (Table 4). Also of particular significance is the fact that, based upon the national average, villages possess a much higher percentage of the uneducated and a much lower percentage of people with advanced and university education. General conclusions which can be drawn from these data are: (a) A larger percentage of the older and uneducated population lives in the villages, (b) they are being exposed to a greater extent to the consequences of transition and (c) they have few opportunities to improve their material situation and social status.

The large differences between individuals and social groups, unemployed versus employed, poor versus rich, uneducated versus educated, old versus young and rural population versus urban population increase the disparity in opportunities for acquiring the rights to use space.

The greatest proportion of the population of low economic status is concentrated in undeveloped areas and rural municipalities. Unless basic conditions are changed, their numbers might increase. The people in these communities possess and use few modern conveniences, do not have access to common social services and are insufficiently integrated into society.

2.3. Social and economic situation

The most noticeable characteristics of the past few years are the significant changes in societal structure (i.e., economic stratification of the population) and an increase in the number of impoverished citizens of the Republic of Macedonia. The level of poverty has increased from 19.0% in 1997 to 22.3% in 2000 (Table 5).

Table 5. Dynamics of poverty by location.

Index	1997		1998		1999		2000	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Index per Capita (%)	20.3	23.3	21.6	25.8	18.7	28.1	17.7	29.4
Index of Poverty Gap	4.3	6.2	4.8	6.6	3.7	6.9	4.0	6.2

Source: State Statistical Institute

Those living in poverty include people with a low level of education, the elderly, families with small children, the unemployed and the portion of the population living in hill or mountain settlements. A high proportion of poor households are in rural areas. The gap between the rich and the poor is increasing. More than one third of the population of the Republic of Macedonia lives in poverty, and many are hungry every day (23% have no money to buy food) (Report of the project on "Social Exclusion and Insecurity of the Citizens of Macedonia," Institute of Sociological and Political-Legal Research, Skopje, 2000). Research shows that 43% of the population living in hill and mountain villages within Macedonia do not have enough money to buy food, while 47% have difficulty in buying clothes and shoes. Due to low and/or unreliable income from agriculture and few employment opportunities, the population of hilly and mountainous areas satisfies some of their basic social needs by collecting forest fruits, mushrooms and medicinal herbs. In 2001, around 77,000 households (or 15% of the total number) received social assistance, which amounts to 57% of the poverty level. Most of the poor have restricted access to income, education, health care and food, especially the populations in hilly, mountainous and undeveloped areas. They face poverty due to their limited access to arable land and because of migration, which seriously reduces the

portion of the population capable of working. One of the factors that keeps people in poverty is the lack of adequate infrastructure, which strongly affects the population in undeveloped areas. This limits their access to those institutions providing public benefits – health, educational and cultural services; public administration etc.

Little progress has been made in the area of disposable income. Funds available for personal consumptive use in the Republic of Macedonia decreased by 30% per household during the period 1998-2000. This has brought about changes in the structure and manner of consumption. Food, housing, fuel, lighting, health and hygiene costs have increased while, at the same time, funds available to purchase clothes, shoes and household items or to place in savings have decreased. This is indicative of a low living standard and quality of life.

In the Republic of Macedonia, many segments of the population are marginalised, especially economically and socially, as a result of unemployment and low or irregular salaries, which make them unable to obtain enough food or to receive health care, education services, social assistance etc. The reasons are numerous, but can be reduced to the two most important: poverty (one-fourth of the population is virtually excluded from the economy) and massive unemployment (many people, particularly the young and insufficiently educated, are deprived of participating in the labour market). The various sources of unemployment are not uniformly present in all regions of Macedonia, and the level of unemployment differs significantly among the individual regions. Difficult and chronic changes are also occurring in the domain of regional development. Regional differences in the level of development are great and, during the course of the past few years, there has been a tendency toward their further divergence.

Macedonia is now facing extreme exploitation of the labour force, increased social divisions, and the illegal acquisition of wealth by a small segment of the population. One the one hand, this has led to privileged social positions and luxurious lifestyles for some, while on the other hand, to extreme and increasing levels of unemployment. In comparison to the beginning of the period of transition, unemployment has doubled. In 2000, according to official statistics, the unemployment rate was 32.1%, which indicates the breadth and severity of the problem. Along with several others, Macedonia has been placed on a list of countries having an “extremely high” rate of unemployment due to this increasing trend. An important characteristic of the unemployed in the Republic is that every second individual has a secondary school education. The time spent waiting to find a job, namely, over four years for 59.4% of unemployed persons (1999 data), is also a relevant indicator of the state of a labour force that is not active.

Another characteristic of the unemployed in Macedonia is the unusual age structure. The number of unemployed persons aged 20-24 (59.6%) is very high in comparison to the common average of 32.2 % (in 2000). As a result of such tendencies, the labour market is unbalanced and is tending toward further deterioration.

After 1996, a relatively positive growth rate for the gross domestic product (GDP) was achieved within the Republic of Macedonia. Thus, in 2000, the economy had a GDP growth rate of 5.1% (per capita) and an average inflation rate of 5.8 %. The GDP per capita was $5,086. The crisis in 2001, however, caused and continues to cause great hardships for the economy. GDP at the end of 2001 recorded a negative rate of growth. The largest impact to the GDP growth rate resulted from a decline in industry, trade, agriculture, construction and tourism.

The right to primary education in the Republic of Macedonia is guaranteed by the Constitution of 1991, and it is obligatory and free of charge. The Constitutional

provisions were implemented through the laws on primary, secondary and university education. Ninety-six point two percent of children are enrolled in primary education, in the urban areas almost fully, but somewhat less in rural areas (88.5% in 1997) (According to the study, "Strategy for Poverty Eradication" [provisional version], 2000). The Constitution of the Republic of Macedonia allows the opening of private secondary schools and colleges as defined by law.

The health care system is financed by obligatory health insurance deductions, which creates the possibility of insurance for all people including those employed in the public and private sectors, retirees, self-employed persons, farmers, the temporarily unemployed, beneficiaries of social assistance and the members of their families. For those citizens not included under any of these categories, costs for health care services are borne by the State. The deduction for health insurance amounts to 9.2% of a person's gross salary. For health care services provided in specialised-consultative clinics or hospital centres, the insured must also use personal funds for payment.

2.4. Political situation

The 1991 Constitution defines the Republic of Macedonia as a sovereign, independent, democratic and social State with its civil government based upon the democratic election of representatives. It is a government which also allows the citizens to express themselves directly through referenda and in other manners and forms.

Political pluralism has its main pillars in the form of political parties, a market economy allowing private ownership, and local self-government by municipalities. The Constitution guarantees the basic personal and political freedoms specified under international law: the right to live, the right to liberty, the right to express one's ethnic affiliation, the protection of one's physical and moral integrity, the prohibition of discrimination and equality before the law. Citizens enjoy equal rights to candidacy in elections and other functions, both at the local and national levels, without any fear of discrimination.

The Constitution guarantees economic and social freedom and other citizens' rights including: the right of property ownership, the right to work, the right to strike, the right to inherit, the right to social insurance and social care, the right to health care, the right to a healthy environment, the right to education etc. The principles of market freedom and entrepreneurship, fundamental values of the Constitutional order of the Republic of Macedonia, allow for broad opportunities to strengthen the economy and to increase the productivity of labour and private initiatives in all areas of the economic system. After independence, a multiparty system was established, political rights and democratic elections were constitutionally affirmed and legally guaranteed, national and ethnic rights were defined and guaranteed etc. Still, there is a need for interethnic cooperation instead of the current conflicts.

Although the principle of the rule of law is ensured by the Constitution, in practice there are serious weaknesses in its implementation. A basic problem in the sphere of rights and freedoms is how to put them into practice within society. There are major and minor differences between the Constitutional provisions and the actuality of their legal enforcement. The Republic of Macedonia is facing many social problems, situations and circumstances (Section 2.3.). On occasion, during the procedure of privatising enterprises, personal interests become more important than society's. The model of paid privatisation employed in Macedonia excluded participation by the citizens in favour of buy-outs by the management, a reduction in the value of the equity and the coerced

purchase of shares by pressure and blackmail. To conclude, although privatisation is in its final phase, the model used did not deliver the expected result of an efficient economic operation.

In the area of human resources legislation, incomplete regulations have brought about numerous cases of the exploitation of employees, particularly low or irregular salaries and a failure to pay health, old age and disability insurance.

Bureaucracy is an additional impediment to complete participation in society. There have been cases of long and difficult administrative procedures in order to acquire certain rights, unreasonable requirements for obtaining documents and difficult procedures for opening a private business or company.

The internal ethnic crisis in the Republic of Macedonia in 1991 altered people's abilities to earn a living, created a climate of insecurity and caused an increase in poverty. In addition, to the detrement of the economy, military actions increased the number of temporarily displaced people, ruined or destroyed residential houses and cultural-historical monuments, set fire to crops and forests and destroyed livestock (in the vicinities of Tetovo, Skopye and Kumanovo). Military actions also incurred a social price.

The process of accession to the European Union (EU) began with the signing of the Agreement for Stabilisation and Association in Luxembourg on 9 April 2002. This process is conditional upon internal reforms of the economic and legal systems (a prerequisite for the successful implementation of legislation revised according to EU standards).

By becoming affiliated with such international organisations as the United Nations (UN), the International Labour Organisation, the Council of Europe, the World Trade Organisation and the EU, the Republic of Macedonia took upon itself certain accompanying obligations, such as the requirement for approximation of its regulations with international documents and standards. As an applicant, the State has to meet certain political criteria such as democracy, the rule of law and human rights, as well as economic criteria, or the existence of a market economy and market forces.

2.5. Infrastructure and development

Transportation Infrastructure

The Republic of Macedonia contains 9,573 km of roads in a categorised road network (1995 data), of which 909 km are motorways, 3,058 km are regional roads and the remaining 5,606 km are local roads. Most of the motorways (584 km) are included in the European road network system of "E" roads. Of this amount, only 138 km of motorway can be considered to be a part of the TEM (Trans–Europe Motorway) system: Kumanovo-Petrovec-Veles-Gradsko, Skopye-Petrovec, Hipodrom-Miladinovci and Tetovo-Gostivar. Of the total length of the categorised road network, 5,400 km (56.4%) are of modern construction (asphalt, concrete, stone blocks etc), 1,182 km (12.4%) are of macadam construction and the remaining 2,991 km (31.2%) are unimproved (either soil base or no improvement whatsoever).

Railroad transportation in Macedonia is poorly developed. It is managed over a network of 699 km of open railway lines, 226 km of rail yards and 102 km of industrial tracks. The Tabanovtse-Skopye-Gevgeliya (213.5 km), General Jankovic-Skopye (31.7 km) and Veles-Bitola-Kremenica (145.6 km) lines are international. The remainder are regional. Out of the total railway network, 231 km are electrified (the Tabanovtse-

Skopye-Gevgeliya line), or approximately 33% of the open lines, and 83 km of rail yards.

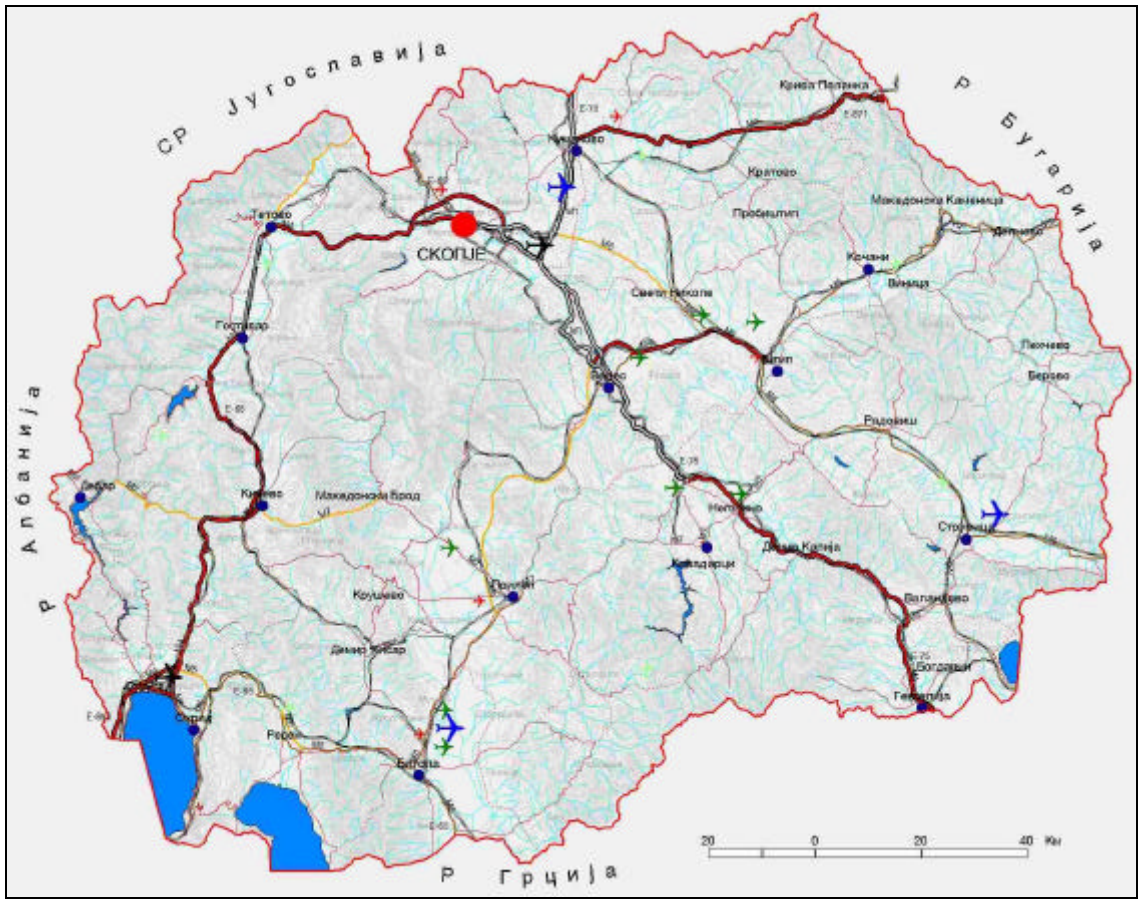


Figure 2. Transportation infrastructure of the Republic of Macedonia.

The air transport of passengers and goods is managed through the airports in Skopye and Ohrid. They have runways for full take-offs and landings which can accommodate, under certain conditions, all types of airplanes, including the heaviest.

Small State-owned airports exist in Skopye, Kumanovo, Bitola, Shtip and Prilep, a sufficient number for the needs of the population. Eight airports are registered for agro-business use. Lake traffic mainly encompasses the transportation of passengers on Ohrid Lake during the tourist season. At the end of 1995, approximately 2,200 motor boats were registered, with an average capacity of 8-10 passengers each. Of these, 150 are used for passenger transport activities (i.e., as taxis), and 150 are fishing boats.

Water economy infrastructure

In the Republic of Macedonia, all municipal centres have constructed public water supply systems, but these can not supply a sufficient amount of water. The current quantity of water extracted from springs, wells, watercourses and reservoirs is approximately 317,284 × 10^3 m^3/year.

Irrigation systems, covering 126,617 ha, require 899,335 × 10^3 m^3/year of water. Currently, only 50,000-60,000 ha are irrigated. The protective coating on most of the main/major pipes, as well as the rest of the pipes in the irrigation network, is in bad

condition. In addition, the installed hydro-mechanical equipment does not function properly. This causes a 20 to 40% water loss due to leakage.

Of all the available hydroelectric potential (6,436 GWh), only 30.5% has actually been utilised, mainly by the hydroelectric power plants in the watersheds of the Vardar (23.6%) and Crni Drim Rivers (6.9%).

Sewerage systems which are more than 80% complete have been built in 12 inhabited areas, from 60-80% complete in eight places and less than 60% complete in five locations. The remaining settlements do not have any sewerage systems.

Three wastewater treatment plants have been built so far: in Ohrid/Struga, including a few nearby tourist areas, in Doyran and in Resen. A small portion of industrial wastewater is subject to chiefly mechanical treatment.

Of the total length of watercourses (559.6 km), only 180.0 km have been improved. Protective embankments totalling 359 km have been built to protect 152 settlements, 122 km of railroads, 555 km of roads and 137,000 ha of land.

Energy infrastructure

Electric power is produced at existing thermal power plants in Negotino (Bitola 1, 2 and 3 and Oslomej), with a total installed generator power threshold of 1,010 MW and potential production of 6,312 GWh of electric power annually (at 6,250 average annual hours of operation). There are 13 large and medium-sized hydroelectric power plants with a total generating capacity of 458.7 MW, several other small hydroelectric power plants (total capacity of 37 MW), and five industrial heating plants, which participate with 1-5%. The total electrical power production of 2,011 GWh in 1980 increased to 6,181 GWh in 1995.

The main elements of the system for transmitting electric power are transmission lines and transformers, with voltage thresholds of 110, 220 and 400 kV. As of 1998, the electrical energy system of the Republic of Macedonia included 77 transformers, with a transfer ratio of 110/x kV/kV and total installed power of 2,011 MVA, four transformers of 220/110 kV/kV and power of 600 MVA and six transformers of 400/110 kV/kV and power of 1,800 MVA, as well as 372.2 km of 400 kV transmission lines, 166.5 km of 200 kV lines, 22.5 km of 150 kV lines and a total of 1,562.4 km of 110 kV lines.

The greatest portion of the country's needs for petroleum derivatives is supplied by the OKTA Crude Oil Refinery in Skopye, whose projected capacity is 2,500,000 tonnes/year; however, it has never operated at full capacity.

In the Republic of Macedonia, there is a branch of the international transit gas pipeline system extending from the village of Zhidilovo (Deve Bair) to Skopye (around 120 km). In the future, there is a plan to extend the gas pipeline network across the Republic and connect it with Greece and Serbia (through Kosovo).

In addition, the oil pipeline from Thessaloniki to the refinery in Skopye has now been completed, and there is presently an oil pipeline from Skopye to Kosovo being built. In the future, the construction of a Balkan oil pipeline (Burgas-Drac) which would pass through the Macedonian towns of Kriva Palanka, Kumanovo, Skopye, Veles, Prilep, Bitola, Resen, Ohrid and Struga is anticipated.

2.6. Property rights and tenure

The right of property ownership can be exercised by all domestic and foreign physical and legal entities, including the State and local self-government units, under conditions stipulated in the *Law on Property and Other Real Rights* (Official Gazette of the Republic of Macedonia 18/2001). The right to own property can be restricted or denied when it is a matter of public interest, as defined by the law. Any asset which can belong to a legal or physical entity is subject to the right of property ownership, except for ones that, due to their

nature or by virtue of the law, can not be subject to this right. Property refers to movable objects and real estate.

Assets considered to be of "common interest" in the Republic of Macedonia include: natural properties, plant and animal life, properties of common usage, construction sites, forests and forest lands, pastures and water resources, as well as objects of special cultural or historical importance. Objects defined by the Constitution or by other special laws as assets of common interest for the State can be subject to the right of property ownership by physical and legal entities.

The forms of ownership over building sites, agricultural and forest lands, pastures and water resources are governed by special regulations. Properties of common usage are objects of State ownership used by all physical and legal entities. The management and care of them lies with the Republic, unless agreed otherwise. The manner and conditions under which certain properties of common interest owned by the State can be released for use (concession) to physical and legal entities is regulated by law.

The right to own property can also be exercised under the auspices of the *Law on Denationalisation* (Official Gazette of the Republic of Macedonia 20/98), for properties expropriated after 2 August 1944.

In Macedonia, 677,886 ha of the total 2,571,300-ha land surface are considered to be private property; 1,865,330 ha are State property. Of the arable lands, 498,051 ha of the total 633,233 ha are private property and 135,182 ha are owned by the State. With regard to pastures, 469,061 ha out of the total 649,092 ha are State-owned; of forests and forest lands, 87% or 827,450 ha of the total 953,322 ha are owned by the State.

Of the total available housing in Macedonia, there are 580,314 flats. According to the census of 1994, 96% or 557,101 flats are privately owned and only 4% or 23,213 flats are State-owned.

2.7. Land use

Land use within the Republic of Macedonia has been categorised on the basis of productive purposes (agriculture and forestry) and nonproductive purposes (water and watercourses, infrastructure, settlements and non-arable land), in accordance with data from the year 2000 State Survey Administration (Table. 6). Productive land has been exhibiting a slight decrease over the past twenty years.

Table 6. Balance of land by category and use.

Type of Surface	'000 ha	%			
Total land	2,543	100.0			
Nonproductive land	231	9.0			
Productive land	2,312	91.0	100.0		
Forests and forest land	1,021	40.1	44.2		
Agricultural land	1,291	50.8	55.8	100.0	
Pastures	632	24.9	27.3	49.0	
Wetlands and fish ponds	2	0.1	0.1	0.1	
Arable land	657	25.8	28.4	50.9	100.0
Ploughed land and fields	554	21.8	24.0	42.9	84.3
Orchards	20	0.8	0.9	1.5	3.0
Vineyards	29	1.1	1.2	2.3	4.4
Meadows	54	2.1	2.3	4.2	8.2

Source: Spatial Plan of the Republic of Macedonia – Proposal, Public Enterprise for Spatial and Urban Planning, Skopje 1999

Forest land includes 22,000 ha of nonproductive areas (rocky terrain). As a result of the measures taken for forest maintenance and artificial reforestation, today the forests in Macedonia have been rehabilitated, with a large part of the shrublands converted into low forests (woodlands), and low forests into high forests**.** Unfortunately, seedlings of White and Black pine have been used in the reforestation process rather than naturally occurring species. Of special note is the fact that 250,000 ha of forests and forest lands are currently almost devoid of vegetative cover (both inside and outside the main forest canopy). Of these, 0.4% are under sparse cover. These are areas suitable for replanting or for allowing natural recolonisation to occur.

Agricultural land includes pastures, temporary pools, drained wetlands still containing reeds and arable land. High quality pastures (192,000 ha) are located in almost all high mountain areas, but the best ones are located in the western mountains (Shar Planina, Bistra, Stogovo, Korab, Deshat and others). Arable land includes ploughed land and gardens, meadows, and a small amount of vineyards and orchards. Cereals dominate within this area (62%), which does not correspond to the favourable soil moisture and temperature conditions.

In general, approximately one-third of farm fields and gardens remain unplanted each year, that is, fallow or untilled (total of 193,000 ha). These are mainly areas of low cadastral class (VI, VII and VIII) located on hilly or mountainous terrain, having unfavourable relief or climatic conditions.

The nature of nonproductive land is shown in Table 7. Water resources comprise most of the total balance of nonproductive land. Watercourses, natural lakes and artificial reservoirs cover an area of 87,493 ha or 3.4% of Macedonia's total land area. A great portion of nonproductive land, however, is covered by settlements and infrastructure (totalling 69,207 ha), mainly in the plains and the most fertile areas. Of particular note has been the expansion of towns and plain settlements within the Skopye Valley, Polog Valley, Kichevsko Pole Plain, Ohrid Valley, Kumanovsko Pole Plain, Slavishko Pole Plain, Strumichko Pole Plain etc.

Table 7. Nature of unproductive surfaces.

Type of Surface	ha	%
Water and waterways	44,083	19.1
Natural lakes	43,410	18.7
Religious objects	1,300	0.6
Roads and railroads	34,094	14.8
Settlements	35,113	15.2
Other barren land	73,000	31.6
Total	231,000	100 %

Source: *Spatial Plan of the Republic of Macedonia – Proposal, Public Enterprise for Spatial and Urban Planning, Skopje 1999*

The category of "other barren lands" (Table 7) includes rocky terrain, high rocky peaks of young mountain ranges, extremely eroded areas, very steep and uncultivated areas, sides of canyons and valleys and the like. The abandoned arable land of cadastral class VII and VIII included in this category suffers from extreme erosion.

2.8. Human pressure on the environment

General historical processes, socioeconomic parameters, the current political situation, infrastructure characteristics and land use in the Republic of Macedonia are

only some of the primary reasons for the unfavourable state of the environment in all of its spheres, hence in the state of biodiversity. The current unfavourable situation is especially influenced by (in no particular order):

- Uncontrolled urbanisation, deagrarianisation and industrialisation, which disturb the environmental balance and contribute to the loss of biological diversity;
- Tourism and construction of infrastructure systems, as well as the expansion of agricultural lands in the plains areas are also important factors;
- The low level of education, especially in rural areas, which means a lack of awareness of the interaction of anthropogenic activities and the environment, sustainable use of biological resources and sustainable transfer of biotechnology;
- Poverty, which has a negative impact on sustainable development and leads toward a disturbance of biological diversity (illegal exploitation of forests, non-sustainable development of agriculture and rural areas, insufficient and inappropriate health/rehabilitation measures for protection of human and environmental health);
- Lack of enforcement of the law, economic instability and military actions considerably contribute to the disturbance of biological diversity;
- Over hunting/fishing, uncontrolled exploitation of forests, and the increasing level of pollution through cumulative effects act toward the disturbance of ecosystem stability and loss of biodiversity.

The conflicts in the environment stem from:

- The continuous migration of people from villages to towns. The increasing concentration of the population in the town centres represents a serious problem not only from a global socioeconomic aspect, but from a spatial aspect as well;
- The use of agricultural land for production of food in areas with reduced environmental quality due to anthropogenic activities, natural contamination and lack of soil quality monitoring;
- Change in use of high quality agricultural land to nonproductive purposes, especially near the larger inhabited places and towns. Also included is the abandonment of arable land, with the overall result being a loss of productive land;
- Degradation of forests near inhabited places, clearing of trees in national parks for use as fuel, destruction of trees by insect pests, physiological damage to forests as a result of reduced air quality and occurrences of acid rain;
- The stagnation of the economy and the use of out-of-date technologies, the use of energy sources of poor quality, as well as the lack of treatment of wastewater and waste gases, which reduces the quality of surface waters, groundwater, soil and air.

The following towns and their closely surrounding areas exhibit the highest and most constant threats to the environment and human health: Skopye, Veles, Bitola, Tetovo and Kavadartsi. Occasional problems with air quality and permanently poor quality of watercourses occur in the following towns and their surrounding areas: Shtip, Kumanovo, Prilep, Gostivar, Strumitsa, Kichevo, Resen, Radovish and Kochani.

There has been a permanent decrease in the quality of some of the watercourses belonging to the watersheds of the rivers Vardar, Crna, Bregalnitsa, Strumitsa, Pchinya, Crni Drim and Treska. This has also occurred downstream from major settlements, mines, industrial centres and thermal power plants. The quality of the groundwater has

not been thoroughly explored; however, during incidental measurements it was noted that the quality of the groundwater was poor in the Skopye region, near the ferro-alloy plant, Yugochrom Chemical Energetic Company, and in the wells used for the water supply of Veles.

Large areas of the country with potentially low environmental quality (due to the use of fertilisers, exploitation of mineral raw materials, presence of airborne pollutants, wastewater from settlements etc.), are the Skopye Valley, Veles region, and the regions of Pelagonia, Polog, Kumanovo, Strumitsa-Radovish, Kichevo, Gevgeliya-Valandovo, Prespa, Tikvesh, Kochani, Demir Hisar, Ohrid-Struga and Ovche Pole Plain.

3. STATUS OF BIODIVERSITY AND ECOSYSTEMS

3.1. Status and quality of research on ecosystems and species

The biological diversity (biodiversity) of the Republic of Macedonia is relatively well studied, both in terms of the quality of the studies and the scope of the taxonomic groups and species studied.

From the first research in flora and fauna made by Frivaldszky (1835, 1836) and Grisebach (1843, 1844) until today, more than 3,000 scientific works have been published. Unlike the first publications which presented fragmented studies, more thorough and more significant research appeared in the period between World War I and II. The most important data from that period in the field of flora occurred in the publications by Kosanin, Bornmüller and Hayek, whereas in the field of fauna Doflein, Karaman and Stankovic are considered the most important.

In the period from World War II to the present, the studies of ecosystems and species, both from floristic and faunal aspects, were detailed and of high quality. Of special note in the fields of floristic and faunal research are the works by H. Em, K. Micevski, J. Shapkarev and T. Petkovski.

The scope of the research and the study of individual floristic groups is as follows:

- Data on the qualitative and quantitative structure of bacteria exist for Ohrid Lake, as compared to riverine ecosystems and reservoirs, where there are data on the structure of only some physiological groups of bacteria.
- Of the lower plant groups, the best studied are diatoms (*Bacillariophyta*), but there is a need to restudy and revise the endemic species described in Ohrid and Prespa Lakes. The group of partially studied Algae includes the Blue-green and Green algae. The other groups (*Chrysophyta, Euglenophyta, Pyrrophyta, Xanthophyta*) are rarely studied and, therefore, it is necessary to initiate basic research on their structure, distribution and ecology. With regard to the key areas researched from the aspect of algology, Ohrid and Doyran Lakes, the Vardar River and its watershed, as well as some marsh ecosystems (Katlanovo, Klimetishko, Monospitovo, Strushko and Stensko Marshes) should be mentioned. Less studied are Prespa Lake and the mountainous aquatic ecosystems, except for those found on Shar Planina Mountain, Pelister, Yakupitsa and Bistra. Data on the other mountainous aquatic biotopes are either incomplete or missing.
- Fungi are relatively well studied on only a small number of sites (Pelister, Galichitsa, Kozhuf, Shar Planina Mountain, the watershed of the Tetovska River and the area around Mavrovo), whereas data for other areas in Macedonia are poor.
- With regard to higher plant groups, complete studies exist on peat mosses, horsetails, gymnosperms and 78 families of angiosperms (*Dicotyledonae: Choripetalae*). There are 24 families of the group (*Dicotyledonae: Sympetalae*), as well as 16 families of the class *Monocotyledonae* that still need to be studied. The floristic research covered the entirety of the Republic of Macedonia, whereas more comprehensive research on vegetative assemblages was done on some mountain massifs and gorges (Bistra, Malesh and Piyanets, Yakupitsa, Skopska Crna Gora, Dobra Voda, Taor Gorge and the other gorges in the watershed of the Vardar River).
- The long tradition of caryological research on higher plants in the Republic of Macedonia began with the identification of the number of chromosomes of some

Angiosperms (Shopova 1966). This research has gradually become more intensive and comprehensive, involving a larger number of domestic and foreign researchers.

- The vegetation diversity of higher plant groups is represented by 30 vegetation classes, 60 orders, 90 alliances and over 260 associations. The aquatic macrophytes (class *Lemnetea* and class *Potametea*), which are found in the three natural lakes of the country, are very well studied. Also well studied is the lowland marsh vegetation (class *Isoeto-Nanojuncetea* and class *Phragmitetea*), whereas there is little data about wetland vegetation located in mountain marshes. Lowland meadows (class *Molinio-Arrhenatheretea*) are relatively well studied; however, meadows from the mountain to the subalpine belt are insufficiently studied. Halophytic vegetation (class *Thero-Salicornietea*) can be found on small areas and is completely studied, while the vegetation of hilly pastures (class *Festuco-Brometea*) is in a phase of intensive research. Plant communities present on silicate soils are better studied than those found on carbonate soils. The forest and shrub vegetation is quite rich and diverse, and is represented by 100 associations. Some of them should be revised and harmonised with the International Code on Phytocenological Nomenclature. The mountain and high mountain vegetation is not sufficiently studied and the existing data is out of date. Because of this, some revisions and new research are necessary.

With regard to the extent of study of individual faunal groups, from a taxonomic standpoint the well-studied phyla include: *Porifera* (sponges), *Plathelminthes* (flatworms), *Mollusca* (Molluscs), *Annelida* (segmented worms) and *Chordata* (Chordates). The study of the Chordates is complete. Concerning the phylum *Protozoa* (Protozoans), the free living Protozoans are well studied; however, only representatives of the subphylum *Ciliophora* (Ciliated protozoans) have been studied from the parasitic Protozoan forms. As for the phylum *Nemathelminthes* (roundworms), the class *Rotifera* (Rotifers) is well studied, while of the class *Nematoda*, the aquatic free-living Nematodes and parasitic Nematodes are more completely studied. Terrestrial Nematodes have been studied only fragmentarily.

Within the phylum *Arthropoda* (Arthropods), which has numerous species, the subphyla *Branchiata* (Branchiate arthropods) and *Chelicerata* (Chelicerates) are fully studied. The class *Myriapoda* (Myriapods) of the subphylum *Tracheata* (Tracheates) is well studied, unlike the class *Insecta* (Insects), where complete data exist only for the orders *Ephemeroptera* (Mayflies), *Lepidoptera* (butterflies), *Odonata* (dragonflies), *Orthoptera* (grasshoppers) and *Plecoptera* (stoneflies). The other orders of this class, with their numerous families, genera and species, are only fragmentarily studied or have never been subject to any systematic study.

Currently, as in the past, the primary areas of research into Macedonian faunal biodiversity are the ecosystems of the three natural lakes, which abound in limnofauna, as well as the other fauna inhabiting the lake basins. In addition, the fauna of hilly pastures and lowlands, and that of mountain ecosystems, has been well explored, while the fauna of forest ecosystems has rarely been studied.

3.2. Biogeography

The great floristic and faunal diversity of the Republic of Macedonia can be explained due to its central geographical position in the Balkan Peninsula and the various influences to which its territory has been exposed. The fluctuations of temperatures before, during and after the Ice Age caused multiple, dramatic migrations

of the inhabiting species, which also greatly affected this region. Such mass movements left indications on the recent flora and fauna, especially in the western Palaearctic where Macedonia is located.

According to fossil findings, the composition of the present flora and fauna in this part of the Palaearctic was definitely formed in the postglacial period, when a heterogeneous assemblage of cryophilic and thermophilic settlers was created from various close and distant refugial centres, as well as from local species (inhabitants of the Balkan area that survived). In that period, subtropical and tropical elements and most of the Upper Pliocene flora and fauna were almost completely destroyed.

With reference to the structure of the living organisms inhabiting the Republic of Macedonia, several biogeographical regions can be distinguished:

- The sub-Mediterranean area of the Mediterranean biogeographical region which includes the southern part of the Vardar Valley and the area near Doyran Lake, for which the climate-zonal community *Querco cocciferae-Carpinetum orientalis* is characteristic. Many Mediterranean and sub-Mediterranean species (from different parts of the Mediterranean region) including *Arbutus andrachne, Phyllirea media, Platanus orientalis, Punica granatum* and *Quercus coccifera*, are associated with this community. The fauna of this area is most frequently represented by Pontus (east)-Mediterranean and Syrian arboreal elements, which extend far into the lowlands of Macedonia (*Eryx jaculus, Pelobates syriacus, Telescopus fallax, Testudo graeca, Typhlops vermicularis* and *Vipera ammodytes*).
- The middle-European biogeographical region, which includes a major part of Macedonia and dominates various climate-zonal broadleaf (primarily Oak) forests. In the western sectors, the most significant azonal phytocenoses of *Aesculus hippocastanum, Quercus trojana* etc. can be found. Regarding fauna, these forested areas are mainly inhabited by east-Mediterranean elements (*Algyroides nigropunctatus, Capreolus capreolus, Cervus elaphus, Coluber gemonensis, Dendrocopus medius, Felis silvestris, Martes martes, Picus viridis, Salamandra salamandra* etc.).
- The central part of Macedonia is characterised by steppe-like vegetation, which is represented by typical steppe floral elements (*Artemisia maritima, Astragalus onobrychis, Festuca valesiaca, Kochia prostrata, Koeleria macrantha, Morina persica, Onobrychis hypargyrea, Stipa pennata* etc). Steppe-like and other dry areas of the country are inhabited partly by Caucasus arboreal and partly by Aral-Caspian eremial (i.e., grassland or desert) elements, such as *Ablepharus kitaibelii, Apodemus agrarius, A. flavicolis, Coluber caspius, Lacerta trilineata, Nannospalax leucodon, Otis tarda, Perdix perdix, Spermophillus citellus citellus* and *Tetrax tetrax.*
- The boreal biogeographical region includes the biome of the European primarily coniferous forests of the boreal type. Sub-forest and forest continental mountainous areas are distinguished by climate-zonal communities of Beech, while subalpine mountainous areas are inhabited by typical boreal floral elements (*Picea abies, Pinus mugo, Populus tremula* etc.). In the areas of boreal forest complexes, characteristic animal species are Siberian arboreal elements of the Ussurian refugial subcentre (*Bombicilla garrulus, Lynx lynx, Picoides tridactylus, Ursus arctos* and *Vipera berus*). The occurrence of noncontiguous areas of boreal-alpine species is characteristic.

- The middle-south European mountainous biogeographical region includes the alpine and partly subalpine zone of the highest mountains. It is characterised by the biome of the arctic-alpine rocky terrains, pastures, snow banks and screes. The region is distinguished by many endemic and relict oreo-tundral (i.e., high-mountain tundral) representatives formed in the process of arctic-alpine disjunction. Representatives of arctic-alpine plants are *Dryas octopetala* and *Silene acaulis.*
- Typical oreo-tundral faunal representatives include *Turdus torquata* and many species of butterflies (genus *Erebia*). Species which are not present in tundra but can be observed in other boreal areas of Macedonia are *Gentiana lutea*, a plant, *Dinaromys bogdanovi* and *Rupicapra rupicapra*, which are mammals, as well as many butterflies.
- With respect to large organisms (fishes, crabs and shellfish), the limnofauna of flowing waters is dominated by Pontus-Caspian invaders, which in most cases have evolved due to their isolation. In the older lakes, the flora and fauna are directly dependent on their location, morphometry and hydrography.

3.3. Status review of ecosystems

3.3.1. Description of key ecosystems

Forest ecosystems cover a large portion of the Republic of Macedonia and are included in several regions.

The "Oak region" is distributed within the lowlands and highlands up to 1,100 m and covers 73% of the total forested area. Climate-zonal, mostly thermophilic Oak and Chestnut forests, as well as orographic-edaphic and hydrologically conditioned forest and shrub communities (including Willow, White poplar, Plane tree, Common ash etc.), are located in these areas. Regarding vertebrate fauna, typical inhabitants of this region are: *Ablepharus kitaibelii, Algyroides nigropunctatus, Coluber caspius, C. gemonensis, C. najadum, Crocidura suaveolens, Dama dama, Dendrocopus medius, Elaphe quatuorlineata, Erinaceus concolor, Felis silvestris, Lacerta trilineata, Malpolon monspessulanus, Mus macedonicus, Mustela nivalis, M. putorius, Myotis blythi, M. capaccinii, Picus viridis, Pipistrellus savii, Podarcis erhardii, Rhinolophus blasii, R. euryale, R. ferrumequinum, Salamandra salamandra, Telescopus fallax, Testudo graeca, T. hermanni, Typhlops vermicularis, Vipera ammodytes* and *Vormella peregusna*.

The "Beech region" covers the mountainous areas between 1,100-1,700 m (about 22% of the total forested area). It may be differentiated into a sub-mountain and a mountain belt. The sub-mountain Beech region is present between 1,100-1,300 m (an area of the climate-zonal community, assn. *Festuco heterophyllae-Fagetum*), where refugial types of Beech forests as well as Pine forest communities (Black pine) can be found. The mountain belt spreads between 1,300 and 1,700 m (the area of the climatogenic assn. *Calamintho grandiflorae-Fagetum*) and is formed by various types of Beech, Beech-Fir forests and, in the secondary habitats, forests of White pine, Aspen and Birch are present.

The "pre-mountain (subalpine) region" is located between 1,700 m and approximately 2,100 m. In these areas, the forests are almost destroyed. Forests of Spruce (*Picea abies*), Mountain pine (*Pinus mugo*) and Molika (*P. peuce*), however, as well as heath of *Bruckenthalia spiculifolia, Vaccinium myrtillus* etc., can be found.

Typical inhabitants of the fauna in this region are: *Anguis fragilis, Apodemus sylvaticus, Bombicilla garrulus, Canis lupus, Capreolus capreolus, Caprimulgus europaeus, Cervus elaphus, Clethrionomys glareolus, Coronella austriaca, Dryomis*

nitedula, Elaphe longissima, Lacerta viridis, Lynx lynx, Martes foina, M. martes, Meles meles, Microtus felteni, Muscardinus avellanarius, Myotis nattereri, Myoxis glis, Picoides tridactylus, Podarcis muralis, Sciurus vulgaris, Sorex araneus, S. minutus, Sus scrofa, Talpa caeca, Ursus arctos and *Vulpes vulpes.*

Dry land/grassland ecosystems occupy a large part of the Republic of Macedonia. They occur in the lowland and highland belt (in the highland pastures), and often in secondary habitats primarily because of permanent degradation of forest phytocenoses (mainly Oak), but also due to recolonisation of abandoned farmland by grassland species. The soils on which they develop are geologically diverse over the entire territory (silicate, limestone, dolomite, serpentine, arsenic, Palaeogenic and Neogenic marls and saline soils) and the ecosystems themselves are present at altitudes of from 60 m to approximately 1,200 m msl. Among the best studied are the communities of the highland pastures which develop on silicate soils (the alliances *Armerio-Potentillion* and *Trifolion cherleri*), steppe-like vegetation (the alliances *Artemision maritimae* and *Saturejo-Thymion*) and halophytes (the alliances *Cypero-Spergularion, Puccinellion convolutae* and *Thero-Salicornion*). Slightly less studied are those communities developing on limestone (alliance *Saturejo-Thymion*), serpentine, antimony and arsenic soils. Representative fauna include: *Apodemus agrarius, A. flavicollis, Burhinus oedicnemus, Coturnix coturnix, Eryx jaculus, Microtus guentheri, M. rossiaemeridionalis, Myotis emarginatus, M. mystacinus, Nannospalax leucodon, Otis tarda, Perdix perdix, Podarcis taurica, Spermophilus citellus citellus, Talpa europaea* and *Tetrax tetrax.*

Mountain ecosystems are found within a large portion of the Republic of Macedonia, especially on mountains over 2,000 m in elevation – Belasitsa, Bistra, Deshat, Duditsa, Galichitsa, Yablanitsa, Yakupitsa, Korab, Kozhuf, Nidze, Osogovo, Pelister, Shar Planina, Stogovo etc. – where there are optimal conditions for their development.

Mountain and high-mountain vegetation which develops above the upper forest boundary (over 1,800 m) is very rich and diverse. Contemporary phytocenological research on these ecosystems has been done on the mountains Bistra and Osogovo, whereas data for the other mountains (Belasitsa, Galichitsa, Yablanitsa, Yakupitsa, Korab, Nidze, Pelister, Shar Planina etc.) are older, and will probably need to be revised. Data on some of the mountains are missing (Duditsa, Kozhuf etc.). The communities in the mountain pastures which are located on silicate (class *Caricetea curvulae*) and carbonate soils (class *Elyno-Seslerietea*) are represented by approximately 15 associations. The communities that develop on limestone and silicate rocks (class *Asplenietea rupestris*), limestone screes (class *Drypetea spinosae*), under snow banks (class *Salicetea herbaceae*), near mountain streams (tall grassy plants of the class *Betulo-Adenostyletea*), in high-mountain marshes (classes *Montio-Cardaminetea* and *Scheuchzerio-Caricetea fuscae*) etc. are also located here.

Typical faunal representatives of the mountain ecosystems are: *Chionomys nivalis, Corvus corax, Dinaromys bogdanovi, Eremophila alpestris, Lacerta agilis, L. vivipara, Monticola saxatilis, M. solitarius, Phoenicurus phoenicurus, Prunella collaris, Pyrrhocorax graculus, P. pyrrhocorax, Rupicapra rupicapra, Spermophilus citellus karamani, Talpa stankovici, Vipera berus* and *V. ursinii*.

Wetland ecosystems in the Republic of Macedonia are present in various forms (relic lakes, glacial lakes, reservoirs, rivers, streams, springs and temporary waters). The group of key aquatic systems includes the three natural lakes and the developed river network, especially the watershed of the Vardar River.

Ohrid Lake, with its relict and endemic organisms, represents the most significant lake ecosystem in Europe (under the protection of the United Nations Educational, Scientific and Cultural Organization [UNESCO]). It is the largest lake in the Republic of Macedonia and is situated in a tectonic valley in the far southwest of the country. It is a typical oligotrophic lake with outstanding transparency, low nutrient content and low production.

The diversity of phytoplankton and zooplankton in Ohrid Lake is relatively poor. The phytoplankton is dominated by *Bacillariophyta*, *Chlorophyta* and *Cyanophyta* while the zooplankton by Rotifers (*Rotatoria*), Copepods (*Copepoda*) and Water fleas (*Cladocera*). The benthos at shallow depths is represented by abundant macrophytic vegetation (representatives of *Charophyta*), and at deeper depths by the dominant diatoms. Zoobenthos consists primarily of sponges (*Porifera*), segmented worms (*Annelida*), flatworms (*Plathelmintes*), snails (*Gastropoda*) and Ostracods (*Ostracoda*). Among the nektonic organisms, the most important are the relict and endemic species of salmonid fishes.

Prespa Lake is the second largest natural lake, located at the juncture of the three countries, Macedonia, Greece and Albania. Rich encrusted layers of Green and Blue-green algae and diatoms can be found on the rocky submerged substrate in the southern portion of the lake. Zooplankton is represented primarily by species of Rotifers (*Rotatoria*), Copepods (*Copepoda*) and Water fleas (*Cladocera*); the zoobenthos is dominated by representatives of sponges (*Porifera*), segmented worms (*Annelida*), flat worms (*Plathelmintes*), snails (*Gastropoda*) and Ostracods (*Ostracoda*). Among the nektonic organisms, the relict species of fishes which are distinguished by a level of high endemism are also dominant in this lake.

Doyran Lake is the smallest tectonic lake in the Republic of Macedonia. It is located in the south-eastern area of the country and is a typical eutrophic lake of the Aegean lake group. It is characterised by high floristic and faunal diversity and low endemism. Diatoms are dominant among the phytoplankton and periphyton. Among the zooplankton, Protozoans (*Protozoa*), Rotifers (*Rotatoria*), Water fleas (*Cladocera*) and Copepods (*Copepoda*) are dominant while, within the zoobenthos, sponges (*Porifera*), segmented worms (*Annelida*), flat worms (*Plathelminthes*), Molluscs (*Mollusca*) and Ostracods (*Ostracoda*) are dominant. Cyprinid species of fishes are dominant among nektonic organisms.

The three natural lakes provide favourable conditions for the development of aquatic macrophytic (floating and submersed) vegetation, as well as the development of shoreline marsh species. In the past, plant communities of these vegetation types used to develop in the numerous swamps and marshes present in most of the valleys of Macedonia (Katlanovo Marsh, Prespa Marsh, Ohrid Marsh, Struga Marsh, Pelagonia Marsh, the marsh near Negortsi Spa, the marsh near the village of Bansko, Monospitovo Marsh, the marsh in Upper Polog [near Gostivar] etc.), of which today only fragments remain.

The Republic of Macedonia has a very rich network of rivers divided among three watersheds: the Vardar, Crni Drim and Strumitsa. The watershed of the Vardar River is the largest. In its upper reaches, thick accumulations of the water mosses *Fontinalis antypiretica* and *Rhynostegium riparoides* are present, as well as the Algae, *Cladophora glomerata* and *Vaucheria* sp. In winter and early spring months, microfloral rock encrusting communities occur, formed mainly by Blue-green algae and diatoms. The substrate is covered with a large quantity of organic sediment, which also covers these

encrusting species and simultaneously facilitates the development of rich communities, represented by the genus *Nitzschia*, on the mud bottom. Within the riverine ecosystems, zooplankton is poorly represented, and the benthos which does occur has very reduced populations. Nekton is characterised by rich relict and endemic fauna, especially fishes.

3.3.2. Assessment of status of key ecosystems

The current status of the key ecosystems in the Republic of Macedonia reflect both the local environmental conditions in which they develop and global climate changes. The extent of anthropogenic impacts over individual ecosystems is not uniform. Therefore, the main criterion used in this assessment was an ecosystem's biological vigor.

3.3.2.1. Forest ecosystems

Very rare and consequently threatened forest communities include: assn. *Aceri heldreichii-Fagetum* (Yakupitsa and Shar Planina Mountains), assn. *Alnetum viridis* (Belasitsa), assn. *Carici elongatae-Alnetum glutinosae* (Polog and Debarca, due to the mining of sand, which lowers the levels of both substrate and groundwater and causes desiccation of the habitat where the assemblage is present), assn. *Daphno-Cytisanthetum radiati calcicolum* (Galichitsa and Yablanitsa Mountains), assn. *Ephedro-Prunetum tenellae* (Kavadartsi-Lyubash, due to reforestation), assn. *Juglando-Aesculetum hippocastani* (Suv Dol near Izvor and Yablanitsa), assn. *Periploco-Alnetum glutinosae* (Monospitovo Marsh), assn. *Periploco-Fraxinetum angustifoliae-pallisae* (Negortsi Spa, due to land drainage), and assn. *Tilio cordatae-Fagetum* (Drevenicka Mountain-Demir Hisar, due to water capture/extraction). Direct reasons for the reduction of forest communities include:

- Forest desiccation (assn. *Abieti-Piceetum scardicum* - Tetovska River; assn. *Fago-Abietetum meridionale* - Bistra-Senechka Mountain and Pelister-Brajchinska River; assn. *Castanetum sativae macedonicum*);
- Forest fires (assn. *Pinetum mugo macedonicum* – Yakupitsa, assn. *Phillyreo-Juniperetum excelsae* - Demir Kapiya Gorge, assn. *Pulsatillo macedonicae-Pinetum nigrae* – Karadzitsa and assn. *Querco-Carpinetum orientalis macedonicum*);
- Forest destruction due to construction activities such as buildings, expansion of tourist settlements, roads, railroads and artificial lakes (e.g., with the construction of Mavrovo Lake, the assn. *Salicetum cinereae-pentandrae* was destroyed);
- Land drainage;
- Mining excavation and fill for slag storage;
- Construction of ski-lifts, transmission lines, television transmitters;
- Forest clearing etc.

Many of these factors also affect the status of faunal groups. The reduction of the populations of individual species can be best seen in the Oak region. With respect to vertebrates, the following species are considered extinct in Macedonia: Golden jackal (*Canis aureus*), Red deer (*Cervus elaphus*) and Fallow deer (*Dama dama*) (although the last two have been reintroduced). The species, Black vulture (*Aegypius monachus*), Bearded vulture (*Gypaetus barbatus*), Pine marten (*Martes martes*) and Marbled polecat (*Vormela peregusna*), exhibit the most reduced populations.

3.3.2.2. Dryland/grassland ecosystems

The dryland/grassland ecosystems are vegetation types which are permanently expanding. Restricted distribution is characteristic for the halophytic communities (on salty soils) which develop on a small area in Ovche Pole Plain and in the steppe-like area between Negotino, Shtip and Veles. They are under intense anthropogenic influences due to cultivation. Among the halophytic communities, the most threatened is assn. *Camphorosmetum monspeliacae* (which develops on solonchak soils), but there is a great probability that other associations (e.g., assn. *Crypsidetum aculeatae balcanicum* and assn. *Pholiureto-Plantaginetum balcanicum*), which develop in small, shallow depressions, will also disappear. The plant communities developing on soils containing arsenic and antimony (including *Viola allchariensis* and *V. arsenica*) at Alshar near Kavadartsi are also restricted to very small areas. They are in potential danger of destruction because they are present on only a small area, where mining and other activities were performed in the past and are likely to be continued in the future.

The communities developing on limestone and dolomite are not completely studied. At many locations in Macedonia where these communities develop, marble is extracted (Cer, Pletvar-Kozyak and Sivets), which has a negative effect on their biological viability, both survival and maintenance.

Within these various ecosystems, reductions in the populations of the following species have been recorded: Stone-curlew (*Burhinus oedicnemus*), Common quail (*Coturnix coturnix*), Sand boa (*Eryx jaculus*), Geoffrey's bat (*Myotis emarginatus*), Whiskered bat (*Myotis mystacinus*), Lesser mole rat (*Nannospalax leucodon*), Great bustard (*Otis tarda*), Common partridge (*Perdix perdix*), European souslik (*Spermophilus citellus karamani*), Common mole (*Talpa europaea*) and Little bustard (*Tetrax tetrax*).

3.3.2.3. Mountain ecosystems

Floral and faunal components of the mountain ecosystems are not generally endangered and their distribution and preservation correspond to the specific environmental conditions of each mountain massif. Mountain ecosystems within the three national parks of the Republic of Macedonia (Galichitsa, Mavrovo and Pelister) are protected by specific legal regulations.

The factors affecting the state of mountain ecosystems are varied. These include overgrazing and the uncontrolled removal of certain plant species for sale or personal use (*Althaea officinalis, Anacamptis pyramidalis, Arctostaphylos uva-ursi, Centaurium erythraea, Dactylorhiza maculata, D. sambucina, Gentiana lutea* subsp. *symphyandra, G. punctata, Hypericum perforatum, Juniperus communis, Origanum vulgare, Primula veris, Pulmonaria officinalis, Sideritis raeseri, S. scardica, Thymus tosevii* var. *degenii* etc.). The construction of ski-lifts, mountaineers' towers, television transmitters and other aerial systems usually installed on mountain peaks often causes degradation of some of those plant communities which have restricted distributions on the summits of the mountains (because of the configuration of the terrain, strong winds etc). Such is the case with the communities of the alliance *Edriantho-Seslerion* (Bistra, Shar Planina and Yakupitsa Mountains) and alliance *Seslerion comosae* (Nidze and Pelister Mountains), which develop on the peaks of these mountain massifs.

With regard to the faunal component of the mountain ecosystems, indirect anthropogenic impacts do not threaten the stability of these populations. The Alpine

chamois (*Rupicapra rupicapra*) never reaches an optimal number within its populations due to uncontrolled hunting, a direct impact.

3.3.2.4. Wetland ecosystems

The status of Ohrid Lake is slightly better than that of the other two natural lakes, Prespa and Doyran. Nevertheless, the proper functioning of the existing integrated collection/treatment system for communal and industrial wastewater along the shoreline of the entire lake is necessary. Today, macrophytic floating vegetation can be found only in a fragmentary state. From a faunal aspect, the representatives of the superclass *Pisces* are the most threatened. According to the International Union for Conservation of Nature (IUCN), six out of seven endemic Ohrid fish species are included within the category, Vu (Vulnerable), while one species is considered to be Ex (Extinct). The two species of trout (*Salmo balcanicus* and *S. letnica*) are particularly caught for food, so their populations are constantly being reduced.

The continuous reduction of the water level of Prespa Lake over the years has adversely affected the state of the floating vegetation and faunal communities in the littoral zone of the lake. The presence of large quantities of organic silt on the lake bottom accelerates the process of eutrophication, which manifests itself with the appearance of phytoplankton blooms during the summer period. Of the floating macrophytic vegetation, the most significant is the assn. *Lemno-Spirodelletum polyrhizae* subassn. *aldrovandetosum*, which develops only within the inshore areas of Prespa Lake (near Dolno Perovo village) and is directly endangered by the lowering of the water level. Among the six endemic species of fishes, the Prespa bleak (*Alburnus belvica*) is the most caught, nevertheless its population is remaining stable. Due to uncontrolled fishing, the Carp (*Cyprinus carpio*) is the most endangered species in Prespa Lake and, according to IUCN, it is included on the list of species being at critical risk (CR).

The establishment of the strictly protected "Ezerani" reserve and the initiative currently underway for proclaiming Prespa Park as a trans-boundary park will surely contribute to the improvement of the state of this lake ecosystem.

The status of Doyran Lake is the most alarming. Since 1988, the level of the water has drastically fallen, contributing to a decrease in water depth and receding of the shoreline, accompanied by a complete loss of the littoral zone and its related biological communities. The accelerated eutrophication has led to intensive sedimentation and a dramatic reduction in the epibenthic communities, as well as serious changes in the structure of the Algal microflora. These changes have particularly affected the reed zone and other aquatic macrophytic vegetation (assn. *Myriophyllo-Nupharetum* is completely extinct).

The zooplankton community, under the influence of these changes, has lost its limnetic character. Until 1988, 94 zooplankton taxa were present in the open waters of the littoral and pelagic zones, whereas the recent status of this community shows a reduction to only 28 taxa. Comparative population density analyses show that the abundance of the zooplankton community within the pelagic complex is one-seventh of its former level, and that of the littoral complex one-tenth of its previous numbers. The current status of the benthic community, although severely disturbed, likely still has enough genetic potential to completely restore itself. The status of the benthos can be inferred from the amount of the annual fish catch, which in optimal conditions used to be

as much as 500 tonnes. In the past few years it has been reduced to 70 tonnes, dropping to only 25 tonnes in 2002.

The accelerated succession of this lake ecosystem is evidenced by the appearance of the Calanoid copepod (*Eudiaptomus gracilis*), a typical representative of marsh ecosystems, which was recorded in Doyran Lake for the first time in 1995. In order to restore the disturbed environmental balance, efforts have been made to bring additional quantities of water to the lake, which is expected to improve the state of the biological communities within the lake ecosystem.

The status of riverine ecosystems in the Republic of Macedonia is also alarming. Almost all of the rivers are under great direct and/or indirect anthropogenic pressures. The situation with the Vardar River, which is the major recipient of all types of wastewater (communal, industrial and agricultural), is the worst. The situation with the other river ecosystems (Bregalnitsa, Crna, Lepenets, Pchinya, Zletovitsa etc.) is similar. Reservoirs have been built on some rivers, and these represent a sink for persistent substances (e.g., Kalimanci and Tikvesh Lakes). The reservoirs which provide drinking or industrial water (Mavrovitsa, Strezhevo, Turiya), although experiencing slight effects from natural eutrophication, have experienced a deterioration in quality in past years due to inappropriate fish stocking and exploitation. Benthic communities in the riverine ecosystems are showing reduced abundance, which will ultimately lead to a decline in fish populations. Six out of the 20 endemic fish species within the Republic of Macedonia (*Chondrostoma vardarense, Cobitis vardarensis, Gobio banarescui, Pachychilon macedonicum, Salmo pelagonicus* and *S. peristericus*) are found in riverine ecosystems. Three of these are considered to be globally threatened species.

Wetland vegetation, which used to develop over large areas of swamps and marshes within all the valleys of Macedonia, experienced great changes under past drainage regimes which converted most of these ecosystems into arable land. In some of them, (e.g., Monospitovo Marsh), numerous rare and endangered Algal taxa were formerly found.

The relict wetland communities, which today appear mainly in a fragmentary state, are the most endangered. They develop on organic soils which are very suitable for growing early vegetable plants (Bansko) after drainage. Some which were present near natural lakes have been destroyed simply because they represent unwelcome marsh vegetation. The most important wetland communities still extant are: assn. *Caricetum elatae* subassn. *lysimachietosum* (today only small fragments remain at Ohrid Lake near Studenchishte) assn. *Cypero-Caricetum acutiformis* (Gostivar), assn. *Glycerietum maximae* (Pelagonia - village Chepigovo), assn. *Mariscetum* (Negortsi Spa), assn. *Osmundo-Thelipteretum* (Bansko), assn. *Scirpo-Alopecuretum cretici* (Monospitovo Marsh) etc. Some of the wetlands which are still preserved are important in serving to explain the genesis of wetland vegetation in the Republic of Macedonia.

Impacts to most of the swamps and marshes have caused a reduction in the populations of all Amphibians, as well as individual species of other invertebrate and vertebrate groups. The most affected are: Water vole (*Arvicola terrestris*), Eurasian bittern (*Botaurus stellaris*), European pond terrapin (*Emys orbicularis*), Otter (*Lutra lutra*), Balkan terrapin (*Mauremys rivulata*), Coypu (*Myocastor coypus*), Dice snake (*Natrix tessellata*), Miller's water shrew (*Neomys anomalus*), Water shrew (*N. fodiens*), Muskrat (*Ondatra zibethicus*), Balkan spadefoot toad (*Pelobates syriacus balcanicus*), Eurasian Spoonbill (*Platalea leucorodia*), Greek marsh frog (*Rana balcanica*), Balkan stream frog (*R. graeca*), Marsh frog (*R. ridibunda*), Alpine newt (*Triturus alpestris*),

Italian crested newt (*T. carnifex*), Balkan crested newt (*T. karelinii*) and Common newt (*T. vulgaris*). Only Belchishta Marsh still exists in its original state, where the population of Otters (*Lutra lutra*), a globally threatened species, is the largest.

Water capture/extraction from mountain springs and streams often causes the desiccation of mountain marshes and bogs, and thus the degradation of wetland communities of the classes *Montio-Cardaminetea* and *Scheuchzerio-Caricetea fuscae.* Communities with assn. *Caricetum macedonicae,* assn. *Carici-Narthecietum scardici*, *Saxifraga aizoides, Saxifraga stellaris alpigena,* representatives of the families *Cyperaceae* and *Juncaceae,* as well as the bog species *Drosera rotundifolia, Sphagnum* sp. etc. are particularly threatened. Such situations also lead to a reduction in Algal diversity, especially Silicate and Green algae. These effects have been recorded on the mountains Yakupitsa, Nidze, Pelister and Shar Planina and in the vicinity of the Pehchevo-Judovi meadows.

3.4. Status review of plant assemblages

3.4.1. Description of key plant assemblages

The vegetation of the Republic of Macedonia represents a mosaic of diverse plant communities with representatives of various vegetation types, of which the most important are as follows:

- Aquatic communities: Aquatic vegetation consists of floating (i.e., present on the water surface) and submersed (underwater) forms. It develops in the natural lakes of the Republic, is well studied and is represented by six associations, two alliances, two orders and two classes (*Potametea* and *Lemnetea*). In the past, aquatic plant communities also used to develop within marshes but, as a result of drainage activities, they were completely destroyed.
- Wetland communities: Lowland marsh vegetation is well studied and represented by 13 associations, five alliances, three orders and two classes (*Phragmitetea* and *Isoeto-Nanojuncetea*). In the past, these communities were widely distributed within numerous marshes and swamps, but drainage activities in the major valleys (Pelagonia, Strumitsa, Skopye, Ohrid-Struga, Polog etc) and the Ovche Pole Plain destroyed large portions of these communities, and the areas they occupied were converted into arable land.
- Meadow communities: Lowland meadows extend from 80 to 1,000 m in almost all valleys. They belong to the class *Molinio-Arrhenatheretea* (alliance *Trifolion resupinati*). The areas on which they develop are now considerably reduced, especially on moist soils. The meadows of the mountain belt (1,000-1,400 m) belong to the alliance *Rumicion thyrsiflori*.
- Halophytic and steppe-like communities: These develop in the central portion of Macedonia, in the region between Negotino, Shtip and Veles. Halophytic communities are present on small areas within the Ovche Pole Plain and in the steppe-like zone (between Negotino and Veles). Taxonomically, they belong to the vegetative class *Thero-Salicornietea*, in which the halophytes *Camphorosma annua, C. monspeliaca, Salicornia herbacea, Suaeda maritima* etc. dominate. Steppe-like vegetation develops on Palaeogenic and Neogenic marls and has a high concentration of steppic species, such as: *Astragalus parnassi, Hedysarum macedonicum, Morina persica, Onobrychis hypargyrea* etc.

- Highland pasture communities: These communities develop at a elevations of from 80 to approximately 1,100 m, on soils of heterogeneous geological origin – andesites, arsenics, dolomites, limestones, serpentines, silicates etc. These communities are often of secondary origin and are formed primarily by the destruction of lowland forests. They are represented by over 10 associations belonging to the vegetative class *Festuco-Brometea*.
- Forest communities: Such communities cover a large portion of the land area of the Republic of Macedonia at elevations of 150-2,200 m. Broadleaf forests dominate (Oak, Hornbeam, Hop-hornbeam, Chestnut and Beech), while evergreen forests (Pine, Fir and Spruce) as well as mixed forests (Fir-Beech) are distributed in small areas. Due to over-harvesting, they have been degraded in the lowland areas and completely destroyed in some places. They are represented by over 80 pure forest stands and include species from seven classes.
- Subalpine and alpine communities: These are distributed at the upper boundary of the forested areas, at 1,600-2,700 m, where climatic conditions are the most unfavourable (long winters, short summers and short growing seasons). Here the various communities develop on heterogeneous substrates (acid soils, carbonate substrates, eroded cliffs, mountain peats, mountain streams, rocks etc.).

Additional communities of other vegetation types are also present, such as those found at forest margins, weeds in crops (on cereals and other crops), ruderal communities (growing on waste or in waste places), communities in trampled places, bush and shrub communities etc.

3.4.2. Rare, endemic or threatened plant assemblages

Within the Republic of Macedonia, many rare, relict and endemic communities occur in almost all vegetation types. Of special importance are those with restricted distribution among the aquatic, wetland, meadow, halophytic, steppe-like, forest, subalpine and alpine vegetation communities, as well as those present in the vegetation of highland pastures. Nevertheless, some of them are seriously endangered and threatened with extinction, while others are considerably reduced in their populations and biological viability (Table 8).

Table 8. Rare and threatened plant assemblages in the Republic of Macedonia.

Assemblage	Location	Type of threat
assn. *Myriophyllo-Nupharetum*	Doyran Lake: Nikolich	Water receding
assn. *Lemno-Spirodelletum polyrhizae* subassn. *aldrovandetosum*	Prespa: Ezerani	Limited distribution, water receding
assn. *Caricetum elatae* subassn. *lysimachietosum*	Ohrid Lake: Studenchishte	Limited distribution, desiccation
assn. *Osmundo-Thelipteretum*	Bansko	Limited distribution, land usurpation
assn. *Mariscetum*	Negortsi Spa	Limited distribution, fragmentation
assn. *Cypero-Caricetum acutiformis*	Gostivar	Limited distribution, drainage
assn. *Scirpo-Alopecuretum cretici*	Monospitovo Marsh	Limited distribution, drainage

assn. *Glycerietum maximae*	Pelagonia: village Chepigovo	Drainage
assn. *Hordeo-Caricetum distantis*	Gevgeliya, Skopye areas	Limited distribution, lowering of the groundwater table
assn. *Camphorosmetum monspeliacae*	Ovche Pole Plain	Limited distribution, direct destruction
assn. *Pholiureto-Plantaginetum balcanicum*	Ovche Pole Plain	Limited distribution, direct destruction
assn. *Crypsidetum aculeatae balcanicum*	Ovche Pole Plain	Limited distribution, direct destruction
assn. *Ephedro-Prunetum tenellae*	Kavadartsi-Lyubash	Reforestation
assn. *Aesculo hippocastani-Fagetum*	Village Izvor: Suvi Dol	Relict, rare
assn. *Periploco-Alnetum glutinosae*	Monospitovo Marsh	Drainage
assn. *Abieti-Piceetum scardicum*	Tetovska River	Forest desiccation
assn. *Castanetum sativae macedonicum*		Forest desiccation
assn. *Pinetum mugo macedonicum*	Yakupitsa	Forest fires
assn. *Pulsatillo macedonicae-Pinetum nigrae*	Karadzitsa	Forest fires
assn. *Querco-Carpinetum orientalis macedonicum*		Forest fires
assn. *Phillyreo-Juniperetum excelsae*	Demir Kapiya	Forest fires
assn. *Caricetum macedonicae*	Bistra, Pelister	Water capture/extraction
assn. *Sclerantho-Biserruletum pelecinae*	Mariovo: Gorge of Crna River	Construction of artificial reservoir
assn. *Edrayantho-Oxytropetum*	Bistra	Limited area
assn. *Seslerietum korabensis*	Korab, Bistra	Limited area
assn. *Rindero-Acantholimonetum*	Galichitsa	Limited area
assn. *Diantho kaimakczalanicensis-Festucetum*	Kaymakchalan	Limited area
assn. *Diantho scardici-Festucetum*	Shar Planina	Limited area
assn. *Diantho jakupicensis-Elynetum*	Yakupitsa	Limited area
assn. *Micromerio-Violetum kosaninii*	Yakupitsa, Kozyak	Limited area

3.5. Status review of species

3.5.1. Micro-organisms

3.5.1.1. Diversity of known micro-organisms

Bacteria, from a taxonomic aspect, are poorly studied. The main studies deal with the quantitative structure of individual physiological groups of bacteria. The available data show that there are 100 determined taxa (this figure also includes pathogenic bacteria).

Previous microbiological studies dealt mainly with industrial and agricultural microbiology. They included some data on the presence of bacteria in thermal springs (*Beggiatoa alba, B. leptomitiformis, B. minima,* and *Thiotrix tenuissima*), as well as faecal indicators (*Clostridium perfrigens* and *Escherichia coli*). *Spaerotiulus natans* can be found in river ecosystems containing increased quantities of organic substances. In waters containing great quantities of iron compounds, the species *Leptotrix ochracea* is present. There are also some data on the bacteria which cause diseases in agricultural plants.

3.5.1.2. Endemism among micro-organisms

According to the studies to date, endemic species of bacteria have not been discovered.

3.5.1.3. Conservation status of micro-organisms

Due to an insufficient taxonomic study, it is not possible to make an assessment on the degree of threat to certain species or taxa of bacteria.

3.5.2. Fungi

3.5.2.1. Diversity of Fungi and centres of diversity

Fungi represent a very heterogeneous group of organisms; however, studies to date have dealt mainly with *Ascomycota* and *Basidiomycota*. The other orders of Fungi are poorly studied.

There are approximately 1,250 recorded species of Fungi. Most belong to the orders *Ascomycota* (130), *Basidiomycota* (1050), *Myxomycota* (10), *Oomycota* (20) and *Zygomycota* (35).

Sites containing the highest mycodiversity, according to current studies, are: Pelister Mountain (location of the Mountain Lodge "Kopanki" and watershed of Braychinska River), Shar Planina Mountain (watershed of Tetovska River), near Mavrovo Lake, Kozhuf-Momina Chuka etc.

Lichens (lichenoid Fungi) (*Lichenes*) number approximately 340 species.

Table 9. Number of Fungi and Lichens by families, genera and species in the Republic of Macedonia.

Types of Fungi	Families	Genera	Species
Acrasiomycota	-	-	-
Ascomycota (without Lichens)	35	60	130
Basidiomycota	49	284	1,050
Chytridiomycota	5	6	10
Dictiosteliomycota	-	-	-
Hyphochytridiomycota	-	-	-
Labyrinthulomycota	-	-	-
Myxomycota	7	7	10
Oomycota	5	9	20
Plasmodiophoromycota	-	-	-
Zygomycota	9	12	35
Total Fungi	110	378	1,250
Lichenes	11	73	340
Total with Lichens	121	451	1,590

3.5.2.2. Endemism among Fungi

There are no known endemic species of Fungi in the Republic of Macedonia.

3.5.2.3. Conservation status of Fungi

The Preliminary Red List of Fungi in the Republic of Macedonia has been prepared and includes 67 species in *Basidiomycota* (Annex 3).

3.5.3. Flora

3.5.3.1. Diversity of known lower and higher plant groups and key centres of plant diversity

With regard to the lower plant groups, Algae represent an especially diverse group of organisms. The Green, Silicate and Blue-green algae are dominant, with other groups found in smaller numbers.

To date, 1,580 species of Algae have been identified, of which Silicate (40.1%) and Green (35.3%) algae form a majority. The most important centres of Algal diversity are Ohrid and Doyran Lakes, while on Prespa Lake there are no current systematic studies. In addition to the relic lakes, mountain aquatic ecosystems appear to be equally important centres of Algal diversity.

Table 10. Number of individual Algal taxonomic groups in the Republic of Macedonia (all types)

Taxonomic group	Families	Genera	Species	Varieties	Forms	Total Taxa
Cyanophyta	16	48	204	10	58	273
Pyrrophyta	5	8	12	3	1	16
Chrysophyta	4	7	10	4	-	14
Bacillariophyta	13	69	512	109	12	633
Phaeophyta	-	-	-	-	-	-
Xanthophyta	2	2	9	-	-	9
Euglenophyta	3	5	23	3	1	27
Chlorophyta	29	90	398	124	35	557
Charophyta	2	2	18	-	3	21
Rhodophyta	6	7	7	-	-	7
Glaucophyta	1	1	1	-	-	1
Eustigmatophyta	1	1	1	-	-	1
Total	82	240	1,195	256	128	1,580

Table 11. Centres of high Algal diversity in the Republic of Macedonia.

Location	Number of species
Ohrid Lake	c. 400
Prespa Lake	c. 350
Doyran Lake	c. 250

The flora of higher plant groups is quite rich, with a mosaic of diverse floral elements (Tertiary relicts, Mediterranean, Greek-Anatolian, Ilyric, Caucasian, Middle-European, Eurasian, arctic-alpine and cosmopolitan) and large number of endemic species (Macedonian, south Balkan, Balkan etc.). It is represented by 210 families, 920 genera and approximately 3,700 species. The most numerous group is flowering (Angiosperm) plants, with about 3,200 species, followed by mosses (350) and ferns (42).

- Mosses. Mosses are represented by 67 families, 167 genera and 349 species. The class *Hepaticae* includes 25 families, 36 genera and 52 species; the class *Anthocerotae* includes one family, one genus and one species, while the class *Musci* includes 41 families, 130 genera and 296 species. In the class *Hepaticae,* the most numerous family is *Lophoziaceae* with eight species, whereas the most numerous families in the class *Musci* are *Bryaceae* (23 species), *Amblystegiaceae* (23) and *Brachytheciaceae* (23). The most polymorphic genera are *Brachythecium* (23

species), *Bryum* (14) and *Orthotrichum* (11). Two species are Macedonian endemics (*Melichoferia paradoxa* and *Orthotrichum insidiosum*).

- Peat mosses. This group is represented by six species which mainly inhabit moist areas and bogs in mountain and high mountain areas. They are only rarely found in lowlands (most often on silicate soils). The species *Diphasium alpinum, Huperzia sellago, Isoetes phrygia* and *Lycopodium clavatum* have very restricted distributions.
- Horsetails. Horsetails are represented by seven species which may be found in very moist places, from lowlands to high mountain areas (by rivers, mountain streams, valleys, gorges, marshes and moist meadows). The most frequent species are *Equisetum arvense* and *E. palustre*, with the rarest being the species *E. fluviatile* and *E. sylvaticum.*
- Ferns**.** In the Republic of Macedonia, 42 species of ferns in 15 families can be observed. The most polymorphic genera are *Asplenium* (11 species) and *Dryopteris* (6). The following species are characterised by a restricted distribution: *Adiantum capillus-veneris, Blechnum spicant, Crytogramma crispa*, *Ophioglossum vulgatum, Osmunda regalis, Phyllitis scolopendrium, Thelipteris palustris,* as well as the endemic species *Asplenium macedonicum* (in the vicinity of Prilep). This group also includes the two species of aquatic ferns (*Marsilea quadrifolia* and *Salvinia natans*).
- Gymnosperms. These are represented by four families, six genera and 15 indigenous species (the most polymorphic are the genera *Juniperus* and *Pinus*, each with five species). Some species have been introduced (exotic), mainly from the genera *Abies, Juniperus, Picea, Pinus, Sequoia, Taxodium* etc.
- Angiosperms. Angiosperms are represented by 120 families, 720 genera and approximately 3,200 species (5,000 taxa). The most polymorphic families of the class *Dicotyledonae* are the families *Caryophyllaceae* (345 species), *Compositae* (c. 470), *Cruciferae* (264), *Labiatae* (c. 260), and *Leguminosae* (457), whereas of the class *Monocotyledonae*, the families *Gramineae* (c. 280) and *Liliaceae* (c.130) are most polymorphic.

Table 12. Number of families, genera, species and lower taxa of higher plants in the Republic of Macedonia.

Group	Families	Genera	Species	Subspecies, Varieties, Forms	Total Taxa
Total mosses (*Bryopsida*) - *Hepaticae* - *Anthocerotae* - *Musci*	67 25 1 41	167 36 1 130	349 52 1 296	-	-
Peat mosses (*Lycopsida*)	3	5	6	-	6
Horsetails (*Sphenopsida*)	1	1	7	13	20
Ferns (*Filicinae*)	15	21	42	18	60
Gymnosperms (*Gymnospermae*)	4	6	15	7	22
Total Angiosperms (*Angiospermae*) - *Dicotyledonae* - *Monocotyledonae*	c. 120 c. 102 c. 18	c. 720 c. 565 c. 155	c. 3,200 c. 2,600 c. 600	c. 1,700 c. 1,500 c. 200	c. 4,900 c. 4,100 c. 800
Total Higher Plants	c. 210	c. 920	c. 3,700	c. 1,740	c. 5,350

Formerly, special attention was paid to cytotaxonomic research in Angiosperm plants. To date, 548 species and subspecies have been reviewed, belonging to 171 genera from 30 families (Annex 5). This review of the chromosome numbers forms a good basis for the preparation of an electronic database using modern information technology.

Table. 13. Centres of high floristic higher plant group diversity in the Republic of Macedonia.

I. Mountain and high-mountain region (forests and pastures) Yakupitsa, Shar Planina, Korab, Deshat, Bistra, Stogovo, Yablanitsa, Galichitsa, Pelister, Nidze, Kozhuf, Duditsa, Belasitsa, Osogovo
II. River gorges Vardar, Treska, Radika, Crni Drim, Pchinya, Raets, Babuna, Topolka, Crna, Boshava, Doshnitsa, Konyska
III. Natural lakes Ohrid, Prespa, Doyran lakes
IV. Lowland swamps and marshes Katlanovo Marsh (remnant), Prespa Marsh-Ezerani, Ohrid Marsh (remnant), Struga Marsh (remnant), Pelagonia Marsh (remnant), the marsh near Negortsi Spa, the marsh near the village of Bansko, Monospitovo Marsh (remnant), the marsh near Gostivar (remnant)
V. Mountain marshes, peats and glacial lakes Shar Planina Mountain, Yakupitsa, Korab-Lukovo Pole Plain, Deshat, Bistra (Toni Voda), Yablanitsa, Pelister, Pehchevo (Yudovi Livadi meadows)
VI. Lowland (upland) region Zheden, Pletvar-Kozyak-Sivets, Treskavets, Mukos, Selechka Mountain, Drenska Mountain, Barbaras, Ilinitsa, Bukovik, Mariovo, Alshar, Vitachevo, Klepa, Dab, Churchulum, Palyurtsi, Doyran, Plavush
VII. Steppe-like areas and saline soils Veles-Bogoslovets-Shtip-Krivolak-Serta Mountain-Negotino, Ovche Pole Plain

3.5.3.2. Endemism among lower and higher plant groups

Among the lower plant groups, Algae are represented by the greatest endemism, with 135 endemic taxa, or 8.5% of the total Algal flora. Most have been recorded in Ohrid and Prespa Lakes, with lesser numbers in Doyran Lake, on Pelister Mountain and the Babuna River.

Table 14. Number of endemic Algal taxa in the Republic of Macedonia by Algal types.

Taxonomic group	Species	Varieties	Forms	Total
Cyanophyta	10	2	11	23
Pyrrophyta	1	-	-	1
Chrysophyta	2	-	-	2
Bacillariophyta	62	16	7	85
Phaeophyta	-	-	-	-
Xanthophyta	-	-	-	-
Euglenophyta	1	-	-	1
Chlorophyta	10	5	1	16
Charophyta	1	1	5	7
Rhodophyta	-	-	-	-
Glaucophyta	-	-	-	-
Eustigmatophyta	-	-	-	-
Total	87	24	24	135

In addition to the numerous Balkan and south-Balkan endemic lower plant species, there are also many endemics in the flora of higher plant groups, with most recorded among the Angiosperms (114). The most important centres of endemism are on the high mountains (Galichitsa and Shar Planina), in river gorges (Babuna, Treska and Vardar) and in portions of the lowland belt (Mariovo, vicinity of Prilep).

Table 15. Number of endemic higher plant species within various taxonomic groups in the Republic of Macedonia.

Taxonomic group	Number of Endemic Species
Mosses (*Bryoposida*)	2
Peat mosses (*Lycopsida*)	-
Horsetails (*Sphenopsida*)	-
Ferns (*Filicinae*)	1
Gymnosperms (*Gymnospermae*)	-
Angiosperms (*Angiospermae*)	
- *Dicotyledonae*	109
- *Monocotyledonae*	5
TOTAL	117

Table 16. Centres of endemism of higher plant groups in the Republic of Macedonia.

Centres of Endemism	Number of Endemic Higher Plants
I. Mountain Endemics	
Galichitsa	15
Shar Planina	10
Yakupitsa-Karadzitsa	6
Pelister	4
Nidze	4
Kozhuf	2
II. River Gorge Endemics	
Treska	7
Vardar (Taor and Demir Kapiya gorges)	7
Babuna	5
Raets	2
Crna	2
III. Lowland Endemics	
Mrezichko-Alshar	10
Mariovo (vicinity of Prilep and of Bitola)	8
Prilep (Markovi Kuli-Treskavets)	6
Kozyak-Pletvar-Sivets	6
Skopye (Vodno-Kitka)	5
Krivolak-Orlovo Brdo	4

3.5.3.3. Conservation status of plants

There are many endemic, rare and threatened Algal taxa within the Republic of Macedonia, but so far none has been placed under any sort of protection regime. The risks threatening the Algal species (especially periphyton) arise from habitat loss due to declining water levels (in natural lakes), as well as the accumulation of organic sediments which cover macrophytes and rock-encrusting communities (this situation is particularly serious in Doyran Lake). The numbers of the populations of oligotrophic

and oligosaprobic indicator species within the aquatic ecosystems are constantly decreasing as a result of intensive anthropogenic impacts.

Data concerning the degree of threat to Algal taxa exist only for diatoms. According to the research to date, many imperiled species are found in Ohrid and Prespa Lakes (*Achnanthes inflata, A. minuscula*, *Diploneis domblitensis*, *Eucocconeis quadratarea* and *Hippodonta rostrata*), Doyran Lake (*Navicula oblonga, Nitzschia elegantula* and *N. reversa*), and the glacial lakes on Shar Planina and Pelister Mountains (*Decussata hexagona, Navicula amphibola, N. concentrica, N. tridentula, Pinnularia alpina, P. infirma, Planothidium peragallii, Stauroneis obtusa* etc).

Table 17. Number of diatoms species according to their degree of threat in the Republic of Macedonia.

Category	Number of Species
Extinct or probably extinct species	9
Threatened species	107
Rare species	107
Endemic species	85

The Red List of threatened plant species within the Republic of Macedonia has not yet been prepared, although there is sufficient data to do so. Great numbers of higher plant species exist within Macedonia, representing a portion of the globally threatened species included in many international documents – international Red Lists, conventions and directives (IUCN Global Red List, Bern Convention, CORINE species), species of national importance (local endemic and relict species), endangered species and, unfortunately, a certain number of extinct species (EX).

The IUCN Global Red List 1997 (Walter and Gillet, 1998) contains 70 taxa from the Republic of Macedonia (of which 18 are local endemics). Of these, one species has the world status EX (Extinct) – *Thymus oehmianus* Ronninger & Soska. It is our belief that this information is incorrect since vital populations of this species still exist within the Republic of Macedonia; a more suitable category would be "EN" (Endangered). Two species have world status "EX/EN" (Extinct/Endangered) – *Astragalus physocalyx* Fisch. and *Ranunculus degenii* Kummerle & Jav., while one species has world status "V" (Vulnerable) – *Ranunculus cacuminis* Strid & Papan. Of the remaining 66 taxa, 61 have world status "R" (Rare) and five have status "I" (Indeterminate).

Appendix 1 of the Bern Convention[*] includes 12 species (11 vascular species and one species of moss) with portions of their ranges located within Macedonia – *Aldrovanda vesiculosa, Astragalus physocalyx, Buxbaumia viridis, Campanula abietina, Fritillaria graeca, F. gussichiae, Galium rhodopeum, Lindernia procumbens, Marsilea quadrifolia, Ramonda serbica, Salvinia natans* and *Trapa natans*.

Of the species listed in EU Habitat Directive[†] Annex II, two species of vascular plants and one species of moss are present within Macedonia. Three species (*F. gussichiae, L. procumbens* and *R. serbica*) are also present from Annex IV.

From the European CORINE list, nine species are present in Macedonia: *Coeloglossum viride*, *Jurinea taygetea*, *Narthecium scardicum, Orchis coriophora,*

[*] Bern Convention, Appendix 1 – Strictly protected species

[†] EU Habitats Directive
Annex II – Animal and plant species of Community interest whose conservation requires the designation of special areas of conservation
Annex IV – Animal and plant species of Community interest in need of strict protection

Ramonda nathaliae, R. serbica, Ranunculus cacuminis, R. fontanus and *Silene vulgaris,* whereas from the national CORINE list, 19 are present – *Aldrovanda vesiculosa, Asplenium macedonicum, Astragalus cernjavskii, A. physocalyx, Colchicum macedonicum, Crocus cvijici, C. pelistericus, Drosera rotundifolia, Isoetes phrygia, Osmunda regalis, Potentilla doerfleri, Ranunculus degeni, Salvia jurisicii, Sambucus deborensis, Silene paeoniensis, Thymus oehmianus, Tulipa mariannae, Viola arsenica* and *V. kosaninii*.

The existing legal regulations addressing the protection of plants include portions of the important floristic areas of the Republic of Macedonia and, within this framework, a certain level of protection has been achieved. Explicitly protected populations of species covered under these acts consist of: *Abies borisii-regis* (Braychino), *Aesculus hippocastanum* (Garska River, Drenachka River and Suvi Dol), *Arbutus andrachne* (Gevgeliya), *Betula pendula* (Neprtka), *Fagus sylvatica* (Kaloyzana), *Juniperus excelsa* (village of Kozhle), *Osmunda regalis* (Bansko), *Picea abies* (Shar Planina Mountain - Popova Shapka), *Pinus mugo* (Yakupitsa), the *Pinus nigra* forest (Mariovo), the *Platanus orientalis* forest (Iberliska River and Mokrino), *Quercus trojana* (Trpeytsa) etc. All of the important floristic sites have not been completely protected, however (although some are in the process of being added to the protected list).

The key threats to the most important elements of floristic diversity are:

- Drainage of marshes – Species endangered by these activities are: *Alopecurus creticus* (Monospitovo Marsh); *Carex elata, Ranunculus lingua, Rumex hydrolapathus* and *Senecio paludosus* (Ohrid and Struga Marshes); *Carex pseudocyperus, Scirpus sylvaticus* and *Thelipteris palustris* (marsh near Gostivar); *Cladium mariscus, Juncus maritimus, Molinia coerulea, Ophioglossum vulgatum, Shoenus nigricans* etc. (Negortsi Spa); *Glyceria maxima* (Pelagonia Marsh); *Isoetes phrygia* and *Osmunda regalis* (Bansko) and *Merendera sobolifera* (Petrovets). The following species are considered to be extinct: *Acorus calamus* (Crni Drim River) and *Sagittaria sagittifolia* (Pelagonia Marsh - Novatsi).
- Construction of artificial hydropower reservoirs in river gorges – By inundating large areas of river gorges, the existing phytocenoses present in the lower vertical profiles of the rivers suffer degradation and partial destruction, and the cover of relict, endemic and rare plant species is reduced. In the Treska River gorge, where the Kozyak hydropower reservoir is being constructed, the holotypes of 13 species were collected (*Locus classicus*). Among them, the relict endemic species *Thymus oehmianus* and *Viola kosaninii* are particularly endangered. With the planned construction of the Cebren hydropower reservoir in the gorge of the Crna River near Mariovo, many habitats of the endemic species *Silene paeoniensis* will be covered with water. The construction of Mavrovo Lake caused two species, *Gentiana pneumonanthe* and *Lysimachia thyrsiflora*, which originated on the Mavrovsko Pole Plain, to become extinct.
- Destruction of areas with halophytic vegetation – The cultivation of the salty soils of the Ovche Pole Plain has endangered some halophytic species and communities. This especially refers to the species *Camphorosma monspeliaca*, but also to other halophytes such as: *Crypsis aculeatus, Puccinelia convoluta, Suaeda maritima* etc. The species *Allium obtusiflorum* is now considered to be extinct.
- Collection of medicinal herbs – This activity endangers the following species: *Aconitum divergens, Adonis vernalis, Althaea officinalis, Anacamptis pyramidalis,*

Arctostaphylos uva-ursi, Centaurium erythraea, Colchicum bivonae, C. macedonicum, C. pieperianum, Convallaria majalis, Dactylorhiza maculata, Daphne blagayana, Digitalis feruginea, D. grandiflora, Gentiana lutea subsp. *symphiandra, G. punctata, Glycyrrhiza glabra, Helychrysum zivojinii, Hepatica nobilis, Hypericum perforatum, Hyssopus officinalis, Juniperus communis, Leucojum aestivum, Lycopodium clavatum, Menyanthes trifoliata, Orchis laxiflora, O. militaris, Origanum vulgare, Paeonia mascula, P. peregrina, Paris quadrifolia, Primula veris, Pulmonaria officinalis, Ruta graveolens, Salvia officinalis, Sambucus nigra, Sideritis raeseri, S. scardica, Thymus oehmianus, Tulipa mariannae, T. scardica* etc.

- Uncontrolled collection of rare plants by professional collectors – The result of this activity is the endangerment of many local endemic plants with restricted distributions: *Astragalus cernjavskii, A. physocalyx, Crocus cvijici, Sambucus deborensis, Thymus oehmianus, Tulipa mariannae, T. scardica* etc.
- Mining and geological works – Alshar (*Knautia caroli-rechingeri, Onobrychis degeni, Thymus alsarensis, Viola allchariensis* and *V. arsenica*) and Sivets (*Centaurea marmorea*).
- Construction of ski-lifts, transmission lines, television transmitters and other aerial systems – These endanger rare species occurring in mountainous areas, especially on mountain peaks: *Colchicum pieperianum* (Bistra), *Gentianella ciliata* and *Picea abies* (Shar Planina - Popova Shapka), *Rhododendron myrtifolium* (Yakupitsa - Solunska Glava), *Viola slavikii* (Krushevo) etc.
- Uncontrolled harvesting of forests, forest fires and land clearing – These activities endanger many forest plant species, as well as species from neighbouring vegetation types.

3.5.4. Fauna

3.5.4.1. Diversity of animals by group and identified key areas/sites for faunal diversity

With regard to the status of some faunal groups, the situation is as follows:

Protozoa (Protozoans) – The diversity of this group of organisms is mainly concentrated in the waters of the three natural lakes (Ohrid, Prespa and Doyran). A total of 113 species has been recorded, of which 79 belong to the group of free-living Protozoans**.** Of the parasitic Protozoans, there are five subphyla; however, only the subphylum *Ciliophora* has been studied (34 species).

Porifera (Sponges) – To date, nine species and one subspecies have been recorded, all inhabiting the three natural lakes.

Plathelminthes (Flatworms) – Of this group, 85 species have been recorded. From the class of Turbellarian worms (*Turbellaria*), 65 species have been recorded, with the dominant representatives from the order *Tricladida*, with a total of 40 species. The other two orders include 25 species (*Rhabdocoela* – 24; *Allocoela* – one). Two classes of this phylum, *Trematoda* and *Cestoda*, are represented by 10 species each. The largest centre of biodiversity of this group of organisms is Ohrid Lake, with 48 recorded species.

Cnidaria (Cnidarians) – These are represented by the class of Hydroid zoophytes (*Hydrozoa)* in freshwater ecosystems, of which two species have been recorded.

Nemertea (Nemertine worms) – Found in the in the sublittoral zone of Ohrid Lake, *Stichostemma graecense* is the only recorded species.

Nemathelminthes (Roundworms) – Of the roundworms, studies have found only two classes, *Rotifera* (Rotifers) and *Nematoda* (Nematodes), represented by 613 species. The data on *Rotifera* originate from the analyses of the plankton communities of the three lakes, recognising 60 species. As planktonic organisms, they are characterised by a wide area of distribution and have no endemic species. Research to date has identified a total of 553 species of Nematodes in Macedonia, which is likely to be much less than the actual number of species. In the first study of roundworms in Ohrid Lake, 23 aquatic, free-living Nematodes were found. Later, greater stress was given to the study of terrestrial Nematodes, mainly in forest ecosystems (450 species), as well as Nematodes which parasitise early vegetables, animals and humans (80 species).

Mollusca (Molluscs) – Molluscs are well studied, with a total of 282 known taxa (276 species and six subspecies). The class of Snails (*Gastropoda)* is represented by 267 taxa (262 species and five subspecies), with 102 (97 species and 5 subspecies) belonging to the Aquatic Gastropods. The Terrestrial Gastropods, although incompletely studied, show a great diversity of species, with 165 recorded to date. From the class of Bivalves (*Bivalvia*), 15 species have been recorded. The most important centre of diversity of this group is Ohrid Lake.

Annelida (Segmented worms) – This is a relatively well studied group, with a total of 182 recorded taxa, (160 species and 22 subspecies). With regard to the class *Oligochaeta* (Oligochaetes), 139 taxa have been recorded (123 species and 16 subspecies), while the class *Hirudinea* (Leeches) is represented by 35 taxa (29 species and six subspecies). Centres of their diversity are natural lakes and other aquatic biotopes.

Arthropoda (Arthropods) – This group has numerous representatives in the animal world and is also well represented within the Republic of Macedonia with a large number of taxa (7,743), including 7,574 species and 169 subspecies.

With regard to the subphylum *Chelicerata* (Chelicerates), representatives of the class *Arachnida* (Arachnids) total of 825 taxa (819 species and six subspecies). Among the six orders in this class, the order *Aranea* (Spiders) is dominant with 558 species. The order *Pseudoscorpiones* (Pseudo-scorpions) is represented by 37 taxa (36 species and one subspecies) and the order *Opiliones* (Daddy longlegs) by 40 taxa (38 species and two subspecies). The order *Scorpiones* (Scorpions) is represented by three species, and the order *Solpugida* (Sun spiders) by one species only. The order *Acarina* (Ticks and mites) is represented by 196 taxa (193 species and three subspecies), most of which belong to the group of Terrestrial mites (123 species), with the remainder being Aquatic mites (70 species and three subspecies). The western portion of Macedonia is an important centre of biodiversity for this group, which is present in various types of habitats.

The subphylum *Branchiata* (Branchiate arthropods), with its unique class *Crustacea* (Crustaceans), represents one of the most thoroughly studied groups of organisms, with a total of 513 taxa (486 species and 27 subspecies). The subclass *Copepoda* (Copepods) is represented by 140 taxa (136 species and four subspecies), separated into three orders. The order *Cyclopoida* is represented by 60 taxa (57 species and three subspecies), the order *Harpacticoida* by 50 taxa (49 species and one subspecies) and the order *Calanoida* by a small number of species (30). From the subclass *Branchiura* (Branchiurans), only one species has been recorded to date – the Carp louse (*Argulus foliaceus*) in Doyran Lake. The subclass *Ostracoda* (Ostracods) is represented by 172 species, the subclass *Branchiopoda* by 105 species, the order *Anostraca* by seven species, the order *Notostraca* by two species, the order *Conchostraca* by three species and the order *Cladocera* by 93 species. The subclass of Malacostracans (*Malacostraca*) is represented

by 95 taxa (72 species and 23 subspecies), separated into three orders. The order *Isopoda* is represented by 47 taxa (34 species and 13 subspecies), the order *Amphipoda* by 43 taxa (33 species and 10 subspecies) and the order *Decapoda* by five species. Since the Branchiate arthropods (*Branchiata*) in Macedonia are linked with freshwater ecosystems, the largest centres of biodiversity occur in the three natural lakes, especially Ohrid Lake.

The subphylum *Tracheata* (Tracheates) is represented by a total of 6,405 taxa (6,269 species and 136 subspecies). The class *Myriapoda* (Myriapods) includes 72 taxa (71 species and one subspecies), separated into two orders: the order *Diplopoda* (Millipedes) with 59 taxa (58 species and one subspecies) and the order *Chilopoda* (Centipedes) with 13 species. The class *Insecta* (Insects) has a total of 6,333 taxa (6,198 species and 135 subspecies), separated into two subclasses. The subclass *Apterygota* (true wingless insects) has a small number of recorded species (18) belonging to three orders: *Collembola* (6), *Protura* (2) and *Diplura* (10). The subclass *Pterygota* (Winged insects) has 6,315 taxa recorded within Macedonia (6,180 species and 135 subspecies). One of the best studied groups of the class *Insecta* is the order *Lepidoptera* (Butterflies), with a total of 2,295 taxa recorded (2,261 species and 34 subspecies). The other orders have the following number of recorded taxa: *Ephemeroptera* (Mayflies) – 63 taxa, *Odonata* (Dragonflies) – 52 taxa, *Plecoptera* (Stoneflies) – 93 taxa, *Orthoptera* (Grasshoppers) – 178 taxa, *Isoptera* (Termites) – two taxa, *Psocoptera* (Book-lice) – 48 taxa, *Thysanoptera* (Thrips) – 4 taxa, *Heteroptera* (True bugs) – 778 taxa, *Homoptera* (Homopterans) – 332 taxa, *Trichoptera* (Caddisflies) – 73 taxa, *Diptera* (Flies and mosquitoes) – 606 taxa, *Hymenoptera* (Ants and bees) – 264 taxa, and *Coleoptera* (Beetles) – 1527 taxa. The most important biodiversity centres of Tracheates (*Tracheata*) are the mountain massifs of Shar Planina, Galichitsa, Yakupitsa, and the refugial centres in the gorges of the Treska, Babuna, Topolka and Vardar Rivers.

Phylum *Chordata* (Chordates) – The fauna of Macedonia is represented by the subphylum *Vertebrata* (Vertebrates), separated into four classes and one superclass.

The superclass *Pisces* (Fishes) is represented by 58 indigenous species, with centres of biodiversity in the three natural lakes, as well as in the Vardar River and its watershed.

The class *Amphibia* (Amphibians) is represented by 15 species and two subspecies, while the class *Reptilia* (Reptiles) by 32 species and eight subspecies. The most important centres of biodiversity for Amphibians are the marsh ecosystems and the temporal aquatic biotopes. With regard to Reptiles, the most important biodiversity centres for the Mediterranean and Aral-Caspian faunal elements are the lowland areas of the lower course of the Vardar River and Doyran region; For the central-European, boreal and oreo-tundral herpetofauna – the mountain massifs of Galichitsa, Pelister, Shar Planina and Yakupitsa are important centres.

The class *Aves* (Birds) is also well studied, with 338 recorded taxa (319 species and 19 subspecies). Of the total number of recorded taxa, 213 species breed locally, while the others appear during the winter or in periods of migration. The most important centres of biodiversity for ornithofauna are the three natural lakes (for waterbirds) and the gorges of the Babuna, Topolka, Treska and Vardar Rivers (for birds of prey). The mountain massifs in western Macedonia are the most important centres of biodiversity for the boreal and arcto-alpine complex of ornithofaunal elements.

The class *Mammalia* (Mammals) is represented by 82 species and one subspecies, belonging to six orders, 18 families and 51 genera. Eight species have been introduced

by humans, either deliberately or accidentally. Three species are extinct in Macedonia, of which two have been reintroduced into the wild. The largest centres of biodiversity for the Mediterranean elements of this class are the lowland areas in south-eastern Macedonia and, for the central-European faunal and boreal elements, the mountain massifs of western Macedonia.

Table 18. Diversity of animals by groups.

Taxonomic category	Taxonomic group	Number of Species	Number of Subspecies	Total Number of Taxa
Phylum	*Protozoa* (Protozoans)	113	-	113
Phylum	*Porifera* (Sponges)	9	1	10
Phylum	*Plathelminthes* (Flatworms)	85	-	85
Phylum	*Cnidaria* (Cnidarians)	2	-	2
Phylum	*Nemertea* (Nemertine worms)	1	-	1
Phylum	*Nemathelminthes* (Roundworms)	613	-	613
Phylum	*Mollusca* (Molluscs)	276	6	282
Phylum	*Annelida* (Segmented worms)	160	22	182
Phylum	*Arthropoda* (Arthropods)	7,574	169	7,743
Phylum	*Chordata* (Chordates)	506	30	536
Total Number		9,339	228	9,567

3.5.4.2. Endemism among each invertebrate and vertebrate group

With a total of 674 endemic taxa (602 species and 72 subspecies), the Republic of Macedonia represents one of the most important centres of endemism in Europe, in spite of its small land area. The endemic taxa are distributed in the different faunal groups:

Two endemic species of free living Protozoans are found in Ohrid Lake. Of the parasitic Protozoans (subphylum *Ciliophora*), there are 30 endemic species which, together with their hosts (*Oligochaeta*), represent relict species. The degree of endemism in *Ciliophora* is as high as 88%. Comparative analyses between parasitic Ciliates from Ohrid Lake and from Baikal Lake point to great similarity.

Out of 10 taxa (nine species and one subspecies) of sponges (*Porifera*), five species and one subspecies are endemic; the degree of endemism is 60%. The species *Ochridospongia rotunda* is the best known of the four endemic sponges found in Ohrid Lake, and it represents a relict genus and species, with its spherical shape closely resembling the endemic sponges of the Sea of Galilee and Baikal Lake.

With regard to the phylum *Plathelminthes* (Flatworms), the highest degree of endemism is found in the class *Turbelaria* (order *Tricladida* – 25 and order *Rhabdocoela* – 10). There are only three endemic *Nemathelminthes* species (Roundworms); all are Nematodes restricted to Ohrid Lake.

The phylum *Mollusca* (Molluscs) shows the greatest degree of endemism in the aquatic Gastropods, with a total of 76 endemic taxa consisting of 71 species and five subspecies (degree of endemism, 74.5%). In contrast, terrestrial snails, which are still insufficiently studied, have a limited number of endemic forms – 21. Of the 15 recorded bivalve taxa, four are endemic (three species and one subspecies), all of the genus *Pisidium.*

Segmented worms, the phylum *Annelida,* includes 54 recorded endemic taxa, the dominant among them being the class *Oligochaeta* (Oligochaetes), with 39 endemics. It is followed by the class *Hirudinea* (Leeches), with 11 endemics, and the taxonomically non-differentiated group of *Branchiobdellidae,* with four endemic taxa.

The most numerous animal phylum, *Arthropoda,* has 419 recorded endemic taxa (367 species and 52 subspecies). The subphylum *Chelicerata* (Chelicerates) has 71 endemic forms (65 species and six subspecies), subphylum *Branchiata* (Branchiate arthropods) – 137 endemics (113 species and 24 subspecies) and subphylum *Tracheata* (Tracheates) – the most endemic forms – 211 (189 species and 22 subspecies). The highest degree of endemism among the *Chelicerates* is seen in the orders *Pseudoscorpiones* (73%) and *Opiliones* (47.5%). Among *Branchiata*, the highest degree of endemism is shown by the subclass *Malacostraca* (orders *Isopoda* [85%] and *Amphipoda* [81.4%]), but is also seen in the subclass *Ostracoda* (26%). Within Tracheates (*Tracheata*), class *Myriapoda* (order *Diplopoda*) shows the highest degree of endemism (37%) and within class *Insecta*, the order *Lepidoptera* has the largest number of endemics (90).

In regard to *Vertebrata,* the class *Pisces* (Fishes) has the highest degree of endemism (34.5%). Among the other classes, only four endemic mammals are known (*Mammalia*).

Of the major centres of faunal endemism, the three relict lakes are especially noteworthy. The largest, Ohrid Lake, with 216 endemic taxa, has been described as the most important centre for endemism in Macedonia and nearby areas. No less important are Prespa and Doyran lakes which, due to their shallower depths, have fewer numbers of endemic and relict species. Of particular interest is the presence of six endemic taxa (four species and two subspecies) common to both Ohrid and Prespa lakes, which confirms the common origin of these lakes from the former Pliocene Desaret Lake.

The groundwater, springs and caves of Macedonia are second in importance as centres of endemism. They are characterised by the presence of thalassophreatic (i.e., from saline waters), limnophreatic (i.e., from fresh waters) and terrestrial relict fauna which date from the Upper Tertiary.

Table 19. Number of endemic taxa of various faunal groups in the Republic of Macedonia.

Taxonomic category	Taxonomic group	Restricted to:				
		Ohrid Lake.	Prespa Lake	Doyran Lake	Other localities in Macedonia	Total number
Phylum	*Protozoa* (Protozoans)	32	-	-	-	32
Phylum	*Porifera* (Sponges)	4	1	1		6
Phylum	*Plathelminthes* (Flatworms)	32	2	-	1	35
Phylum	*Nemathelminthes* (Roundworms)	3	-	-	-	3
Phylum	*Mollusca* (Molluscs)	61	8	1	31	101
Phylum	*Annelida* (Segmented worms)	26	3	5	20	54
Phylum	*Arthropoda* (Arthropods)	51	4	4	360	419
Phylum	*Chordata* (Chordates)	7	6	1	10	24
Total Number of Endemic Taxa		216	24	12	422	674

3.5.4.3. Conservation status of animals

The European Red List includes 113 of the vertebrate species present within the Republic of Macedonia (30 fishes, 66 birds, 16 Mammals and one species of Reptile). Seventeen of the 20 endemic fishes are included within the category of globally threatened species. Seven are restricted to Ohrid Lake (*Acantholingua ohridana, Phoxinellus epiroticus, Rutilus ohridanus, Salmo aphelios, S. balcanicus, S. letnica* and *S. lumi*), six to Prespa Lake (*Alburnus belvica, Barbus prespensis, Chondrostoma prespense, Cobitis meridionalis* and *Rutilus prespensis*), one to Doyran Lake (*Sabanejewia doiranica*) and three endemic species occur within other aquatic ecosystems (*Gobio banarescui, Salmo pelagonicus* and *S. peristericus*).

Table 20. Threatened vertebrate species in the Republic of Macedonia.

Threatened Species of Fishes	30
Threatened Species of Reptiles	1
Threatened Species of Birds	66
Threatened Species of Mammals	16
Total Number of Threatened Species	113

Because the National Red List has yet to be prepared, the most important species to be protected at the national level are considered to be the endemic fish species. The remaining endemic vertebrate species should also be included, as well as some other specific vertebrate species whose ranges end in or pass through Macedonia (*Algyroides nigropunctatus, Coluber gemonensis, Cyrtopodion kotschyi, Lacerta agilis, Pelobates syriacus, Rana balcanica, R. graeca, R. temporaria, Testudo graeca, Triturus alpestris, Vipera berus* etc.)

The reason for the disappearance of species and/or the reduction of their populations is primarily due to human activity, but there are also global causes which have not been completely identified. If global factors endangering biodiversity, including changes in climate, are excluded, then all remaining essential factors having direct or indirect impacts on faunal diversity, the observed changes within ecosystems (especially aquatic and forest types), changes in the ozone layer, some fungal pandemics etc., are of anthropogenic origin.

Regarding the conservation of aquatic systems and their environs, where the greatest faunal diversity is recorded, it is necessary to notice some key factors which cause disturbances to natural conditions in biotopes and thus the reduction of biodiversity as a whole. These include:

- Usage of various pesticides and other chemical agents in agriculture and forestry;
- Inappropriate disposal of household waste;
- Unplanned or inappropriate use of water for irrigation;
- Changes made in localised or wider areas through habitat destruction, fragmentation and isolation;
- Tourism;
- Road traffic;
- Hunting for commercial purposes and collection for scientific, hobby and other non-scientific uses;
- Colonisation by invader species;
- Insufficient knowledge regarding basic population parameters and the distribution of individual faunal groups.

3.5.5. Summary of species in Macedonia

3.5.5.1. Summary of diversity and endemism of species

Based on an analysis of the abundance of biodiversity of the countries on the European continent, the Republic of Macedonia holds the top position in the "European Hotspot" list. Despite the fact that the biodiversity of the flora and fauna has not been fully studied, the findings to date indicate its huge wealth. As an example, the diversity of invertebrate species on a relatively limited surface at some sites (Ohrid Lake, marsh ecosystems and others) can be directly compared to the diversity of coral reefs; in some cases, the biodiversity in Macedonia is higher.

Table 21. Diversity and endemism of species in the Republic of Macedonia.

Taxonomic group	Number of Species in Macedonia	Endemics
Fungi (*Fungi*)	1,250	-
Lichens (*Lichenes*)	340	-
Total Fungi and Lichenes	1,590	-
Algae (*Algae*)	1,580	135
Mosses (*Bryoposida*)	349	2
Peat mosses (*Lycopsida*)	6	-
Horsetails (*Sphenopsida*)	7	-
Ferns (*Filicinae*)	42	1
Gymnosperms (*Gymnospermae*)	15	-
Angiosperms (*Angiospermae*)	c. 3,200	114
Total of Cormophyta	c. 3,700	117
Protozoans (*Protozoa*)	113	32
Sponges (*Porifera*)	9	5
Flatworms (*Plathelminthes*)	85	35
Cnidarians (*Cnidaria*)	2	-
Nemertine worms (*Nemertea*)	1	-
Roundworms (*Nemathelminthes*)	613	3
Molluscs (*Mollusca*)	276	95
Segmented worms (*Annelida*)	160	42
Arthropods (*Arthropoda*)	7,574	367
Chordates (*Chordata*)	506	23
Total Fauna	9,339	602

Diatoms (*Bacillariophyta*) have the highest diversity, represented by 512 species and 62 endemics; Green algae (*Chlorophyta*) by 398 species and 10 endemics and Blue-green algae (*Cyanophyta*), by 204 species and 10 endemics.

Fungi are represented by approximately 1,250 species, however there are no endemic species. Most belong to *Basidiomycota* (1,050), which is currently under intensive study. Lichenes are represented by 340 species.

Higher plant groups are represented by 3,700 species, including 30 vegetation classes, 60 orders, 90 alliances and over 260 associations. Of the species which are completely studied, five are peat mosses, seven are horsetails, 42 are ferns and 15 are Gymnosperms.

The richest diversity is found in *Angiospermae*, with 3,200 species (i.e., about 1.5% of the total number of Angiosperms present on Earth). The group *Choripetalae* is almost completely known, while the *Sympetalae* and *Monocotyledonae* are currently under intensive study. The next most diverse species is the mosses, with approximately 350 species with two endemics. Among the mosses, the class *Musci* is the most studied, and the class *Hepaticae* the least studied. Additional research is expected to increase the number of known moss species by 120-130.

Of the 117 known endemic higher plant species, 114 belong to the Angiosperms. The class *Dicotyledonae* is represented by 109 endemic species and the class *Monocotyledonae* by five. The families with the most endemic species are: *Compositae* (18), *Caryophyllaceae* (17), *Labiatae* (12), *Violaceae* (10), *Scrophulariaceae* (9), *Rosaceae* (9) etc.

A general characteristic of the fauna of Macedonia is its high degree of taxonomic diversity, represented by 9,339 species and 228 subspecies, for a total of 9,567 taxa. In addition, the complex zoogeographical structure, with faunal elements of various origins and zoogeographical affiliations (resulting not only from the geographical location within the country, but also from the complex historical development of the organisms [i.e., from the Tertiary through the Ice Age to the present]), is manifested by a high degree of relict and endemic forms.

Macedonian endemic faunal elements are represented by 674 taxa, including 602 species and 72 subspecies (7% of the total current number of recorded taxa). Representatives of *Arthropoda*, the largest phylum in the animal world, also occur in large numbers in Macedonia (7,743 taxa). The degree of endemism at the phylum level, in descending order, is as follows: *Porifera* – 60%, *Plathelmintes* – 41%, *Mollusca* – 35.8%, *Annelida* – 29.6% and *Protozoa* – 28.3%. Lower taxonomic groups (subphyla, classes, orders, families) show higher degrees of endemism. The level of endemism within the subphylum *Ciliophora* is 88%, the order *Isopoda* – 85%, the order *Amphipoda* – 81.4% and within aquatic Gastropods – 74.5%. Among the Vertebrates (*Vertebrata*), the highest degree of endemism appears within the superclass *Pisces* – 34.5%, a real curiosity even within Europe.

3.5.5.2. Summary of the conservation status across all species

The most threatened species among the lower plant groups are diatoms (74), especially the species: *Achnanthes brevipes, A. inflata, Actinocyclus normanii, Caloneis amphisbaena* f. *subsalina, Cyclotella iris, Cymbella hauckii, Eunotia arculus, Gomphonema hebridense, Hippodonta rostrata, Naviculadicta pseudosilicula, Nitzschia sinuata* var. *tabellaria, Placoneis gastrum* var. *signata, Stauroneis borrichii* etc.

There are 67 potentially threatened species of Fungi (*Basidiomycota)*, especially among the following: *Antrodia juniperina, Battarea phalloides, Boletus regius, Chroogomphus helveticus, Inonotus tamaricis, Myriostoma coliforme, Peniophora tamaricicola, Pleurocybella porigens, Poronia punctata, Pyrofomes demidoffii* and *Suillus sibiricus.*

Lichens have 12 threatened species: *Evernia divaricata, Parmelina exasperatula, P. omphaloides, P. pastillifera, P. sorediata, Peltigera venosa, Pertusaria coccodes, Ramalia carpatica, R. polymorpha, Staurothele clopimoides, Usnia carpatica and U. causasica.*

The most threatened groups of the higher plants are the Angiosperms (with approximately 280-300 species), Ferns (15), Mosses (20) and Gymnosperms (7).

Especially threatened are the aquatic and wetland plants, such as: *Aldrovanda vesiculosa, Alopecurus creticus, Beckmannia eruciformis, Carex elata, Cladium mariscus, Drosera rotundifolia, Glyceria maxima, Isoetes phrygia, Merendera sobolifera, Nymphaea alba, Osmunda regalis, Ranunculus lingua, Rumex hydrolapathum, Salvinia natans, Senecio paludosus* etc. The following group includes relict species, as well as some of the Macedonian endemics which have a restricted distribution and whose habitats have been impacted by certain anthropogenic activities such as the construction of roads, hydropower reservoirs, agricultural conversion etc. These are: *Anthoceros punctatus, Astragalus cernjavskii, A. physocalyx, Buxbaumia indusiata, Camphorosma monspeliaca, Crypsis aculeatus, Knautia caroli-rechingeri, Onobrychis degeni, Puccinelia convoluta, Rhodobryum roseum, Salvia jurisicii, Sambucus debarensis, Sideritis scardica, Silene paeoniensis, Suaeda maritima, Thymus alsarensis, T. oehmianus, Tulipa mariannae, Viola allchariensis, V. arsenica, V. kosaninii* etc.

Table 22. Threatened species of Fungi, flora and fauna in the Republic of Macedonia.

Taxonomic group	Number of Threatened Species
Fungi (*Fungi*)	67
Lichens (*Lichenes*)	12
Total Fungi and Lichens	79
Algae (*Algae*) – *Bacillariophyta*	74
Mosses (*Bryoposida*)	20
Peat mosses (*Lycopsida*)	6
Horsetails (*Sphenopsida*)	2
Ferns (*Filicinae*)	16
Gymnosperms (*Gymnospermae*)	8
Angiosperms (*Angiospermae*) - *Dicotyledonae* - *Monocotyledonae*	 283 57
Total Higher Plants	392
Fishes (*Pisces*)	30
Reptiles (*Reptilia*)	1
Birds (*Aves*)	66
Mammals (*Mammalia*)	16
Total Fauna	113

Because the National Red List of Fauna in the Republic of Macedonia has not yet been prepared, the numbers of threatened species listed are in accordance with the European Red List of Vertebrates. According to this list, in absolute numbers, birds have the highest number of threatened species (66), followed by Fishes (30), Mammals (16) and then Reptiles (1).

The most threatened group of organisms in the Republic of Macedonia are fishes, with 51.7% of the total recorded species. In this group, *Salmo lumi* is considered an extinct species (EX), whereas populations of Carp (*Cyprinus carpio*) are at a level of critically endangered (CR). Of birds, 20.7% of the total recorded number of species are

threatened. Among them, the most threatened species are the Bearded vulture (*Gypaetus barbatus*) and the Black vulture (*Aegypius monachus*). Mammals have 19.5% of their species listed as threatened; however, the formerly locally extinct species *Cervus elaphus* (Red deer) and *Dama dama* (Fallow deer) have been successfully reintroduced and now have steadily increasing populations.

Amphibians and Reptiles, according to the European Red List of Vertebrates, are regarded as the least threatened. However, on a national level, a considerable reduction in the populations of most of the species has been recorded, with the most noteworthy cases being the Balkan spadefoot toad - *Pelobates syriacus balcanicus* (due to draining of marsh ecosystems) and the Yellow-bellied toad - *Bombina variegata* (due to water capture/extraction from natural springs).

Major portions of the endemic invertebrate fauna in Macedonia are intrinsically linked to the aquatic ecosystems. The high threat level to this fauna results from the decline in the water levels of certain lakes, eutrophication of these lakes and the pollution of riverine ecosystems.

3.6. Key threats to biodiversity

3.6.1. Habitat loss, modification and fragmentation

In the Republic of Macedonia, habitat loss, modification and fragmentation have been occurring from prehistoric times to the present; however, these processes have intensified over the past few decades.

The terms “loss” and “modification” of habitats are interwoven and often cannot be separated because the loss of a habitat is always connected with its modification.

3.6.1.1. Land conversion

The loss of natural habitats due to conversion is most evident within aquatic habitats, particularly swamps and marshes. During the decades following World War II, almost all of the major swamps and marshes were drained, mainly for two reasons: to acquire new agricultural areas and to combat malaria. Because of this, marsh biocenoses became seriously endangered, fragmented or threatened with extinction (Sections 3.3.2.4. and 3.5.3.3.). This process is still continuing (the Ohrid marsh, Studenchishte, has been converted into a landfill for construction waste).

One method of habitat modification is through its transformation. In Macedonia, this is particularly seen as a result of artificial reservoir construction. There are many examples of plant species becoming endangered or extinct due to the transformation of terrestrial habitats into aquatic ones (Sections 3.3.2.4. and 3.5.3.3.). In the past, during the construction of more than 20 major reservoirs, no regard was given as to whether valuable habitats would be destroyed.

Currently, the conversion of natural habitats into agricultural uses does not represent a serious threat to biodiversity. On the contrary, the most striking losses have been of the extensive number of meadows (in the foothills and mountain areas) and of the pastures in the lowlands. The diversity and mosaic-like distribution of habitats characteristic of traditional agriculture are seriously threatened. As a result, it is expected that, in two or three decades, this portion of the landscape will disappear, having been modified into shrubs and low forests.

3.6.1.2. Land degradation

One of the most serious reasons for the loss of habitats (or their parts) is the inadequate planning for the expansion of urban centres, weekend homes and tourist-recreation zones. The desire for more tourist-recreational centres at the expense of habitat conservation (particularly mountain springs and streams, tall grass communities etc) is constantly growing.

The situation is similar with the major and minor industrial complexes which, due to lack of adequate controls, are constructed in various natural or semi-natural habitats (for example, the quarry near Demir Kapiya, Damyan Mine, coal mine near Novatsi etc.). (Sections 3.3.2. and 3.5.3.3.).

3.6.1.3. Fragmentation of habitats

The main cause of habitat fragmentation is traffic infrastructure (Section 5.8.). Although the quantity of traffic using highways and main roads could be considered a problem by some, since these roads were constructed within long-used transportation corridors in Macedonia, they have not contributed to the additional partition of habitats. Some main roads, however, do intersect habitats that serve as biocorridors for vertebrates, especially large mammals. One such example is the saddle, Gyavato, which is the only connection between the mountain Pelister (and hence, of Gramos and Pindus in Greece) and the mountain range containing the peaks Bigla, Plakenska and Ilinska (and through them, Stogovo and Bistra). An increase in traffic or the construction of a limited access highway would completely disrupt this corridor. The situation is similar in Mavrovo National Park. Railways are very underdeveloped compared with roads and do not represent a threat to natural habitats.

Fragmentation of aquatic habitats (e.g., the upper and middle courses of rivers and streams) is a frequent occurrence within the country. Additionally, recommendations for biological minimums for watercourses and for the construction of fish passages are not observed. This has led, for example, to the disruption of the natural migration/spawning path of the eel in Ohrid Lake.

Another example of habitat fragmentation concerns aerial transmission lines, some of which pass through national parks.

It is obvious that the loss, modification and fragmentation of habitats have negative impacts and lead toward the endangerment of biodiversity.

3.6.2. Overuse of biological resources

3.6.2.1. Overgrazing of grasslands and pastures

The Republic of Macedonia has approximately 650,000 ha for use as summer and winter pastures (hilly and high-mountain pastures). Pasture degradation is chiefly due to the expansion of shrubby vegetation (e.g., Juniper and wild blueberry) resulting from a lack of grazing rather than from overgrazing. The dominance of shrub vegetation reduces biodiversity because grass communities are more heterogeneous and richer in species.

The average carrying capacity (number of head of livestock/ha) is 3/ha. This allows for the grazing of two million sheep and goats on the available pastureland, without any measures to improve the grass composition. According to official statistical data, current numbers of ruminants do not exceed one million; therefore, the threat of pasture overgrazing is not of concern.

3.6.2.2. Over hunting/fishing

Even though hunting management plans exist and there is also Public Enterprise for Game Wardens and Hunting Inspections, poaching is still at a high level. In addition, occurrences of illegal fishing and the use of prohibited fishing gear (including certain types of nets, chemicals and explosives) cause grave concern.

There is insufficient data to allow a determination of the state of biological resource exploitation resulting from hunting.

3.6.2.3. Trade in wildlife

Unfortunately, current data on the commerce of natural products do not exist; therefore, it is not possible to make an assessment of its affect on the loss of biodiversity. Prior to 2002, there was no information on the export of wild species, nor any sanctions for its prevention. That year, the Ministry of Environment and Physical Planning (MoEPP) began to prepare lists of endangered wild species of Fungi and plants (such lists are also planned for animal species). In order to initiate the keeping of records on the export of wild species from the Republic of Macedonia, these lists were submitted to the Ministry of Agriculture, Forestry and Water Management and to the Administration for Plant Protection, in order to be included on the list of products that are inspected for health safety at border crossings. The system for monitoring the export of wild species of flora and fauna has now commenced. Unfortunately, however, internal trade remains unregulated. This is a pressing problem that should be dealt with as soon as possible.

Implementation of the *Convention on International Trade in Endangered Species of Wild Fauna and Flora* (CITES), which regulates the control of international trade in wild species, faces many difficulties in the Republic of Macedonia. These are due primarily to an overlap of administrative responsibilities, especially within the Ministry of Agriculture, Forestry and Water Management, but also due to a lack of personnel in the departments responsible for the inspection and control of trade.

3.6.2.4. Water extraction

Extraction of water from the upper and middle courses of rivers and streams is conducted for the purposes of supplying drinking water to inhabited areas and/or irrigation water to agricultural lands. As a result of the arid climate and the hydrological regime within the Republic of Macedonia, such activities are very common. Unfortunately, the priority of providing safe drinking water seldom takes protection of natural watercourses into consideration (Section 3.3.2.4.).

Water extraction (i.e., water supply systems) is under the purview of the Ministry of Agriculture, Forestry and Water Management (Administration for Water Management). In cases of major water withdrawals, new construction projects have to provide for the continuance of an ecological minimum water flow, which is often calculated as the flow of the smallest recorded watercourse in the watershed. With such projects, several serious problems can occur:

- accurate flow measurements are unknown for most of the small waterways in Macedonia;
- inadequate ecological minimums may be chosen;
- control (or compliance) mechanisms and methods for sanctioning are lacking.

A lack of monitoring for water extraction operations is also widespread. Notable examples are the Petruska, Kovanska and Sermeninska Rivers, which are dry in their lower courses during most of year due to water withdrawal for irrigation purposes. In addition, the inhabitants of the village of Podgortsi (Yablanitsa) dug a channel to the Podgortsi glacial lake, which is another demonstration of how a rare habitat type can be destroyed.

A further drastic example is the proposal to withdraw water from the Boshava River in order to irrigate the Kavadarechko Pole Plain. This plan endangers the existence of this significant aquatic ecosystem (i.e., its middle and lower courses) and would cause significant changes in the hydrology of the wider area, since the waters of the Boshava River flow into another watershed (that of the Luda Mara River).

The problem of water extraction is serious enough to be ranked among the basic threats to biodiversity in Macedonia.

3.6.3. Pollution

3.6.3.1. Water pollution

Surface waters in the Republic of Macedonia are seriously endangered by various sources of physical, chemical and biological pollution. The trend toward the dramatic deterioration of water quality in riverine ecosystems was first noted in the mid-1970s. It resulted from the development of heavy industry and an increase in urban populations on the one hand, and a complete disregard for the problem of communal and industrial wastewaters, on the other. The irresponsible discharge of high concentrations of organic and inorganic pollutants over a period of years has led to the deterioration of riverine ecosystems (Table 23).

Table 23. Major river systems in the Republic of Macedonia, types of pollution, sources of pollution, legal category and observed category.

River System (and Location)	Pollution	Source of Pollution	Regulated Category	Observed Category
Vardar:				
- Vrutok	Organic	Solid waste	I	I-II
- Jegunovse	Inorganic	Chromium	II	III-IV
- Skopye-Saray	Organic-inorganic	Agriculture, wastewater	II	III-IV
- Skopye-Yurumleri	Organic-inorganic	Industry, wastewater	II	>IV
- Veles	Organic-inorganic	Industry, wastewater	III	>IV
- Fertiliser factory - Veles	Inorganic	Chemical industry	III	>IV
- Demir Kapiya	Organic-inorganic	Wastewater, tributaries	II	IV- >IV
- Gevgeliya	Organic-inorganic	Wastewater, industry, agriculture	II	IV- >IV
Lepenets	Inorganic	Asphalt plant, industry	II	IV-III
Treska	Organic	Wastewater	II	II-III
Pchinya	Organic-inorganic	Industry, wastewater	II	IV- >IV
Bregalnitsa	Organic-inorganic	Wastewater, mines	II-III	IV- >IV
Crna	Organic-inorganic	Wastewater, industry	III-II	IV- >IV
Dragor	Organic-inorganic	Wastewater, industry	III	>IV

The state of eutrophic aquatic ecosystems is also alarming in terms of pollution. This is of particular concern in Doyran Lake, which is rapidly losing its identity as a lake ecosystem, instead being reduced to the status of a marsh. Although direct efforts have been undertaken for the protection of Ohrid Lake, little has been done to protect Prespa Lake, the main source of water in this relic system. In addition, the major reservoirs Strezhevo, Tikvesh Lake and Turiya are also under great pressure.

In general, there is no continuous monitoring of the state of the groundwater, with analyses being made only on an as-needed basis. One of the analyses made in the area of Skopye recorded the presence of trichloroethylene and zinc in the vicinity of the industrial complex, "OHIS," as well as increased levels of radioactivity (about 13 Bq/l) near Petrovets airport.

Such a state of degraded water quality strongly affects biodiversity and the stability of all aquatic ecosystems. Only those aquatic systems located high in the mountains are relatively unspoiled, but past military operations which took place on Shar Planina Mountain are likely to have had some adverse impacts on even these.

The main polluters of water in Macedonia consist of the following industries: chemical, leather, food processing, metal refining and other industries, as well as swine production facilities and communal wastewaters.

3.6.3.2. Terrestrial and soil pollution

Soil pollution in Macedonia is extensive and represents a serious threat to biodiversity. There are several distinct sources of pollution, characteristic of the conditions in Macedonia:

- industry and mining (through atmospheric emissions and wastewater – primarily from heavy metals);
- periodic irrigation with polluted water in some regions (heavy metals and nitrates);
- use of pesticides and fertilisers (persistent organic compounds);
- improper disposal of wastes (toxic organic substances);
- transportation, especially exhaust gases from vehicles (heavy metals – lead [Pb]);
- trans-border pollution etc.

Regardless of the source for the pollution, there are several heavily polluted regions in Macedonia:

- the regions in and around major urban centres (mainly due to traffic);
- industrial regions (due to emission of pollutants into the environment), such as Veles, Skopye and Bitola;
- agricultural regions under intense use (Strumichko Pole Plain, Polog, Pelagonia, Kochansko Pole Plain etc);
- smaller areas surrounding landfills, dumps etc;

The most endangered ecosystems and habitats in terms of soil pollution are the agricultural habitats located in the Oak forest belt. Because this belt covers a large part of the Republic of Macedonia, certain rare habitats are not directly endangered; however, the pollution of the soil still represents a threat to the habitats which exist in at-risk locations through their reduction and/or destruction.

3.6.3.3. Air pollution

Air and soil pollution (Section 3.6.3.2.) are closely related. The regions of the country with the highest amounts of soil pollution are also the same as those characterised by high amounts of air pollution (this also includes agricultural regions, with air pollution primarily coming from ammonia, nitrates, phosphorus etc).

The most frequent pollutants in the air of urban or industrial centres are $SO_{x,}$ NO_x, CO_x, chloro-fluorocarbons (CFCs), smoke and breathable dust (< 10 μm) and high concentrations of heavy metals.

According to the indicators from Sections 5.4-5.8, industrial production in the Republic of Macedonia experienced a steady decrease over the past ten years, resulting in a reduction of air pollution (except in the region of Veles). The reverse is true regarding traffic, which has seen a steady increase in passenger vehicles and a corresponding increase in the total amount of air pollution. This continues to be a problem, especially in urban centres, primarily Skopye. Additionally, the age and poor maintenance of the vehicles and the low quality of fuel increasingly burden the air with pollutants.

The impact of air pollution on biodiversity is apparent in the major urban areas and the nearby valleys. Pollution threatens the natural environment in these areas as a direct result of the anthropogenic factor. Although occurrences of acid rain in the Republic of Macedonia are not frequent, they do occur near the large urban and industrial centres of Skopye and Veles, and even occasionally in rural areas (Prespa 1988-1990, Melovski, 1996). They are usually the result of the trans-border arrival of pollutants. Additionally, changes have been noted in the composition of the diatoms in some glacial lakes (Pelister). For example, powerful acidophilic and acid tolerant species (*Aulacoseira distans* var. *nivalis)* have been recorded, which were not initially characteristic for those habitats.

Currently in Macedonia, large-scale projects are being implemented to reduce pollution from substances damaging to the ozone layer (the project is in an advanced phase and is delivering excellent results), as well as pollution from persistent organic substances (polychlorinated biphenyls and furans). The situation in the Republic of Macedonia is expected to be adequately regulated in the future.

It can be concluded that air pollution is not a key threat to the biodiversity of the Republic of Macedonia.

3.6.4. Introduced and invasive species

The introduction of floristic and faunal species into a country increases its total biodiversity (e.g., new crops for use in agriculture, industry and horticulture, pure breeds of domestic animals etc). Due to inherently high reproductive rates, however, many of them may become invasive, especially if their expansion is not controlled. Additionally, they occupy the habitats of indigenous species and displace them.

In Macedonia, most of the invasive plant species are found on ruderal sites and in some aquatic ecosystems. An example is the species *Elodea canadensis* (Elodea), which was first introduced into Ohrid Lake through the channel Studenchishte in 1957. It is an invasive weedy species which rapidly reproduces and expands, out-competing the indigenous submersed macrophytic species and occupying their habitat. The expansion of this species, which can also be found near the springs of St. Naum (Ohrid Lake), the Shum spawning area and in the Crni Drim River, is under constant monitoring. Another invasive species is the Asian *Ailanthus altissima*, which has spread throughout large areas of lowlands and is characterised by a high reproduction capability. Over the past few years, a large number of new American species have also been recorded – species of the genera *Conyza*, *Juncus*, *Solanum* etc. With regard to forestry and reforestation, careful consideration must be taken concerning the excessive planting of only one species, *Pseudotsuga douglasii*, which has aggressively spread into Beech areas, as well as into lowland areas with indigenous conifers.

Most of the introduced and invasive species of fauna belong to the superclass *Pisces* (11) and class *Mammalia* (8). Invasive species from the other vertebrate classes (*Amphibia*, *Reptilia* and *Aves*) have not yet been found among the introduced species which are periodically recorded.

Concerning the fish fauna of natural aquatic ecosystems, the following introduced species are now considered to be invasive: *Acerina cernula*, *Ameiurus nebulosus*, *Carassius auratus*, *C. carassius*, *Lepomis gibbosus*, *Oncorchynchus mykiss* and *Pseudorasbora parva.* The abundance of the populations of these fish species is continuously increasing due to the competitively inferior indigenous species. These invasive species are found primarily in the key ecosystems of Ohrid and Prespa Lakes, as well as in the watershed of the Vardar River.

Among Mammals (*Mammalia*), the group of exotic species includes the Muskrat (*Ondatra zibethicus*), whose population has spread in a north-south direction along the Vardar River and into the eastern part of its watershed, and the Coypu (*Myocastor coypus*), which is currently restricted to Prespa Lake and the upper course of the Vardar River. Fortunately, these two species have not yet had a direct negative impact on the indigenous fauna of mammals.

3.6.5. Natural Pathogens

Based on an analysis of the current status of plant diseases and pests among the forests, crops and seedling production facilities of the Republic of Macedonia, the following pests and pathogens are frequently noted:

Table 24. Common plant diseases and pests.

Agent	Disease	Affected Species
Chryphonectria parasitica	Desiccation	*Castanea sativa*
Melampsorella caryophylacearum	Tumor of Fir	*Abies borissi-regis*
Microsphaera alphitoides	Rust disease of Oak	*Quercus* spp.
Ophiostroma novo-ulmi	Desiccation of Elm	*Ulmus* spp.
Ophiostroma ulmi	Desiccation of Elm	*Ulmus* spp.
Ungulina annosa	Desiccation of White and Black pine stands	*Pinus nigra, P. sylvestris*
Ungulina fomentaria	Tree rot	Mostly *Fagus sylvatica* and other species
Cuscuta spp.	Parasite (Flax dodder)	Various types of floral plants, alfalfa
Viscum album	Parasite (immela)	*Abies, Pinus*

Table 25. Harmful insects.

Agent	Affected Species or Ecosystems
Aphididae	Floral plants
Coleophora laricella	Plants of *Larix europaea*
Euproctis chrysorrhoea	Oak forests
Geometridae	Oak forests
Malacosoma neustria	Broadleaf forests
Nediprion sertifer	*Pinus nigra* plants
Orchestes fagi	Beech forests
Pissodes notatus	*Pinus* spp.
Porthetria dispar	Oak forests
Rhyacionia buoliana	Forest stands of *Pinus* spp.
Scolytidae	*Pinus* spp.
Thaumatopoea pityocampa	Pine stands
Tortricideae	Oak forests

3.6.6. Climate change

On the basis of an evaluation of the impacts of climatic changes on biodiversity, the future horizontal and vertical distribution of plant and animal species are expected to change, (i.e., migration toward the north and/or migration to higher elevations). Such changes will particularly affect the relict plant and animal species living in high mountain zones.

According to the results presented by the MoEPP in the First National Report on Climate Changes, the areas most sensitive to climatic changes are the refugial zones: Taor Gorge; Treska River gorge; Crna River, including the gorges of the Raets and Blashnitsa Rivers; Jama; Mavrovo-Radika; Pelister; Ohrid-Prespa and Nidze-Kozhuf. Within these zones, many refugial phytocenoses are present which would be endangered by temperature increases and by the accompanying decreases or distributional changes in precipitation.

With an increase in temperature of 3.2ºC (IS92a model) over the next 100 years, even the highest peaks would suffer higher mean annual temperatures on a par with the current temperatures in the higher subalpine zones (i.e., the zones of species distribution would migrate upward by 500 m), so that alpine pastures would be expected to disappear completely on some mountains.

In contrast to the alpine pastures, the thermophilic communities, such as the *pseudomaquis* (a type of Mediterranian shrubland), would expand their ranges into northern regions and higher altitudes. New thermophilic communities would be expected to appear, such as Mediterranean grass communities. Other climate-zonal communities would experience changes in their areal and elevational distributions, depending on the rate of advancement of the climatic changes.

3.6.7. Natural Disasters

Natural disasters do occur, but only infrequently and of minor intensity. Macedonia is a seismic area, however, and a large part of its territory is arid and semiarid and there are frequent landslides, avalanches etc.

Droughts are frequent natural disasters. In addition to the droughts of short duration which are characteristic for a major portion of the country, there are also extended periodic droughts, which cause great economic hardships for agriculture, as well as serious damage to the natural inland mesophilic ecosystems. Examples of this include reduction in the growth rates of forests, defoliation and increased susceptibility to parasites and other pests, the desiccation of marsh ecosystems, disturbances to the hydrology of aquatic ecosystems (Doyran and Prespa lakes) etc.

Forest fires are usually caused by human activities; however, due to their dramatically increased frequency during periods of drought, they can be listed as natural disasters. They are frequent in the sub-Mediterranean and hot continental areas, where communities of scrub forests and Hornbeam important from the aspect of biodiversity develop.

Landslides are frequent occurrances, but take place in a much more localised area than drought or fire. These are phenomena where millions of cubic metres of soil begin to suddenly move, destroying large agricultural areas (Kavadartsi) and forests (Dolna River near the village of Bitushe). In the area of Kavadartsi (near the village of Vatasha), a large landslide thirty years ago closed the gorge of the Luda Mara River, forming a reservoir which is currently being used for irrigation.

Floods are not a frequent phenomenon in the Republic of Macedonia, usually occurring only during certain times of the year, but they can cause serious economic damage when they do happen. They are restricted to plains areas, where natural ecosystems are rare due to the presence of agriculture, or are represented by riparian habitats accustomed to periodic flooding.

Avalanches frequently occur on various mountains in Macedonia. They cause damage to Beech, Fir and mixed Beech-Fir forests on Bistra Mountain (Trebishka Rupa, near the village of Sentse); Beech-Fir forests on Galichitsa (Volkolegalo) and Spruce and Beech forests on Shar Planina Mountain (Leshnitsa) – as well as on other mountains, although to a lesser extent.

Earthquakes of minor and major intensity are regular phenomena. To date, there are no data on any serious damage to biodiversity as a consequence of earthquakes.

Due to the low intensity, low frequency or narrow scope of avalanches, floods and landslides; the ecosystems' ability to adapt to arid conditions and the limited extent of fires, natural disasters are not considered to be serious threats to biodiversity in the Republic of Macedonia.

3.6.8. Knock-on effects (chain of extinction) and other factors

Other factors that can have negative impacts on biodiversity or cause a chain of effects are:

- Lack of, or inappropriate, legal regulations on the conservation of biodiversity, lack of clarity in institutional authority and overlap of responsibilities and authorities. Further, there is a lack of enforcement of the legal regulations which do exist;
- Low public and institutional awareness of the importance of biodiversity and insufficiently developed awareness among non-governmental organisations (NGOs);
- Economic instability, low standard of living and unemployment strongly affect the threats of the type discussed in Section 3.6.2;
- Inappropriate implementation of spatial planning guidelines;
- Armed conflicts in certain regions and within the country pose serious and direct threats to natural resources. The government of the Republic of Macedonia does not yet have full control over some areas of the country;
- Erosion is a serious problem, and it develops as a result of previous and current agricultural practices in Macedonia;
- Incomplete research on various aspects of biodiversity in Macedonia: there are no Red Lists or books, vegetation maps, pedologic maps, maps of ecosystems and habitat distribution, lists of characteristic and endangered species, information systems nor databases, and there is a low number of professional, scientific and institutional personnel working in the field of biodiversity;
- Insufficient personnel in the institutions of the governmental system: MoEPP, inspection services, customs, Fund for the Environment etc and poor interagency cooperation;
- No monitoring system for biodiversity (except for partial monitoring in the three national parks).

There are other less important factors which can also cause a chain of effects negatively impacting biodiversity, including various forms of non-sustainable uses of natural resources in all economic sectors. In addition, indirect negative environmental impacts may occur as a consequence of the threats to biodiversity described previously in Sections 3.6.1-3.6.7.

4. USE AND VALUES OF BIODIVERSITY

4.1. Agrobiodiversity

Biological diversity in agriculture is one of the most critical areas of the overall biodiversity on the globe, with 75% of all food production based upon only about 100 plant species and domestic animals. As civilisations developed, humans strove to create plant varieties and domestic animals with more useful traits, which contributed to an increase in the diversity of the genetic resources of the various species. By crossing various genetic materials, humans began the practical creation of varieties and breeds. This process has been occurring for at least the past 50-100 years and continues even now. Today, however, under the pressure of increased profitability, far more specialised genotypes characterised by the term, "high input – high output," are being promoted. At the same time, traditional breeding using natural species is often neglected, although it often offers the best solutions for the existing conditions in a given environment. As a result of this tendency, many varieties and breeds have not been able to endure under this modern capitalistic onslaught and have been lost as genetic resources. This trend is still continuing, and there are estimates which show that, worldwide, about 30% of domestic animal breeds have permanently disappeared.

In the Republic of Macedonia, biological resources represented by indigenous varieties, breeds and species should be preserved for the sake of economic, scientific, cultural, socioeconomic and environmental interests.

4.1.1. Crops

Macedonia possesses significant agrobiological plant diversity due to its favourable geographic location and climatic conditions. The diversity of a large portion of the local species has not been adversely affected because agricultural production is not intensive in many regions. In such areas, indigenous species and locally-bred varieties are grown, representing an important source of genetic material no longer appearing within the genotype of commercial species.

The major portion of the total arable land is used for field and garden production (84.2%), with the greatest percentage consisting of wheat, tomatoes and peppers. Fruit and grape production comprises 7.1 %, mostly consisting of native and introduced grapes (4.4 %), apples and plums. Meadows cover 8.5%, and are most often planted with alfalfa. The breakdown of grain crops, vegetables and fodder crops is presented in Annex 6, Table1, whereas that of fruit production in Annex 6, Table 2.

The trends in the production of individual crops vary by year, as evidenced by the disappearance of some crops (e.g., poppy, flax, hemp and cotton), reducing the diversity of species cultivated. On the contrary, cucurbit crops, which appear in great diversity but are not considered an important part of agricultural production, are expected to cover about 2,000 ha in 2005.

The bulk of the crops produced consist of commercial varieties, the major portion of which are imported from abroad, with a minor number of locally-developed varieties, mainly created by the Institute of Agriculture in Skopye. Small producers still grow local varieties and indigenous species, especially in garden plant production. The number of varieties/species used in agricultural production within Macedonia is evidence of great biological diversity. There are 129 recognised domestic varieties and 2,205 imported varieties used domestically. A detailed review of the number of varieties by crop is presented in Annex 6, Table 3.

4.1.2. Wild relatives of crops

Most of the crops in Macedonia have wild relatives in close proximity to cultivated varieties. Such wild relatives are sometimes seen in the cereal grains (*Avena* spp., *Hordeum* spp. *a*nd *Triticum* spp.), and in some industrial crops (*Cannabis sativa* and *Papaver* spp.). In fruit production, wild relatives are used most often, both for food and as rootstocks. Some of them have been domesticated or cultivated. The diversity of these crops is large because small growers primarily use indigenous species. They continue to persist because they are actively collected and used directly for food or are processed into other products.

Fodder crops grown in Macedonia, mainly distributed within ploughed fields and meadows (natural or sown), were created by selection and cultivation of wild species. Some have been cultivated since long ago, and others began to be cultivated only recently. Because fruit and fodder crops appear far more often as wild or indigenous types, they are presented separately (Annex 6, Tables 4 and 5).

During the period 1968-1971, indigenous and wild relatives were collected in Macedonia under an international project with the United States. The collected samples are still stored in the Germplasm Resources Information Network (GRIN) database, where they are available for exchange and reintroduction whenever Macedonia will be able to provide the proper conditions for their maintenance.

4.1.3. Native breeds of livestock

Domesticated animals contribute 30-40% of the world's food production. Moreover, they are able to transform large quantities of coarse plant material and by-products from the agricultural and food processing industries into proteins and other highly valuable substances intended for human consumption. Many of the breeds developed for specific climatic regimes or breeding zones appear not to be able to survive in the wake of modern management techniques.

As is the case in other countries, there are indigenous breeds and varieties of domesticated animals in Macedonia which are fully accommodated to local breeding conditions. During the past 50 years, however, new, more productive breeds have been imported. Both the original imported breeds and crosses with local varieties are still present today. Crosses between indigenous breeds/strains and imported breeds are known in several species:

Busha is a local breed of cattle found in highland and mountain areas. During the last 30-40 years, it was crossed with many imported breeds. According to official statistical data (*Statistical Yearbook of the Republic of Macedonia*, 2000), Bushas comprise 50% of the total number of cattle raised.

Pramenka (sheep) is represented by three strains: Karakachanska, Ovchepolska and Sharplaninska. While the Karakachanska strain is considered to be endangered, as classified by the Food and Agriculture Organization (FAO) (2000), the other two strains are widely used in sheep production.

Domestic (Balkan) goat. Although its numbers are on the increase, it is difficult to make a clear distinction concerning this breed. The goats come in different colours (white, grey and multicoloured), with outstanding long hair and sword-like horns.

Local primitive pig is raised on ranges in the regions of Makedonska Kamenitsa, Strumitsa and Sveti Nikole (St. Nicholas). Although it is a very primitive breed, more field and laboratory research is needed in order to clearly define its status.

Table 26. Indigenous breeds and species.

Species	Breed	Strain	Status of Population
Cattle (*Bos Taurus)*	Busha		Stable
Sheep (*Ovis aries)*	Pramenka		
		Karakachanska	Critical
		Ovchepolska	Stable
		Sharplaninska	Stable
Goat (*Capra hircus)*	Domestic (Balkan) goat		Stable
Pig (*Sus scrofa)*	Local primitive pig		Unknown (critical)
Dog (*Canis familiaris*)	Sheep dog – Sharplaninets		Stable

Sheep dog - Sharplaninets. This indigenous breed developed in an independent, natural and authentic manner without any significant participation by humans, which is its great advantage. Its name derives from its place of origin (the mountain massifs of Shar Planina, Bistra, Korab and Kozhuf), where the configuration of the relief and other natural and geographical conditions have all contributed to its genetic stabilisation. Upon the request of the Kinological Association of Macedonia (KAM), the Federation Cynologique International (FCI) registered this animal under the name Sheep Dog – Sharplaninets. It is listed as having a dual country of origin, the Republic of Macedonia and Serbia and Montenegro. Today it is used both as a highly rated sheepdog for the protection of herds of sheep and goats from predators and as a pet animal in urban settings.

4.2. Wild species of economic importance

4.2.1. Use of wild plants

Although pastures are used in livestock production and represent the most important economic non-cultivated plant resource, their total productivity, which is directly influenced by seasonal climatic conditions, has not been calculated to date. Most pastures are not utilised, being present in the high mountains. They are managed by the Public Enterprise for Pastures at the national level. The lack of significant grazing in these pastures has contributed to a change in the composition of herbaceous vegetation, the invasion of woody shrubs and the degradation of the humic layer.

Other species - There are legal regulations (*Regulations on the Manner of Use of Other Forest Products*, Official Gazette of the Republic of Macedonia 13/00), but they do not provide a mechanism for obtaining a precise assessment of the current status of wild plant species. Moreover, the concessionaire with the right to use the particular resource has no legal responsibility for its management. Thus, one of the priorities is to prepare legal regulations defining the sustainable use of these species, in order to prevent their disappearance. The implementation of an organic system of controlled usage of biological resources, with adequate certification and labelling of the local products, will increase their availability in international markets and, at the same time, the obligation for permanent supervision and control.

4.2.1.1. Food

Species of plants intended for human consumption yield both fresh, whole, semi-processed products (frozen, dried or dehydrated) and fully processed products (salted, pickled or preserved). Without respect to processing technique, the following groups of wild plants are of greatest economic importance:

Mushrooms: There are about 2,800 species of mushrooms, 800 of which are edible, with about 50 being commonly collected in Macedonia. They appear to possess an enormous economic value for the local population; however, there is no published data on the number of collectors or the quantity of fresh wild mushrooms purchased domestically. The most purchased species are reported to be: *Boletus pinicola, B. edulus, B. aereus, Cantharellus cibarius, Marasmius oreades, Amanita caesarea, Lactarius deliciosus, Morchella* spp., *Agaricus campestris, Macrolepiota procera, Calvatia* spp., *Bovista* spp. and *Lycoperdon* spp. They represent an important export product (328,693 kg/year; estimated value $2,000,000) for the companies registered to purchase wild-collected mushrooms. These firms have annual contracts for a specific quantity with the concessionaire which is, in general, either the public enterprise "Makedonski Shumi" (Macedonian Forests) or the national parks themselves, but the real quantity collected per year is never known. Although a permit for the export of commercial species (i.e., not on the list of endangered species) can be obtained from the MoEPP, no regional or local productivity data exists on which to base sustainable use restrictions or regulate the quantities available for purchase.

Tea: A large spectrum of wild plants is used for the preparation of tea or as spices. In the Republic of Macedonia, there is virtually no cultivated tea production. What exists is insignificant in relation to the wild collection performed by various companies (e.g., Alkaloid Bilka, Jaka, Koro etc) and by the local population for personal use. The amount of tea exported in 2001 was 1,127,825 kg, with a value of $1,453,052. In other years, as much as $4.5 to 5 million were realised from tea exports.

Wild fruit and nuts: These consist mainly of high mountain fruits, the most important of which is the blueberry (*Vaccinium myrtillus*), a product used chiefly for export (in 2001, 83,284 kg worth $86,196). Blueberries are found in almost all high pastures (over 1,300 m msl). Following in importance are dog rose, raspberries, blackberries, Cornelian cherry and plums**,** used by the local population for making juice and jam. In recent years, there has been an increase in the collection of wild apples, pears and cherries, which are used as ingredients in the fruit teas very much in demand for export. They are found throughout Macedonia. In addition, the collection of Chestnuts (*Castanea sativa*) is very significant, with approximately 250,000 kg collected per year, intended mostly for the home market.

4.2.1.2. Timber/fuelwood

According to the data obtained from Macedonian Forests in 2001, the legal timber harvest in the Republic of Macedonia was 520,915 m^3 (of which 463,840 m^3 were cut by local Macedonian Forests branches and 57,075 m^3 by private individuals in public forests). The total quantities of timber harvested included 417,355 m^3 of fuelwood and 97,837 m^3 commercial timber. Data concerning the forest reserves of the Republic of Macedonia and the ownership structure by species are presented in Annex 6, Tables 7 and 8.

The tree species primarily harvested are: Beech (fuelwood and commercial timber), Oak (fuelwood and commercial timber) and Pine (commercial timber). Other species (Chestnut, Fir, Poplar and Walnut) are of significantly lesser importance.

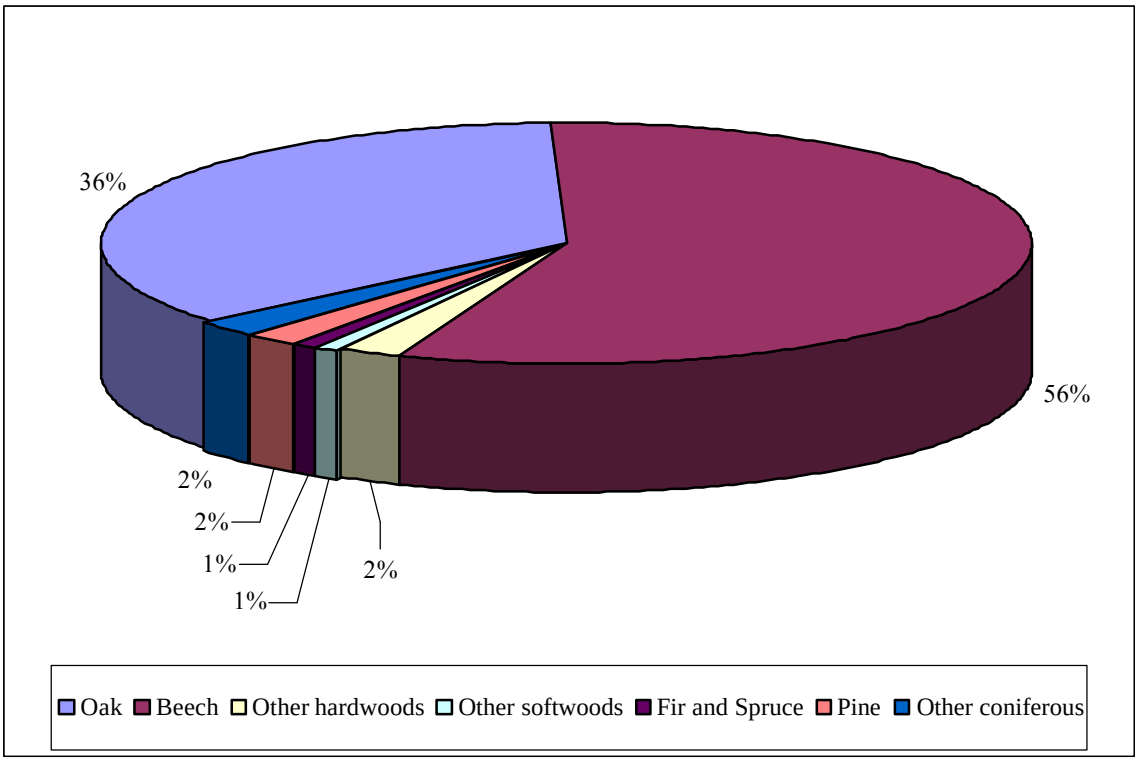


Figure 3. Composition of the timber harvest.

The deterioration of the security situation during the course of 2001 and 2002 contributed to a significant increase in illegal timber cutting, which had been a large scale problem for quite some time before then. This refers particularly to the region of the Shar Planina mountain group, but the situation is little better in other regions (e.g., Kumanovo, Skopye, Struga, Resen, Bitola and others). At the present time, it would be difficult to make an accurate assessment of the actual magnitude of illegal harvesting, but it is assumed to be ongoing at the same intensity. According to informal worst-case assessments, it is possible that illegal cutting is greater than the legal timber harvest, to the point that the overall situation with forest reserves could qualify as alarming.

4.2.1.3. Horticulture

Traditionally, wild species of flowers, as well as decorative plants, are grown in home gardens. A small percentage are collected and sold in local markets, such as: *Buxus sempervirens*, *Colhicum autumnale*, *Crocus* spp., *Cyclamen hederifolium*, *Galanthus nivalis*, *Geranium* spp., *Helleborus odorus*, *Narcisus poeticus*, *Primula* spp., *Syringa vulgaris*, *Viola* spp. etc.

4.2.1.4. Medicinal use

There are approximately 3,500 vascular plant species in Macedonia, of which 700 have medicinal properties, but only 120 species are utilised. Most of these plants are herbaceous, a small portion are shrubby and the fewest, woody. Their qualitative and quantitative distributions within the Republic have not been fully determined (i.e., a chorographic atlas of the medicinal plants has yet to be published). Available data do not reflect the current situation with medicinal plants, due to a lack of legal regulations on their collection, use, care, conservation, trade and export. The data, although insufficient,

do indicate an alarming situation, demonstrated in the maximum annual quantities of medicinal plant material exported in the last decade: *Altahea officinalis* (80 tonnes), *Chamomilla recutita* (75 tonnes), *Gentina lutea* and *G. punctata* (3-4 tonnes), *Hypericum perforatum* (5,000 tonnes), *Lichenes* (1,200 tonnes) and *Tilia cordata* (60 tonnes).

Annex 6, Table 6 lists the medicinal plant species used in Macedonia. The collection and use of medicinal plants can be divided into three categories: personal use, retail/wholesale trade and other economic purposes. A mechanism for regulation and classification is necessary before it can be determined how much dry plant material an individual can collect from an area and before a permit for this collection can be issued.

The collection of medicinal plants for economic purposes in Macedonia varies widely with the species collected, the collectors themselves and the seasonal quantity of the collected material. Most serious is the large seasonal demand by foreign buyers for specific plant species, facilitated by certain local trade companies which have no previous experience in this field. According to the nature of the plant material used (e.g., root, fruit, leaf, flower or stem), the greatest risks and threats are for those plants which are used whole, followed by those whose roots are collected and then those with useful bark. Species with a restricted area of distribution are most threatened (e.g., *Acorus calamus, Salvia officinalis* and *Sideritis scardica*). Based on data from the past ten years, the most troubling situations are with the species: *Adonis vernalis, Colchicum autumnale, Herniaria glabra, H. hirsuta, Gentiana lutea, G. punctata, Hypericum perforatum, Lichenes*, various species within the genera of the family *Orchidaceae*, whose parts are used in the production of salep, *Sideritis scardica, S. raeserii* and *Thymus* spp.

4.2.1.5. Other uses, including species used in foreign trade

Wild species are sometimes used in the cosmetics, alcohol and construction industries. Lichens and mosses, used in the cosmetics industry, are collected in the eastern and western mountains of Macedonia and then exported (the annual purchase reaches 600-800 tonnes dry weight; the exported amount in 2001 was 83,334 kg, valued at $79,624). Essential oils are extracted from cones, needles or seeds of Pine and other plant species. For the production of gin, the alcohol industry uses the berries (mainly the blue ones) of the juniper bush. The exported amount in 2001 was 991,067 kg, valued at $758,463. The annual purchase of juniper berries by various organisations is 3-4,000 tonnes. Reeds, Cattails and Willows are used in construction, either dried, woven, as thatch or in handicraft products. They are mainly collected on the lakes (Ohrid, Prespa, Doyran), however this activity is on the decline.

4.2.2. Use of wild animals

4.2.2.1. Hunting

Hunting is conducted through hunting associations combined under the Hunting Union of Macedonia. The largest portion of the land licensed for hunting consists of forests and forested areas. Protective measures for the care of forests and of game often do not agree. There is a need to coordinate these measures within the two sectors.

With the *Law on Hunting*, 127 species of game were given special consideration:

Table 27. Species of game given special consideration under the Law on Hunting.

Level of Protection	Number of Species	Fur-bearing Animals	Birds
Permanently protected	79	9	70
With a closed season	31	6	25
Without protection	17	9	8
Total	127	24	103

Macedonia is divided into 11 areas managed for hunting, with 107 hunting sites for large game (47% of the total area, excluding lakes) and 145 hunting sites for small game (49% of the area). The hunting sites are managed by hunting associations and organisations working in the field of forestry. The total number of organised hunters is about 30,000.

In addition, five enclosed areas totalling 4,041 ha have been established for the breeding of large game and one pheasant farm with a yearly production capacity of 40,000 two-month old pheasants.

Table 28. Optimal and current numbers of game species in Macedonia (excluding national parks).

Species of Game	Optimal Number	Current Status		Difference (+/-)
		Number	%	
Mammals				
Alpine chamois *(Rupicapra rupicapra)*	4,309	700	16.2	-3,609
Brown bear *(Ursus arctos)*	250	60	24.1	- 190
Brown hare *(Lepus europaeus)*	189,000	38,000	20.1	- 151,000
Red deer *(Cervus elaphus)*	3,018	200	6.6	-2,818
Roe deer *(Capreolus capreolus)*	43,484	5,400	12.4	-38,084
Wild boar *(Sus scrofa)*	14,032	3,600	25.6	-10,432
Birds				
Common partridge *(Perdix perdix)*	239,200	34,000	14.2	- 205,000
Common pheasant *(Phasianus colchicus)*	42,000	10,000	25.4	- 32,000
Rock partridge *(Alectoris graeca)*	58,800	9,000	15.3	- 49,800

4.2.2.2. Fishing

Fishing is allowed on all natural lakes, reservoirs and rivers, and includes both commercial and sport fishing. Fish species that are important in commercial fishing are:

Ohrid Lake: *Anguilla anguilla*, *Alburnus alburnus, Salmo letnica*. The greatest percentage of the total annual catch is from these three species. In the past, the annual catch in Ohrid Lake was 220-240 tonnes of fish, 50% of which was trout. At present, this quantity is considerably less (under 100 tonnes). The trout catch has declined markedly from the periods when over 140 tonnes of trout were caught annually to the present catch of only 35 tonnes.

Prespa Lake: *Alburnus belvica* and *Cyprinus carpio*. The annual catch of fish in Prespa Lake is 100 tonnes.

Doyran Lake: *Alburnus alburnus, Cyprinus carpio, Perca fluviatilis, Rutilus rutilus,* and *Scardinius erithrophthalmus*. Traditionally, these species amount to 98% of the total fish catch. While the annual catch in Doyran Lake was formerly over 500 tonnes, it

currently ranges from 70-90 tonnes/year. The major component of the catch today is *Carassius carassius*, with *P. fluviatilis* and *C. carpio* representing minor constituents.

Concerning the fish catch in reservoirs, there are no valid statistical data. There are estimates that over 200 tonnes/year of fish are caught from Tikvesh Lake only, mostly *R. rutilus*, followed by, in decreasing order, Carp, Catfish**,** Bleak, Perch and Nase.

With respect to sport fishing, in addition to those species listed previously under commercial fishing, important species also include: *Barbus barbus* (Barbel), *B. meridionalis* (Mediterranean barbel), *Chondrostoma nasus* (Nase), *Gobio gobio* (Gudgeon), *Leuciscus cephalus* (Chub), *L. delineatus* (Moderlieschen), *Silurus glanis* (European catfish), *Salmo trutta* (Brown trout), and *Vimba melanops* (Balkan vimba).

Again, there are no relevant data on the total fish catch by sports anglers. Occurrences of illegal fishing and the use of prohibited fishing gear (including certain types of nets, chemicals and explosives) cause grave concern.

Using the basic data on the number of water bodies (natural lakes, reservoirs and rivers) and their areas, estimates are that the annual fish catch in the Republic of Macedonia ranges from 800 to 1,200 tonnes; however, a major portion of the catch is not recorded.

4.2.2.3. Collection for medicinal use

In comparison with plants, the collection of animals for medicinal uses is rather inconsiderable.

Until 1990, there was organised collection of the Medical leech (*Hirudo medicinalis*) and the Nose-horned Viper (*Vipera ammodytes*), whose venom was used in the preparation of the serum, antiviperinum. Today, such activities have been discontinued.

In traditional folk medicine, the Spur-thighed tortoise (*Testudo graeca*), Hermann's tortoise (*T. hermanni*) and the 23 species of bats (*Chiroptera*) are still used. The collection of these species does not appear to have reduced their populations, however.

On the mountain Yakupitsa (central Macedonia) at the site, "Begovo Pole Plain," the restricted population of the Macedonian endemic subspecies of the European souslik (*Spermophilus citellus karamani*) may be found. The Macedonian common name of this subspecies (Stobolka) is related to its use in traditional medicine, that is, it was believed to be able to cure 100 aches (sto bolki). Although the collection of European souslik has declined in recent decades, it does still occur, directly threatening the survival of this Macedonian endemic subspecies.

4.2.2.4. Other uses, including species used in foreign trade

Other animals used primarily as foreign trade items consist of several snails. Two of these are particularly important:

- The Edible (French) snail, *Helix pomatia*, the collection of which is forbidden according to the international Bern Convention. In addition, in compliance with IUCN, it belongs to the category of "vulnerable species." In Macedonia, this snail lives in fragmented areas of small populations. It can be found in eastern Macedonia (Osogovo, Maleshevo mountains and Kozyak), and also on the Kozhuf and Shar Planina Mountains in the west. The fact that this species is listed as a purchasable species but has a reduced population makes it very likely that its future collection and purchase will be prohibited in order to rebuild the populations.

- The Roman (Turk) snail (*Helix lucorum),* for which there was no purchase limit until recently, is present throughout Macedonia in valleys and low mountain regions (up to 1,200 m msl). Approximately 200 tonnes used to be purchased annually, but its numbers have declined due to the uncontrolled collection. This species has been recommended for protection and its collection, purchase and export regulated due to the drastic reduction of its populations. It is also planned that a temporary ban on its collection, purchase and export will be imposed every two years. During the alternate years when collection, purchase and export (1 June - 1 October) are allowed, a quota of 40,000 kg of whole live specimens, that is, 8,000 kg of processed meat, will be introduced. In 2001, 1,323,795 kg of whole snails (valued at $3,063,991) were exported from Macedonia.
- In addition to the Edible (French) snail, permanent protection will be provided to the following: the Common snail (*Helix vulgaris*), a south-Balkan endemic species present in a limited area south of Demir Kapiya; the Striped snail (*Cepaea vindobonensis*), a south- and east-European species found in the Skopye Valley, Ohrid-Prespa area, Shtip and Doyran region and the valley of the Vardar and Treska Rivers and the species *Helix figulina,* a south-Balkan endemic found in the region of Gevgeliya and Doyran.

4.2.3. Assessments of Sustainability

As previously discussed, brcause of excessive and uncontrolled exploitation of wild plant and animal species, there is a serious danger that many will disappear. Due to the importance of maintaining biological resources, there is a pressing need to adopt regulations concerning these species and to specify annual collection quotas. It is also necessary to introduce a register of trained collectors and a controlled on-site purchase point in order to keep daily records and to regulate purchased quantities. The concession for harvesting should be issued on a yearly basis and, as a condition of that issuance, a professional opinion by a scientific institution should be submitted attesting to the current status and reproductive capability of each species to be collected, an essential requirement to prevent any further reduction of populations in the area.

In addition, it is necessary to introduce a system of organic certification for the collected species, which will not only establish the real value of the product, but will also oblige users to exercise self-control, thus guaranteeing sustainable management of this activity.

4.3. Use of biodiversity for bio-technology and genetic extraction

Plant biotechnology is still in its infancy; therefore, Macedonian plant resources are not used in this manner.

The possibilities for using molecular biology and genetic engineering in the characterisation of biological diversity (of both domestic and wild animals) and in the selection process for producing new genetic varieties are continuously increasing. The use of sophisticated equipment during these analyses facilitates quick and accurate results.

In the Republic of Macedonia, biological diversity is not used in biotechnology or for genetic potential extraction, except in a few limited applications in livestock breeding.

4.4. Access to genetic resources

With regard to agricultural production, FAO, as an international organisation protecting the interests of the agriculture profession (among other areas), pays considerable attention to genetic diversity. Within the structure of the organisation, independent bodies exist which deal with plant and animal biological diversity (IPGRI – International Plant Genetic Resources Institute and DAD – Domestic Animal Diversity), an important factor for agricultural production. The Republic of Macedonia is a member of these organisations, which operate through working groups that form an information system under which each of the member countries is obliged to submit reports and provide:

- a basic characterisation of varieties and breeds;
- support for planning, identification, collection and use of biological diversity;
- suggestions, exchanges of experiences and facilitation of the interactive participation of all interested members in the process of genetic diversity maintenance;
- for the creation, maintenance and updating of genetic resource databases.

All relevant information is available through the publications of FAO via the internet (www.cegiar.org/ipgri and www.fao.org/dad-is).

The access to plant genetic resources stored in gene-banks is not legally regulated in the Republic of Macedonia. The collections in the gene-banks are freely available for exchanges with any other gene-bank. All one must do is make a request by ordinary letter, since such cases are generally arranged through personal contacts. Macedonian collections can not be found on the internet, nor are any portions of the databases present on other plant networks existing around the world. Consequently, they are unknown to the worldwide community unless someone has personal contact with some of the breeders in Macedonia. Since collections in gene-banks are free for exchange anywhere in the world, it is necessary to immediately prepare methodologies and documents in order to achieve that purpose. Furthermore, data in existing collections should be updated and placed in appropriate information systems, allowing them to become part of the international databases of specific plants. This will help increase the interest in the biological diversity found within Macedonia and eventually provide economic benefits arising from the profits generated by any commercial breeding company which uses Macedonian materials in the production of commercial varieties.

4.5. Indirect uses of biodiversity

Nature's great diversity has its own intrinsic value, which imposes a moral requirement upon humanity to evaluate biodiversity. This tenet gave rise to the movement at the end of the twentieth century (especially in the United States) called "deep ecology" (Tobias, M. ed. 1985. *Deep Ecology.* Avant Books: San Diego, CA, 285 pp.). Essentially, it means "all organisms are entitled to live."

The prevention, or at least reduction, of the continual loss of biodiversity, however, is linked to its exploitation and to political decisions. In order to help politicians in their decision-making, it is necessary to assign appropriate values to biodiversity, which is the objective of this section. In addition to direct, easily measurable values, biodiversity also has indirect values, without which the human community could not survive. Most of these values are not specific to Macedonia, but are universal.

Human society derives great benefits from the use of species in natural ecosystems. Nevertheless, the desire for these benefits must not be allowed to impact the sustainability and dynamic balance of these systems. The rational utilisation of natural resources (Sections 4.1. through 4.4.) directly depends on the stability of said ecosystems: forests, meadows, pastures, rivers, lakes etc. Each species in an ecosystem has its own place in the food web.

Plant communities (particularly forests) have a great influence on the modification of climate in the area where they develop. Living conditions for humans in the severely degraded habitats by the Vardar River are quite different by comparison to those in the surrounding forested areas.

The role of biodiversity in the maintenance of watersheds and in the protection against erosion is evident in Macedonia. Extremely degraded areas around the Vardar River and some of its tributaries suffer serious damage from erosion. The presence of forest cover in the watersheds of western Macedonia, among other factors, contributes to the greater capacities of the local springs in comparison to most of those in eastern Macedonia.

On a global level, photosynthesis by vegetation (especially forests) is the main process by which carbon from atmospheric CO_2 is encorporated into the living plant biomass. In this way, biodiversity represents a principal regulator of the level of CO_2 in the atmosphere and the cycle of carbon in the biosphere.

One of the most important unmeasurable indirect values of biodiversity is the relation of animals (particularly insects) to plants made possible through the process of pollination and dissemination of fruits (fishes, birds and mammals). In this way, the continuance of life for many plants is ensured, not only for wild species, but also for cultivated ones.

Beekeeping, to a large extent, is likewise indirectly affected by biodiversity, but these effects are also difficult to measure. Under conditions in Macedonia, the production of honey is a branch of the food industry and is directly dependant upon the biodiversity of nectar-producing plants. Keeping bees requires that bees collect nectar in natural habitats, with a complete dependence upon wild nectar-bearing plants.

The quality of the water used for water supplys and other everyday purposes depends directly upon microorganisms, Fungi, plants and animals. Many sectors of human activity (e.g., industry, mining, energy and traffic) depend upon biodiversity in some fashion. Many of life’s pleasures (e.g., aesthetics, recreation etc) are an indirect, but solid, reflection of biodiversity.

4.6. Economic values of biological resources

Biological resources have great economic value, chiefly due to their wide use as food for humans, but also in the production of fuel and as raw materials in industry. In Macedonia, however, the quantification of the economic values of biological resources is practically impossible due to a lack of specificity in official statistic data. Nevertheless, some of the relevant Ministries do provide an official economic evaluation of some characteristic groups of biological resources. For example, the economic value for agricultural production (one of several large-scale industries) will be the subject of discussion in a subsequent section.

4.7. Cultural or traditional values of biodiversity

Bio-resources hold an important place in the traditions and cultures of every country, which is inherently unchangeable in the local and lesser developed communities. It is essential to pay greater attention to biological diversity that is traditionally utilised, and to endeavour to create recognisable standards for quality, origin and certain other traits for specific products.

4.7.1. Wildlife and national cuisine

Wild animals have always been consumed by humans. In the past, the preparation of game for food was done strictly in accordance with the specific rituals of the time. Game was eaten mostly in areas with developed hunting. In specific periods and regions, eating the meat of both game and domesticated animals was forbidden because people believed that the souls of their dead ancestors resided in some animals. It was also believed that certain meats should not be eaten during days of fasting, that is, meat of taboo animals in the pre-Christian period.

In Macedonia, the wild birds most often eaten were Partridge, Pheasant, Collared doves and Sparrows. As for Mammals, Wild boar, Roe deer, Alpine chamois, hares, bears etc. were consumed.

4.7.2. Arts, folklore and music

Ethnographic and folkloric materials point to numerous beliefs in the supernatural powers of animals and plants by the Macedonian people. These include beliefs and images concerning the origins of certain animals, the formation of animal cults, rituals performed, relating to the cult animals etc. Snakes, bears, wolves and other wild and domesticated animals were the subjects of cultic rituals.

In Macedonian legends, one can encounter the motif of the bear originating from a human, that is, a girl. Animals were frequently the subjects of metaphors relating some positive or negative trait to the human character. Many songs, especially those related to feasts devoted to specific animals, attest to their good or bad traits.

The use of animals as symbols was a theme frequently used by artists. The deer symbolised light and victory, and was considered a defender and leader of the dead. For example, a deer standing at a watering place was a Christian symbol related to christening. It is found throughout Christian art – in floor mosaics, church decorations etc. Bears were addressed with many different names: grandmother, aunt, she, and in some regions, Menda. As characters and on masks, bears can be seen at the carnivals in Prilep, where the so-called “mechkari” (bear-tamers) have a performance during the celebration of “Prochka” (Forgiveness-Asking Day). Christian symbolism sometimes emphasised the bad traits of the bear. In art from the Middle Ages, the bear is represented as the incarnation of the devil, and the wolf was considered to be the devil’s creature, a true conquerer of bad demons. In folk stories, the wolf is represented as a stupid animal, personifying negative traits. The theme of marriage between a wolf and a girl is also frequent.

In folk art, costumes were decorated with stylised motifs of animals and plants, for example, snakes, wolves, birds, leaves, boughs etc. The snakelike “chiusteks” had apothropeic (intended to ward off evil) significance.

Many plants (mostly trees) or parts of animals (horns, teeth, skin and fur) were used in the production of handicraft products of practical and artistic value. The production of many instruments in folklore was closely related to biodiversity.

4.7.3. Spiritual values of biodiversity

4.7.3.1. The animal world

A great amount of archaeological and ethnological evidence shows that animals had a central place in the beliefs of hunters, with some of these ideas continuing to exist in modern society. The folk beliefs and customs which pay respect to animals are heterogeneous, and sometimes contradictory. Some animals, such as wolves, bears, snakes, some birds etc., were drawn in connection with religious beliefs. Later, with the formation of more complex religious concepts, they were considered as homes for their ancestors' spirits, the personification of demons, even later as incarnations or with attributes of pagan gods, that is, their successors – Christian saints. Due to the supernatural powers attributed to animals, people attached many prohibitions and taboos to them. A great number of the taboos and restrictions were mainly apothropeic. Only those animals living in the immediate proximity of humans were exempt, instead being considered as protectors of human, as was the case with the home snake.

There were also many prohibitions and restrictions against killing certain animal species. Such beliefs were founded on a fear of revenge or of further consequences. For example, it was believed that whoever killed a taboo animal would have one of his own close relatives killed. Also, when hunters would kill a wolf, they had to appease the animal by throwing a gun over the body and reciting the appropriate incantation. By doing this, the guilt of the killing would be transferred to the gun, and the skinning of the animal could then be done by a ritually clean man.

Some animals were not killed, not as a result of fear, but rather because they were considered to bring good luck, assistance and protection to the people and their surroundings. For example, the Fir tree was a symbol of happiness, the home snake a protector of the household and the family. It was believed that the protective function of some animals extended over a wide area, encompassing the whole village. Because of this, prohibitions against the killing of animals had to be observed by all inhabitants of the village.

With the development of religious concepts and images of gods, animals were worshipped because of their link to a god's power. Within Macedonia, the religious status of animals was related to certain persons and events from Christian mythology. Such animals were considered sacred, and killing them a sin which would bring certain sanctions, that is, God's punishment.

Another great monotheistic religion, Islam, has also influenced the prohibition against the killing of animals. For example, Muslem populations considered some animals to be sacred because they were related to characters from the Koran. Those animals were considered taboo. The Collared dove (gugutka) for example, which the Turks brought into Macedonia from the east, was not to be hurt or killed.

Within the yearly cycle of folk customs, there was a link between cultic activities and certain animal sacrifices. Examples of this include: (a) feasts devoted to the wolf were observed twice per year (11-17 November and 1-3 March), (b) the feast day of St. Andrea (30 November) honoured the bear and (c) the feast day of St. Jeremiah, a day of protection against snakes, celebrated the medicinal properties of the snake twice per year, on 22 March (40 Martyrs) and on Blagovets (another religious holiday).

Today, many traditions are still preserved. For example, when a house is built, a lamb is slaughtered and its head buried in the foundation, which is believed to bring peace and happiness to the house.

4.7.3.2. The plant world

Living in a natural environment, many rituals relating to the plant world, especially to certain trees, were developed. These rituals held an important place in religion, celebrating the revival of nature and its cyclic repetition. To some, trees represented a theophany, an image of the cosmos, a symbol of life or the centre of the world. The most frequent trees mentioned in folklore are the Oak, the Hazelnut, the Linden and sometimes the Pear. Sweet basil is also referenced because it was considered to be God's flower. In national tradition, the Maple is linked with ancestors and the cult of the dead. Because of this, churches are often built under these trees, believing that the boughs contain some beneficial properties.

Christianity modified the tree cult to a great extent, but did not destroy it. In national tradition, many different images, from animistic to Christian, are linked with various species of trees.

According to the beliefs of animism, any contact with a tree was considered to be contact with the anima (soul) which took up residence in it. For example, a tree with a specific size or shape might be the dwelling place of a soul or spirit. Such trees were therefore made taboo. Cutting a certain tree or bough meant that a spiritual force was injured and would seek revenge. It was also believed that various supernatural beings, for example, fairies etc., gathered around the larger trees.

The ban placed on cutting trees also included trees growing in cemeteries, which had the same function as a tombstone, that is, to bind the soul of the deceased person and protect the living. Muslems planted a Plum tree on the grave of a young girl because some considered the Plum tree to be a match for the wedding tree.

The belief in the Yule-tree, which was most often an Oak, was especially widespread, and was observed by collecting Yule-logs at the beginning of the calendar year and burning them on Christmas Eve. It was believed that this tree held a demon of the vegetation and, by burning it, one expected protection of the house and the people living in it, and happiness and fertility in the new year. Another tradition involved making a sacrifice to the tree whose branch was chopped for the wedding flag. Before the wedding of her son, a mother would address the tree and invite it to the wedding; the next day a chicken would be slaughtered near its roots. The Walnut tree symbolises a secret which is hidden, as is the kernel in its nutshell. It also represents fortune telling, fertility, strength and patience. During weddings, Walnuts were thrown when the bride entered into the new house. In Christianity, the Walnut is symbolic of man: the green husk is the human body, the hard shell – bones, and the kernel – the soul.

In other traditions, the Hazelnut tree symbolises fertility and love, the Dogwood, durability, strength and health and, at Gyurgyovden (a religious holiday), the doors were decorated with boughs of Acacia. On St. Triphon's Day (in February), vines are pruned. St. Triphon was thought to have started this custom, believing that it would make the coming year fertile. In some regions, this custom is still observed with great feasting and with numerous visitors.

The basic objective of the customs related to plants was the provision of good health for family members, the house and livestock. On Letnik Day (a religious holiday), the entire house was decorated with various types of vegetation in order to transfer the magic power from the plants to the people. There was also a custom where people hit each other with green boughs in order to win the power of the greenery for themselves.

4.7.4. Recreation and biodiversity

The relationship between recreation and biodiversity in ethnological terms is best represented through the outdoor walks of the young people (i.e., to specific places on certain holidays, performing certain rituals and having fun). This type of gathering usually takes place during the spring holidays of Letnik, Cvetnitsi and Gyurgyovden, when vegetation is reviving. Young people swing on tree swings, desiring to transmit the strength and rebirth of nature upon themselves. Swinging also has a prophylactic role, representing an efficient way of driving out evil spirits and diseases, as well as fertilisation and marriage functions for young girls.

Another kind of recreation, which has an economic function as well, is the collection of plants used for the preparation of teas and medicines. In recent times, biological diversity and the traditional practices of growing plant and animal species and preparing food from them, are widely used for recreational purposes. People often go to unpolluted places where they can get healthy food for weekends and holidays and, in this way, contribute to the development of rural and monastic tourism.

4.7.5. Other values

Wild animals have also been used in folk medicine. It was believed that snakes had special healing power on 22 March. The sick, and especially childless couples, would throw pieces of their clothing in front of a snake's burrow where it was expected to emerge. If the snake passed over the clothes three times, it could help them have children. Some parts of snakes' bodies were also worn as amulets. The eagle was hunted for the medicinal power of its fat against rheumatism. Bears were used for therapeutic purposes. A sick person would lie down and allow a bear to step on him to drive out pain. Fumigation with the burnt hair of a bear would also ease pain, or could release the demons from pregnant women.

There were many beliefs surrounding the healing power of certain trees. For example, a sick person was supposed to sleep under an Ash tree or Hawthorn, which both had therapeutic powers, and the fairies dwelling there at night would cure the person. It was also a practice to bathe people in water where Hawthorn boughs had previously been placed. In order to cure some diseases, people would leave towels, shirts, pieces of clothing, scarves or money under medicinal trees.

5. KEY ECONOMIC SECTORS AFFECTING BIODIVERSITY

5.1. Agriculture

5.1.1. Current status and economic importance of the sector

Agriculture (together with hunting and forestry) has been providing a relatively stable contribution to the GDP (by method of production) of about 11% over the course of the last several years (or, more precisely, 10.9% in 1997, 11.4% in 1998 and 11.0% in 1999). During this same period, capital expenditures have experienced relatively high fluctuations (excluding the private sector, and including social [worker-owned], co-operative, mixed and State-owned sectors). Thus, compared to 436,182,000 denars in 1997, capital expenditures dropped to 251,899,000 denars in 1998, but increased to 341,825,000 denars in 1999 (these amounts have not been adjusted for inflation; however, there was a low level of inflation during the subject period).

The total area of agricultural production has noted a declining trend (which is the main indicator of non-sustainable and inefficient utilisation). Thus, from 1,291,000 ha in 1996 (Table 6), the area of production fell to 1,236,000 ha in 2000. This same trend can be seen in arable land, which fell from 658,000 ha (1996) to 598,000 ha (2000). Arable land area typically completely covers valley relief. In the case of pastures, which comprise the remaining areas of agricultural production, an opposite or increasing trend has been observed, from 632,000 ha (1996) to 636,000 ha (2000). About one third of this area is of the mountain or high mountain-type, while the remaining two-thirds is situated in the hilly areas of the valleys.

Soil types in Macedonia are divided into seven classes by their quality (although this process has not yet been finalised). About 290,000 ha have been classified under the most fertile classes I and II, about 450,000 ha belong to class III, 200,000 ha to class IV, and the remainder to classes V, VI and VII (these are mainly mountainous soils not suitable for cultivation).

The current state of agriculture is burdened with many problems: agrarian overpopulation in the lowlands and the need for deagrarianisation, fragmentation of agricultural areas and the need for their more effective use, poor quality of equipment and the need for modernisation and the degradation of soils.

Deagrarianisation in Macedonia has been conducted in a spontaneous, disorganised, premature and excessive manner. Because of this, the portion of the total population working in agriculture decreased from 22% (according to the 1981 census) to 14.7% in 1991, and 11.8% in 1994.

In addition to the decrease in agricultural workers, there are also problems with the increased numbers of private agricultural enterprises in combination with the fragmentation of agricultural lands and the need for their more effective utilisation. Specifically, in Macedonia there has been a steadily decreasing trend in the average quantity of land owned per household, from 2.04 ha in 1980, to 1.29 ha in 1994. Additionally, the properties are fragmented into relatively high numbers of lots per household (7.7 on average), with the average size of one being 0.14 ha. Current legislation (the *Law on Inheritance*) is attempting to solve this problem.

From an economic viewpoint, the poor quality of equipment and infrasctucture is the next relevant problem in the field of agriculture. This is one of the main reasons for the increasing dependence on natural weather and land conditions. Due to an insufficient number of artificial reservoirs for irrigation use, droughts are causing serious problems which are preventing the full realisation of the country's agricultural potential, and thus

leading to yearly fluctuations in production. Irrigation systems constructed so far cover around 126,600 ha, but only 50-70% of the area is actually irrigated. The inadequate use of agro-technical measures, as well as antiquated agricultural equipment, are additional problems. According to some estimates, the average age of tractors in Macedonia in 2000 (a total of 61,063, according to the *Statistical Yearbook of the Republic of Macedonia*, p. 430) was about 15-20 years, and the extent of their utilisation was around 80-90%. Combines are also generally outdated. Although their useful life is customarily considered to be six years, in Macedonia in 2000, only 25% of the total number of combines in use were under 6 years old; 45% had been in operation from six to 15 years, and 30% for longer than 15 years.

5.1.2. Changes in the sector over time

Over the course of the past decade of transition, the agricultural sector has faced many problems as a result of the inadequate policies which were applied by the former Yugoslavian economic system. In general, this sector entered the transition period already lagging behind, not only with regard to needs, but also with regard to possibilities. Thus, it was not even able to meet the demands of the food industry.

The most significant progress over the course of the past decade has been made in privatisation of the socially owned and cooperative sector and the associated denationalisation of land, that is, the return of agricultural areas to their former owners. The land was taken during agrarian reforms in 1945 and nationalisation in 1953. One of the key measures included in the *Law on Privatisation in Agriculture* refers to the possibility of the further expansion of the private sector through the release of an additional 15% of agricultural land possessed by agricultural cooperatives. This land would be transferred to individual farmers to cultivate and use under lease, but for a long term (e.g., for perennial crops).

Beginning with the reforms in 1988/89 and continuing to the present, under the framework of the Socialist Federal Republic of Yugoslavia, the practice of State price controls has been abandoned. Prices are allowed to fluctuate freely, being driven by the market. At the end of 2000, for social reasons, the State did set the price of Type 500 flour, as well as the price of bread produced from the flour, but the measure was subsequently abolished. Today, the State has control of only the prices of wheat and tobacco.

The needs of the agricultural sector in the coming years can be summarised as follows: more astute and more efficient utilisation of agricultural lands, modernisation of production processes in agriculture, incentives to encourage investment in agriculture (in particular, identification of possibilities for increased credit for private farmers), incentives related to the export of agricultural products, more efficient operation of vocational services which support agriculture etc.

5.1.3 Impact on biodiversity

Agriculture is a sector posing a severe threat to the biological diversity of the Republic of Macedonia, especially due to the current unfavourable conditions and negative development trends. The impact of agriculture on biological diversity is described in more detail in Sections 3.5.3.3., 3.6.1. and 3.6.3. No assessment is available as to how the processes of denationalisation and privatisation might affect biological diversity in the Republic of Macedonia.

5.2. Forestry and lumber industry

5.2.1. Current status and economic importance of the sector

Forestry is a sector that has been neglected for a long period and inadequately treated by the economic policy makers. Such a poliy is based upon its limited contribution to the GDP. This may be further evidenced by the fact that, in the official statistical methodology, forestry is combined with agriculture, making it impossible to glean explicit information on its sole contribution to the GDP. It is possible, however, to draw certain conclusions regarding the capital expenditures made in this sector over the course of the last several years. An analysis of the magnitude of investments in the forestry sector confirms its low significance. More specifically, in 1997 the modest share forestry received out of the total sum of capital expenditures in the Macedonian economy was only 0.9%. It decreased in subsequent years to 0.4% in 1999 (Source: *Statistical Yearbook of the Republic of Macedonia* 2001, State Statistical Office, Skopje, p.397).

Forests in the Republic of Macedonia cover 950,594 ha, representing 37% of its land area. By growth form, high forests constitute less than 30% of the total forest cover, while low forests account for 70%. As a result, only one-third of the forests are considered to be suitable as a source for raw materials for the lumber industry. Some of the data indicate that wood reserves are quite insignificant (slightly above 82 m^3/ha), and are characterised by an exceptionally low annual growth rate (slightly above 2 m^3/ha).

Deciduous species, both in pure and mixed tree stands, dominate the total reserves of wood. The ratio among reserves of deciduous to coniferous trees in pure stands is 94 to 6, with the predominant constituents consisting of Beech and Oak versus Fir and Pine, respectively. Consequently, within the structure of Macedonian forests, wood reserves with low market and economic value predominate (in comparison with coniferous species, which yield high-value commercial timber).

Over the course of the last 10 years, the average gross volume of timber harvested has totalled 1,033,000 m^3, of which 76% (786,000 m^3) originated from State-owned forests and 24% (247,000 m^3) from private ones. Statistical data on the timber harvested from private forests are not available. At present, it is not possible to make a satisfactory estimate of the tree harvest, nor is it possible to estimate the level of utilisation of harvesting equipment.

Usage, by category, of timber harvested from State-owned forests has been economically inefficient for a long period of time. Fuelwood is the predominant use, with a share of more than 75% of the total volume of harvested timber. Wood intended for industrial processing, that is, sawing for lumber, constitutes less than 20%. Inefficient economic utilisation is evidenced by the fact that the highest and best usage of logs, for veneer, either does not occur or exists only in negligible quantities. This inefficient usage of harvested timber by category is also seen in the trade sphere, where fuelwood possesses the highest share (an average of about 80% during a 10-year period), to the detriment of lumber and veneer production. It is characteristic that both the total quantity of harvested timber and the amounts represented by each individual category show a decreasing trend.

Of approximately 7,300 km of forest roads (as of 1999), 84% are unimproved, with as few as 16% possessing hard surfaces. Construction of forest roads has noted an increasing trend. The quality of the mechanised equipment used for the sawing and transportation of lumber is good, but it can not keep up with the demand.

Of the total available quantity of logs intended for the lumber industry, approximately two-thirds are sawn into lumber. Of these, on the average 75% originate

from deciduous species and 25% from evergreen species. It should be noted that the percentage of logs from deciduous trees is generally decreasing in comparison with logs from coniferous trees.

Capital expenditures made in the general lumber industry and in the finished wood products sector are satisfactory in technical structure. The amount of investment in equipment is proportionally higher, but still needs to be increased within the areas of sawn timber and plywood (i.e., increasing investments in favour of equipment instead of constructed facilities).

Foreign trade within the lumber industry has been experiencing an increasing trend. This industry has noted a much higher increase in imports compared with exports, which have also increased, but at a much lower rate. Finished goods constitute 67% of total lumber industry exports and 55% of imports. The total external trade balance within the lumber industry was positive until 1995 but, since 1996, has reversed (i.e., imports are now much higher than the exports).

The lumber industry share of the GDP of the Republic of Macedonia is very low – 0.3%.

5.2.2. Changes in the sector over time

Usage of forests during the period of transition has not experienced any dramatic changes, although the manner of management has undergone a transformation (a public company for forest management was established). Although the name has been changed, the same former enterprises have essentially remained in place, controlling the same forest areas and using the same forest management planning.

Following the trend of the general economy, the lumber industry in the Republic of Macedonia has passed through a phase of privatising State-owned enterprises. The trend toward the establishment of new enterprises, however, has been much more prominent. By 1998, there were a total of 1,263 registered enterprises within the lumber industry, compared to 72 in 1989 (a more than 17-fold increase). In 1998, the number of enterprises engaged in the sawing of timber and the production of plywood was 235 or 18.6%, while the number producing finished wood products was 1,028, or 81.4%.

Regarding production facilities, plants for the sawing of timber (i.e., sawmills) are predominant; establishments producing veneer and plywood are represented by only one or two facilities each. The majority of enterprises for finished wood products produce various types of furniture, with only a minor number being registered for the production of parquet, cardboard and paper wrapping material or houses and sheds.

The average number of employees in the lumber industry has noted a decreasing trend in recent years. Such trends are also seen in specific areas, such as in the production of lumber and plywood and in the production of finished wood products. Of the total number of employees in the lumber industry, on the average employees engaged in lumber and plywood production account for 20%, while those involved in the manufacture of finished wood products comprise 80%.

Based upon an analysis of the number of employees per individual enterprise, prior to 1992, the lumber industry consisted primarily of medium-sized enterprises (i.e., between 51 and 250 employees). From 1992 onward, they were transformed into small enterprises (up to and including 50 employees). Today, the so-called micro-enterprises (i.e., 10 or less employees) are becoming more and more dominant within the Republic of Macedonia.

All types of wood production, including sawn materials, furniture, veneer, parquet, cardboard, paper wrapping material etc., have experienced a decrease during the transitional period, despite the increasing trend in the actual number of enterprises.

5.2.3. Impact on biodiversity

The impact of forestry activities on biodiversity is manifested within forest ecosystems. Impacts from forest roads (erosion), over-harvesting, and ecosystem-wide changes in nutrient cycling resulting from the huge quantities of biomass (i.e., waste) left behind after harvesting differ in each different forest ecosystem. This can vary both with soil moisture and temperature factors, as well as with local relief and the manner of harvesting. Changes occurring in indigenous forest types which result from the introduction of alien tree species or the change in natural vegetation caused by the planting of inappropriate species (Black pine most frequently) are of particular relevance. Detailed descriptions of the impacts of forestry on biodiversity are contained in Sections 3.5.3.3., 3.6.1., 3.6.3. and 3.6.7.

5.3. Fisheries

5.3.1. Current status and economic importance of the sector

There is no published data on the total income from the fishery industry in the Republic of Macedonia. According to official statistical data, the consumption of fish in the Republic of Macedonia amounts to around 7,500-8,000 tonnes/year, or consumption of 3.4-3.7 kg per capita. Officially, domestic production meets only 13.2-13.5% of the total annual demand; however, in practice, 25-30% is a more realistic value (according to findings by M. Naumovski).

Multi-year development plans for fisheries envisaged a production of 2,500 tonnes in 1995 and 3,000 tonnes in 2,000, that is, 5,000 tonnes by 2005. The current political and economic circumstances within the country and region have had an adverse impact on fisheries and on the implementation of adopted plans, however. Total fish production in 1999 was about 420 tonnes (249.3 tonnes of trout, 138 tonnes of carp and 30.3 tonnes of other species). Unfortunately, this is less than half of the fish production recorded for 1990, when total production amounted to 1,000 tonnes.

Macedonia exports between 10 and 37 tonnes of fish annually, mainly eel and trout, generating a profit of several hundred thousand dollars per year. Many more fish are imported than exported, however, especially elvers (young eels) for stocking in Ohrid Lake.

5.3.2. Changes in the sector over time

The general assessment of changes to fishing in open water bodies within Macedonia is negative. Drastic reductions in the annual fish catch in the three natural lakes have been noted, particularly in Doyran Lake due to degraded hydrological conditions.

Doyran Lake, recorded in world scientific literature as one of the most productive lakes in Europe, used to have an average annual fish production of 180 kg/ha (regarding the annual catch, see Section 4.2.2.2.). In the past, it played an important role in supplying the population with fish, an integral part of the fishing economy of the country. Its average annual catch represented 50% of the total production of fish in Macedonia (prior to the beginning of more intensive construction of artificial fishponds). Today, the disastrous status of fish stocks can be seen in the statistical data on total

fishing within the lake (Section 4.2.2.2.). Again, the main reason for the drastic reduction in fish stocks is the catastrophic hydrological condition of the lake.

Conversely, the intensive culture of fish in artificial fishponds is recording a steady increase. The captive raising of fish in systems of cages in several reservoirs throughout the country is also becoming more and more significant.

5.3.3. Impact on biodiversity

Fishing, both commercially and for sport, is the main manner for utilising the fish stocks of aquatic ecosystems. Planned and organised fishing does not significantly adversely impact biodiversity. The current trend of intensive, uncontrolled fishing, however, does impact fish populations and leads to an unbalanced ecosystem by reducing the populations of one fish species while favouring others.

A reduction in the numbers of Perch (*Perca fluviatilis*), which are sensitive to changes in the oxygen regime, and increases in the numbers of Crucian carp (*Carassius carassius*), which previously had never been a very important part of the lake's ichthyofauna, have been observed in Doyran Lake.

Despite protective measures, the overutilisation of fish resources in Ohrid Lake is increasing, which is also evident in the statistical data on fishing from the last several years. Ohrid trout (*Salmo letnica* – in the statistical data, all taxa are represented under this name) is under particular threat as its populations become scarcer and scarcer. As smaller size classes become more dominant within fishing areas, it is indicative that the fishing intensity has exceeded the optimum limit. It has been noted that the average catch weight has dropped from 700 g to 250-300 g, an alarming decrease.

Struga trout (*Salmo balcanicus*) have also been experiencing a trend of steadily reduced catches, especially after the diversion of the Sateska River into Ohrid Lake and the completion of hydro-technical works on the Crni Drim River. It is obvious that the negative trend is not due to fishing alone. By 1993, the average catch of trout in the vicinity of Struga was 25-28 tonnes; however, the catch has decreased significantly since 1994 (5.2 tonnes) and continues to decrease (1995 – 5.1 tonnes, 1996 – 4.2 tonnes, 1997 – 1.0 tonne).

The status of fish biodiversity in rivers is significant for several reasons. A drastic drop in the density of the populations of certain species has been recorded; other species that used to be integral parts of the ichthyofauna of some watercourses can no longer be found and there has been a change in the horizontal distribution of species. In addition, the unplanned and uncontrolled stocking of open water bodies with fish will lead to changes in fish populations. Through such methods, exotic species are now present in the open water resources of Macedonia, introduced without any justification, either by error or as a result of ignorance. Their presence is unwelcome and, to a certain degree, harmful.

Intensive artificial fish culture can lead to other problems from an ecological point of view. Some of these problems are related to watercourses becoming burdened with substantial quantities of organic matter, creating a significant trend for the accelerated eutrophication of reservoirs where cage farms are located. Impacts of this kind lead to changes in the structure of the ichthyofauna of these water resources.

The overstocking of artificial reservoirs can lead to drastic changes in the composition of the Algal flora. This situation can be seen in the reservoirs of Mavrovitsa, Strezhevo and Turiya, where Carp breeding (*Ciprinus carpio*) brought about

blooms of Blue-green algae (*Anabaena planctonica, Aphanizomenon flos-aquae, Microcistis aeruginosa).*

5.4. Industry

5.4.1. Current status and economic importance of the sector

In terms of its contribution to the Macedonian GDP, industry still occupies the leading position in the Macedonian economy, despite the fact that, from the beginning of the process of transition, industry's average share has been declining. According to the new classification system of activities and sectors, light manufacturing is particularly noteworthy in this context. It is interesting that, during the last years of the past decade, industry contributed about 18% to the Macedonian GDP (18.9% in 1997, 18.1% in 1998, and 17.6% in 1999 – according to the *Statistical Yearbook of the Republic of Macedonia* 2001, State Statistical Office, Skopje, p. 314-315.). Capital expenditures in industry also tend to maintain rather stable levels compared with total investments in the Macedonian economy as a whole. The percent share was 39.4% in 1997, 40.9% in 1998, and 35% in 1999 (Ibid., p. 396 – refers to social [worker-owned], cooperative, mixed and State-owned sectors). This provides evidence that, despite the problems faced by industry, its contribution to the Macedonian economy has remained relatively stable. Moreover, during last several years, modest signs of a gradual recovery from the transitional recession have been noted (e.g., the basic indices of production in industry). For example, in 1996, the basic index of production compared with 1990 (arbitrarily defined as 100) was only 49; however, in 2000 the index was 53 (Ibid., p. 485).

Some of the current problems faced by industry in Macedonia include: a disproportionate share by certain industries (traditional and raw materials related branches, which are characterised by low productivity, low levels of capital reserves, low revenues and exports and inadequate domestic raw material resources), lagging technical knowledge and technologies, a low level of modernisation and a high incidence of age-related equipment failure. These factors result in low productivity and over-employment, insufficient utilisation of facilities and poor export capability.

In reference to the existing industrial structure (i.e., the shares individual types of industries control among the industry as a whole - Figure 4), it can be concluded that several changes have occurred over the course of the last several years. In essence, production of raw materials and semi-finished products is still dominant (around one-third); however, over time, the shares of the tobacco industry; construction materials industry; chemical industry and the generation, transmission and distribution of energy have increased. The majority of other industrial sectors have declined, including nonferrous ore mining, the production of oil derivatives, the manufacture of metal products, the manufacture of transportation equipment, the electric and mechanical industries, production of finished wood products, textile and leather production, the food products industry etc.

5.4.2. Changes in the sector over time

In the early 1990s, with the independence of the Republic of Macedonia, the process of industry ownership restructuring was initiated. Unfortunately, at the same time Macedonia encountered drastically different economic conditions than were previously the case. At the beginning of the period of restructuring, many traditional markets in former Yugoslavia were lost. This was followed by the problems of economic and political blockades against the country. Those unfavourable conditions were further

exacerbated by the initiation of the privatisation process, resulting in decreased industrial productivity.

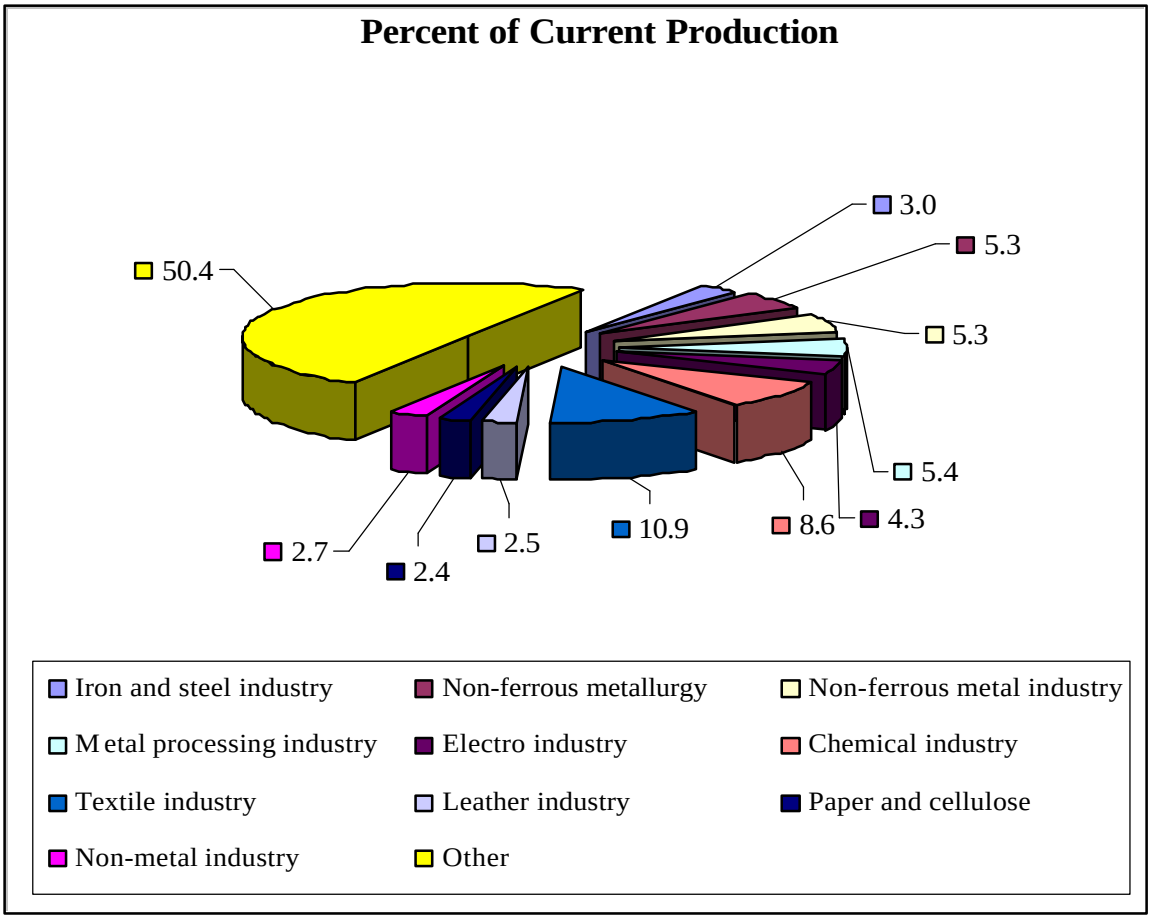


Figure 4. Share of individual industrial branches in current production (%).

The decline in the productivity of this sector reached -15%/year at the beginning of the last decade (or an average annual rate of decline of -13% during the period 1991-1995). More recently, the industry has experienced somewhat of a revitalising trend, that is, many years have seen positive growth (4.5% in 1996, 2.9% in 1997, 4.5% in 1998, -2.5% in 1999 and 5.0% in 2000).

5.4.3. Impact on biodiversity

The industrial sector of Macedonia contributes both direct and indirect adverse impacts to the environment (air, water and soil) and, thus, on biodiversity as well. Industry also significantly adversely affects humans due to its geographical distribution, old technology, failure to apply technical and technological standards for the treatment of gaseous pollutants, poor management of effluents and wastes, use of toxic production materials and dirty energy resources, non-compliance with environmental codes etc.

Impacts of industry on biodiversity may be observed through:

- air pollution (full monitoring is under development). The highest emissions of air pollutants have been recorded in urban/industrial centres (Section 2.8.), supplemented by additional emissions from vehicular traffic. The most frequently

detected air pollutants include SO_x, NO_x, CO_x, CFCs, smoke and breathable dust (diameter of less than 10 μm) with high concentrations of heavy metals. Effects on biodiversity are directly noticeable through acidification and through changed relationships within animal food webs (Section 3.8.3.);

- water contamination (Section 3.8.3.1.);
- improper disposal of various types of solid waste (often toxic);
- contamination of soil.

5.5. Construction

5.5.1. and 5.5.2. Current status and economic importance of the sector and changes in the sector over time

Construction is a significant sector, holding a specific position in Macedonia. In terms of available capacity, it exceeds the market within the country. This situation was inherited from former Yugoslavia, where the construction sector served as an absorber of under-qualified labour (originating from rural areas) which were unable to find employment in industry. This was particularly seen in the early 1980s, with the outbreak of the economic crisis in other sectors. As a result, a large number of construction companies were established in Macedonia using low-paid labour, which enabled them to acquire a competitive advantage and receive significant tenders, especially in the markets of former socialist countries. Unfortunately, the initiation of the process of transition brought about the loss of these markets.

The construction sector in Macedonia has undergone a great upheaval during the last several years. Its contribution to the generation of domestic macroeconomic aggregate variables has exhibited a decreasing trend, from 10.4% in 1980 to 4.6% in 1990. A minor improvement was recorded in 1995 (7.3%), when the first modest signals of a Macedonian economic recovery appeared; however, in the course of the next two to three years, its contribution to the GDP had stabilised at about 5% (5.3% in 1997, 5.8% in 1998 and 5.2% in 1999) (*Statistical Yearbook of the Republic of Macedonia* 1999, p. 209, and *Statistical Yearbook of the Republic of Macedonia* 2001, p. 314-315, State Statistical Office, Skopje).

Of interest is the trend in the number of firms engaged in construction activities. In the first half of the 1980s (corresponding to the commencement of the economic crisis in former Yugoslavia), the number of enterprises increased, accompanied by a slight reduction in the number of workers. These contradictory indicators provide evidence of the initial stages of the crisis faced by the construction sector. The trend toward a reduction in the labour force continued during the 1990s, actually accelerating, but stabilised by the end of the decade at about 35,000 employees.

This by no means indicates that over-employment has been eliminated but, rather, reflects the state of the uncompleted process of privatisation in former worker-owned construction companies. On the other hand, the growth in the number of companies in this sector is rather indicative (from 253 in 1990 to as many as 1,999 in 1997) (*Statistical Yearbook of the Republic of Macedonia* 1999, p. 436, State Statistical Office, Skopje). This is further supported by the registration records of the large number of small construction companies which were privately owned from the beginning, have a relatively low number of employees (i.e., they do not address the over-employment problem) and are extraordinary flexible.

5.5.3. Impact on biodiversity

The construction sector adversely affects biodiversity through: air pollution, new impacts to natural land areas, use of mechanisation, noise, pollution of aquatic ecosystems and soils (due to the disposal of waste materials from construction and demolition activities), destruction of habitats and their fragmentation and isolation. There are no specific data available on the extent of these impacts in the Republic of Macedonia.

5.6. Mining

5.6.1. and 5.6.2. Current status and economic importance of the sector and changes in the sector over time

There is no relevant economic information specific to the mining sector, because this sector is incorporated within the established category of metallurgy. In the Republic of Macedonia, this sector is represented by the extraction of both metals and non-metals. The mining of lead and zinc ore (eastern Macedonia), iron ore (central and western Macedonia), coal (south-western Macedonia) and non-metals, mainly marbles and travertines (central and north-eastern Macedonia), dolomites, lime, silicates, ceramic clay, feldspar, gypsum, diatomaceous earth etc. is of particular importance.

In the past, the non-metal industry contributed 2.2% of the economic structure of the country; however, since the establishment of the value-added tax (VAT) for industry and metallurgy, it now represents 2.7% of total current production.

5.6.3. Impact on biodiversity

The main activities causing negative impacts on biodiversity are excavation, the opening of new mines, and pollution caused by wastewater from the flotation process and from slag piles.

Effluent from the flotation process contaminates many downstream natural systems. For example, effluent reaching the river Zletovitsa continues downstream to the river Bregalnitsa which, in turn, flows into the Vardar River, polluting them all with heavy metals (lead, zinc, cadmium, mercury, thallium and arsenic) and causing enormous damage to these aquatic ecosystems (Sections 3.5.3.3., 3.6.1. and 3.6.3.).

In conjunction with the opening of a new mine, construction activities and new transportation infrastructure cause additional losses of biodiversity, most frequently by the fragmentation of un-relocatable communities.

5.7. Energy

5.7.1. and 5.7.2. Current status and economic importance of the sector and changes in the sector over time

The energy sector (together with gas and water supplies) participates with a modest 4.5% in the GDP of Macedonia. This percentage participation has been maintained during the second half of the 1990s. The share of capital expenditures in electricity is relatively high compared with overall investments in the social, cooperative, mixed and State-owned sectors. They constitute about one-fourth of total capital expenditures, indicating high investment efforts under restrictive conditions (26.1% in 1997, 26.4% in 1998 and 22.2% in 1999).

With regard to energy consumption, it is clear that the beginning of the transition process has brought about a decrease in consumption, due to the transitional recession through which the Macedonian economy has been passing. This trend was particularly notable during the first half of the 1990s, that is, up to 1995/96. In contrast, if the issue is

observed from the perspective of the period that followed, it is obvious that the situation is extremely troubling. The expected exit from the transition period should be marked with increased energy consumption, not only in business and industry, but also by private household consumers. Instead, the current status is markedly unfavourable. Any comparison of Macedonia's GDP with that of other countries, not to mention average salaries, the average price of electricity and specific consumption of individual types of energy, will confirm Macedonia's disadvantageous position.

Based upon these factors, fundamental changes (decreases) in consumption are necessary. Otherwise, non-sustainable exploitation of energy resources may take place, as well as degradation of the energy infrastructure.

The most important domestic energy resources available for use in the future are coal reserves (for the next 10-15 years), fuelwood, hydropower and geothermal energy. It is necessary to decrease the consumption of fuelwood, accompanied by a gradual increase in the areas of solar energy, wind power, biomass etc. This is certainly related to the status of the payment balance that would either provide for or prevent the importation of adequate technologies for utilisation of these types of energy.

5.7.3. Impact on biodiversity:

This sector impacts biodiversity through electricity generation, transportation and distribution (the description of impacts to biodiversity is the same as the one presented for industry [Section 5.4.3.]).

Energy generation leads to air, water and soil pollution. Air pollution is caused by the emissions of SO_x, CO_x, NO_x, smoke and dust and, according to production capacities, is highest at the coal-fired Bitola and Oslomey Mining Energy Companies. Electricity transportation requires construction activities (a detailed description is presented in Sections 3.7.3.3., 3.8.1. and 3.8.3.). Spatial distribution of long-distance aerial power lines (Section 2.5.) is the main reason for changes in the status of biodiversity.

The effects from wastewater generated by production processes for energy generation are similar to those from the industry sector. However, the thermal impacts to those habitats receiving the heated effluent wastewater are specific to this sector.

Slag piles occupy natural habitats, increase the concentration of dust in the atmosphere and impact the quality of groundwater resources through changes in pH and increases in the concentrations of heavy metals.

The effects from the construction of hydropower reservoirs in river gorges are presented in more detail in Sections 3.7.3.3. and 3.8.1.

5.8. Transport (traffic)

5.8.1. Current status and economic importance of the sector

The transportation sector of the Republic of Macedonia is undergoing changes similar to those present in the overall Macedonian economy, that is, lagging behind the current trends seen in other countries. In general, it can be stated that the existing transportation and communication systems (i.e., the so-called tracom system**)** in the Republic of Macedonia are not yet fully developed. One of this system's most serious problems is its lack of modernisation. Excluding Albania, the Republic of Macedonia probably has the oldest transportation network in the Balkans (except for the road network), with a relatively low density of roads, railways and airports. This is due to a lack of investment in the development and maintenance of transportation facilities over

the past several years. It has resulted in the current insufficient level of development and a lack of modern technical knowledge and technologies. A comparison of data on the levels of railway development from 1937 and 1996 shows that progress was actually greater in 1937, indicating a 50-year period of stagnation. In 1937, Macedonian railways were in full compliance with the European regulations of that time concerning stability and speed of transportation, which is not currently case. The outdated technology used by the railways reduces, to a great extent, their stability and speed of the transport.

Another major problem faced by the transportation sector is its configuration, that is, the routes of the main transportation lines. Due to Macedonia's multi-decade existence within the confines of a wider community (the former Socialist Federal Republic of Yugoslavia [SFRY]), its overall transportation infrastructure is characterised by marked development of the main, north-south corridor (a part of European Corridor 10). In contrast, the east-west corridor (part of European Corridor 8) has been almost completely neglected. The period following the independence of Macedonia (with its accompanying problems) has shown that both of these corridors are equally important in the development of its transportation infrastructure. For example, the closure of the border with Serbia and Montenegro and the blockade by Greece during the early 1990s resulted in extremely adverse impacts to the Macedonian economy.

Despite all of these problems, transportation as a sector has been gradually increasing its contribution to the GDP over the last several years. Thus, from a 6.1% GDP share in 1997, its share increased to 7.3% in 1998 and to 8.2% in 1999.

5.8.2. Changes in the sector over time

With reference to the structural changes undergone by the transportation sector, especially after the independence, the main trends seen internationally are also present within Macedonia. More specifically, in parallel with development, the transport of goods and passengers has been carried out less frequently by railways, and more often by road vehicle traffic. During the course of the last several years, air traffic has gained in importance, especially with regard to passenger transportation. The development of new oil and gas pipelines should also contribute to the development of the pipeline transportation sector.

The current status of railway traffic is far from satisfactory. The length of the lines has been stagnating for the last 15-20 years. A comparison with some developed countries shows that Macedonia has a relatively low density of railway networks (27 km of railway lines per 1,000 km^2, i.e., 339 km of lines per million inhabitants).

The air traffic sector has experienced sudden growth in the Republic of Macedonia during the period after its independence and the beginning of its transition. The general assessment of this sector is not satisfactory, however, when taking into account the constant problems resulting from unsettled conditions.

Telecommunications systems in Macedonia are poorly developed. Full digitalisation of the telecommunications network in the country has not been completed, mobile telephone service does not cover the entire country etc.

5.8.3. Impact on biodiversity

The transportation sector impacts biodiversity through the fragmentation of habitats, as well as through air pollution and noise. Considering the current circumstances in the Republic of Macedonia, these impacts are low by comparison with those of developed

European countries. Nevertheless, this is one of the most severe threats to biodiversity in Macedonia.

A more detailed presentation of the impacts from the transportation sector is contained in Section 3.6.1.3.

5.9. Tourism and recreation

5.9.1. Current status and economic importance of the sector

The Department of Tourism within the Ministry of Economy plays the main role in creating the touristic policy of the Republic of Macedonia. It is responsible for all the legal means by which tourism is regulated, and the *Law on Tourism, Catering and Hospitality* provides the highest standard of management. Apart from the Ministry, numerous social and economic organisations function within the system, such as: the Tourist Union of the Republic of Macedonia, tourist unions of individual cities, numerous travel agencies (around 160), numerous touristic and catering facilities, the Faculty of Tourism and Catering in Ohrid, the Department of Tourism in the Institute of Geography (Faculty of Natural Science and Mathematics) in Skopye etc. Of the four main types of touristic destinations (City of Skopye, tourist health/spa resorts, tourist vacation resorts [mountains and lakes] and other, typically non-touristic areas), the City of Skopye exhibited the highest tourist turnover, followed by vacation and health/spa resorts.

At present, touristic and catering activities employ around 10,000 people (2,895 of whom are female), or only 3.2% of the total number of employed persons in Macedonia. Total revenues generated by tourism and catering activities during 2001 amounted to €8.5 million or 2.0% of the total gross national product (GNP).

5.9.2. Changes in the sector over time

In reference to the tourist, catering and hospitality trades, the number of establishments reached its highest level, 3,497, in 1990. Currently, the number of these businesses is approximately half, or 1,798. The number of seats in catering and other related service facilities in 1990 was 187,928; today, this number is as low as 73,759. The total number of beds, which amounted to 82,411 in 1990, is similar, dropping to 78,913 in 1995 and to 73,759 at present. With regard to tourist turnover, the total number of tourists in the Republic of Macedonia in 1990 was 974,537, spending a total of 3,099,508 nights. Since this period, primarily due to social and political events in this region of the Balkans, tourist turnover appears to have experienced a permanent decrease, reaching its lowest value in 1997, when the country was visited by only 476,025 tourists who spent a total of 1,587,146 nights (the absolute minimum since 1978). During the three years since 2000, the number of visitors and nights spent have noted gradual average increases, or 632,523 and 2,434,639, respectively. It is noteworthy, however, that tourism has one of the best prospects for economic growth considering the extraordinary favourable conditions for its development in terms of natural, geographic and anthropogenic factors.

5.9.3. Impact on biodiversity

Considering the scope of the term ‘biodiversity,’ it is absolutely undisputable that tourism and biodiversity are in an indivisible symbiosis, that is, in an uninterruptible interaction with each other. The development of tourism in some regions, for example, results in adverse impacts related to degradation of the quality of the land, which further

impacts the biodiversity within these areas. A specific example concerns the construction of more than 600 weekend houses in the vicinity of Skopye (residential tourism, which is also widespread in other areas), irreversibly taking the modest agricultural areas out of production (Section 3.6.1.). The primary protection measure in such situations would be a plan to control the urbanisation of touristic weekend settlements.

Another notable case is the illegal construction of various touristic structures on the shores of Macedonian natural lakes. Adverse impacts are evident not only in the degradation of surrounding upland ecosystems, but also in the direct pollution of the lakes themselves. There are many specific examples of this (Lagadin on Ohrid Lake, 1,200 weekend houses around Mavrovo Lake within Mavrovo National Park etc).

5.10. Other key sectors affecting biodiversity

We may say that there are no other known key sectors in the Republic of Macedonia that have major direct impacts on biodiversity. Nevertheless, the army, that is, the defence sector, education, research and trade are significant factors/sectors influencing biodiversity.

5.10.1. Defence

During the period of the dissolution of former Yugoslavia, the army's installations and numerical status decreased drastically. Following 2000, the situation changed due to the internal conflict, at least with regard to activities and installations. Currently, there is no planned involvement of the army in the protection of the environment, especially of biodiversity. The activities of the army are perceived to be of high national interest and the possible consequences to biodiversity from any type of military activity are not questioned.

There are examples of negative impacts to biodiversity from the activities of the defence sector: building of roads in various areas without any consultation with the MoEPP (the same is true for international forces - United Nations Protection Force [UNPROFOR], North Atlantic Treaty Organisation [NATO] and Kosovo Force [KFOR] – stationed in the Republic of Macedonia); development and extensions of military proving grounds; pollution etc. The largest military proving ground in the Republic of Macedonia, Krivolak, is situated in an area (Slan Dol) with abundant endemic and rare plants and invertebrates.

In the coming period, the Ministry of Defence should prepare a sectoral action plan on biodiversity protection, as well as reports on the progress in this field.

5.10.2. Education and research

Within the education system of Macedonia, some efforts have been made to introduce educational topics in the area of environment under the compulsory curriculum. Such courses, however, are still optional and at the primary school level only. As far as biodiversity is concerned, there has been no evidence of its emphasis in teaching. Section 6. contains more detail on this issue.

In the Ministry of Education and Science, research related to biodiversity is rather neglected in their financial allocations for scientific projects.

5.10.3. Trade

Unless trade in biological resources is considered to be a direct cause of biodiversity loss (as is comprehensively discussed in Section 3.6.3.), this sector does not significantly impact biodiversity in Macedonia. Areas occupied by trade activities are usually placed in urban centres, while the remaining activities of trade are connected with other sectors already discussed (e.g., transport).

5.11. Sectoral analysis

A careful analysis of the previously presented data will show that not all sectors impact biodiversity equally. A preliminary ranking of the main economic sectors by their impact on biodiversity includes:

- agriculture, which has had a particular impact on biodiversity in the decades following the Second World War. Serious threats to fish diversity in the Republic of Macedonia are caused by over-fishing (especially in Ohrid Lake);
- transport sector, especially due to the fragmentation of habitats;
- the energy sector represents a threat to biodiversity for several reasons, including pollution, construction of hydropower reservoirs and, especially, the transmission of energy;
- industry and mining;
- tourism also poses a serious threat to biodiversity. In this context, illegally constructed weekend settlements and incomplete communal infrastructure in the main tourist resorts are of particular concern;
- national defence is a threat that can be easily overcome in the future;
- construction poses a threat due to the use of agricultural land of high cadastral class for nonproductive purposes, habitat destruction, disturbance of animals, as well as pollution due to the construction of waste disposal sites. This sector would not be ranked very high, however;
- the social, economic and political situation in the country, following periods of rapid and uncontrolled development of the economic sector (especially agriculture and industry), results in poor conditions for preservation of the existing biodiversity richness. At present, great efforts intended for biodiversity protection are being made by the MoEPP. Other ministries and the Macedonian government undertake almost no coordinated activities, however.

The most important secondary benefit related to the protection of biodiversity in the Republic of Macedonia would be the adoption of an inter-sectoral approach. Such an approach towards problem solving is posed as a matter of urgency. The Strategy and the Action Plan for Biodiversity Protection can be considered a first step towards that goal.

6. EXISTING MEASURES AND PROGRAMMES FOR BIODIVERSITY CONSERVATION

6.1. Legislation and policy for biodiversity use and conservation

6.1.1. Constitutional framework

The term *biodiversity* is not used in Macedonia's highest legal framework – *The Constitution of the Republic of Macedonia*. The key elements of the constitutional method of protection can be recognised in most of its provisions, however. Thus, the nomenclature of *the fundamental values of the constitutional system of the Republic,* inter alia, includes *environment and nature protection and promotion* (Article 8, Paragraph 1, Item 10). In addition, the Constitution guarantees the right of all citizens to a *healthy environment* and the Republic provides appropriate conditions for exercising this right. At the same time, protection of the environment and nature is regulated as a constitutional obligation of all people (Article 43). Furthermore, the Constitution provides for the possibility of legal limitations on the *freedom of the market and entrepreneurship* (Article 55, Paragraph 3) on behalf of biological diversity. Finally, it provides equal *constitutional status* for all *natural properties* and *plant and animal life* as a whole (status of *properties of common interest for the Republic*). Such a status implies special protection for each individual property of common interest, as well as specific protection of the entity to which it belongs, as a group object of protection (Article 56, Paragraph 1).

This constitutional framework provides a solid basis for establishing and developing a coherent system of environmental protection and, within it, designing a clear model for biodiversity conservation.

6.1.2. Environmental protection and regulation laws

Basic issues related to environmental protection are regulated under the 1996 *Law on the Conservation and Promotion of the Environment and Nature*. The original text has been modified and supplemented (Revision: 51/00; modification and supplementation: 96/00 and 45/02).

Officials are aware that the matter of nature conservation should be removed from the law and regulated separately. In other words, a new law should be adopted which address only environmental protection and promotion. In this regard, however, it should be stressed that the issue of normative policy, indeed the entire normative conception of environment protection, is still open.

6.1.3. Protected areas laws

Issues relating to protected areas are regulated by laws, regulations and decisions adopted by the local government.

Laws pertaining to this consist of:

- *Law on the Protection of Natural Rarities* (41/73, with its modifications and supplements, 42/76, 10/90 and 62/93);
- *Law on the Protection of National Parks* (33/80, with its modifications and supplements, 10/90 and 62/93);
- *Law on Declaring a Portion of the Forested Areas on Pelister Mountain as a National Park* (38/48, with its modification/supplement, 16/65);

- *Law on Declaring a Portion of the Forested Areas around Mavrovo Lake as a National Park* (10/49, with its modifications and supplements, 23/52 and 16/65);
- *Law on Declaring a Portion of the Forested Areas on Galichitsa Mountain as a National Park* (31/58, with its modification/supplement, 16/65);
- *Law on the Protection of Ohrid, Prespa and Doyran Lakes* (45/77);
- *Law on Declaring the Ornithological Reserve "Ezerani" as a Strict Natural Reserve* (37/96);
- *Law on Declaring the Ornithological Reserve "Tikvesh" in the Gorge of the Crna River as a Strict Natural Reserve* (35/97).

In addition, the strict natural reserves are subject to the following regulations:

- *Regulations on the Implementation of Measures for the Protection of the Strict Natural Reserve "Ezerani" on Prespa Lake* (29/97);
- *Regulations on the Implementation of Measures for the Protection of the Strict Natural Reserve "Tikvesh" in the Gorge of the Crna River* (44/97).

On the basis of the authority delegated by the *Law on the Protection of Natural Rarities*, municipal assemblies and the city of Skopye (i.e., local governments) have made a number of decisions by which certain natural properties have been declared as protected areas within a particular category. Such decisions include:

- *Decision of the Assembly of the City of Skopje on Declaring a Portion of Vodno Mountain as an Area with Specific Natural Characteristics* (1970);
- *Decision of the Assembly of the City of Skopje on Declaring the Site of "Ostrovo" near the Village of Trubarevo as a Natural Monument* (1976);
- *Decision of the Assembly of the City of Skopje on Declaring the Katlanovo Area as a Natural Monument* (1991);
- *Decision of the Assembly of the City of Skopje on Declaring the Matka Gorge as a Natural Monument* (1994);
- *Decision of the Assembly of the Municipality of Kavadarci on Declaring the Area of Relict Communities near the Drenachka Gorge as a Natural Monument* (1991);
- *Decision of the Council of the Municipality of Prilep on Declaring the Site of "Zrze" as a Natural Monument* (1996);
- *Decision of the Council of the Municipality of Bitola on Declaring the Gradeshka River Gorge as a Natural Monument* (1996).

In order to address the particular issue of the usage and conservation of protected areas, fundamental changes will be required. A clear normative conception will need to be built.

6.1.4. Laws on flora and fauna

The first group of special laws relating to flora and fauna includes:

- *Law on Fishing* (62/93);
- *Law on Hunting* (20/96, 26/96 and 34/47);
- *Law on Plant Protection* (25/98, with its modification/supplement, 6/00);

- *Law on Forests* (47/97, with its modification/supplement, 7/00);
- *Law on Pastures* (3/98, with its modification/supplement, 101/00);
- *Law on Seeds, Seedlings and Materials for Propagation, Recognition, Approval and Protection of Varieties* (41/00);
- *Law on Cattle Breeding* (61/97);
- *Law on Veterinary Health* (28/98);
- *Regulations on the Use of Other Forest Species* (13/00).

The level of regulation of flora and fauna requires certain conceptions and other adjustments, especially starting from the need to create a harmonised system of nature protection.

6.1.5. Legislation on land use and development

The following laws pertain to this issue:

- *Law on Agricultural Land* (25/98 and 18/99);
- *Law on Protection against Damage to Farm Fields* (20/90 and 83/92);
- *Law on the Reorganisation of Land* (18/76);
- *Law on the Redistribution of Land* (7/90);
- *Law on Construction Sites* (53/01 and 97/01);
- *Law on Spatial and Urban Planning* (4/96, 28/97, 18/99 and 53/01).

In addition to these laws, there are subsidiary acts:

- *Regulations on the Requirements, Methods and Procedures for Obtaining Permission for Construction* (24/96 and 21/01);
- *Regulations on Standards and Norms for Spatial Development* (2/02);
- *Regulations on the Contents and Graphical Design of Plans and the Procedure for Adopting Urban Plans* (2/02).

It is obvious that the regulations in this area need some updating, particularly with respect to spatial and urban planning.

6.1.6. Legislation on pollution

This group includes:

- *Law on Protection against Air Pollution* (20/74);
- *Law on Water* (4/98, with its modification/supplement, 19/00);
- *Law on Waste* (37/18);
- *Law on Hazardous Waste Transport* (27/90, with its modifications and supplements, 45/90 and 12/93);
- *Law on Public Hygiene Maintenance and the Collection and Transport of Communal Solid and Technological Wastes* (37/98);
- *Law on Public Utilities* (45/97, with its modifications and supplements, 5/99, 23/99 and 45/02);
- *Law on Protection against Ionising Radiation and on Radiation Safety* (48/02);
- *Law on Noise* (10/84, with its modifications and supplements, 21/84, 10/90 and 62/93).

In addition to the laws, there are also relevant regulations:

- *Regulations on Classification of Water Resources* (18/99);
- *Regulations on Categorisation of Watercourses, Lakes, Reservoirs and Ground Waters* (18/99 and 71/99);
- *Decision on Establishing the Boundaries of the Protected Zones of Rasche Spring and Defining Measures of Protection* (36/90);
- *Regulations on the Method of Defining and Maintaining Protection Zones around Drinking Water Springs* (17/83 and 15/89);
- *Regulations on the Health and Safety of Drinking Water* (5/84);
- *Regulations on the Transport of Hazardous Waste by Road* (82/90);
- *Regulations on the Macedonian Standards for and Quality of Liquid Fuels* (32/99 and 44/99);
- *Regulations on Monitoring and Identifying Harmful Substances in the Air* (9/76);
- *Regulations on the Classification of Facilities Discharging Harmful Substances that Could Pollute the Air of Inhabited Places and the Establishment of Zones of Sanitary Protection* (13/76);
- *Regulations on the Maximum Allowable Concentrations and Quantities of Other Harmful Substances that Could be Discharged into the Air by Certain Sources of Pollution* (3/90);
- *Regulations on the Method and Terms for Submitting Reports on the Measurement, Control and Keeping of Records Concerning Emissions of Harmful Substances into the Air* (9/76);
- *Regulations on the Method and Terms for Reporting to Competent Authorities Concerning the Systematic Monitoring and Examination of Air Pollution Carried out in the Republic* (7/76);
- *Regulations on the Requirements for Siting, Construction, Operational Testing, Start-up and Use of Nuclear Facilities* (52/88).

6.1.7. Other relevant sectoral legislation affecting biodiversity

This group of laws includes:

- *Criminal Code* (37/96);
- *Law on Concessions* (25/02);
- *Law on Energy* (47/97, with its modifications and supplements, 40/99 and 98/00);
- *Law on Mineral Raw Materials* (18/99, with its modifications and supplements, 48/99 and 29/02);
- *Law on Public Roads* (26/96);
- *Law on Investment* (15/90, with its modifications and supplements, 11/91, 11/94 and 18/99);
- *Law on Property and Other Material Rights* (18/01);
- *Law on Local Self-Government* (5/02);
- *Law on the Organisation and Operation of Public Administrative Bodies* (58/2000);
- *Law on Protection against Natural Catastrophes* (39/77, with its modifications and supplements, 47/89 and 27/90);
- *Law on Fire Fighting* (43/86, with its modifications and supplements, 37/87, 51/88, 36/90 and 12/93);
- *Law on Foreign Trade Operations* (31/93).

6.1.8. International agreements and conventions

With respect to biodiversity, the following international agreements and conventions (worldwide and regional) appear to apply to the Republic of Macedonia (RM):

- *Convention on Wetlands of International Importance Particularly as Waterfowl Habitat* (Ramsar, 1971) - ratified by decree (Official Gazette of SFRY 9/77). The Republic of Macedonia acceded to this convention with an Act of Succession in 1995;
- *Convention on the Protection of the World's Cultural and Natural Heritage* (Paris, 1972) - ratified by law (Official Gazette of SFRY 56/74);
- *Convention on International Trade in Endangered Species of Wild Fauna and Flora* (CITES) (Washington, 1973) - ratified by law (Official Gazette of RM 82/99). The Republic of Macedonia has been a member of this convention since 2 October 2000;
- *Convention on the Conservation of Migratory Species of Wild Animals* (Bonn, 1979) - ratified by law (Official Gazette of RM 38/99) and implemented in November 1999;
- *Convention on the Conservation of European Wildlife and Natural Habitats* (Bern, 1982) - ratified by law (Official Gazette of RM 49/97) and implemented in April 1999;
- *Agreement on the Conservation of Bats in Europe* (London, 1991) - ratified by special law (May 1999) and implemented on 15 October 1999;
- *Amendment to the Agreement on the Conservation of Bats in Europe* - ratified in February 2002;
- *Agreement on the Conservation of African-Eurasian Migratory Water-Birds* (Hague, 1995) - ratified by special law (June 1999) and implemented 1 November 1999;
- *European Convention on the Protection of Vertebrate Animals Used for Experimental and Other Scientific Purposes* (Strasbourg, 1986). Ratification of the convention is in Parliamentary procedure;
- *Convention on Biological Diversity* (Rio de Janeiro, 1992) - ratified by law (Official Gazette of RM 54/97) and implemented in 1998;
- *Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters* (Aarhus, 1998) - ratified by law (Official Gazette of RM 40/99);
- *Convention on Environmental Impact Assessment in a Transboundary Context* (Espoo, 1991) - ratified by law (Official Gazette of RM 44/99);
- *Convention on Long-Range Transboundary Air Pollution* (Geneva, 1979) - ratified by law (Official Gazette of RM 6/97) and implemented on 28 April 1998;
- *Convention on Long-Range Transboundary Air Pollution* (Geneva, 1979) - ratified by law (Official Gazette of SFRY 11/86), signed by the Republic of Macedonia on 17 November 1991 and followed by eight protocols;
- *Protocol on Long-Term Financing of the Cooperative Programme for Monitoring and Evaluation of the Long-Range Transmission of Air Pollutants in Europe* (Geneva, 1984) - ratified (Official Gazette of SFRY 2/87), implemented in 1988 and awaiting ratification through an Act of Succession;
- *Convention on the Protection of the Ozone Layer* (Vienna, 1985) - ratified by law (Official Gazette of SFRY 1/90);

- *Montreal Protocol on Ozone Layer Depleting Substances* (Montreal, 1987) - ratified on 10 March 1994;
- *London Amendment to the Montreal Protocol* (London, 29 June 1990) - ratified on 27 May 1998 (Official Gazette of RM 25/98);
- *Copenhagen Amendment to the Montreal Protocol* (Copenhagen, 25 November 1992) - ratified on 27 May 1998 (Official Gazette of RM 25/98);
- *Montreal Amendment to the Montreal Protocol* (Montreal, 17 September 1997) - ratified on 30 July 1999 (Official Gazette of RM 51/99);
- *Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal* (Basel, 1995) - ratified by law (Official Gazette of RM 49/97);
- *United Nations Convention to Combat Desertification in Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa* (UN, 2000) - ratified in February 2002 (Official Gazette of RM 13/02).

These international acts define extensive obligations which must get their normative expression in the national legislation. As a matter of course, the harmonisation of the national legislation with both the ratified international agreements and those still under the ratification procedure should be a priority task in the normative policy of the sphere of biodiversity conservation.

6.2. Protected areas system

6.2.1. Description of extent, location and coverage of protected areas

According to the official data, which was based on previous scientific research, there should be approximately 107 protected areas of differing categories covering about 18% of the land surface of the Republic of Macedonia. Despite five decades of organised conservation of natural rarities, however, the network of protected areas now includes only 68 sites covering an area of 170,235 ha or 6.62% of the land surface.

The status of protected properties by category are as follows:

- three national parks encompassing 108,338 ha or 4.21%;
- three sites of special natural character covering 2,338 ha or 0.09%;
- 14 areas outside nature reserves containing certain plant and animal species, 2,709 ha or 0.10%;
- 48 natural monuments encompassing 56,850 ha or 2.22%.

It is recommended that an additional 39 natural properties be included in the system of protected areas. These are:

- two national parks;
- nine strict nature reserves;
- 14 scientific-research reserves;
- 14 sites of special natural character.

By geographic location, both the currently protected natural properties and those yet to be protected are distributed throughout Macedonia. Most of them are located in the western part of the country, with some also being present in regions with tourism.

The comparison of data on the numbers and types of currently protected natural properties with those deserving to be placed under protection might be problematic, as the existing system of classification and categorisation of natural rarities has not been harmonised with international standards. It should also be stressed that the subject data do not apply to those areas protected in accordance with the laws of other sectors closely related to natural heritage protection (e.g., laws on forests, water, hunting etc).

6.2.2. Legal and management status of protected areas

In compliance with the existing laws of the Republic of Macedonia, protected areas generally have the legal status of "natural rarities." In some laws, however, such as the *Law on the Conservation and Promotion of the Environment and Nature*, the generic term for protected areas is "special natural wealth." There is an obvious inconsistency of terms in the relevant national legislation, as well as a deviation from international nomenclatural standards for the identification of protected areas.

According to the current overriding law, the legal status of "protected areas as natural rarities" is defined in detail in the *Act for Proclamation* within a law or decision, depending on the type of special character to be protected. Protected areas can have the legal status of:

A. Nature Reserve
   1. Common Nature Reserve
      (a) National Park
      (b) Strict Nature Reserve
      (c) Scientific-Research Reserve
      (d) Site of Special Natural Character
      (e) Characteristic Landscape
   2. Special Nature Reserve

B. Natural Monument
C. Natural Sites of Historic Importance
D. Areas Outside Nature Reserves Containing Certain Plant and Animal Species

Undoubtedly, this classification system for considering protected properties as natural rarities does not correspond to the classification scheme developed by IUCN or the United Nations Environmental Programme's (UNEP) World Conservation Monitoring Centre (WCMC). In this regard, harmonisation of the national classification system for protected areas with international standards (number, name and definition of categories of protected areas) will be one of the priority tasks in developing new legal measures for nature conservation, specifically of biodiversity.

Based upon existing regulations, management of protected areas is described in only a rudimentary way. Nevertheless, a key provision of the existing protection model requires that natural rarities (i.e., protected areas) be managed by their "holders" which, in most cases, appears to be the State. The State accomplishes the management of these protected areas, as both a right and an obligation, in ways such as:

- establishing specialised institutions;
- transferring the right of use to certain legal entities;
- concessioning.

Within the existing system of natural rarities protection, only the specialised organisations for national park protection and management are currently functioning, under joint administration by the enterprise, National Parks and Hunting Sites. The status of the three existing organisations (Galichitsa National Park, Mavrovo National Park and Pelister National Park) and their umbrella enterprise has not yet been adjusted to the new constitutional system. In fact, there is a dilemma as to whether specialised legal entities should have the status of a public enterprise or a public institution. Alternatively, park management could be accomplished by establishing a separate administration for national parks (either as a constituent body with the status of a legal entity or as an independent administrative organisation) within the relevant Ministry or by creating a legal entity separate from the relevant ministry. At present, the question of the management of natural lakes, which are protected as natural monuments, is also considered to be unresolved.

The issue of the management of certain protected properties was resolved with an *Act for Proclamation*. In other words, the right of use has been transferred to other individual legal entities such as local self-governments, trade companies and NGOs. This model of management is not fully developed, however.

There is also the possibility of granting concessions for the management of protected properties; however, the new law concerning natural heritage protection has yet to be adopted, so the terms and methods for granting concessions have also not yet been established. This legal deficiency should be solved with the adoption of the new law, which will be a supplement to the existing *Law on Concessions*.

To summarise, the legal status and management of protected areas is one of the key problems in the existing system of natural rarities conservation.

6.2.3. Assessment of gaps in current protected areas system

As a general recommendation, essential changes of various kinds are needed in the current system for regulating protected areas. The conservation of protected areas within the existing system of urban and spatial planning, both a constitutional and legal obligation, has demonstrated that, in practice, such plans are not the most suitable instruments for use as the main tool for the conservation of protected areas. In this instance, it will not be sufficient to merely close legal loopholes in an effort to upgrade the existing system; instead, considerable reforms are needed. That being the case, several questions are open, particularly:

- Identification of protected areas: (a) official terminology for the key terms to be used in describing the protected areas and the individual categories of protected properties, (b) legal definitions of protected areas (general definition and specific definitions for each category of property) and (c) official classification of protected areas;
- Protection objectives: (a) main objectives of protection and (b) specific objectives regarding each category of protected area;
- Establishment of protection: (a) previous protection and (b) proclamation of protected areas (competences, acts, procedures, public participation and publication of the *Act on Protection*);
- Protection regime: (a) degree (categorisation) of protection, (b) prohibitions and restrictions, (c) specific measures for protection and (d) damage liability;
- Organisation and coordination of protection and management of protected areas;

- Instruments of protection: (a) national programme, (b) national register, (c) protected area management plans and (d) monitoring;
- Rights and obligations of the owners and restrictions on ownership based on protection for public interests;
- Financing of the conservation of protected areas;
- Sanctions for violations of the law;
- Transitional regime.

6.3. Conservation outside protected areas

6.3.1. In-situ conservation measures in broader landscape

Within the Republic of Macedonia, no in-situ conservation measures in broader landscapes have been undertaken to date, with the exception of protected areas.

6.3.2. Ex-situ conservation measures

6.3.2.1. Plant propagation in botanic gardens and nurseries

The botanic garden of the Institute of Botany at the Faculty of Natural Science and Mathematics in Skopye is the only institution within Macedonia which attempts to adhere to the ratified *Convention on Biological Diversity* and is scientifically engaged in carrying out ex-situ conservation of wild flora. With the construction of the facilities for acclimatisation, reproduction and growth of endemic, relict and medicinal Macedonian flora, several endemic, relict and endangered species have been successfully transplanted, such as: *Astragalus mayeri* Micev., *Cladium mariscus* (L.) Pohl, *Hedysarum macedonicum* Bornm., *Osmunda regalis* L., *Ramonda nathaliae* Panc. & Petr., *Sambucus deborensis* Kosanin, *Sempervivum octopodes* Turrill, *Thymus alsarensis* Ronniger, *T. oehmianus* Ronniger & Soska, *Tulipa mariannae* Lindtner and *Viola allchariensis* G. Beck, as well as some portions of the aquatic, wetland, meadow and steppe vegetation.

The Department of Microbiology at the Botanic Institute within the same faculty is developing a rich collection of active aerobic and anaerobic moulds and yeasts used in industry, whereas the Department of Mycology has about 1,000 species of macroscopic Fungi at its disposal.

The Institute of Agriculture in Skopye is maintaining the following crop collection:

Table 29: Ex-situ collections of crops at the Institute of Agriculture in Skopye.

Crop		Number of Varieties	Crop		Number of Varieties
Triticum aestivum	Soft wheat	150	*Malus* spp.	Apple	77
Triticum durum	Hard wheat	273	*Pyrus* spp.	Pear	49
Triticale spp.	Triticale	26	*Prunus domestica*	Plum	36
Hordeum vulgare	Barley	243	*Prunus persica*	Peach	33
Zea mays	Maize	196	*Prunus armeniaca*	Apricot	30
Oriza sativa	Rice	175	*Prunus avium*	Cherry	16
Capsicum annuum	Pepper	39	*Prunus cerasus*	Sour cherry	14
Allium cepa	Onion	15	*Amygdalus* spp.	Almond	42
Lycopersicon lycopersicum	Tomato	40	*Juglans regia*	Walnut	7
Dactylis glomerata	Cocksfoot	1	*Corylus avelana*	Hazelnut	9

Festuca arundinaceae	Tall fescue	1	*Rubus eubatus*	Blueberry	2
Arrhenatherum elatius	Tall oatgrass	1	*Rosa canina*	Dog rose	1
Medicago sativa	Alfalfa	2	*Rosa rugosa*		1
Medicago falcata	Yellow alfalfa	2	*Actinidia chinensis*	Actinidia	1
Onobrychis sativa	Sainfon	1	*Ziziphus jujuba*	Jujube	6
Vicia spp.	Vetch	1	*Vitis vinifera*	Grape	151
Pisum arvense	Cattle pea	1			

The Institute for Southern Crops in Strumitsa maintains the following collection ex-situ:

Table 30: Ex-situ collections of crops at the Institute for Southern Crops – Strumitsa.

Crop		Number of Varieties	Crop		Number of Varieties
Capsicum annuum	Pepper	169	*Allium porrum*	Leek	1
Lycopersicon esculentum	Tomato	27	*Lactuca sativa*	Lettuce	3
Cucumis sativus	Cucumber	2	*Cucumis melo*	Melon	13
Solanum melongena	Eggplant	2	*Arachis hypogaea*	Peanuts	14
Citrulus vulgaris	Watermelon	4	*Gossypum hirsutum*	Cotton	16
Cucurbita pepo	Pumpkin	5	*Sesamum indicum*	Sesame	10

At the Tobacco Institute in Prilep, a total of 117 varieties of tobacco are maintained ex-situ, of which 73 are of the Virginia type, 37 of the oriental and seven of the semi-oriental type.

6.3.2.2. Captive breeding in zoological parks

The Zoological Garden in Skopye continuously maintains populations of the species of animals shown below. The total number of individuals listed was as of the date of publication of this report.

Roe deer (*Capreolus capreolus*), ? 1	Wolf (*Canis lupus*) ? 2-9	Golden eagle (*Aquila chrysaetus*) ? 10
Fallow deer (*Dama dama*) ? 2, ? 7	Domestic goat (*Capra hircus*) ? 6, ? 2-7	Imperial eagle (*Aqila heliaca*) ? 3-10
Donkey (*Equus asinus*) ? 1	Wild boar (*Sus scrofa*) ? 2-8, ? 2-8	Eagle owl (*Bubo bubo*) ? 1
Domestic horse (*Equus cabalis*) ? 5	Brown bear (*Ursus arctos*) ? 9-21, ? 7	Common buzzard (Buteo buteo) ? 1
Hybrid mule (*Equus mulus*) ? 3	Red fox (*Vulpes vulpes*) ? 7	Griffon vulture (*Gyps fulvus*) ? 2-13

6.3.2.3. Materials held in genetic collections and gene-banks

In the case of crop agrobiodiversity, several separate and unrelated projects were supported by the Ministry of Agriculture, Forestry and Water Management. As a result, cold chambers (4ºC) for the short-term storage of seeds were installed at the Agricultural Institute in Skopye, Institute for Southern Crops in Strumitsa and Tobacco Institute in Prilep. Subsequently, collections of local/imported commercial varieties and selected lines were established. Within these collections, no indigenous local crop varieties are held. The seeds are being stored in plastic boxes, but they were not adequately treated for long-term storage nor divided into basic and active collections. Certificates of Origin (passport data), descriptions and evaluations of varieties (e.g., germination percentages) were not completed and no data were entered into an electronic database.

With regard to domesticated animals, concrete measures for conservation of the Pramenka sheep "Karakachanska" have already been undertaken. With the assistance provided by the Ministry of Agriculture, Forestry and Water Management, a collection of 100 sheep and 12 rams has been established. The heads were placed in two independent locations for morphological characterisation. They are now undergoing biochemical analyses on DNA and proteins in order to determine polymorphism within the satellite bands and genetic markers. In the future, it is planned to cryogenically preserve a sufficient quantity of sperm and fertilised embryos, in order to facilitate the long-lasting conservation of genetic material.

6.4. Other existing projects and programmes for biodiversity conservation

6.4.1. Biodiversity inventory and monitoring and research

Existing regulations within the Republic of Macedonia do not provide for a strict legal obligation to keep a unique or central inventory of biodiversity, nor for conducting special monitoring in that sphere. The existing *Law on the Conservation and Promotion of the Environment and Nature* only provides for an inventory of polluters and certain environmental monitoring.

Some laws, especially the ones related to protected areas, require the keeping of records and documentation, registers and other public ledgers containing relevant data on the kinds of natural resources, their amounts and their values. Such non-specific solutions, however, could not be considered to be appropriate as regards biodiversity in general and as the subject of specific legal protection.

Hence, the issue of biodiversity inventories, as well as the issue of special monitoring, deserve particular attention and adequate normative consideration in future regulations on biodiversity conservation.

6.4.2. Educational programmes and training

In compliance with the *Law on the Conservation and Promotion of the Environment and Nature*, public institutions in the field of education are obligated to include the acquisition of knowledge and the creation of an attitude of activism towards the conservation and promotion of the environment and nature in their work plans and programmes. This obligation applies to all public educational institutions, starting with primary school (Article 10).

To date, no thematic survey has been conducted regarding the adequacy in which biodiversity conservation is addressed in the curriculum of public educational institutions, neither at the primary, secondary nor university level. Consequently, few conclusions can be drawn. Further, there are no comparative analyses of university

teaching plans and programmes in the fields of biology, forestry, agriculture, veterinary medicine, environmental protection, environmental law and other educational areas with regard to the subject of biodiversity conservation.

6.4.3. Public Awareness

Raising public awareness concerning protection of the environment and nature is defined as a strict legal obligation of public institutions in the education, health care, information, culture and science fields in the *Law on the Conservation and Promotion of the Environment and Nature* (Article 10). In addition, the relevant laws on the protection of natural rarities define the legal obligations of the responsible institutions, to wit: (a) to issue publications related to the protection of natural rarities and prepare publicity materials on the protected resource and (b) to encourage and develop interest in a positive attitude toward the preservation of natural rarities by means of regular and occasional exhibitions, the showing of films and other forms of cultural and educational activities.

By all accounts, the pertinent public institutions can not be said to be executing these duties satisfactorily. The underlying reason for this is the fact that, so far, the government has made no official statements regarding the work of public institutions. Special programmes and projects for nurturing and developing an awareness regarding the conservation of biodiversity are rare and, in most of cases, have failed to get the necessary financial support from the budget or other public funds.

A common characteristic of both the print and electronic media within the Republic of Macedonia (regardless of ownership) is that they do not give much attention to the issue of biodiversity conservation, especially in regard to its systematic monitoring.

More recently, many NGOs, especially in the field of ecology, have shown great interest in efforts to raise public awareness about biodiversity conservation. In many cases, however, their projects and programmes have not been supported by the central government or by local authorities. Foreign grants and grants from foreign foundations registered in Macedonia are still relatively unavailable or are intended for other specific purposes. There has also been poor organisation on the part of domestic legal entities.

6.4.4. Conservation planning

In the Republic of Macedonia, a very complex model of biodiversity conservation planning exists and is implemented. In point of fact, the planning instruments are quite varied and differ in type, order of precedence, period of validity, type of holder, procedure for adoption etc.

In accordance with the current system of laws, in order to assess the situation and identify the measures to be undertaken, the government of the Republic of Macedonia developed a *National Environmental Action Plan* (NEAP) for the purpose of conserving the environment in Macedonia. According to this plan, municipalities and the city of Skopye must adopt *Local Environmental Action Plans* (LEAPs) (Article 14). The law also specifies that those entities managing special natural heritage sites (i.e., protected areas) are obligated to prepare a programme on the protection of these resources and submit it to the MoEPP (Article 33). The *Law on the Protection of National Parks* specifies that those organisations managing these protected resources adopt annual and long-term programmes on national park protection. The special *Law on the Protection of Ohrid, Prespa and Doyran Lakes* provides for the adoption of a programme for the protection of these lakes by the Parliament of the Republic of Macedonia (Article 5).

Similarly, the laws adopted in related fields also provide for separate planning instruments (e.g., *Water Management Master Plan, General Plan on Forest Management* etc). Environment and nature conservation is an obligatory component of spatial plans. Regarding national parks, the adoption of spatial plans for national parks is also provided for.

Existing regulations do not mandate nor provide the possibility for the adoption of special planning instruments for biodiversity conservation.

It is recommended that the Republic of Macedonia prepare:

- *National Biodiversity Conservation Strategy;*
- *National Biodiversity Conservation Programme,* as a mid-term plan (5 year);
- *Annual Biodiversity Conservation Programmes,* at the national and local levels.

6.4.5. Domestic projects

No.	Project Description	Funding Source / Implementing Agency
1.	Preparation of slide-documentation and a herbarium for endemic, relict, rare and threatened flora of the Republic of Macedonia	MoEPP / Agency for the Environment
2.	Preparation of a report on the natural values of the site "Ploche Rock Pools," Stratsin	MoEPP / Agency for the Environment
3.	Preparation of an report on the natural values of the site "Lokvi – Golemo Konjari"	MoEPP / Agency for the Environment
4.	Strict Nature Reserve – Golem Grad Valuation for preparation of a report	MoEPP / Agency for the Environment
5.	Strict Nature Reserve – Demir Kapiya Valuation for preparation of a report	MoEPP / Agency for the Environment
6.	Atlas of the birds of prey of the Republic of Macedonia	MoEPP / Agency for the Environment
7.	Conservation of the Natural Monument, "Two Plane trees," village of Smolare, Municipality of Novo Selo	MoEPP / Agency for the Environment
8.	Doyran Lake Recovery Project (releasing an additional quantity of water into Doyran Lake taken from the alluvial aquifer Gyavato near Bogdantsi)	Budget of the Republic of Macedonia, 2002, Compensation funds / MoEPP
9.	Project for supply and installation of a wastewater treatment plant at the Lead and Zinc Smelting Company in Veles	MoEPP
10.	Industrial complex for the collection, recycling and destruction of hazardous waste	Govt. of the Republic of Macedonia / MoEPP

6.4.6. International projects

No.	Project Description	Funding Source / Implementing Agency
1.	Protection of the Vardar River against pollution with chromium	European Agency for Reconstruction (EAR) / Agency for the Environment
2.	Solid waste management in south-western Macedonia	KfW Group
3.	Wastewater treatment plants in Gevgeliya	Government of the Republic of Greece / Agency for the Environment
4.	Waste management in the region of Gevgeliya (project under negotiation)	Government of the Kingdom of Spain / Agency for the Environment
5.	Regional strategy for hazardous waste management	Government of the Kingdom of the Netherlands / Agency for the Environment
6.	Project for development of national framework for biosafety	GEF/UNEP / Agency for the Environment
7.	Preparation of initial implementation of LEAPs for six municipalities	German Society for Technical Co-operation – a quasi-governmental organisation (GTZ)
8.	Activities related to biological diversity and needs assessments	GEF/World Bank
9.	Office for Ozone Layer Protection – Institutional support (Phase III)	Multilateral Fund of the Montreal Protocol/ United Nations Industrial Development Organization (UNIDO)
10.	Enabling activities for facilitating actions toward the early implementation of the Stockholm Convention on Persistent Organic Polluters (POPs) in the Republic of Macedonia	GEF/UNIDO
11.	PSO Programme/Netherlands assistance/PSO 01/MA/02/13 – Implementation of modernisation of the process of powdered enamelling in the production of boilers	Netherlands (PSO/2002) LEOV Company, Veles
12.	Phare Programme for trans-border cooperation with Greece – Automatic monitoring of water in the Vardar River	Phare ’97 / Hydro-Meteorological Affairs Administration
13.	Monitoring system for the rivers of Macedonia	Governments of Switzerland and the Republic of Macedonia
14.	Integrated management of the ecosystem in the transboundary region of Prespa Park	GEF/KfW Group/other donors / MoEPP (for projects assigned to Macedonia)

15.	Lake Ohrid Conservation Project	GEF/World Bank
16.	Phare (SOP99) – Supply of three fixed automatic monitoring stations for air quality (Kochani, Kumanovo and Kichevo)	EU/EAR
17.	European Environment Information and Observation Network (EIONET)	Agency for the Environment / Macedonian Environmental Information Center (MEIC)
18.	Identification of areas of special conservation interest – Emerald Network	Council of Europe / Agency for the Environment
19.	Phare (COP97)	EU/EAR
20.	RERePP 1.12 (Regional Environmental Reconstruction Programme for South Eastern Europe) – Support for acceptance and implementation of multilateral environmental agreements in south-eastern Europe	Government of the Netherlands
21.	RERePP 1.2 – Assistance in priority investment programmes – development and implementation	EU
22.	RERePP 1.3 – Assistance in the preparation of draft versions of legal acts related to the environment	EU
23.	RERePP 1.4 – Building capacities for Environmental Impact Assessments	EU/US Environmental Protection Agency (USEPA)
24.	RERePP 1.5.1 – Networking of financial and environmental experts in south-eastern Europe	EU
25.	RERePP 1.7 – Strengthening national environmental agencies and their offices for inspection in south-eastern Europe through creation of a regional “Balkan Environmental Regulatory Compliance and Enforcement Network “ (BERCEN)	Government of the Netherlands
26.	RERePP 1.7.1 – Environmental compliance in south-eastern Europe - Environmental compliance inspections in south-eastern Europe for use in comparing their levels of compliance, education/training and equipment resources in order to strengthen the capacities of the national agencies	EU/Phare – Renewal
27.	RERePP 1.8 – Development of National Environmental Information Systems	Government of the Netherlands

28.	RERePP 1.9 - Building capacities within the countries of south-eastern Europe for their approximation to the EU	GTZ
29.	RERePP 1.10 – Regional strategy for hazardous waste in south-eastern Europe	EU
30.	RERePP 2.1 – Regional Environmental Press Center (REPC) – the project is run by an NGO from Macedonia and the Environmental Press Center (EPC)	Government of the Netherlands
31.	RERePP 2.2 – Support for the development of strategies for use in implementing the Aarhus Convention	Government of the Netherlands
32.	RERePP 2.2.1 – Building capacities for implementation of the Aarhus Convention	Government of the Netherlands
33.	RERePP 2.3 – Electronic network of environmental NGOs in south-eastern Europe	Governments of Norway and the Netherlands
34.	RERePP 2.5.2 – Strengthening NGOs in south-eastern Europe	USEPA
35.	RERePP 2.6 – Support for the development of Environmental Legal/Consulting Centres	Government of the Netherlands
36.	Balkan Information Service	USEPA
37.	South Eastern European Environmental NGOs Network (SEEENN)	Regional Environmental Center for Central and Eastern Europe (Government of the Netherlands)/European Commission – Department of the Environment
38.	Enabling the Republic of Macedonia to prepare the First National Communication on Climate Changes as an obligation of the UN Framework Convention on Climate Changes	GEF/United Nations Development Programme (UNDP)
39.	Regional project involving 12 countries – Strengthening capacities for the development of national inventories of green house gases	GEF/UNDP

6.5. Existing financial resources and mechanisms for biodiversity conservation

Mechanisms

The mechanisms for biodiversity conservation are defined within the relevant legal acts. Those acts possessing the appropriate framework or special character regulate the measures and mechanisms for conservation, sustainable use, preservation and restoration of biodiversity by means of investigations, scientific research, proposals, in-situ and ex-situ protection etc. Representative examples include:

- *Law on the Conservation and Promotion of the Environment and Nature*: Article 38 states that in order to provide financial resources and to encourage preventive and undertake restorative measures for protection of the environment and nature, the Fund for the Conservation and Promotion of the Environment and Nature was established within the MoEPP. Revenues from vehicle registration fees flow into this fund, which is then used to finance activities for implementing preventive and restorative measures in all environmental spheres, including biodiversity and habitat conservation, through the national programme corresponding to the NEAP. In addition, in compliance with Article 40 of this law, legal and physical entities registered as pollution generators must also pay an eco-tax to be used for the protection of the environment and nature;
- *Law on the Protection of Natural Rarities*: In addition to regulating the protection of natural rarities, it creates favourable conditions for their maintenance, development and promotion; prevents negative impacts and provides a financial basis for these activities;
- *Law on the Protection of Ohrid, Prespa and Doyran Lakes*: Defines the penalties for disturbing the water regime of the lakes, polluting the water with harmful or hazardous substances, discharging untreated wastewater etc;
- *Law on Hunting*: Makes provisions for monetary penalties for pursuing protected game out of season and for temporary or permanent prohibitions on hunting particular species;
- *Law on Fishing*: Establishes the fines to be paid for fishing in restricted areas (not allowed for use), polluting the water with harmful or hazardous substances which could change or affect the water quality and consequently endanger the fish stocks or other plants or animals and fishing during closed seasons or spawning periods;
- *Law on Forests*: Establishes the fines to be paid for unauthorised timber harvesting, forest destruction, building objects in forests without obtaining the proper permit, polluting forests with household or chemical wastes and cutting rare tree species without permission;
- *Law on Seeds, Seedlings and Materials for Propagation, Recognition, Approval and Protection of Varieties*;
- *Law on Pastures*;
- *Law on Agricultural Land*;
- *Criminal Code of the Republic of Macedonia*: Contains a separate section on criminal activities against the environment which may result in prison sentences.

Resources

Financial resources within the sphere of biological diversity are defined in:

- *Budget of the Republic of Macedonia*: Using its own financing mechanisms, apart from the allocation of budget funds to the relevant ministries, it finances activities that are State priorities in the field of the environment. An example is the Doyran Lake Recovery Project;
- *Budget of the MoEPP*: Includes the financing of activities in certain areas related to the annual work programme of the Ministry. These include the protection of biodiversity and habitats (wetland, terrestrial and forest), as well as spatial planning, among other activities. Funds from the Ministry's budget are also used for research, preparation of feasibility studies, studies related to the implementation of direct protection measures for threatened species and habitats and activities for proclaiming general nature reserves (national parks, strictly protected reserves, scientific-research reserves, sites of special natural character and characteristic landscapes). The category, special nature reserve, includes enclosed areas where specific biocenological, floristic, faunal, geologic and/or hydrologic characteristics are protected. Special nature reserves afford a greater degree of protection for some plant and animal species within the system of nature reserves and natural monuments (based upon floristic and faunal properties and/or other natural phenomena);
- *Fund for the Environment*: Adopts programmes for the financing of projects in environmental conservation, including financing activities for biodiversity and habitat conservation (e.g., conservation of threatened plant and animal species and protection of ecosystems, biotopes etc.). In addition, this fund finances campaigns for raising public awareness about the protection of nature, especially, biodiversity;
- *Budget of the Ministry of Education and Science* and *the Ministry of Culture*: Allocate funds to facilitate the functioning of the institutes that belong to them and have an important role in the protection of biodiversity, monitoring and improvement of habitat quality;
- *Law on Customs*: Provides tax exemptions for imported goods that are intended for environmental and nature protection;
- *Business sphere*: Under the provisions of the laws which regulate disturbances to nature caused by certain types of capital expenditures (and the consequent direct effects to the survival of biodiversity), businesses are obligated to designate funds for prevention or restoration measures.

In the period since 1995, foreign donors have been largely responsible for financing the protection of Macedonian biodiversity, mainly through large-scale projects of international character or through activities arising from obligations as a member State to certain international conventions. The main donors have been: GEF, via the World Bank, UNDP, EU, other bilateral donations and the *Convention on Biological Diversity* through its small grants program.

Positive examples of participation include: Preparation of the *National Environmental Action Plan* of the Republic of Macedonia, financed by the World Bank (1995-1997); Lake Ohrid Conservation Project (GEF/World Bank – 1999-2003); National Biodiversity Strategy (GEF/World Bank – 2001-2003) and Project for Capacity Building within the MoEPP (UNDP – 1999-2001). The EU, through the Phare/CARDS (Community Assistance for Reconstruction) programme, finances projects for the

institutional strengthening of the MoEPP and other bureaus involved in the conservation process and in the preparation of those laws and regulations which, when harmonised with the directives of EU, will give a good basis for the efficient protection of biodiversity. In addition, interest by the governments of Great Britain, Germany, Greece, France and Switzerland in financing projects in this field should be mentioned.

Weaknesses observed

- Insufficient financial allocations to the MoEPP from the budget of the Republic of Macedonia inhibit the ability to perform biodiversity conservation activities;
- The overlap of responsibilities within the governmental structure, as defined by the *Law on Organisation and Operation of Governmental Bodies in the Republic of Macedonia*, results in the inadequate allocation of budget funds to institutions dealing with biodiversity conservation among the various ministries;
- Ambiguous mechanisms in the existing structures and special laws allowing for the financing or self-financing of certain institutions involved in biodiversity conservation;
- Lack of enforcement of existing legal/penal measures and lack of conformance with laws which are already part of the general legal framework regulating biodiversity conservation;
- Inappropriate expenditures of funds earmarked for activities for biodiversity and natural resource conservation which, for various reasons, are instead placed in the general treasury of the Republic of Macedonia.

6.6. Organisations involved in biodiversity conservation and management

6.6.1. Government structures and agencies for biodiversity management

Government of the Republic of Macedonia

The National Committee for Biological Diversity, established by a decision of the government of the Republic of Macedonia as an obligation of the State arising from the *Convention on Biological Diversity*, is composed of twenty distinguished scientists and experts having made significant achievements in the field of biodiversity conservation. Its objectives are to monitor the implementation of the Convention at the national level, and to contribute to the making of quality decisions on biological diversity conservation issues by the MoEPP.

Ministry of Environment and Physical Planning

Agency for the Environment

- Performs professional tasks and supervises protected reserves and natural areas, as well as sources of soil, water and air pollution.
- Proposes expert and technical/technological solutions for the reduction and prevention of pollution and degradation of the environment and nature.
- Prepares professional documents, and measures and monitors the state of and changes to the environment and nature.
- Prepares reports with an adequate interpretation of the results.
- Conducts research at sites with rare, threatened and important tree species.
- Prepares the documentation on the status of special natural heritage sites and makes proposals for new sites.
- Monitors the state of phytocenological diversity.

- Works on projects for the biological conservation of threatened tree species.
- Conducts research in areas of nature having geological values.
- Determines the value of natural resources and prepares necessary documentation.
- Proposes protection measures and the use of natural resources.

State Inspectorate of the Environment
- Supervises compliance with the *Law on the Conservation and Promotion of the Environment and Nature*.

Local Unit of Ohrid Lake Conservation
- Conducts affairs related to the management of the Ohrid Lake Conservation Project and implements regional protection programmes.

Local Unit of Doyran Lake Recovery
- Conducts affairs related to the management of the Doyran Lake Recovery Project and implements regional protection programmes.

Ministry of Education and Science
- The Botanical Institute and its Botanic Garden within the Faculty of Natural Science and Mathematics in Skopye.
- The Hydro-Biological Institute - Ohrid, which performs scientific and related activities, is the competent authority for the monitoring of the status of lakes in the Republic of Macedonia, is responsible for the biological components of the lakes and their promotion and conservation, keeps evidence, and monitors water quality and any changes.

Ministry of Agriculture, Forestry and Water Management
- Hydro-Meteorological Administration
- Veterinary Administration
- Water Management Administration
- Seed and Seedling Administration
- Plant Protection Administration
- State Inspectorate of Agriculture
- State Inspectorate of Forestry and Hunting

Ministry of Culture
- Commission for UNESCO
- Macedonian Museum of Natural History

The Museum was established in 1926 and has several responsibilities, including the normal activities of a museum: collecting, publishing, research, education and pedagogy. It has exhibits related to the areas of mineralogy and petrography, palaeontology, botany, invertebrates, insects, fishes, amphibians, reptiles, mammals and birds.

Ministry of Economy
- Tourist Bureau

Other

- Veterinary Institute
- Institute of Fishing
- Institute of Fishing in Shum/Struga
- Institute of Orchardry

6.6.2. Non-governmental organisations (NGOs)

There are 71 registered NGOs in the Republic of Macedonia with about 33,716 total members, or approximately 500 members per organisation on the average. They are mainly financed by domestic budgets and grants, membership fees and foreign grants. Their priority areas of activity are education in environmental issues, nature protection, public participation, publications and reforestation.

6.6.3. Academic/Research Institutions

- Macedonian Academy of Science and Arts (MANU)
- Faculty of Natural Science and Mathematics - Institute of Biology with the Department of Botany (and the Botanic Garden), Department of Zoology, Department of Physiology and Biochemistry and Institute of Geography.
- Faculty of Forestry
- Faculty of Agriculture
- Faculty of Pharmacology
- Faculty of Veterinary Medicine
- Economic and Social Research Institute

6.6.4. Business and private sector

- National Parks Administration
- Galichitsa National Park Administration
- Mavrovo National Park Administration
- Pelister National Park Administration

These administrations manage the issues related to:

- Study, research and scientific reports on issues related to the protection of national parks;
- Keeping professionally gathered data and documentation on natural and other values and aesthetics of the parks;
- Providing conditions for the use of national parks for scientific, educational, cultural, health, sports and tourist-recreational purposes, without risking the basic characteristics of the parks;
- Undertaking protection measures for certain zones or of specific species in the parks;
- Issuing scientific and professional publications, information and other materials;
- Running campaigns for raising public awareness of the importance of parks, their natural wealth and the ways that they can be preserved.

6.6.5. Community groups

This segment includes:

- Hunting associations and other for-profit organisations registered in the Republic of Macedonia, whose dual role is not only to organise hunting in specific areas but also to care for the game;
- Plant collection centres, which function at a local level and are often profitable, though their role in the sustainable use of natural resources is suspicious.

Structures assessment and efficiency

From the previous sections, it is evident that biological diversity and habitats fall under the jurisdiction and interest of several State bodies, scientific institutes, other institutions and NGOs. Despite the impressive number of institutions involved in biological conservation and management with the Republic of Macedonia, there is a lack of strategic planning that would define a general and long-term biodiversity conservation policy. This lack results in short-term and inadequate solutions which contribute to the loss of the rich biodiversity characteristic for this region. This can be observed through the following:

- Lack of a legal framework to respond to the need for the conservation of biological diversity and natural habitats and their sustainable use;
- Overlap of responsibilities of State administrative bodies;
- Institutes and other institutions with the responsibility for biological diversity monitoring and conservation are not properly situated within the central government hierarchy;
- Inadequate technical equipment and personnel in existing institutes and laboratories dealing with biological diversity monitoring and conservation;
- Insufficiently developed political and public awareness of the need for biodiversity conservation in the context of improving their quality of life;
- A lack of political awareness and reduced economic power of the State resulting in a shortage of financial resources allocated for biodiversity and habitat conservation, reconstruction and development;
- Poor coordination and cooperation between the central government, local governments, the scientific community and the non-governmental sphere towards united biodiversity protection.

Possibilities for new roles

The adoption of the National Biodiversity Conservation Strategy will initiate a reorganisation at a national, local, scientific and non-governmental level. The new legal framework on environmental protection will encourage the establishment of new organisational structures in the government of the Republic of Macedonia and consequently, the reorganisation of institutes and other institutions dealing with biodiversity conservation, as well as restructuring in the scientific sphere and in the private sector. New economic and financial instruments to regulate these issues are expected to be introduced, which will promote a new, more efficient system of protection and financing. NGOs, which are numerous but without significant influence, will be able to organise on a higher level and will draft their basic goals and objectives in compliance with the legal documents; thus, they will expect to be entitled to a stronger influence on decision-making concerning environmental issues.

6.7. Summary of existing measures, capacity and experience for biodiversity management

The measures for biodiversity and habitat conservation are defined in the *National Environmental Action Plan* adopted in January 1997, the *Law on the Conservation and Promotion of the Environment and Nature*, the *Law on the Protection of Natural Rarities, Law on the Protection of Ohrid, Prespa and Doyran Lakes, Law on Spatial and Urban Planning* and in separate spatial plans, all representing legal acts implemented by the MoEPP. Laws implemented by other ministries but pertaining to the field of biodiversity and habitat protection include the *Law on Water*; *Law on Hunting*; *Law on Fishing*; *Law on Forests*; *Law on Seeds, Seedlings and Materials for Propagation, Recognition, Approval and Protection of Varieties*; *Law on Pastures*; *Law on Agricultural Land*; *Law on Protection against Natural Catastrophes* and the *Criminal Code of the Republic of Macedonia.*

The main finding is that the basic capacities for biodiversity management have been established. The MoEPP is already well established to manage the implementation of the basic laws and strategies related to the protection of the environment and biodiversity, through the Agency for the Environment and the local units for Ohrid Lake Conservation and Doyran Lake Recovery. Within the Ministry there is a State Inspectorate of the Environment, which, among other things, deals with supervision of the measures implemented for protection of biodiversity, natural rarities, natural reserves (common and special), individual plant and animal species outside nature reserves and natural monuments.

There are educational and scientific institutions dealing with the study and monitoring of biodiversity and which propose measures of protection, reproduction and selection: Macedonian Academy of Sciences and Arts, University Departments, Hydro-Biological Institute - Ohrid, Macedonian Museum of Natural History, Zoological Garden, Veterinary Institute, Research Laboratory within the Faculty of Agriculture, Botanic Garden within the Faculty of Natural Science and Mathematics, City Museum - Struga etc.

There is joint organisation of the national parks through National Parks and Hunting Sites, and separate Administrations for the three national parks – Galichitsa, Mavrovo and Pelister.

The points enumerated above point to the fact that the foundation for biological diversity protection in the Republic of Macedonia actually exists, but problems are present in the realms of functional structure and organisation. That is, the evident overlap of responsibilities within the governmental bodies influences the implementation of biodiversity protection.

The increasing influence of NGOs towards quality protection measures for biodiversity is a positive trend. The numerous NGOs equally participate in campaigns for strengthening public awareness on the importance of biodiversity and its protection and actually run certain projects for practical protection.

Despite many campaigns conducted by the relevant Ministries and NGOs in order to raise public awareness about the importance of biodiversity protection, there is still a perceived lack of awareness at the desired levels. It appears that the perception of the connection between citizens and natural wealth, which is the necessary ingredient for quality primary conservation, is lacking. This has been particularly emphasised in the

sections of this document on the use of forests, pastures, fish stocks, hunting, medicinal plants, lack of care for protected or endangered areas, associations, species etc.

Although the economic entities are obligated to pay taxes according to the applicable regulations, there is a compliance failure. The frequent cases of avoidance of legal obligations points to an inefficient judiciary.

The experiences in biodiversity management point to the urgent need for new organisation at the governmental level, approximation of legislation with that of the EU, application of the provisions of international agreements in the domain of biological diversity and habitats and application of European and world methodologies and criteria in this realm. These conclusions were reached as a result of experiences gained in projects of international character and operated with foreign assistance.

7. PROBLEM ANALYSIS

7.1. Current loss of, or effects on, biodiversity

The present status of biodiversity in the Republic of Macedonia is a consequence of the environmental conditions in which its components (species and ecosystems) are developing, global changes and anthropogenic impacts.

Aquatic and wetland ecosystems are the most endangered. The assn. *Myriophyllo-Nupharetum* (Doyran Lake) has almost disappeared, whereas assn. *Lemno-Spirodelletum polyrhizae* subassn. *aldrovandetosum* (Prespa Lake) is threatened with extinction.

Relict lowland marsh communities can be found only in a generally fragmented state, with six of them particularly endangered (assn. *Caricetum elatae* subassn. *lysimachietosum* - Ohrid Lake, near Studenchishte; assn. *Cypero-Caricetum acutiformis* - Gostivar; assn. *Glycerietum maximae* - Pelagonia; assn. *Mariscetum* - Negortsi Spa; assn. *Osmundo-Thelipteretum* - Bansko and assn. *Scirpo-Alopecuretum cretici* - Monospitovo Marsh).

With regard to meadows, the most endangered are those associations developing on very wet terrain (assn. *Hordeo-Caricetum distantis* - Gevgeliya and Skopye).

Three communities among the halophytic vegetation are the most endangered, particularly assn. *Camphorosmetum monspeliacae.*

Among forest vegetation, nine forest phytocenoses are endangered: assn. *Aceri heldreichii-Fagetum* - Yakupitsa and Shar Planina Mountains; assn. *Alnetum viridis* - Belasitsa; assn. *Carici elongatae-Alnetum glutinosae* - Polog, Debartsa; assn. *Daphno-Cytisanthetum radiati calcicolum* - Galichitsa and Yablanitsa; assn. *Ephedro-Prunetum tenellae* – Kavadartsi and Lubas; assn. *Juglando-Aesculetum hippocastani* - Suv Dol, near Izvor, and Yablanitsa; assn. *Periploco-Alnetum glutinosae* - Monospitovo Marsh, assn. *Periploco-Fradzinetum angustifoliae-pallisae* - Negortsi Spa and assn. *Tilio cordatae-Fagetum* - Drevenicka Mountain.

Within the lower plant groups**,** the best available knowledge is on phylum Bacillariophyta. Nine species are considered to be extinct and 107 are endangered. As for the Fungi, a Preliminary Red List has been developed, including 67 endangered species from phylum *Basidiomycota* and 12 from Lichens.

Among the higher plant groups, the most endangered group is that of Angiosperms (280-300 endangered species), ferns (15), mosses (20) and Gymnosperms (7). Five species of Gymnosperms are considered to be extinct.

The current faunal diversity of the Republic of Macedonia is facing great pressure resulting from direct and indirect anthropogenic impacts. Thus, as many as 113 vertebrate species are included in the category of threatened species, which is 22.3% of the entire vertebrate fauna (17 are Macedonian endemic species).

Invertebrate faunal diversity suffers from even greater anthropogenic pressure, which leads to a reduction in the populations of large numbers of species and eventually to extinction. Special attention and care needs to be paid to 650 endemic invertebrate taxa, many of which are limited to the three natural lakes (Doyran Lake – 11, Prespa Lake – 18 and Ohrid Lake – 209). The disappearance of these species will represent an immeasurable loss, not only at the national level, but also at a global level.

Despite a large amount of research, there is still not enough information on a large portion of the endemic species concerning the current status of their populations and the direct threats to their survival.

7.2. Direct causes of biodiversity loss

The direct causes of biodiversity loss are many and varied. Most of them are common to all types of biodiversity, while some are specific to either flora, fauna or ecosystems:

- Inadequate management of the waters of aquatic ecosystems.
- Drainage of marshes and swamps.
- Construction of hydropower reservoirs in river gorges.
- Lack of water treatment plants (for riverine and lake ecosystems).
- Mine excavations and other geological works.
- Construction of ski lifts, transmission lines, television transmitters and other antenna systems.
- Loss of habitats (or their parts) during unplanned expansion of urban centres, weekend settlements and tourist-recreation zones.
- Modification of habitats.
- Fragmentation of habitats, due mainly to traffic infrastructure, where highways intersect habitats that are important as vertebrate corridors (particularly for large mammals). When aquatic habitats are artificially fragmented, recommendations for maintaining ecological minimum flows in watercourses are not followed.
- Destruction of areas with natural vegetation (halophytes and meadows).
- Uncontrolled destruction of forests through forest fires, through clearing, in order to provide building land, for the construction of roads and railroads, for the expansion of tourist settlements and through forest desiccation.
- Uncontrolled collection of medicinal plants and wild animals.
- Illegal collection of rare plants (especially endemic plants) by professional and commercial collectors, illegal collection of birds' eggs, certain species of butterflies etc.

7.3. Underlying causes of biodiversity loss

The basic factors which have led to the current unfavourable state of the environment in the Republic of Macedonia in all of its spheres, including biodiversity, include general historical processes, a bad socioeconomic situation, an unstable political situation, inadequate spatial planning and inappropriate land use.

In the desire to accomplish economic development at any cost, a general trend toward the erosion of moral and traditional societal values can be observed, neglecting the principle of sustainable development. Instead, natural resources are used beyond the limits of their sustainability, which produces a real threat of extinction for endangered plant and animal species and varieties, and thus impinges upon traditional rural landscapes. Aiding in this process is the poor awareness by the citizens of Macedonia of the issues surrounding the conservation of national biological resources and the possibilities for their sustainable use. This situation is especially felt within biological communities (wild plants and animals). On the one hand, the State has not developed legal regulations to facilitate the sustainability of populations. On the other, in a rush to achieve quick profits (often by people living at the bare subsistence level), wild species are collected uncontrollably and without any care for their normal reproduction or for environmental impacts resulting from their disappearance.

Several basic reasons for the permanent loss of biological diversity can be distinguished:

- A low level of education and a lack of information, especially in rural areas, which has contributed to a low awareness in the general population of the relationship between human activities and the environment, the sustainable use of biological resources and the sustainable transfer of biotechnology;
- Reduced and unstable economic power of the State, in addition to the military actions that have been rocking the region for a long period of time;
- Growing poverty, which does not recognise the principles of sustainable development, is manifesting itself through illegal forest and other resource overuse, hunting and fishing overuse, non-sustainable development of agriculture etc.;
- Inadequate and incomplete legislation which fails to clarify duties or avoid the overlap of responsibilities and competencies within the agencies responsible for enforcement;
- Non-compliance with existing regulations;
- Lack of spatial planning regulations for areas with special natural values;
- Uncontrolled urbanisation, deagrarianisation (in the traditional sense) and industrialisation are the main processes that disturb the environmental balance (considering the cumulative effects of pollution);
- The continual process of migration of the population from villages to towns. Increased concentrations of people in urban centres represent a growing problem not only from a global, socioeconomic aspect but also from a spatial aspect;
- Stagnation of the economy and use of outdated technologies, poor quality of energy sources resulting from low economic power and lack of treatment of wastewater and waste gases, which leads to deterioration of the air, soil, surface water and groundwater quality;
- Outdated spatial planning with insufficient continuity, improper land use changes, construction of infrastructure systems and previous agricultural conversion;
- The process of earning a profit under highly competitive market conditions, the permanent trend toward globalisation and the favouring of newer, more profitable varieties which have fully supplanted the indigenous, low producing and/or less profitable genetic types.

7.4. Key sectors affecting biodiversity

On the basis of the analysis of data in Section 5., a preliminary ranking of the main economic sectors can be made in accordance with their effect on biodiversity:

- Agriculture was particularly adversely affected in the decades after World War II. Most of the marshes and swamps were drained, and arable land was expanded into other natural habitats without regard for their importance. Another serious threat to biodiversity was the enlargement of agricultural land surfaces during the period of nationalisation, when the areas of natural vegetation at the edges of cultivated fields were destroyed. This, in turn, led to a loss of important biocorridors. In more recent times, the reduction of agricultural activities in rural (especially hilly) areas has contributed to the full degradation of the centuries-old appearance of the Macedonian landscape.

- The reduction of livestock and the gradual abandonment of traditional practices of cattle management (i.e., widespread grazing in favour of feedlots). This practice reduces the amount of carrion in the environment and may have already led to the extinction of two vulture species.
- Fishing is a serious threat to fish diversity, especially in Ohrid Lake.
- In the transport sector, habitat fragmentation is an important threat to many mammals, especially large ones. It has been the norm to use the cheapest proposed alternative and abandon the ones that are the most appropriate for the undisturbed existence of wild species.
- Energy sector - from several aspects, such as environmental pollution, construction of hydropower reservoirs and transmission of energy.
- Industry and mining rank high on this list. Environmental pollution caused by industry has declined over the past several years due to the reduction of the capacity of industrial plants; however, in individual cases, pollution is growing as a result of the use of low-quality fuels and non-functioning treatment systems - both a result of a lack of financial resources. This sector causes the degradation of soils over large areas through the activities of surface mining, slag deposits, technological waste from smelting and energy complexes, industrial landfills of harmful and dangerous wastes and failure to reclaim abandoned mining areas and landfills. Systems for the treatment of waste gases and communal and industrial water do not exist and, consequently, the quality of surface waters and groundwater worsens.
- Tourism, especially through illegal weekend settlements and unsolved communal infrastructure in the main tourist lake and mountain centres. An important aspect is the inappropriate behaviour of tourists when outdoors due to their low awareness of natural sustainability.
- Civil engineering, through the use of highly productive agricultural land for non-agriculture-related purposes, especially near cities and towns, and through the abandonment of cultivated lands, resulting in a loss of agricultural production. Even so, this sector can not be ranked highly.

7.5. Constraints to conservation

- A lack of a strategy for high quality conservation of biological diversity.
- The *National Environmental Action Plan* is now outdated.
- Legislation is not harmonised with that of the EU.
- Insufficient implementation of the existing legislation on biological diversity.
- Inefficient inspections.
- Inefficient judicial system.
- Implementation of the provisions of the signed and ratified conventions related to biodiversity is insufficient.
- Implementation of the principle of sustainable development and sustainable use of natural resources is neglected.
- Responsibilities overlap within the governmental Ministries of the Republic of Macedonia.
- Long-term and short-term plans with defined priorities for activities leading to biodiversity conservation do not exist.
- Continuous monitoring of biological diversity and habitats harmonised with European and world standards does not exist.

- Institutes and laboratories dealing with these issues are detached and lack appropriate technical equipment and personnel.
- Unique data bank on the biological diversity of Macedonia, with an analysis of impacts leading to the increase or reduction of its availability does not exist.
- Registers (Red Books) of endangered plant and animal species do not exist.
- Literature on biological diversity is insufficiently available.
- Transparency among the government sector, science, non-government sector and economy is low.
- Efforts of NGOs in the field of biological diversity are insufficient, in spite of their increasing number.
- Knowledge and education of the public is unsatisfactory.
- Shortage of financial resources for developing activities for biodiversity conservation and promotion.
- Lack of interest within the international community for investing in biological diversity conservation due to insufficient information and lack of engagement by the Macedonian government in these matters.
- Insufficient implementation of science in practical conservation of biodiversity.
- Failure to conduct strong supervision and law enforcement in the conservation of biodiversity.
- Incomplete education and instruction of the younger generation or poor coverage of the principles of biodiversity in the educational process.
- The relationship between citizens and natural wealth, which is the necessary ingredient for quality primary conservation, is not properly developed.
- Daily political impacts and politicisation of environmental issues on the whole.

7.6. Opportunities for conservation

In the framework of the already established mechanisms, there are certain factors aimed at further extension of the scope and efficiency of biodiversity conservation in the Republic of Macedonia. Some of them are:

- Development of legal and strategic documents on biodiversity;
- Approximation of the national legislation to that of the EU and other international conventions;
- Inclusion of biodiversity conservation within the spatial planning process;
- Increase in the number of projects in the sphere of biodiversity study and conservation, financed by international and national sources;
- Strengthening of the MoEPP, as well as the accompanying scientific and professional institutions;
- Strengthening of the cooperation between the MoEPP, NGOs and scientific institutions;
- Continuing the increase in scientific work in the field of taxonomy of plant and animal groups in the Republic of Macedonia;
- Improving education about ecological concepts at all levels of instruction (primary, secondary and university) and increasing research in the understanding of ecological relationships between plants, animals and their habitats and ecosystems. Conservation of species is impossible without an understanding of their habitats.

ANNEXES

ANNEX 1
Endemic species of flora in the Republic of Macedonia

Table 1. List of endemic Algae.

No.	Scientific Name
	CYANOPHYTA
1.	*Anabaena hallensis* Jancz *var. campaniensis* Petkov
2.	*Anabaena polinis* Stojanov
3.	*Calothrix inaequabilis* Cado
4.	*Camptylonema umidum* Cado
5.	*Hydrocoleus stankovici* Cado
6.	*Lyngbia martensiana* Meneghini fo. *Macedonica* Cado
7.	*Lyngbia nigra* Agardh fo. *lichnida* Cado
8.	*Microcoleus ivlevii* Cado
9.	*Oscilatoria anguna* (Bory) Gom. fo. *tenuis* Petrovska
10.	*Oscillatoria animalis* Agardh fo. *violacea* Petrovska
11.	*Oscillatoria curviceps* Agardh fo. *tenuis* Petrovska
12.	*Oscillatoria ornata* (Kützing) Gom. fo. *tenuis* Petrovska
13.	*Oscillatoria tenuis* Agardh var. *valadovensis* Petrovska
14.	*Phormidium ercegovici* Cado
15.	*Phormidium gelatinosum* Woronich. fo. *ochridana* Cado
16.	*Phormidium macedonicum* Cado
17.	*Phormidium purpurascens* (Kützing) Gom. fo. *ochridiana* Cado
18.	*Phormidium undosum* Cado
19.	*Plectonema spelaeoides* Cado
20.	*Rhabdoderma sigmoidea* N. Carter fo. *macedonica* Cado
21.	*Rivularia lapidosa* Cado
22.	*Synechococcus elongatus* Naegeli var. *vestitus* Corp. fo. *maximus* Petrovska
23.	*Synechococcus vulcanus* Naegeli *var. bacillaroides* Corp. fo. *Incrustrans* Petrovska
	PYRROPHYTA
1.	*Cystodinium dominii* Fott
	CHRYSOPHYTA
1.	*Diceras ohridana* Fott
2.	*Stylopyxis Stankocicii* Fott
	BACILLARIOPHYTA
1.	*Achnanthes clevei* Grunow *var. balcanica Hustedt*
2.	*Amphora ovalis* (Kützing) Kützing var. *elongata* Jurilj
3.	*Amphora transsylvanica* (Pantocsek) Jurilj
4.	*Caloneis macedonica* Hustedt
5.	*Caloneis silicula* (Ehrenberg) Cleve fo. *recta* Jurilj
6.	*Caloneis silicula* (Ehrenberg) Cleve *var. paralella* Jurilj
7.	*Campylodiscus cadoi* Jerkovic
8.	*Campylodiscus echinatus* Jurilj
9.	*Campylodiscus hibernicus* Ehrenberg var.*transsylvanicus* (Pantoscek) Jurilj
10.	*Campylodiscus juriljii* Jerkovic
11.	*Campylodiscus marginatus* Jurilj
12.	*Campylodiscus marginatus* Jurilj var. *rudis* Jurilj
13.	*Campylodiscus marginatus* Jurilj var. *tenuis* Jurilj
14.	*Campylodiscus noricus* Ehrenberg fo. *quadratus* Stojanov
15.	*Campylodiscus pervusus* Jurilj
16.	*Campylodiscus spinosus* Jurilj
17.	*Campylodiscus striatus* Jurilj

18.	*Cocconeis robusta* Jurilj
19.	*Cyclotella bifacialis* Jurilj
20.	*Cyclotella fottii* Hustedt
21.	*Cyclotella hustedtii* Jurilj
22.	*Cyclotella petrovskae* (Jerkovic) Stojanov
23.	*Cyclotella thiemanii* Jurilj
24.	*Cyclotella thinemanni* Jurilj var. *minuscula* Jurilj
25.	*Cyclotella verrucosa* (Jerkovic) Cado
26.	*Cymatopleura solea* (Brébisson) W.Smith var. *obtusata* Jurilj
27.	*Cymbella juriljii* Stojanov
28.	*Diploneis budayana* (Pantocsek) Jurilj
29.	*Diploneis budayana* (Pantocsek) Jurilj *var. punctata* Jurilj
30.	*Diploneis heisingeriae* Jurilj
31.	*Diploneis modica* Hustedt
32.	*Diploneis ostracodarum* (Pantocsek) Jurilj
33.	*Diploneis ostracodarum* (Pantocsek) Jurilj var. *elongata* Jurilj
34.	*Diploneis praeclara* (Pantocsek) Jurilj
35.	*Diploneis praeclara* (Pantocsek) Jurilj var. *densa* (Pantocsek) Jurilj
36.	*Diploneis tavcarii* Jurilj
37.	*Epithemia lunata* Jurilj
38.	*Epithemia lunata* Jurilj var. *obesa* Jurilj
39.	*Epithemia zebra* (Ehrenberg) Kützing var. *fracta* Jurilj
40.	*Gomphoneis transsilvanica* (Pantocsek) Krammer
41.	*Gomphonema angustatum* (Kützing) Rabenhorst var. *linearis* (Hustedt) Jurilj
42.	*Gomphonema augur* Ehrenberg fo. *obesum* Stojanov
43.	*Gomphonema irroratum* Hustedt
44.	*Gomphonema macedonicum* Hustedt
45.	*Gomphonema olivaceum* (Hornemann) Brébisson var. *capitata* Jurilj
46.	*Gomphonema olivaceum* (Hornemann) Brébisson var. *fonticola* Hustedt
47.	*Helissella glabra* Jurilj [syn.: *Surirella helisela* Jurilj]
48.	*Klinodiscus obliquus* Jurilj
49.	*Iconella variabilis* Jurilj [*syn. Surirella iconella* Jurilj]
50.	*Navicula acuta* Stojanov
51.	*Navicula arvensoides* Hustedt
52.	*Navicula gracilis* Ehrenberg fo. *parvulo-undosa* Cado
53.	*Navicula hastata* Jurilj
54.	*Navicula inclinata* Hustedt
55.	*Navicula jakovljevici* Hustedt
56.	*Navicula modica* Hustedt
57.	*Navicula mollicula* Hustedt
58.	*Navicula ochridana* Hustedt
59.	*Navicula perturbata* Jurilj
60.	*Navicula praeterita* Hustedt
61.	*Navicula rotunda* Hustedt
62.	*Navicula rotundata* Hustedt
63.	*Navicula scutelloides* W. Smith ex Gregory var. *tenuis* Jurilj
64.	*Navicula subgastriformis* Hustedt
65.	*Navicula submitis* Hustedt
66.	*Navicula submuralis* Hustedt
67.	*Navicula subrotunda* Hustedt
68.	*Navicula subrotundata* Hustedt
69.	*Neidium dubium* (Ehrenberg) Cleve var. *maius* Jurilj
70.	*Nitzschia gradifera* Hustedt
71.	*Nitzschia speciosa* Hustedt
72.	*Pinnularia nobilis* Ehrenberg var. *macedonica* Stojanov

73.	*Pinnularia viridis* (Nitzsch) Ehrenberg fo. *areata* Jurilj
74.	*Pinnularia viridis* (Nitzsch) Ehrenberg fo. *brevis* Jurilj
75.	*Scoliodiscus costatus* Jurilj [syn. *Plagiodiscus costatus* Jurilj]
76.	*Scoliodiscus echinatus* Jurilj [syn. *Plagiodiscus echinatus* Jurilj]
77.	*Scoliodiscus glaber* Jurilj [syn. *Plagiodiscus glaber* Jurilj]
78.	*Spirodiscus obesus* Jurilj
79.	*Spirodiscus spiralis* Jurilj
80.	*Stauroneis lychnidis* Jurilj
81.	*Stauroneis smithii* Grunow var. *elliptica* Hustedt
82.	*Surirella biseriata* Brébisson var. *lineopunctata* Jurilj
83.	*Surirella costata* Jurilj [syn. *Surirella cincta* Jurilj]
84.	*Surirella imbuta* Jurilj
85.	*Surirella rotunda* Jurilj
	EUGLENOPHYTA
1.	*Leptocinclis plana* Fott
	CHLOROPHYTA
1.	*Closterium macedonicum* Petkov
2.	*Cosmarium planctonicum* Petkov
3.	*Cosmarium strugense* Petkov
4.	*Cosmarium subprotumidum* Nordstedt var *peristerii* Petkov
5.	*Didymogenes dubia* Fott
6.	*Dispora vilhelmii* Fott
7.	*Lagerheimia dofleinii* Schröder
8.	*Oocystis rhomboidea* Fott
9.	*Spirogyra drilonensis* Petkov
10.	*Staurastrum brevispina* Brébisson var. *prespanse* Petkov
11.	*Staurastrum hantzschii* Reinsch var. *major* Petkov
12.	*Staurastrum macedonicum* Petkov
13.	*Staurastrum ochridense* Petkov
14.	*Staurastrum paradoxum* Mayer var. *osceolense* Wolle fo. *biradiata* Georgevitch
15.	*Staurastrum pilealum* Delp. var. *ressenense* Petkov
16.	*Staurastrum unguiferum* Turner var. *prespanese* Petkov
	CHAROPHYTA
1.	*Chara ohridana* Kostic

Table 2. List of endemics of the higher plant groups.

No.	Scientific Name
	BRYOPSIDA
	MUSCI
1.	*Melichopheria paradoxa* Herzog
2.	*Orthotrichum insiduosum* Herzog
	FILICINAE
1.	*Asplenium macedonicum* Kumm.
	ANGIOSPERMAE
	DICOTYLEDONAE
1.	*Alchemilla peristerica* Pawl.
2.	*Alkanna noneiformis* Griseb.
3.	*Alkanna pulmonaria* Griseb.
4.	*Allysum skopjensis* Micev.
5.	*Alyssum bargalense* Micev.

6.	*Alyssum debarensis* Micev.
7.	*Alyssum gevgelicensis* Micev.
8.	*Alyssum kavadarensis* Micev.
9.	*Alyssum serpentinum* Micev.
10.	*Armeria vandasii* Hayek
11.	*Astragalus cernjavskii* Stoj.
12.	*Astragalus gracanini* Micev.
13.	*Astragalus mariovoensis* Micev.
14.	*Bupleurum mayeri* Micev.
15.	*Centaurea cylindrocephala* Bornm.
16.	*Centaurea demirkapiensis* Micev.
17.	*Centaurea formanekii* Hal.
18.	*Centaurea galicicae* Micev.
19.	*Centaurea grbavacensis* (Rohl.) Stoj. et Stef.
20.	*Centaurea kavadarensis* Micev.
21.	*Centaurea kozjakensis* Micev.
22.	*Centaurea leucomalla* Bornm.
23.	*Centaurea marmorea* Bornm. et Soška
24.	*Centaurea rufidula* Bornm.
25.	*Centaurea skopjensis* Micev.
26.	*Centaurea soskae* Hayek ap. Koš.
27.	*Centaurea tomorosii* Micev.
28.	*Centaurea trescana* Micev.
29.	*Centaurea wagenitzii* Micev.
30.	*Centaurea wetsteini* Degen & Dörfl.
31.	*Corydalis zetterlandii* Lind.
32.	*Crataegus incana* Dzekov
33.	*Crataegus sericea* Dzekov
34.	*Dianthus galicicae* Micev.
35.	*Dianthus jablanicensis* Micev.
36.	*Dianthus jacupicensis* (Koš.) Mic.
37.	*Dianthus jugoslavicus* Micev.
38.	*Dianthus kajmaktzalanicus* Micev.
39.	*Dianthus kapinensis* Markg. et Lindtn.
40.	*Dianthus macedonicus* Micev.
41.	*Dianthus ochridanus* Micev.
42.	*Dianthus prilepensis* Micev.
43.	*Dianthus skopjensis* Micev.
44.	*Dianthus vodnensis* Micev.
45.	*Edrayanthus horvatii* Lakuš.
46.	*Ferulago macedonica* Mic. et Mayer
47.	*Genista fukarekiana* Micev.
48.	*Hedysarum macedonicum* Bornm.
49.	*Helichrysum zivojinii* Cernj. et Soška
50.	*Heptaptera macedonica* (Bornm.) Tutin
51.	*Hesperis macedonica* Adam.
52.	*Hypericum dimoniei* Vel.
53.	*Knautia caroli-rechingeri* Micev.
54.	*Laserpitium ochridanum* Micev.
55.	*Micromeria kosaninii* Šilic
56.	*Moehringia minutiflora* Bornm.
57.	*Nepeta ernesti-mayeri* Dikl. et Nikolic
58.	*Nepeta macedonica* Micev.
59.	*Onobrychis degenii* Dörfler
60.	*Pedicularis ferdinandii* Bornm.

61.	*Potentilla macedonica* Micev.
62.	*Potentilla pletvarensis* Micev.
63.	*Potentilla suskalovicii* Adam.
64.	*Potentilla topolkae* Micev.
65.	*Potentilla tridentula* Vel.
66.	*Potentilla velenovskyi* Hayek
67.	*Salvia jurisicii* Košan.
68.	*Sambucus deborensis* Koš.
69.	*Satureja adamovicii* Šilic
70.	*Satureja formanekiana* Šilic
71.	*Saxifraga grisebachii* Degen et Dörfl.
72.	*Saxifraga karadzicensis* (Degen. et Koš.) Bornm.
73.	*Scrophularia emi* Penzes
74.	*Sempervivum galicicum* Micev.
75.	*Sempervivum klepae* Micev.
76.	*Sempervivum octopodes* Turr.
77.	*Sempervivum thompsonianum* Wale
78.	*Seseli vandasii* Hayek
79.	*Silene horvatii* Micev.
80.	*Silene paeoniensis* Bornm.
81.	*Silene prilepensis* Micev.
82.	*Silene schmuckeri* Wettst.
83.	*Silene viscariopsis* Bornm.
84.	*Stachys babunensis* Micev.
85.	*Stachys macedonica* Micev.
86.	*Taraxacum apiculatoides* Malecky
87.	*Thesium macedonicum* Hendr.
88.	*Thymus alsarensis* Ronn.
89.	*Thymus karadzicensis* Matev. et Micev.
90.	*Thymus oehmianus* Ronn. et Soška
91.	*Thymus skopjensis* Micev. et Matev.
92.	*Tragopogon kindigeri* Adam.
93.	*Verbascum adenantum* Bornm.
94.	*Verbascum chrysanthum* Murb.
95.	*Verbascum herzogi* Bornm.
96.	*Verbascum lesnovoensis* Micev.
97.	*Verbascum macedonicum* Koš. et Murbeck
98.	*Verbascum pachyurum* Bornm.
99.	*Veronica kindlii* Adam.
100.	*Viola allchariensis* Beck
101.	*Viola arsenica* Beck
102.	*Viola babunensis* Erben.
103.	*Viola bornmulleri* Erben
104.	*Viola gostivarensis* (W. Becker et Bornm.) Bornm.
105.	*Viola halacsyana* Deg. et Dorfl. (*V. allchariensis x arsenica*)
106.	*Viola herzogi* Bornm.
107.	*Viola ivonis* Erben
108.	*Viola schariensis* Erben
109.	*Viola slavikii* Form.
	MONOCOTYLEDONAE
1.	*Aira scoparia* Adam.
2.	*Anthoxanthum pauciflorum* Adam.
3.	*Colchicum macedonicum* Košanin
4.	*Tulipa marianae* Lindtn.
5.	*Tulipa scardica* Bornm.

ANNEX 2
Endemic species of fauna in the Republic of Macedonia

Phylum Protozoa

No.	Scientific name	Restricted to			
		Ohrid Lake	Prespa Lake	Doyran Lake	Other Localities
	Sarcodina – Rhizopoda				
1.	*Centropyxis ohridensis* Golemanski, 1967	+			
2.	*Psammonobiotus communis* Golemanski, 1967	+			
	Ciliophora				
1.	*Anoplophrya cavernosa* Georgevic, 1941	+			
2.	*Anoplophrya longinuclea* Georgevic, 1941	+			
3.	*Anoplophrya ochridensis* Georgevic, 1941	+			
4.	*Anoplophrya pelmatoida* Georgievic, 1941	+			
5.	*Anoplophrya pilosa* Georgevic, 1941	+			
6.	*Anoplophrya stromboides* Georgevic, 1941	+			
7.	*Anoplophrya tchadoi* de Puytorac, 1957	+			
8.	*Butschliella longicollis* Georgievic, 1941	+			
9.	*Butschliella subaculeata* Georgevic, 1941	+			
10.	*Cotylothigma heidenreichi* de Puytorac, 1957	+			
11.	*Cotylothigma limnodrili* Meier,	+			
12.	*Georgevitchiella aculeata* Georgevic, 1941	+			
13.	*Hoplitophrya georgievitchi* de Puytorac, 1957	+			
14.	*Intoshellina macrogongylos* de Puytorac, 1957	+			
15.	*Intoshellina sapkarevi* de Puytorac, 1957	+			
16.	*Juxtaradiophrya ocevskii* de Puytorac, 1957	+			
17.	*Juxtaradiophrya ohridana* de Puytorac, 1957	+			
18.	*Maupasella criodrili* Heid,	+			
19.	*Metalostomum ochridense* Georgevic, 1941	+			
20.	*Metaradiophrya criodrili* Georgevic, 1950	+			
21.	*Ochridanus kozarovi* de Puytorac, 1957	+			
22.	*Ochridanus ocellatus* Georgevic, 1950	+			
23.	*Protoradiophryopsis ochridensis* Georgievic, 1941	+			
24.	*Ptychostomum jirilomi* de Puytorac, 1957	+			
25.	*Ptychostomum meieri* de Puytorac, 1957	+			
26.	*Ptychostomum ochridanus* de Puytorac, 1957	+			
27.	*Ptychostomum stankovici* de Puytorac, 1957	+			
28.	*Radiophrya ohridana* de Puytorac, 1957	+			
29.	*Radiophrya pachycallima* Georgevic, 1941	+			
30.	*Radiophrya pachycallima* Georgievic, 1941	+			

Total number of endemic taxa of the Phylum Protozoa	32

Phylum Porifera

No.	Scientific name	Restricted to			
		Ohrid Lake	Prespa Lake	Doyran Lake	Other Localities
	Poriphera				
1.	*Eunapius carteri dojranensis* Hadzisce, 1953			+	
2.	*Ochridospongia interlithonis* Gilbert & Hadzisce, 1982	+			
3.	*Ochridospongia rotunda* Arndt, 1937	+			
4.	*Ochridospongilla stankovici* Gilbert & Hadzisce, 1982	+			
5.	*Spongilla prespensis* Hadzisce, 1953		+		
6.	*Spongilla stankovici* Arndt, 1939	+			

Total number of endemic taxa of the Phylum Porifera	6

Phylum Plathelminthes

No.	Scientific name	Restricted to			
		Ohrid Lake	Prespa Lake	Doyran Lake	Other Localities
	Tricladida (Plathelminthes: Turbellaria)				
1.	*Dendrocoelum adenodactylosum* (Stankovic & Komarek, 1927)	+	+		
2.	*Dendrocoelum albidum* Kenk, 1978	+			
3.	*Dendrocoelum cruciferum* (Stankovic, 1960)	+			
4.	*Dendrocoelum decoratum* Kenk, 1978	+			
5.	*Dendrocoelum dorsivittatum* Kenk, 1978	+			
6.	*Dendrocoelum jablanicensis* Stankovic & Komarek, 1927				+
7.	*Dendrocoelum komareki* (Stankovic, 1935)	+			
8.	*Dendrocoelum lacustre* (Stankovic, 1932)	+			
9.	*Dendrocoelum lychnidicum* (Stankovic, 1969)	+			
10.	*Dendrocoelum maculatum* (Stankovic & Komarek, 1927)	+			
11.	*Dendrocoelum magnum* (Stankovic, 1969)	+			
12.	*Dendrocoelum minimum* Kenk, 1978	+			
13.	*Dendrocoelum ochridense* (Stankovic & Komarek, 1927)	+			
14.	*Dendrocoelum porfirevi* Krstanovski, 1994	+			
15.	*Dendrocoelum prespense* (Stankovic**,** 1969)		+		
16.	*Dendrocoelum sanctinaumi* (Stankovic & Komarek, 1927)	+			
17.	*Dendrocoelum sapkarevi* Krstanovski, 1994	+			
18.	*Dendrocoelum sinisai* Kenk, 1978	+			
19.	*Dendrocoelum tockoi* Krstanovski, 1994	+			
20.	*Dendrocoelum translucidum* (Stankovic, 1978)	+			
21.	*Phagocata macedonica* (Stankovic, 1938)				+
22.	*Phagocata maculata* (Stankovic, 1938)	+			
23.	*Phagocata ochridana* (Stankovic & Komarek, 1927)	+			
24.	*Phagocata stankovici* (Reisinger, 1960)	+			
25.	*Phagocata undulata* (Stankovic, 1960)	+			

Rhabdocoela (Plathelminthes: Turbellaria)					
1.	*Castrada ochridense* An Der Lan, 1939	+			
2.	*Castradella unidentata* An Der Lan, 1939	+			
3.	*Dalyellia minima* An Der Lan, 1939	+			
4.	*Jovanella balcanica* An Der Lan, 1939	+			
5.	*Macrostomum leptos* An Der Lan, 1939	+			
6.	*Mesovortex stankovici* An Der Lan, 1939	+			
7.	*Opistomum macedonicum* An Der Lan, 1939	+			
8.	*Proamphibolella simplex* An Der Lan, 1939	+			
9.	*Proamphibolella st.naumi* An Der Lan, 1939	+			
10.	*Promacrostomum paradoxum* An Der Lan, 1939	+			

Total number of endemic taxa of the Phylum Plathelminthes	35

Phylum Nemathelminthes

No.	Scientific name	Restricted to			
		Ohrid Lake	Prespa Lake	Doyran Lake	Other Localities
Nematoda (Nemathelminthes)					
1.	*Neochromadora trilineata* (Schneider, 1940)	+			
2.	*Punctodora ochridensis* (Schneider, 1940)	+			
3.	*Theristus subsetosus* (Schneider, 1940)	+			

Total number of endemic taxa of the Phylum Nemathelminthes	3

Phylum Mollusca

No.	Scientific name	Restricted to			
		Ohrid Lake	Prespa Lake	Doyran Lake	Other Localities
Aquatic Gastropods (Mollusca: Gastropoda)					
1.	*Acroloxus improvisus* Polinski, 1929	+			
2.	*Acroloxus macedonicus* Hadžišce, 1956	+			
3.	*Ancylus lapicidus* Hubendick, 1960	+			
4.	*Ancylus scalariformis* Stankovic & Radoman, 1953	+			
5.	*Ancylus tapirulus* Polinski, 1929	+			
6.	*Baglivia karamani* Kuščer, 1937				+
7.	*Bythinella drimica drimica* Radoman, 1976				+
8.	*Chilopyrgula sturanyi* Brusina, 1896	+			
9.	*Dolapia ornata* (Radoman, 1956	+			
10.	*Ginaia munda munda* (Sturany, 1894)	+			
11.	*Ginaia munda sublitoralis* Radoman, 1978	+			

12.	*Gocea ohridana* Hadžišce, 1956	+			
13.	*Graecoanatolica macedonica* Radoman & Stankovic, 1978			+	
14.	*Grossuana serbica macedonica* Radoman, 1973				+
15.	*Grossuana serbica scupica* Radoman, 1973				+
16.	*Gyraulus (Gyraulus) albidus* Radoman, 1953	+			
17.	*Gyraulus (Gyraulus) crenophilus* Hubendick & Radoman, 1959	+			
18.	*Gyraulus (Gyraulus) fontinalis* Hubendick & Radoman, 1959	+			
19.	*Gyraulus (Gyraulus) lychnidicus* Hesse, 1928	+			
20.	*Gyraulus (Gyraulus) paradoxus* Sturany, 1928	+			
21.	*Gyraulus (Gyraulus) stankovici* Hadžišce, 1953		+		
22.	*Gyraulus (Gyraulus) trapezoides* Polinski, 1929	+			
23.	*Horatia macedonica* (Kuščer, 1936)				+
24.	*Horatia novoselensis* Radoman, 1966				+
25.	*Iglica macedonica* Karaman, 1935				+
26.	*Limnaea (Radix) pinteri* Schütt, 1974		+		
27.	*Lyhnidia gjorgjevici* Hadžišce, 1956	+			
28.	*Lyhnidia hadzii* Hadžišce, 1956	+			
29.	*Lyhnidia karamani* Hadžišce, 1956	+			
30.	*Lyhnidia stankovici* Hadžišce, 1956	+			
31.	*Lyhnidia sublitoralis* (Radoman, 1967)	+			
32.	*Lymnaea relicta* Polinski, 1929	+			
33.	*Macedopyrgula pavlovici* (Polinski, 1929)	+			
34.	*Macedopyrgula wagneri* (Polinski, 1929)	+			
35.	*Micromelania relicta* Kuščer, 1937				+
36.	*Micropyrgula stankovici* Polinski, 1929	+			
37.	*Neofossarulus stankovici* Polinski, 1929	+			
38.	*Ohridohauffenia depressa* (Radoman, 1965)	+			
39.	*Ohridohauffenia drimica* (Radoman, 1964)				+
40.	*Ohridohauffenia minuta* (Radoman, 1955)	+			
41.	*Ohridohauffenia rotonda* (Radoman, 1964)	+			
42.	*Ohridohauffenia sanctinaumi* Radoman, 1964	+			
43.	*Ohridohauffenia sublitoralis* (Radoman, 1962)	+			
44.	*Ohridohoratia carinata* (Radoman, 1956)	+			
45.	*Ohridohoratia pygmaea* (Westerlund, 1902)	+			
46.	*Ohridopyrgula macedonica charensis* Radoman, 1978	+			
47.	*Ohridopyrgula macedonica macedonica* (Brusina, 1896)	+			
48.	*Ohrigocea karevi* Hadžišce, 1956	+			
49.	*Ohrigocea miladinovorum* Hadžišce, 1956	+			
50.	*Ohrigocea samuili* Hadžišce, 1956	+			
51.	*Ohrigocea stankovici* Hadžišce, 1956	+			
52.	*Orientalina curta kicavica* Radoman, 1973				+
53.	*Parabythinella macedonica* Hadžišce, 1958		+		
54.	*Planorbis (Crassiplanorbis) presbensis* Sturany, 1894		+		
55.	*Planorbis (Planorbis) macedonicus* Sturany, 1894	+			
56.	*Polinskiola polinskii* (Radoman, 1960)	+			
57.	*Polinskiola sturanyi* (Westerlund, 1902)	+			
58.	*Prespiana lacustris* Radoman, 1973		+		
59.	*Prespolitorea valvataeformis* Radoman, 1973		+		
60.	*Prespopyrgula prespaensis* (Urbanski, 1939)		+		
61.	*Pseudohoratia brusinae* (Radoman, 1953)	+			
62.	*Pseudohoratia lacustris* (Radoman, 1964)	+			
63.	*Pseudohoratia ohridana* (Polinski, 1929)	+			
64.	*Pyrgohydrobia grochmalickii* (Polinski, 1929)	+			
65.	*Pyrgohydrobia jablanicensis* Radoman, 1955	+			
66.	*Pyrgohydrobia sanctinaumi* Radoman, 1955	+			

67.	*Stankovicia baicaliformis* Polinski, 1939	+			
68.	*Strugia ohridana* Radoman, 1973	+			
69.	*Trachyohridia filocincta* Polinski, 1939	+			
70.	*Valvata (Cincinna) stenoterma* Polinski, 1929	+			
71.	*Valvata (Costovalvata) hirsutecostata* Polinski, 1929	+			
72.	*Valvata (Costovalvata) rhabdota* Sturany, 1894	+			
73.	*Valvata (Ohridotropidina) relicta* Polinski, 1929	+			
74.	*Xestopyrgula dybowskii* Polinski, 1929	+			
75.	*Zaumia kusceri* Hadžišce, 1956	+			
76.	*Zaumia sanctizaumi* (Radoman, 1964)	+			

Terrestrial Gastropods (Mollusca: Gastropoda)					
1.	*Delima dofleini* Wagner, 1928				+
2.	*Delima perstriata* Wagner, 1919				+
3.	*Delima platistoma* (Kust., 1847)				+
4.	*Deroceras turcicum* (Simroth, 1894)				+
5.	*Gyralina (Gyralina) mirabilis* Pinter & Riedel, 1973				+
6.	*Gyralina (Gyralina) rempei* Guttenberger, 1975				+
7.	*Gyralina (Gyralina) velkovrhi* Riedel, 1984				+
8.	*Gyralina (Spelaeopatula) gyralinaeformis* (Riedel, 1976)				+
9.	*Gyralina (Spelaeopatula) korabensis* (Riedel, 1973)				+
10.	*Laciniaria rebeli* (Sturany, 1897)				+
11.	*Lehmania bruneri* (Wagner, 1931)				+
12.	*Lehmania szigethyae* Wiktor, 1975				+
13.	*Limax (Limax) conemenosi* Boottger, 1882				+
14.	*Limax (Limax) graecus* Simroth, 1889				+
15.	*Limax (Limax) wohlberedti* Simroth, 1900				+
16.	*Limax (Limax) cephalonicus* Simroth, 1886				+
17.	*Malacolomax mrazeki* (Simroth, 1904)				+
18.	*Tandonia albanica* Soos, 1924				+
19.	*Tandonia kusceri* (Wagner, 1931)				+
20.	*Tandonia macedonica* Rahle, 1974				+
21.	*Tandonia serbica* (Wagner, 1930)				+

Bivalvia (Mollusca: Bivalvia)					
1.	*Pisidium edlaueri* Kuiper, 1960	+			
2.	*Pisidium maasseni* Kuiper, 1987		+		
3.	*Pisidium subtruncatum recalvum* Kuiper, 1960	+			
4.	*Sphaerium parenzani* Gambetta,	+			

Total number of endemic taxa of the Phylum Mollusca:	101

Phylum Annelida

No.	Scientific name	Restricted to			
		Ohrid Lake	Prespa Lake	Doyran Lake	Other Localities
	Oligochaeta (Annelida)				
1.	*Allolobophora vardarensis* Sapkarev, 1991				+
2.	*Aporrectodea smaragdinoides* Sapkarev, 1989				+
3.	*Criodrilus ochridensis* Gjorgjevic, 1949	+			
4.	*Dendrobaena alpina mavronensis* Sapkarev, 1971				+
5.	*Dendrobaena alpina popi* Sapkarev, 1971				+
6.	*Dendrobaena kozuvensis* Sapkarev, 1971				+
7.	*Dendrobaena macedonica* Mrsic, 1991				+
8.	*Dendrobaena olimpica pelisterica* Sapkarev, 2001				+
9.	*Dendrobaena sasensis* Sapkarev, 1977				+
10.	*Eiseniella ochridana ochridana* (Cernosvitov, 1931)	+			
11.	*Eiseniella ochridana profunda* (Cernosvitov, 1931)	+			
12.	*Haplotaxis gordioides dubius* Hrabe, 1931	+			
13.	*Helodrilus balcanicus* Cernosvitov, 1931				+
14.	*Isochaeta dojranensis* Hrabe, 1958			+	
15.	*Italobalkaniona demirkapiae* (Karaman Sp., 1969)				+
16.	*Italobalkaniona macedonica* (Sapkarev, 1973)				+
17.	*Italobalkaniona pyrenaicoides* (Sapkarev, 1977)				+
18.	*Italobalkaniona stankovici* (Sapkarev, 1971)				+
19.	*Italobalkaniona treskavensis* Mrsic, 1991				+
20.	*Lamprodrilus michaelseni* Hrabe, 1929				+
21.	*Lamprodrilus pygmaeus intermedia* Hrabe, 1931	+			
22.	*Lamprodrilus pygmaeus ochridanus* Hrabe, 1931	+			
23.	*Monopylephorus montanus* Hrabe, 1962				+
24.	*Peloscolex cernosvitovi* Hrabe, 1953	+			
25.	*Peloscolex stankovici litoralis* Sapkarev, 1953	+			
26.	*Peloscolex stankovici stankovici* Hrabe, 1931	+			
27.	*Peloscolex stankovici sublitoralis* Hrabe, 1931	+			
28.	*Peloscolex tenuis* Hrabe, 1931	+	+		
29.	*Potamothrix isochaetus* Hrabe, 1931	+			
30.	*Potamothrix ochridanus* Hrabe, 1931	+			
31.	*Potamothrix prespaensis* Hrabe, 1931		+		
32.	*Psammoryctes ochridanus ochridanus* Hrabe, 1931	+	+		
33.	*Psammoryctes ochridanus variabilis* Hrabe, 1931	+	+		
34.	*Psammoryctes oligosetosus* Hrabe, 1931				+
35.	*Rhizodrilus montanus* Hrabe, 1962				
36.	*Rhynchelmis komareki breviristra* Hrabe, 1931	+			
37.	*Rhynchelmis komareki komareki* Hrabe, 1927				+
38.	*Serbiona dofleini udei* Sapkarev, 1991				+
39.	*Stylodrilus leucocephalus* Hrabe, 1931	+			
	Branchiobdellidae (Annelida incertae sedis)				
1.	*Branchiobdella capito* Georgevitch, 1955			+	
2.	*Cambarincola dojranensis* Georgevitch, 1955			+	
3.	*Pterodrilus prion* Georgevitch, 1955			+	
4.	*Xironodrilus crassus* Georgevitch, 1955			+	

Hirudinea (Annelida)					
1.	*Dina eturrshem* Sket, 1988	+			
2.	*Dina krilata* Sket, 1988	+			
3.	*Dina kuzmani* Sapkarev, 1990	+			
4.	*Dina lepinja* Sket & Sapkarev, 1986	+			
5.	*Dina lyhnida* Sapkarev, 1990	+			
6.	*Dina ohridana* Sket, 1968	+			
7.	*Dina profunda* Sapkarev, 1990	+			
8.	*Dina svilesta* Sket, 1988	+			
9.	*Glossiphonia complanata maculosa* Sket, 1968	+			
10.	*Glossiphonia pulchella* Sket, 1968	+			
11.	*Piscicola (Cystobranchus) pavlovskii* (Sket, 1968)	+			

Total number of endemic taxa of the Phylum Annelida	54

Phylum Arthropoda: Subphylum Chelicerata

No.	Scientific name	Restricted to			
		Ohrid Lake	Prespa Lake	Doyran Lake	Other Localities
Pseudoscorpiones (Chelicerata: Arachnida)					
1.	*Allochernes balcanicus* Hadži, 1937				+
2.	*Atemnus balcanicus* Hadži, 1937				+
3.	*Chthonius (Chthonius) macedonicus* Curcic, 1972				+
4.	*Chthonius (Chthonius) ognjankae* Curcic et al., 1997				+
5.	*Chthonius (Chthonius) ohridanus* Curcic et al., 1997				+
6.	*Chthonius (Chthonius) radigost* Curcic et al., 1997				+
7.	*Chthonius (Chthonius) tenuichelatus* Hadži, 1937				+
8.	*Chthonius (Chthonius) troglobius* Hadži, 1937				+
9.	*Chthonius (Chthonius) vodan* Curcic et al., 1997				+
10.	*Chthonius (Chthonius) zmaj* Curcic et al., 1997				+
11.	*Chthonius (Ephippiochthonius) kupalo* Curcic et al., 1997				+
12.	*Chthonius (Ephippiochthonius) lychnidis* Curcic et al., 1997				+
13.	*Chthonius (Ephippiochthonius) microtuberculatus* Hadži, 1937				+
14.	*Chthonius (Ephippiochthonius) serbicus* (Hadži, 1937)				+
15.	*Chthonius (Ephippiochthonius) tuberculatus* Hadži, 1937				+
16.	*Chthonius (Ephippiochthonius) vid* Curcic et al., 1997				+
17.	*Chthonius (Globochthonius) perun* Curcic et al., 1997				+
18.	*Chthonius (Neochthonius) karamanianus* Hadži, 1937				+
19.	*Neobisium (Blothrus) karamani* (Hadži, 1929)				+
20.	*Neobisium (Blothrus) ohridanum* Hadži, 1940				+
21.	*Neobisium (Neobisium) meridieserbicum* Hadži, 1937				+
22.	*Neobisium (Neobisium) muscorum balcanicum* Hadži, 1937				+
23.	*Neobisium golemanskyi* Curcic & Dimitrijevic, 2001				+
24.	*Roncus (Parablothrus) parablothroides* Hadži, 1937				+
25.	*Roncus jaoreci Curcic, 1984*				+
26.	*Roncus rujevit* Curcic & Legg, 1994				+
27.	*Roncus stankokaramani* Curcic & Dimitijevic, 2001				+

Opiliones (Chelicerata: Arachnida)					
1.	*Astrobunus macedonicus* Hadži, 1973				+
2.	*Bolea ephippiata* Hadži, 1973				+
3.	*Metadasylobus macedonicus* Hadži, 1973				+
4.	*Metaphalangium propinquum denticulatum* Hadži, 1973				+
5.	*Mitostoma (Mitostoma) macedonicum* Hadži, 1973				+
6.	*Mitostoma (Mitostoma) olgae zorae* Hadži, 1973				+
7.	*Mitostoma (Mitostoma) zmajevicae* Hadži, 1973				+
8.	*Nemastoma (Dromedostoma) bolei* Hadži, 1973				+
9.	*Nemastoma (Dromedostoma) carneluttii* Hadži, 1973				+
10.	*Nemastoma (Dromedostoma) multisignatum* Hadži, 1973				+
11.	*Nemastoma (Dromedostoma) nigrum* Hadži, 1973				+
12.	*Nemastoma (Lugubrostoma) sarae* Hadži, 1973				+
13.	*Nemastoma (Nemastoma) amuelleri* Roewer, 1951				+
14.	*Nemastoma (Nemastoma) gostivarense* Hadži, 1973				+
15.	*Nemastoma (Nemastoma) macedonicum* Hadži, 1973				+
16.	*Opilio macedonicus* Hadži, 1973				+
17.	*Siro gjorgjevici* Hadži, 1933				+
18.	*Siro ohridanus* Hadži, 1973				+
19.	*Stankiella montana* Hadži, 1973				+

Aranea (Chelicherata: Arachnida)					
1.	*Gnaphosa expilator* Drensky, 1929				+
2.	*Gonatium strugaense* Drensky, 1929				+
3.	*Hypomma brevitibiale* (Wunderlich, 1980)				+
4.	*Lycosa macedonica* (Giltay, 1932)				+
5.	*Macedoniella karamani* Drensky, 1935				+
6.	*Philodromus hadzii* Silhavy, 1944				+
7.	*Philodromus pelagonus* Silhavy, 1944				+
8.	*Poecilochroa ochridana* Drensky, 1929				+
9.	*Pterotricha extiabilis* Drensky, 1929				+
10.	*Theridion peristeri* Drensky, 1929				+
11.	*Troglohyphantes draconis* Deeleman-Reinhold, 1978				+
12.	*Troglohyphantes inermis* Deeleman-Reinhold, 1978				+
13.	*Troglohyphantes kratochvili* Drensky, 1935				+
14.	*Xysticus tenebrosus ochridensis* Silhavy, 1944				+
15.	*Zora affinis* Drensky, 1936				+
16.	*Zora prespaensis* Drensky, 1929				+

Acarina (Chelicerata: Arachnida)					
1.	*Acherontacarus halacaroides* Viets, 1936				+
2.	*Atractides graecus* (Viets, 1936)				+
3.	*Atractides nodipalpis inflatipalpis* Viets, 1936				+
4.	*Atractides petkovskii* Schwoerbel, 1963				+
5.	*Copidognathus tectiporus profundus* Viets, 1936	+			
6.	*Kongsbergia hansvietsi* Viets, 1936				+
7.	*Lebertia macedonica* Viets, 1936				+
8.	*Stygohalacarus scupiensis* Viets, 1936				+
9.	*Torrenticola dudichi cognata* Viets, 1936				+

Total number of endemic taxa of the Subphylum Chelicerata	71

Phylum Arthropoda: Subphylum Branchiata

No.	Scientific name	Restricted to			
		Ohrid Lake	Prespa Lake	Doyran Lake	Other Localities
	Cyclopoida (Crustacea: Copepoda)				
1.	*Allocyclops kieferi* Petkovski, 1971				+
2.	*Allocyclops minutissimus* (Kiefer, 1933)				+
3.	*Cyclops ochridanus* Kiefer, 1932	+			
4.	*Diacyclops ichnusoides* Petkovski & Karanovic, 1997	+			
5.	*Diacyclops pelagonicus* Petkovski, 1971				+
6.	*Diacyclops stygius macedonicus* Petkovski, 1954				+
7.	*Microcyclops varicans dojranensis* Petkovski, 1954			+	
8.	*Ochridacyclops arndti* Kiefer, 1937	+			
9.	*Ochridacyclops arndti prespensis* Petkovski, 1959		+		
10.	*Reidcyclops trajani* (Reid & Strayer, 1994)				+
	Harpactioida (Crustacea : Copepoda)				
1.	*Bryocamptus mirus* Petkovski & Karanovic, 1997	+			
2.	*Elaphoidella brevipes* Chappuis, 1937				+
3.	*Parastenocaris balcanica* Petkovski, 1959				+
4.	*Parastenocaris rascana* Petkovski, 1959				+
5.	*Parastenocaris similis macedonica* Petkovski, 1959				+
6.	*Speleocamptus incertus* Petkovski, 1956				+
	Ostracoda (Branchiata: Crustacea)				
1.	*Candona alta* Klie, 1939	+			
2.	*Candona dedelica* Petkovski, 1969	+			
3.	*Candona depressa* Klie, 1939	+			
4.	*Candona expansa* Mikulic, 1961	+			
5.	*Candona formosa* Mikulic, 1961	+			
6.	*Candona goricensis* Mikulic, 1961	+			
7.	*Candona hadzistei* Petkovski, Scharf & Keyser, 2002	+			
8.	*Candona hartmanni* Petkovski, 1969	+			
9.	*Candona holmesi* Petkovski, 1960	+			
10.	*Candona jordae* Petkovski, Scharf & Keyser, 2002	+			
11.	*Candona litoralis* Mikulic, 1961	+			
12.	*Candona lychnitis* Petkovski, 1969	+			
13.	*Candona macedonica* Mikulic, 1961	+			
14.	*Candona margaritana* Mikulic, 1961	+			
15.	*Candona marginata* Klie, 1942	+			
16.	*Candona marginatoides* Petkovski, 1960	+	+		
17.	*Candona media* Klie, 1939	+			
18.	*Candona ohrida* Holmes, 1937	+			
19.	*Candona ovalis* Mikulic, 1961	+			
20.	*Candona trapeziformis* Klie, 1939	+			
21.	*Candona triangulata* (Klie, 1939)	+			
22.	*Candona vidua* Klie, 1942	+			
23.	*Cypria karamani* Petkovski, 1976				+

24.	*Cypria obliqua* Klie, 1939	+			
25.	*Eucandona krstici* (Petkovski, 1969)	+			
26.	*Eucipris bronsteini* Petkovski, 1959				+
27.	*Eucypris heinrichi* Diebel & Pietrzeniuk, 1978				+
28.	*Eucypris kurtdiebeli* Petkovski & Keyser, 1997				+
29.	*Heterocypris erikae* Petkovski & Keyser, 1995				+
30.	*Heterocypris gevgelica* Petkovski, Scharf & Keyser, 2000				+
31.	*Leptocythere angulata* Klie, 1939				+
32.	*Leptocythere prespensis* Petkovski, 1959	+	+		
33.	*Leptocythere proboscidea* Klie, 1939	+			
34.	*Paralimnocythere alata* (Klie, 1939)	+			
35.	*Paralimnocythere diebeli* (Petkovski, 1969)				+
36.	*Paralimnocythere georgevitschi* (Petkovski, 1960)	+			
37.	*Paralimnocythere karamani* (Petkovski, 1960)	+			
38.	*Paralimnocythere ochridense* (Klie, 1934)	+			
39.	*Paralimnocythere slavei* (Petkovski, 1969)	+			
40.	*Paralimnocythere umbonata* (Klie, 1939)	+			
41.	*Physocypria inversa* (Klie, 1941)			+	
42.	*Pseudocandona slavei* (Petkovski, 1969)	+			
43.	*Psychrodromus peristericus* (Petkovski, 1959)				+
44.	*Stenocypris macedonica* Petkovski & Meisch, 1996				+

Anostraca (Crustacea: Branchiopoda)					
1.	*Chirocephalus pelagonicus* Petkovski, 1986				+

Cladocera (Crustacea: Branchiopoda)					
1.	*Alona smirnovi* Petkovski & Flossner, 1972	+			

Isopoda (Crustacea: Malacostraca)					
1.	*Alpioniscus (Alpioniscus) vejdovskyi* (Frankenberger, 1939)				+
2.	*Alpioniscus (Alpioniscus) boldorii macedonicus* Buturovic, 1954				+
3.	*Alpioniscus (Alpioniscus) karamani damjanicus* Buturovic, 1954				+
4.	*Alpioniscus (Alpioniscus) karamani karamani* Buturovic, 1954				+
5.	*Alpioniscus (Macedonethes) skopjensis* Buturovic, 1955				+
6.	*Alpioniscus slatinensis* Buturovic, 1955				+
7.	*Armadillidium obenbergeri* Frankenberger, 1941				+
8.	*Armadillidium storkani* Frankenberger, 1941				+
9.	*Asellus arnautovici arnautovici* Remy, 1932	+			
10.	*Asellus arnautovici elongatus* Karaman, 1953	+			
11.	*Asellus gjorgjevici gjorgevici* Karaman, 1933	+			
12.	*Asellus gjorgjevici litoralis* Karaman, 1933	+			
13.	*Asellus montenigrinus macedonicus* Karaman, 1955				+
14.	*Asellus remyi acutangulus* Karaman, 1953	+			
15.	*Asellus remyi nudus* Karaman, 1953	+			
16.	*Asellus remyi remyi* Monod, 1932	+			
17.	*Epironiscellus multicostatus* Karaman, 1961				+
18.	*Hyloniscus pilifer* Verhoeff, 1933				+
19.	*Hyloniscus zorae* Karaman & Cemerlic, 1999				+
20.	*Macedoniscus vardarensis* Buturovic, 1954				+
21.	*Microcerberus stygius* Karaman, 1933				+
22.	*Microcharon latus latus* Karaman, 1934				+
23.	*Microcharon major* Karaman, 1954				+
24.	*Microcharon profundalis kumanovensis* Karaman, 1940				+

25.	*Microcharon profundalis profundalis* Karaman, 1940				+
26.	*Microcharon stygius stygius* (Karaman, 1933)				+
27.	*Microparasellus puteanus* Karaman, 1933				+
28.	*Monocyphoniscus loritzi* Karaman, 1966				+
29.	*Platiarthrus schobli stadleri* Karaman, 1961				+
30.	*Porcellio parenzani* Arcangeli, 1931				+
31.	*Porcellium productum pallidum* Frankenberger, 1940				+
32.	*Porcellium productum productum* Frankenberger, 1940				+
33.	*Porcellium productum storkani* Frankenberger, 1940				+
34.	*Protracheoniscus komareki* Frankenberger, 1940				+
35.	*Stenasellus skopljensis skopljensis* Karaman, 1937				+
36.	*Trachelipus dimorphus* Frankenberger, 1940				+
37.	*Trachelipus phaecorum* (Verhoeff, 1901)				+
38.	*Trachelipus squamuliger* (Verhoeff, 1907)				+
39.	*Trichoniscus semigranulatus* Buturovic, 1954				+
40.	*Vardaroniscus tetraceratus* Buturovic, 1955				+

Amphipoda (Crustacea: Malacostraca)					
1.	*Balcanella acherontis* Karaman S. 1933				+
2.	*Balcanella macedonica* Karaman S. 1959				+
3.	*Balcanella petkovskii* (Karaman S. 1957)				+
4.	*Bogidiella glacialis* (Karaman S.1959)				+
5.	*Bogidiella longiflagellum* (Karaman S.1959)				+
6.	*Bogidiella skopljensis* (Karaman S.1933)				+
7.	*Gammarus albimanus* (Karaman G.1968)				+
8.	*Gammarus halilicae* (Karaman G.1969)				+
9.	*Gammarus ochridensis abyssalis* Karaman S.1931	+			
10.	*Gammarus ochridensis ochridensis* (Schäferna, 1925)	+			
11.	*Gammarus rambouseki* (Karaman S.1931)				+
12.	*Gammarus triacanthus prespensis* (Karaman S & G.1959)		+		
13.	*Gammarus triacanthus semiarmatus* (Karaman S. 1929)				+
14.	*Gammarus triacanthus strumicae* (Karaman S. & G.1959)				+
15.	*Hadzia gjorgjevici gjorgjevici* Karaman S.1932				+
16.	*Niphargus bitoljensis* Karaman S.1943				+
17.	*Niphragus jovanovici jovanovici* Karaman S.1931				+
18.	*Niphragus macedonicus* Karaman S.1929				+
19.	*Niphragus maximus maximus* Karaman S.1929				+
20.	*Niphragus maximus petkovskii* Karaman G.1963				+
21.	*Niphragus ohridanus fontophilus* Karaman S.1943				+
22.	*Niphragus ohridanus ohridanus* Karaman S.1929	+			
23.	*Niphragus pancici dojranensis* Karaman G.1960			+	
24.	*Niphragus pancici pancici* Karaman S.1929				+
25.	*Niphragus parvus* Karaman S.1943				+
26.	*Niphragus pellagonicus* Karaman S.1943				+
27.	*Niphragus sanctinaumi* Karaman S.1943	+			
28.	*Niphragus skopljensis* Karaman S.1929				+
29.	*Niphragus stankoi* Karaman G. 1973				+
30.	*Niphragus tauri osogovensis* Karaman S. 1959				+
31.	*Niphragus velesensis* Karaman S. 1943				+
32.	*Niphragus vodnensis banjanus* Karaman S. 1943				+
33.	*Niphragus vodnensis kosanini* Karaman S. 1943				+
34.	*Niphragus vodnensis vodnensis* Karaman S. 1943				+
35.	*Synurella longidactylus* Karaman S. 1929	+			

Total number of endemic taxa of the Subphylum Branchiata	137

Phylum Arthropoda: Subphylum Tracheata

No.	Scientific name	Restricted to			
		Ohrid Lake	Prespa Lake	Doyran Lake	Other Localities
Tracheata: Myriapoda					
	Diplopoda				
1.	*Acanthopetalum albanicum* (Verhoeff, 1923)				+
2.	*Acanthopetalum macedonicum* (Verhoeff, 1923)				+
3.	*Acanthopetalum thessalorum lychnitis* (Verhoeff, 1932)				+
4.	*Albanoglomus ljubotensis* Attems, 1929				+
5.	*Brachydesmus (Brachydesmus) macedonicus* Mrsic, 1988				+
6.	*Brachydesmus henrikengoffi* Mrsic, 1993				+
7.	*Brachydesmus ljubotensis* Attems, 1912				+
8.	*Brachydesmus peristerensis* Verhoeff, 1932				+
9.	*Leptomastigoiulus hamuligerus* (Verhoeff, 1932)				+
10.	*Macedoiulus storkani* Verhoeff, 1932				+
11.	*Megaphyllum crassum (* Attems, 1929)				+
12.	*Megaphyllum herculeus* (Verhoeff, 1901)				+
13.	*Ochridaphe albanica* (Verhoeff, 1932)				+
14.	*Paeonisoma faucium* Verhoeff, 1932				+
15.	*Polydesmus juergengruberi* Mrsic, 1993				+
16.	*Polydesmus wardaranus* Verhoeff, 1937				+
17.	*Polyxenus macedonicus* Verohoeff, 1952				+
18.	*Schizmohetera curcici* Makarov, 2001				+
19.	*Schizmohetera sketi* Mrsic, 1987				+
20.	*Typhloiulus (Typhloiulus) albanicus* Attems, 1929				+
21.	*Xestoiulus (Oroiulus) macedonicus* (Attems, 1927)				+
22.	*Xestoiulus (Oroiulus) storkani* (Verhoeff, 1932)				+

Total number of endemic taxa of the Class Myriapoda	22

Tracheata: Insecta

	Collembola				
1.	*Tomocerus skopjensis* Curcic & Lucic, 2001				+

	Ephemeroptera				
1.	*Chorterpes balcanica* Ikonomov,				+
2.	*Ephemerella ikonomovi* Putz, 1972				+
3.	*Ephemerella maculocaudata* Ikonomov,				+
4.	*Habrophlebia konjarensis* Ikonomov, 1963				+
5.	*Paraleptophlebia lacustris* Ikonomov, 1962				+

Plecoptera					
1.	*Brachyptera macedonica* Ikonomov, 1983				+
2.	*Capnioneura balcanica macedonica* Ikonomov, 1978				+
3.	*Isoperla breviptera* Ikonomov, 1980				+
4.	*Isoperla vevcianensis* Ikonomov, 1980				+
5.	*Nemoura peristeri* Aubert, 1963				+
6.	*Nemoura zwiski* Sivec, 1979				+
7.	*Protonemura miacense* Ikonomov, 1983				+
8.	*Rhabdiopteryx doiranensis* Ikonomov, 1983				+
9.	*Taeniopteryx fusca* Ikonomov, 1980				+
10.	*Taeniopteryx stankovici* Ikonomov, 1978				+

Trychoptera					
1.	*Rhyacophila loxalis* Schmid, 1979				+

Hemiptera (Homoptera)					
1.	*Cicadetta montana macedonica* Schedl, 1999				+
2.	*Edwardsiana mirjanae* Jankovic, 1978				+

Orthoptera					
1.	*Ameles heldreichi* Brunner von Wattenwyl, 1982				+
2.	*Andreiniimon nuptialis* (Karny, 1918)				+
3.	*Metrioptera knipperi* (Ramme, 1951)				+
4.	*Oropodisma macedonica* Ramme, 1951				+
5.	*Pholidoptera aptera gjorgjevici* Karaman, 1960				+
6.	*Pholidoptera stankoi* Karaman, 1960				+
7.	*Platycleis macedonica* (Berland et Chopard, 1922)				+
8.	*Poecilimon chopardi* Ramme, 1933				+
9.	*Poecilimon macedonicus* Ramme, 1926				+
10.	*Poecilimon mavrovi* Karaman, 1958				+
11.	*Poecilimon pancici* Karaman, 1958				+
12.	*Poecilimon vodnensis* Karaman, 1958				+
13.	*Troglophilus lazaropolensis* Karaman, 1958				+

Psocoptera					
1.	*Liposcelis macedonicus* Günther, 1980			+	

Coleoptera (Coleoptera aquatica)					
1.	*Hydraena macedonica* D'Orch,				+
2.	*Hydraena meschniggi* Pretner,				+
3.	*Hydraena pulsata* D'Orch,				+
4.	*Hydraena simonidea* D'Orch,				+
5.	*Potamonectes macedonicus* Gueorgiev,				+
Coleoptera (Carabidae)					
1.	*Calathus purkynei* (Maran, 1935)				+
2.	*Duvalius gogalai* Pretner, 1963				+
3.	*Duvalius macedonicus*(J. Müller, 1917)				+
4.	*Duvalius peristericus* (J. Müller, 1914)				+
5.	*Duvalius vignai* Casale, 1983				+
6.	*Nebria macedonica* (Maran, 1938)				+

7.	*Pachycarus macedonicus* Guèorguiev & Guèorguiev, 1997				+
8.	*Tapinopterus comita* Jedlicka, 1935				+
9.	*Tapinopterus heyrovskii* Jedlicka, 1939				+
10.	*Tapinopterus monastirensis* Reitter, 1913				+
11.	*Tapinopterus purkynei* Jedlicka, 1928				+
12.	*Tapinopterus rambousekianus* Maran, 1933				+
13.	*Trechus goebli* Breit, 1913				+
14.	*Trechus hajeki* Reitter, 1913				+
15.	*Trechus midas* Jeannel, 1927				+
16.	*Trechus pachycerus* Apfelbeck, 1918				+
Coleoptera (Catopidae)					
1.	*Albaniola rambouseki* Knirsch, 1931				+
2.	*Attaephilus niger* Z. Karaman, 1953				+
3.	*Catops macedonicus* Z. Karaman, 1953				+
4.	*Catops mavrovi* Z. Karaman, 1958/59				+
5.	*Ceutophyes bukoviki* Z. Karaman, 1968				+
6.	*Ceutophyes karamani* Jeannel, 1924				+
7.	*Ceutophyes lazaropolensis* Z. Karaman, 1954				+
8.	*Choleva macedonica* Z. Karaman, 1954				+
9.	*Eocatops skopjensis* Z. Karaman, 1957				+
10.	*Hussonela ovata* Z. Karaman, 1954				+
11.	*Leptostagus babunae* Z. Karaman, 1954				+
12.	*Ochridiola marinae* Sbordoni, 1971				+
13.	*Petkovskiella stygia* (Z. Karaman, 1954)				+
14.	*Purkynella rambouseki* Knirsch, 1924				+
Coleoptera (Curculionidae)					
1.	*Ohiorhynchus sorbivorus* Reitter, 1913				+
2.	*Otiorhynchus armipes* Apfelbeck, 1918				+
3.	*Otiorhynchus asper* Solari, 1931				+
4.	*Otiorhynchus cirrhocnemis* Apfelbeck, 1918				+
5.	*Otiorhynchus cirrogaster* Apfelbeck, 1918				+
6.	*Otiorhynchus kruperi regliae* Reitter,1912				+
7.	*Otiorhynchus latitarsis* Apfelbeck, 1922				+
8.	*Otiorhynchus liliputanus* Apfelbeck, 1905				+
9.	*Otiorhynchus macedonicu. novakianus* Lona, 1943				+
10.	*Otiorhynchus macedonicus conorhynchus* Solari, 1931				+
11.	*Otiorhynchus macedonicus* Reitter, 1913				+
12.	*Otiorhynchus marmota kajmakcelensis* Lona, 1943				+
13.	*Otiorhynchus marmota* Stierlin, 1883				+
14.	*Otiorhynchus midas* Reitter, 1913				+
15.	*Otiorhynchus oligolepis* Apfelbeck, 1918				+
16.	*Otiorhynchus pierinus* Reitter, 1913				+
17.	*Otiorhynchus plagiator*, Apfelbeck, 1918				+
18.	*Otiorhynchus rambuseki* Apfelbeck, 1918				+
19.	*Otiorhynchus relictus* Apfelbeck, 1918				+
20.	*Otiorhynchus shardagensis arammichnoides* Lona, 1943				+
21.	*Otiorhynchus vodonensis* Formanek,				+
22.	*Otiorhynchus wernerianus* Reitter, 1913				+
Coleoptera (Pselaphidae)					
1.	*Arcopagus blacensis* Z. Karaman, 1954				+
2.	*Arcopagus comita* Rambousek				+
3.	*Arcopagus karaormani* Z. Karaman, 1954				+
4.	*Arcopagus meridionalis* Z. Karaman, 1954				+

5.	*Paramaurops mavrovi* Z. Karaman, 1958				+
6.	*Paramaurops vitolistensis* Z. Karaman, 1954				+
7.	*Pselaphus treskanus* Z. Karaman				+
	Coleoptera (Cerambycidae)				
1.	*Dorcadion heirovskyi* Breuning, 1943				+
2.	*Dorcadion kaimakcalanum* Jurecek, 1929				+
3.	*Dorcadion macedonicum* Jurecek, 1929				+
4.	*Dorcadion purkynei* Heirovsky, 1925				+
5.	*Leptorhabdium nitidum* Holzschuh, 1974				+
6.	*Purpuricenus renyvonae* Slama, 2001				+
7.	*Vadonia dojranensis* Holzschuh, 1984				+

	Trichoptera				
1.	*Apatania plicatus* Radovanovic, 1943				+
2.	*Limnephilus petri* Marinkovic, 1975				+

	Lepidoptera				
	Noctuidae				
1.	*Agrochola thurneri* Boursin, 1953				+
2.	*Agrocola wolfschlageri* Boursin, 1953				+
3.	*Copiphana lunaki* Boursin, 1959				+
4.	*Cosmia rhomopsis* Boursin, 1947				+
5.	*Cryphia seladona burgeffi* Draudt,				+
6.	*Euchalcia chlorocharis* Dufay, 1961				+
7.	*Hadena clara macedonica* Boursin, 1959				+
8.	*Porphyrinia thurneri* Zerny, 1936				+
	Microlepidoptera				
9.	*Aciptilia ivae* Kasy, 1960				+
10.	*Acrolepia heringi* Klimesch, 1956				+
11.	*Acrolepia macedonica* Klimesch, 1956				+
12.	*Acrolepia wolfschlageri* Klimesch, 1956				+
13.	*Aethes kasyi* Razowski, 1962				+
14.	*Agnopteryx thurneri* Rebel, 1941				+
15.	*Argyresthia kasyi* Friese, 1961				+
16.	*Bucculatrix pseudosylvella* Rebel, 1941				+
17.	*Bucculatrix species* Klimesch, 1968				+
18.	*Caryocolum xuthellum* Rebel, 1941				+
19.	*Cnephasia klimeschi* Razowski, 1958				+
20.	*Coleophora coarctataephaga* Toll, 1961				+
21.	*Coleophora depunctella* Toll, 1961				+
22.	*Coleophora flavescentella* Toll, 1961				+
23.	*Coleophora gigantella* Toll, 1961				+
24.	*Coleophora kasyi* Toll, 1961				+
25.	*Coleophora latilineella* Toll, 1961				+
26.	*Coleophora macedonica* Toll, 1959				+
27.	*Coleophora medicagivora* Toll, 1961				+
28.	*Coleophora quadristraminella* Toll, 1961				+
29.	*Coleophora scabrida* Toll, 1959				+
30.	*Coleophora species* Klimesch, 1968				+
31.	*Douglasia species* Klimesch, 1968				+
32.	*Ephysteris treskensis* Povolny, 1964				+
33.	*Eremica kasyi* Gozmany, 1961				+
34.	*Incurvaria species* Klimesch, 1968				+

35.	*Infurcitinea kasyi* Petersen, 1962				+
36.	*Infurcitinea ochridella* Petersen 1962,				+
37.	*Infurcitinea olympica* Petersen, 1958				+
38.	*Kessleria macedonica* Friese, 1963				+
39.	*Neurothaumasia macedonica* Petersen, 1962				+
40.	*Obesoceras forsteri* Petersen, 1964				+
41.	*Obesoceras litochorella* Petersen, 1964				+
42.	*Pantacordis pantsa* Gozmany, 1963				+
43.	*Parachronistis lunaki* Rebel, 1941				+
44.	*Scirtopoda spec*ies Klimesch, 1968				+
45.	*Scythris subschleischiella* Hannemann, 1961				+
46.	*Scythris albostriata* Hannemann, 1961				+
47.	*Scythris crypta* Hannemann, 1961				+
48.	*Scythris similis* Hannemann, 1961				+
49.	*Stagmatophora klimeschiella* Riedl, 1966				+
50.	*Stigmella globularia* Klimesch, 1968				+
51.	*Symmoca klimeschiella* Gozmany, 1959				+
52.	*Teleiopsis species* Klimesch, 1968				+
	Geometridae				
53.	*Calostigia wolfschlagerae* Pinker, 1938				+
54.	*Chesias pinkeri* Schawarda, 1939				+
	Bombyces & Sphinges				
55.	*Bankesia macedoniella* Rebel, 1934				+
56.	*Chamaespecia balcanica* Zukowsky, 1929				+
57.	*Dysauxes ancilla bipunctata* Buresch, 1915				+
58.	*Eriogaster lanestris macedonica* Silbernagel, 1945				+
59.	*Rebelia macedonica* Pinker, 1956				+
60.	*Synthomis marjana macedonica* Daniel, 1934				+
61.	*Zygaena achilleae macedonica* Burgeff, 1926				+
62.	*Zygaena achilleae winneguthi* Holik, 1937				+
63.	*Zygaena carniolica paeoniae* Burgeff, 1926				+
64.	*Zygaena carniolica scopjina* Burgeff, 1926				+
65.	*Zygaena ephialtes istoki* Silbernagel, 1944				+
66.	*Zygaena ephialtes vardarica* Daniel, 1956				+
67.	*Zygaena laeta orientalis* Burgeff, 1926				+
68.	*Zygaena purpuralis bukuwkyi* Holik, 1936				+
69.	*Zygaena purpuralis doiranica* Burgeff, 1926				+

	Diptera				
	Empididae				
1.	*Chelifera macedonica* Wagner & Nikolovskai, 1987				+
2.	*Chelifera wagneri* Horvat, 1990				+
3.	*Roederiodes macedonicus* Wagner & Horvat, 1993				+
4.	*Wiedemannia andreevi* Joost, 1982				+
5.	*Wiedemannia dinarica* Engel, 1940				+
6.	*Wiedemannia microstigma* (Bezzi, 1904)				+
	Syrphidae				
7.	*Cheilosia melanura* Becker, 1894 *rubra* Vujic, 1996				+
8.	*Chrysogaster mediterraneus* Vujic, 1999				+
9.	*Merodon albonigrum* Vujic, Radenkovic & Simic, 1996				+
10.	*Merodon recurvus* Strobl, 1898				+
11.	*Psarus abdominalis* (Fabricius), 1794				+
12.	*Sphegina sublatifrons* Vujic, 1990				+

Hymenoptera					
1.	*Empria atrata* Cingovski, 1958				+
2.	*Tenthredopsis macedonica* Cingovski, 1958				+

Total number of endemic taxa of the Class Insecta	189

Total number of endemic taxa of the Subphylum Chelicerata	71
Total number of endemic taxa of the Subphylum Branchiata	137
Total number of endemic taxa of the Subphylum Tracheata	211

Total number of endemic taxa of the Phylum Arthropoda	**419**

Phylum Chordata

No.	Scientific name	Restricted to			
		Ohrid Lake	Prespa Lake	Doyran Lake	Other Lcalities
Pisces (Chordata: Vertebrata)					
1.	*Acantholingua ohridana* (Steindachner, 1892)	+			
2.	*Alburnus belvica* Karaman,1924		+		
3.	*Barbus prespensis* Karaman, 1924		+		
4.	*Chondrostoma prespense* Karaman, 1924		+		
5.	*Chondrostoma vardarense* Karaman, 1924				+
6.	*Cobitis meridionalis* Karaman, 1924		+		
7.	*Cobitis vardarensis* Karaman, 1924				+
8.	*Gobio banarescui* Dimovski & Grupce, 1974				+
9.	*Pachychilon macedon icum* (Steindachner, 1892)				+
10.	*Phoxinellus epiroticus* (Steindachner, 1896)	+			
11.	*Phoxinellus prespensis* (Karaman, 1924)		+		
12.	*Rutilus ohridanus* (Karaman, 1924)	+			
13.	*Rutilus prespensis* (Karaman, 1924)		+		
14.	*Sabanejewia doiranica* Economidis & Nalbant, 1996			+	
15.	*Salmo aphelios* Kottelat, 1997	+			
16.	*Salmo balcanicus* (Karaman, 1927)	+			
17.	*Salmo letnica* (Karaman, 1924)	+			
18.	*Salmo lumi* Poljakov, Filipi & Basho, 1958	+			
19.	*Salmo pelagonicus* Karaman, 1938				+
20.	*Salmo peristericus* Karaman, 1938				+

Mammalia (Chordata: Vertebrata)					
1.	*Microtus felteni* Malec & Storch, 1963				+
2.	*Mus macedonicus* Petrov & Ruzic, 1983				+
3.	*Spermophilus citellus karamani* (Martino & Martino, 1940)				+
4.	*Talpa stankovici* V. Martino & E. Martino, 1931				+

Total number of endemic taxa of the Phylum Chordata	24

Endemic taxa within the fauna of Macedonia

Total number of endemic taxa of the Phylum Protozoa	32
Total number of endemic taxa of the Phylum Porifera	6
Total number of endemic taxa of the Phylum Plathelminthes	35
Total number of endemic taxa of the Phylum Nemathelminthes	3
Total number of endemic taxa of the Phylum Mollusca	101
Total number of endemic taxa of the Phylum Annelida	54
Total number of endemic taxa of the Phylum Arthropoda	419
Total number of endemic taxa of the Phylum Chordata	24

Total number of endemic taxa	**674**

ANNEX 3
Rare and threatened species of flora in Macedonia

Table 1. Rare and threatened species of diatoms, sites and type of threat.

No.	Taxon	Site	Activity
1.	*Achnanthes brevipes* Agardh	Ohrid	Eutrophication
2.	*Achnanthes inflata* (Kützing) Grunow	Ohrid	Eutrophication
3.	*Achnanthidium kryophila* (Petersen) Bukhtiyarova 1995	Pelister	Acidification
4.	*Actinocyclus normanii* (Gregory ex Greville) Hustedt	Selakovski lakes	Eutrophication
5.	*Anomoeneis serians* (Brébisson) Cleve 1895	Selakovski lakes	Pollution
6.	*Caloneis alpestris* (Grunow) Cleve 1894	St. Naum, Ohrid	Eutrophication
7.	*Caloneis amphisbaena* (Bory) Cleve fo. *subsalina* (Donkin) Van Der Werff & Huls	Doyran Lake	Eutrophication
8.	*Caloneis pulchra* Messikommer 1927	Bukovik	Pollution
9.	*Cyclotella iris* Brun et Héribaud	Vardar	Pollution
10.	*Cymatopleura elliptica* var. *hibernica* (W.Smith) V.H. 1896	Doyran Lake	Eutrophication
11.	*Cymbella alpina* Grunow 1863	Shar Planina	Eutrophication
12.	*Cymbella balatonis* Grunow in A. Schmidt et al. 1875	Ohrid Lake	Pollution
13.	*Cymbella hauckii* Van Heurck	Doyran Lake	Eutrophication
14.	*Denticula elegans* Kützing 1844	Anska River	Pollution
15.	*Denticula thermalis* Kützing 1844	Thermal springs	Pollution
16.	*Diatoma anceps* (Ehrenberg) Grunow 1878	Doyran Lake	Eutrophication
17.	*Diatomella balfouriana* Greville 1855	Selakovski lakes	Pollution
18.	*Diploneis alpina* Meister 1912	Ohrid Lake	Pollution
19.	*Eucocconeis alpestris* (Brun) Lange-Bertalot in 1999	Shar Planina	Eutrophication
20.	*Eucocconeis flexella* (Kützing) Cleve 1895	Shar Planina	Eutrophication
21.	*Eunotia arculus* (Grunow) Lange-Bertalot & Nörpel	Bukovik, Pehcevo	Mining activities
22.	*Frustulia crassinervia* (Brébisson) L-B. & Krammer 1996	Selakovski lakes Shar planina	Pollution Eutrophication
23.	*Gomphonema augur* var. *gauteri* Van Heurck 1885	Doyran Lake	Eutrophication
24.	*Gomphonema hebridense* Gregory	Bukovik, Pehcevo	Mining activities
25.	*Gyrosigma nodiferum* (Grunow) Reimer 1966	Ohrid Lake	Eutrophication
26.	*Gyrosigma parkerii* (Harrison) Elmore 1921	Ohrid Lake	Pollution
27.	*Hippodonta rostrata* (Grunow) Lange-Bertalot	Prespa Lake	Eutrophication
28.	*Luticola undulata (Hilse) D.G. Mann 1990*	Pelister	Acidification
29.	*Luticola ventricosa* (Kütz.) D.G. Mann	Shar Planina	Eutrophication
30.	*Mastogoia smithii* Thwaites 1856	Ohrid Lake	Pollution
31.	*Navicula protracta* (Grunow) Cleve 1894	Doyran Lake	Eutrophication
32.	*Navicula roteana* (Rabenhorst) Grunow	Pelister	Acidification
33.	*Navicula rotunda* Hustedt 1945	Prespa Lake	Eutrophication
34.	*Naviculadicta pseudosilicula* (Hustedt) Lange-Bertalot	Big Lake	Acidification
35.	*Neidium alpinum* Hustedt 1943	Shar Planina	Eutrophication
36.	*Neidium bisulcatum* (Lagersted) Cleve 1894	Selakovski lakes	Pollution
37.	*Nitzschia sigma* (Kützing) W. Smith 1853	Doyran Lake	Eutrophication
38.	*Nitzschia sinuata* (Thwaites) Grunow var. *tabellaria* (Grunow) Lange-Bertalot	White Lake (Shar Planina)	Eutrophication
39.	*Nitzschia sinuata* var. *delognei* (Grunow) L-Bertalot 1980	Shar Planina	Eutrophication
40.	*Pinnularia acrosphaeria* Rabenhorst 1853	Monospitovo Marsh	Eutrophication
41.	*Pinnularia angusta* (Cleve) Krammer 1992	Selakovski lakes	Pollution
42.	*Pinnularia appendiculata* (Agardh) Cleve 1895	Pelister	Acidification
43.	*Pinnularia gentilis* (Donkin) Cleve 1895	Shar Planina	Eutrophication

44.	*Pinnularia lata* (Brébisson) Rabenhorst 1853	Golema Reka (river)	Pollution
45.	*Pinnularia legumen* (Ehrenberg) Ehrenberg 1843	Bukovik	Pollution
46.	*Pinnularia nobilis* Ehrenberg 1843	Shar Planina	Eutrophication
47.	*Placoneis gastrum* (Ehrenberg) Mereshkowsky var. *signata* Hustedt	Ohrid Lake	Eutrophication
48.	*Sellaphora pupula* fo. *rostrata* (Hustedt) Bukhtiyarova 1995	St. Naum – Ohrid	Eutrophication
49.	*Sellaphora seminulum* (Grunow) D. G. Mann 1990	St. Naum – Ohrid	Eutrophication
50.	*Stauroneis producta* Grunow *1880*	Shar Planina	Eutrophication
51.	*Stauroneis smithii var. incisa* Pantocsek *1902*	Ohrid Lake	Eutrophication
52.	*Surirella capronii* Brébisson in Kitton 1869	Doyran Lake	Eutrophication
53.	*Surirella elegans* Ehrenberg 1843	Doyran Lake	Eutrophication
54.	*Surirella peisonis* Pantocsek 1901	Doyran Lake	Eutrophication
55.	*Surirella turgida* W. Smith 1853	Doyran Lake	Eutrophication

Table 2. List of extinct diatoms.

No.	Species	Site	Cause
1.	*Cyclotella petrovskae* (Jerkovic) Stojanov 1976	Doyran Lake	Water level lowering (intensive eutrophication)
2.	*Eunotia naegelii* Migula in Thomé 1907	Stensko Swamp	Desiccation
3.	*Gyrosigma spenceri* (W. Smith) Cleve	Stensko Swamp	Desiccation
4.	*Hantzschia spectabilis* (Ehrenberg) Hustedt 1959	Katlanovo Marsh	Desiccation
5.	*Neidium kozlowii* Mereschkowsky 1906	Doyran Lake	Water level lowering (intensive eutrophication)
6.	*Nitzschia perminuta* (Grunow) M. Pergallo 1903	Katlanovo Marsh	Desiccation
7.	*Nitzschia reversa* W.Smith 1853	Doyran Lake	Water level lowering (intensive eutrophication)
8.	*Sellaphora americana* (Ehrenberg) D.G. Mann	Doyran Lake	Water level lowering (intensive eutrophication)
9.	*Stauroneis tackei* (Hustedt) Krammer & Lange-Bertalot 1985	Katlanovo Marsh	Desiccation

Table 3. List of Fungi proposed to be protected.

No.	Species	MAK	ERL
1.	*Agaricus macrosporus* (Moll. & J.Schaef.) Pil.	EKSP	
2.	*Amanita caesarea* (Scop.: Fr.) Pers.	EKSP	D
3.	*Amanita vitadinii* (Moretti) Vittad.	RV	
4.	*Amylostereum areolatum* (Chaill.in Fr.) Boid.	RS	
5.	*Antrodia juniperina* (Murril) Niemelä et Ryv.	RS	
6.	*Apoxona nitida* (Dur.et Mont.) Donk	RS	
7.	*Armillariella tabescens* (Scop.: Fr.) Sing.	EKSP	
8.	*Basidiodendron caesiocinereum* (v.Hohn.et Litsch.) Luck	RV	
9.	*Battarea phalloides* (Dicks.) Pers.	RS	D
10.	*Boletus aereus* Bull.: Fr.	EKSP	C
11.	*Boletus fechtneri* Velen.	EKSP	B
12.	*Boletus pulverulentus* Opat.	RV	
13.	*Boletus regius* Krombh.	EKSP	A
14.	*Boletus rhodoxanthus* (Krombh.) Kallenb.	RV	A
15.	*Boletus satanas Lenz*	EKSP	A
16.	*Chroogomphus helveticus* (Sing.) Mos.	RS	
17.	*Clathrus ruber* Mich.: Pers.	RV	

18.	*Craterellus cornucopioides* (L.) Fr.	EKSP	
19.	*Creolophus cirrhatus* (Pers.: Fr.) P.Karst.	RV	
20.	*Dichomitus albidofuscus* (Domanski) Domanski	RV	
21.	*Diplomitoporus flavescens* (Bres.) Doman.	RV	
22.	*Exidia pithya* Fr.	RS	C
23.	*Geastrum minimum* Schw.	RV	
24.	*Gloeocystidiellum ochraceum* (Fr.: Fr.) Donk	RV	
25.	*Gloeoporus dichrous* (Fr.) Bres.	RV	D
26.	*Hericium erinaceus* (Bull.: Fr.) Pers.	RV	B
27.	*Heterochaetella dubia* (Bourd.et Galz.) Bourd. Et Galz.	RV	
28.	*Hirneola auricula judae* (Bul.: St.Am.) Berk	RV	
29.	*Hygrocybe reai* R.Mre.	RV	
30.	*Hygrophorus marzuolus* (Fr.) Bres.	EKSP	D
31.	*Hyphoderma pallidum* (Bres.) Donk	RV	
32.	*Inonotus tamaricis* (Pat.) Maire	RS	
33.	*Lachnellula suecica* (de Bary : Fuck.) Nannf.	RV	
34.	*Langermania gigantea* (Batsch.) Rostk	RV	
35.	*Leptosporomyces galzinii* (Bourd.) Julich	RV	
36.	*Lindtneria chordulata* Parm.	RV	
37.	*Macrolepiota procera* (Scop.: Fr.) Sing.	EKSP	
38.	*Metulodontia nivea* (Karst.) Parm.	RV	
39.	*Mutinus caninus* (Huds.: Pers.) Fr.	RV	
40.	*Mycoacia nothofagi* (Kun.) Donk	RV	
41.	*Mycoaciella bispora* (Stalpers) Erikss.et Ryv.	RV	
42.	*Myriostoma coliforme* (With.: Pers.) Corda	RV	
43.	*Parmastomyces krawtzewianus* (Bond.et Par.) Kotl.et Pouz.	RV	
44.	*Paxilus atrotomentosus* Schwalb.	RV	
45.	*Peniophora junipericola* J.Erikss.	RS	
46.	*Peniophora tamaricicola* Boidin	RS	
47.	*Perenniporia narymica* (Donk) Ryv.	RV	
48.	*Phanerochaete martelliana* (Bres.) Erikss.et Ryv	RV	
49.	*Phellinus rimosus* (Berk.) Pilat	RV	
50.	*Phellinus robustus* (P.Karst.) Bourd.et Galz.	RS	
51.	*Phlebia griseo-flavescens* (Litsch.) Erikss.et Hjortst.	RV	
52.	*Pleurocybella porigens* (Pers.: Fr.) Singer	RS	
53.	*Pleurotus dryinus* (Pers.) Kumn.	RV	
54.	*Poronia punctata* Fr.	RV	
55.	*Porostereum spadiceum* (Boidin) Ryv.	RV	
56.	*Pyrofomes demidoffii* (Lev.) Kotl.et Pouz.	RS	
57.	*Rigidoporus undatus* (Pers.) Donk	RV	
58.	*Sarcodon imbricatus* (L.: Fr.) Karst.	RV	
59.	*Sarcoporia salmonicolor* (Berk.et Kurt.) Doman.	RV	
60.	*Steccherinum litschaueri* (Bourd.et Galz.) Berk.& Kurt.	RV	
61.	*Suillus sibiricus* (Sing.) Sing.	RS	
62.	*Trametes ljubarskii* Pilàt	RV	
63.	*Tremella folliacea* Pers.: Fr.	RV	
64.	*Tulostoma brumale* Pers.: Pers.	RV	
65.	*Tulostoma melanocyclum* Bres. in Petri	RV	
66.	*Utathobasidium ochraceum* (Massee) Donk	RV	
67.	*Volvariella bombycina* (Sch.: Fr.) Singer	RV	

RV – very rare or rare species in Macedonia
RS – species existing only on endangered or rare habitats
EKSP – very rare or rare species endangered due to over-exploitation
ERL – species included in the European Red List

Table 4. Rare and severely endangered species of Fungi, sites and type of threat.

No.	Rare and severely endangered species	Sites of endangered species	Type of threat
1.	*Antrodia juniperina* (Murril) Niemelä et Ryv.	Golem Grad, Katlanovo-Pchinya, Valandovo area	Rare supstratus - *Juniperus excelsa*
2.	*Battarea phalloides* (Dicks.) Pers.	Golem Grad, proximity of Doyran Lake	Destruction of habitat
3.	*Boletus regius* Krombh.	Pelister, Struga area	Exploitation for food
4.	*Chroogomphus helveticus* (Sing.) Mos.	Pelister	Relict communities of molika
5.	*Inonotus tamaricis* (Pat.) Maire	Gevgeliya area	Anthropogenic impact on habitat
6.	*Myriostoma coliforme* (With.: Pers.) Corda	Golem Grad, D. Kapiya	Rare thermophilic species
7.	*Peniophora tamaricicola* Boidin	Gevgeliya area	Anthropogenic impact on habitat
8.	*Pleurocybella porigens* (Pers.: Fr.) Singer	Shar Planina	Rare supstratus - *Picea abies*
9.	*Poronia punctata* Fr.	Kozuf, Berovo	Rare species, growing on cattle excrements
10.	*Pyrofomes demidoffii* (Lev.) Kotl.et Pouz.	Golem Grad, Katlanovo-Pchinya, D. Kapija, Valandovo area	Rare supstratus - *Juniperus excelsa*
11.	*Suillus sibiricus* (Sing.) Sing.	Pelister	Relict communities of Molika

Table 5. Rare and severely endangered species of Lichens, sites and type of threat.

No.	Rare and severely endangered species	Sites of endangered species	Type of threat
1.	*Evernia divaricata* (L.) Ach.	Shar Planina	Anthropogenic impact
2.	*Parmelia exasperatula* Nyl.	Pelister, S.C.Gora	Anthropogenic impact
3.	*Parmelia omphalodes* (L.) Ach.	Karadzitsa	Anthropogenic impact
4.	*Parmelina pastillifera* (Harm.) Hale	Galichitsa	Anthropogenic impact
5.	*Parmelina sorediata* (Ach.) Th.	Pelister	Anthropogenic impact
6.	*Peltigera venosa* (L.) Hoffm.	Shar Planina, Galichitsa	Anthropogenic impact
7.	*Pertusaria coccodes* (Ach.) Nyl.	Karadzitsa	Anthropogenic impact
8.	*Ramalia carpatica* Koerb.	Pelister, Galichitsa	Anthropogenic impact
9.	*Ramalia polymorpha* (Liljebl.) Ach.	Galichitsa, Karadzitsa	Anthropogenic impact
10.	*Staurothele clopimoides* (Anzi) Steiner	Shar Planina	Anthropogenic impact
11.	*Usnea carpatica* Mot.	Shar Planina, Mavrovo	Anthropogenic impact
12.	*Usnea causasica* Vain.	Shar Planina, Mavrovo	Anthropogenic impact

Table 6. List of higher plant groups of national importance – species included in the IUCN 1997 Red List of Threatened Plants, Annex I of the Bern Convention (BERN), (CORINE species), endangered species in Macedonia or globally endangered species (En, of the flora of Macedonia.

No.	Species	IUCN 1997 Red List of Threatened Plants - World status	BERN (1992, 2000)	CORYNE, E, M, Al	Endangered species (En)
1.	*Acer heldreichii* Orph. ex Boiss. subsp. *visiani* H. Maly (I)	I			
2.	*Adonis vernalis* L.				Kumanovo
3.	*Ajuga piscoi* Degen & Dald.	R		Corine/a.	
4.	*Aldrovanda vesiculosa* L.		+	Corine/m	Prespa Lake - Ezerani
5.	*Alkanna pulmonaria* Griseb.	R			
6.	*Alkanna stribrnyi* Velen.	R			
7.	*Alopecurus creticus* Trin.				Monospitovo
8.	*Alyssum doerfleri* Degen	R			
9.	*Anchusa serpentinicola* Rech.f.	R			
10.	*Andreaea rupestris* Hedw.				Shar Planina., Bistra, Rudoka, Pelister, Yakupitsa
11.	*Anthemis meteorica* Hausskn.	R			
12.	*Anthoceros punctatus* L.				Bogdantsi
13.	*Armeria vandasii* Hayek	R			
14.	*Asplenium macedonicum* Kümm.			Corine/m	Markovi Kuli,
15.	*Astragalus baldacii* Degen	R		Corine/a.	
16.	*Astragalus cernjavskii* Stoj.			Corine/m	Orlovo Brdo
17.	*Astragalus physocalyx* Fischer	Ex/En	+	Corine/m	Bogdantsi
18.	*Aubrieta thessala* Boissieu	R			
19.	*Beckmannia eruciformis* (L.) Host.				Pelagonia, Skopsko
20.	*Botrychium lunaria* (l.) Swartz			Corine/a	
21.	*Buxbaumia viridis* (Moug. ex Lam. & DC.) Brid. ex Moug. & Nestl.		+		Pelister, Shar Planina
22.	*Campanula abietina* Griseb.		+		
23.	*Camporosma monspeliaca* L.				Ovche Pole
24.	*Carex elata* All.				Studenchishte
25.	*Catoscopium nigritum* (Hedw.) Brid.				Shar Planina.
26.	*Centaurea grbavacensis* (Rohl.) Stoj. & Acht.	R			
27.	*Centaurea kosaninii* Hayek	R		Corine/a	
28.	*Centaurea rufidula* Bornm.	R			
29.	*Centaurea soskae* Hayek ex Kosanin	R			
30.	*Centaurea wettsteinii* Degen & Dörfl.	R			
31.	*Cladium mariscus* (L.) Pohl				Negortsi Spa Basyi
32.	*Coeloglossum* viride (L.) Hartman			Corine/e	
33.	*Colchicum macedonicum* Košanin	R		Corine/m	Yakupitsa
34.	*Colchicum piepeianum* Margraf	R		Corine/a	

35.	*Crocus pelistericus* Pulevic			Corine/m	Pelister
36.	*Crocus cvijici* Košanin			Corine/m	Galichitsa
37.	*Crypsis aculeata* (L.) Aiton				Ovche Pole
38.	*Dianthus myrtinervius* Griseb.	R			
39.	*Drosera rotundifolia* L.			Corine/m	Pehchevo
40.	*Erodium guicciardii* Heldr. ex Boiss.	R			
41.	*Eryngium serbicum* Pancic	R			
42.	*Fritillaria graeca* Boiss. & Spruner		+		
43.	*Fritillaria gussichiae* (Deg. & Dorfl.) Rix	R	+		
44.	*Fritillaria macedonica* Bornm.	R			
45.	*Galium rhodopeum* Vel.		+		
46.	*Genista nissana* Petrovic	R			
47.	Gentiana lutea *L. subsp*. Symphyandra *(Murb.) Hayek*			Corine/a	Shar Planina, Yablanitsa, Pelister
48.	*Gentiana punctata* L.				Pelister, Nidze
49.	*Gladiolus palustris* Gaudin	I			
50.	*Glyceria maxima* (Hart.) Holm.				Chepigovo
51.	*Gypsophila macedonica* Vandas	R			
52.	*Hedysarum macedonicum* Bornm.	R			
53.	*Heptaptera macedonica* (Bornm.) Tutin	I			Ljubash
54.	*Isoetes phrygia* (Boiss.) Hausskn.			Corine/m	Markovi Kuli, Bansko
55.	*Jurinea taygetea* Hal.	R		Corine/e	
56.	*Knautia caroli-rechingeri* Micevski				Alshar
57.	*Leucobryum glaucum* (Hedw.) Angstr.				village Malino
58.	*Lindernia procumbens*(Krocker) Philocox		+		
59.	*Linum elegans* Spruner ex Boiss.	R			
60.	*Listera cordata* (L.) R. Br.				Shar Planina
61.	*Malus florentina* (Zuccagni) C.K.Schneid.	R			
62.	*Marsilea quadrifolia* L.		+		
63.	*Melampyrum heracleoticum* Boiss. & Orph.	R			
64.	*Merendera sobolifera* C.A.Meyer				Petrovets
65.	*Minuartia baldaccii* (Halácsy) Mattf.	R			
66.	*Moehringia minutiflora* Bornm	R			
67.	*Narthecium scardicum* Košanin	R		Corine/e	
68.	*Nymphaea alba* L.				Doyran Lake
69.	*Onobrychis degenii* Dörfler	I			Alshar
70.	*Ophioglossum vulgatum* L.				Bansko, Negortsi Spa
71.	*Orchis coriophora* L.			Corine/e	
72.	*Osmunda regalis* L.			Corine/m	Bansko
73.	*Oxytropis purpurea* (Baldacci) Markgraf	R			
74.	*Pedicularis ferdinandi* Bornm.	R			
75.	*Pedicularis limnogena* A. Kerner	R			
76.	*Pinus heldreichii* H.Christ var. *leucodermis* (Ant.) Markgraf ex Fitschen	R			
77.	*Pinus peuce* Griseb.	R			
78.	*Potentilla doerfleri* Wettst.	R		Corine/m	Shar Planina
79.	*Potentilla visianii* Pancic	R			
80.	*Puccinellia festuciformis* (Host.) Parl subsp. *convoluta* (Hornem.) W.E.Hughes				Ovche Pole
81.	*Ramonda nathaliae* Pancic & Petrovic	R		Corine/e	

82.	*Ramonda serbica* Panc.	R	+	Corine/e	
83.	*Ranunculus cacuminis* Strid & Pap.	V		Corine/e	
84.	*Ranunculus degeni* Kümm. & Jav.	Ex/En		Corine/m	Shar Planina
85.	*Ranunculus fontanus* C. Presl.			Corine/e	
86.	*Ranunculus lingua* L.				Kalishte
87.	*Ranunculus wettsteinii* Dörfl.	I			
88.	*Rhodobryum roseum* (Hedw.) Limpr.				Vodno, Modrich
89.	*Rindera graeca* (A.DC.) Boiss. & Heldr.	R			
90.	*Rumex hydrolapathum* Hudson				Kalishte
91.	*Salvia jurisicii* Košanin	R		Corine/m	Bogoslovets, Ovche Pole
92.	*Salvia officinalis* L.				Lukovo
93.	*Salvinia natans* L.		+		Doyran Lake
94.	*Sambucus deborensis* Košanin			Corine/m	Debar
95.	*Sempervivum kindingeri* Adam.	R			
96.	*Sempervivum kosaninii* Praeger	R			
97.	*Sempervivum macedonicum* Prager	R			
98.	*Sempervivum octopodes* Turill	R			
99.	*Sempervivum thompsonianum* Wale	R			
100.	*Senecio paludosus* L.				Kalishte
101.	*Sideritis raeseri* Boiss. & Heldr.			Corine/a.	
102.	*Sideritis scardica* Griseb.				Shar Planina
103.	*Silene paeoniensis* Bornm.			Corine/m	Chebren
104.	*Silene schmuckeri* Boiss.	R			
105.	*Silene viscariopsis* Bornm.	R			
106.	*Silene vulgaris* (Moench) Garcke			Corine/e	
107.	*Soldanella pindicola* Hausskn.	R			
108.	*Solenanthus scardicus* Bornm.	R			
109.	*Stipa rechingeri* Martinovsky, - R	R			
110.	*Suaeda maritima* (L.) Dumort.				Ovche Pole
111.	*Thymus alsarensis* Ronn.				Alshar
112.	*Thymus oehmianus* Ronn. & Soška	Ex		Corine/m	Kapina, Ocha
113.	*Trapa natans* L.		+		
114.	*Tulipa mariannae* Lindtner			Corine/m	Orlovo Brdo
115.	*Verbascum herzogii* Borm.	R			
116.	*Verbascum macedonicum* Košanin & Murb.	R			
117.	*Vicia montenegrina* Rohl	R			
118.	*Viola allchariensis* Beck				Alshar
119.	*Viola arsenica* Beck			Corine/m	Alshar
120.	*Viola brachphylla* W. Becker.	R			
121.	*Viola elegantula* Schott	R			
122.	*Viola eximia* Form	R			
123.	*Viola kosaninii* (Degen) Hayek	R		Corine/m	Kozyak
124.	*Viola stojanovii* W.Becker	R			

ABREVIATIONS:

Corine E- Corine species from the European list
Corine M- Corine species in Macedonia
Corine Al- Corine species in Albania
IUCN World status: R-Rare
I- Indeterminate
V-Vulnerable
Ex (Extinct)
Ex/En (Extinct/Endangered)

Table 7. Extinct species of the higher plant groups.

1.	*Alismataceae*	*Sagittaria sagittifolia* L.	+ Novatsi	+
2.	*Araceae*	*Acorus calamus* L.	+ Struga	+
3.	*Gentianaceae*	*Gentiana pneumonanthe* L.	+ Mavrovo	+
4.	*Liliaceae*	*Allium obtusiflorum* DC (Syn.: *A. maritimum* Rafin)	+ Ovce Pole	+
5.	*Primulaceae*	*Lysimachia thyrsiflora* L.	+ Mavrovo	+

ANNEX 4

Threatened species of fauna in the Republic of Macedonia

List of threatened species of vertebrates

EUROPEAN RED LIST OF VERTEBRATES, COUNCIL OF EUROPE & EUROPEAN ENVIRONMENT AGENCY, OCTOBER, 2002.
Threatened Species means species evaluated as Critically Endangered (CR); Endangered (EN) and Vulnerable (VU).

Threatened Fish Species

No.	Scientific name	Macedonian Common Name	English Common Name	European IUCN Threat Category
1.	*Acantholingua ohridana* (Steindachner, 1892)	Ohridska mekousna pastrmka; Ohridska belvica	Ohrid Salmon	VU
2.	*Acipenser sturio* Linnaeus, 1758	Atlantska esetra	Sturgeon	CR
3.	*Alburnus belvica* Karaman, 1924	Prespanska belvica; Nivichka	Prespa Bleak	VU
4.	*Alosa falax* (La Cepede, 1803)	Lojka; Haringa; Sledj	Twaite Shad	VU
5.	*Barbatula bureschi* (Drensky, 1928)	Strumichka vretenushka	Strumica Loach	VU
6.	*Barbus prespensis* Karaman, 1924	Prespanska mrena	Prespa Barbel	VU
7.	*Chondrostoma prespense* Karaman, 1924	Prespanski bojnik; Skobust	Prespa Nase; Undermouth	VU
8.	*Cobitis meridionalis* Karaman, 1924	Prespanska shtipalka	Prespa Loach	VU
9.	*Cyprinus carpio* Linnaeus, 1758	Krap	Carp	CR
10.	*Eudontomyzon hellenicus* Vlad., Ren., Kott & Econ., 1982	Vardarska zmiorka	Vardar Lamprey	EN
11.	*Eudontomyzon stankokaramani* Karaman, 1974	Drimska zmiorka	Drim Lamprey	EN
12.	*Gobio banarescui* Dimovski & Grupce, 1974	Vardarska krkushka; Govedarka	Macedonian Gudgeon	VU
13.	*Phoxinellus epiroticus* (Steindachner, 1896)	Ohridsko grunche	Ohrid Minnow	VU
14.	*Phoxinellus prespensis* (Karaman, 1924)	Prespansko grunche	Prespa Minnow	VU
15.	*Rutilus karamani* Fowler, 1977	Drimski grunec	Drim Roach	VU
16.	*Rutilus ohridanus* (Karaman, 1924)	Ohridski grunec	Ohrid Roach	VU
17.	*Rutilus prespensis* (Karaman, 1924)	Prespanski grunec	Prespa Roach	VU
18.	*Sabanejewia balcanica* (Karaman, 1922)	Zlatna shtipalka	Golden Loach	VU
19.	*Sabanejewia doiranica* Economidis & Nalbant, 1996	Doyranska shtipalka	Doyran Loach	VU
20.	*Salaria fluviatilis* (Asso 1801)	Kamenjarche; Bapka; Mremka	Freshwater Blenny	VU
21.	*Salmo aphelios* Kottelat, 1997	Drimska pastrmka	Drim Trout	VU
22.	*Salmo balcanicus* (Karaman, 1927)	Strushka pastrmka	Struga Trout	VU
23.	*Salmo dentex* Heckel, 1852	Zapadno- balkanska pastrmka	Westbalkan Trout	EN

24.	*Salmo letnica* (Karaman, 1924)	Ohridska pastrmka	Ohrid Trout	VU
25.	*Salmo lumi* Poljakov, Filipi & Basho, 1958	Ohridska potochna pastrmka	Ohrid Stream Trout	EX
26.	*Salmo marmoratus* Cuvier, 1829	Glavatica	Marbled Trout	EN
27.	*Salmo pelagonicus* Karaman, 1938	Pelagoniska pastrmka	Pelagonian Trout	VU
28.	*Salmo peristericus* Karaman, 1938	Pelisterska pastrmka	Pelister Trout	VU
29.	*Vimba melanops* (Heckel, 1837)	Popadika	Balkan Vimba	VU
30.	*Zingel balcanicus* (Karaman, 1936)	Vardarski vretenar	Vardar Little Chop	CR

Total number of threatened fish species	30

Threatened Reptile Species

No.	Scientific name	Macedonian Common Name	English Common Name	European IUCN Threat Category
1.	*Vipera ursinii*	Ostroglava sharka		EN

Total number of threatened reptiles species	1

Threatened Bird Species

For Breeding Birds, the species have been identified by Birdlife International as Species of European conservation concern (SPECs), defined as those having an unfavourable conservation status in Europe (assigned a European threat status as: E-Endangered; V-Vulnerable; R-Rare; D-Declining; L-Localized or Ins-Insufficiently Known. If the European Threat status is provisional, it is indicated between brackets.
Threatened Species means species evaluated as: Endangered-E and Vulnerable-V.

No.	Scientific name	Macedonian Common Name	English Common Name	European IUCN Threat Category
1.	*Acrocephalus paludicola*	Voden trskar	Aquatic Warbler	E
2.	*Aegypus monachus*	Crn mrshojadec	Black Vulture	V
3.	*Alauda arvensis*	Polska chuchuliga	Skylark	V
4.	*Alectoris graeca*	Erebica kamenjarka	Rock-Partridge	(V)
5.	*Anas acuta*	Patka lastovicharka	Pin tail	V
6.	*Anas querquedula*	Patka pupcharka	Garganey	V
7.	*Anas strepera*	Siva patka	Gadwall	V
8.	*Anser erythropus*	Mala belochelna guska	Lesser White-fronted Goose	V
9.	*Anthus campestris*	Polska trepetlivka	Tawny Pipit	V
10.	*Aquila clanga*	Golem kresliv orel	Spotted Eagle	E
11.	*Aquila heliaca*	Carski orel; Orel krstash	Imperial Eagle	E

12.	*Ardea purpurea*	Purpurna chapja	Purple Heron	V
13.	*Ardeola ralloides*	Grivesta chapja; Zholta chapja	Squacco Heron	V
14.	*Asio flammeus*	Blatna kratkoushesta utka	Short-eared Owl	(V)
15.	*Aythya nyroca*	Njorka; Kozhufar; Belooka potopnica	Ferrugineous Duck	V
16.	*Botaurus stellaris*	Golem voden bik	Bittern	(V)
17.	*Bubo bubo*	Golem buf	Eagle Owl	V
18.	*Burhinus oedicnemus*	Churulin	Stone Curlew	V
19.	*Buteo rufinus*	Lisest Yastreb gluvchar	Long-legged Buzzard	(E)
20.	*Calandrella brachydactila*	Kratkoprsta chuchuliga	Short-toed Lark	V
21.	*Calidris alpina*	Severen peskar	Dunlin	V
22.	*Ciconia ciconia*	Bel shtrk	White Stork	V
23.	*Circus cyaneus*	Polska eja	Hen Harrier	V
24.	*Circus macrourus*	Stepska eja	Pallid Harrier	E
25.	*Coturnix coturnix*	Potpoloshka	Quail	V
26.	*Crex crex*	Livadska blatna kokoska	Corncrake	V
27.	*Emberiza cia*	Planinska strnarka	Rock Bunting	V
28.	*Emberiza hortulana*	Polska strnarka	Ortolan Bunting	(V)
29.	*Emberiza melanocephala*	Crnoglava strnarka	Black-headed Bunting	(V)
30.	*Falco biarmicus*	Yuzhen sokol	Lanner	(E)
31.	*Falco cherrug*	Stepski sokol	Saker Falcon	E
32.	*Falco naumanni*	Mala vetrushka	Lesser Kestrel	(V)
33.	*Falco vespertinus*	Vecherna vetrushka	Red-footed Falcon	V
34.	*Gallinago media*	Golema bekasina	Great snipe	(V)
35.	*Gavia arctica*	Crnogusha severna potopnica	Black-throated Diver	V
36.	*Gavia stellata*	Crvenogusha severna potopnica	Red-throated Diver	V
37.	*Gelochelidon nilotica*	Debelokluna vrtimushka Debelokluna ribarka	Gull-billed Tern	(E)
38.	*Glareola pratincola*	Blatna lastovica	Collared Pranticole	E
39.	*Grus grus*	Siv zherav	Crane	V
40.	*Gypaetus barbatus*	Bradest mrshojadec	Lammergier	E
41.	*Hieraaetus fasciatus*	Yastreboviden orel	Bonelli's Eagle	E
42.	*Hippolais pallida*	Sivo-maslinest Grmushar	Olivaceous Warbler	(V)
43.	*Ixobrychus minutus*	Mal voden bik	Little Bittern	(V)
44.	*Lanius nubicus*	Belochelno svrache	Masked Shrike	(V)
45.	*Lanius senator*	Crvenoglavo svrache	Woodchat Shrike	V
46.	*Limicola falcinellus*	Ploskokluna peskarka	Broad-billed Sandpiper	(V)
47.	*Limosa limosa*	Crnoopashesta shljuka	Black-tailed Godwit	V
48.	*Lullula arborea*	Shumska chuchuliga	Woodlark	V
49.	*Marmaronetta angustirostris*	Mramorna patka	Marbled Teal	E
50.	*Mergus albellus*	Mal potopnik; Mal ronec	Smew	V
51.	*Milvus migrans*	Crna lunja	Black Kite	V
52.	*Monticola solitarius*	Sin skalen drozd	Blue Rock Thrush	(V)
53.	*Neophron percnopterus*	Egipetski mrshojadec	Egyptian Vulture	E
54.	*Oenanthe hispanica*	Shpanska belogaska	Black-eared Wheatear	V

55.	*Oxyura leucocephala*	Beloglava patka	White-headed Duck	E
56.	*Pelecanus crispus*	Kadroglav pelikan	Dalmatian Pelican	V
57.	*Perdix perdix*	Erebica polka	Grey Partridge	V
58.	*Phalacrocorax pygmeus*	Mal kormoran	Pygmy Cormorant	V
59.	*Phoenicurus phoenicurus*	Crvenoopashka	Redstart	V
60.	*Platalea leucorodia*	Chapja lazicharka	Spoonbill	E
61.	*Pyrrhocorax pyrrhocorax*	Crvenokluna galka	Chough	V
62.	*Scolopax rusticola*	Shumska shlyuka	Woodcook	V
63.	*Sterna caspia*	Golema vrtimushka	Caspian Tern	(E)
64.	*Sylvia hortensis*	Orfeevo koprivarche	Orphean Warbler	V
65.	*Tetrao tetrix*	Mal tetreb	Black Grouse	V
66.	*Tetrax tetrax*	Mala droplya; Prskach	Little Bustard	V

Total number of Threatened Species of Birds	66

Threatened Mammal Species

No.	Scientific name	Macedonian Common Name	English Common Name	European IUCN Threat Category
1.	*Barbastella barbastellus*	Shirokoushest lilyak	Barbastelle	VU
2.	*Canis lupus*	Volk	Wolf	VU
3.	*Felis silvestris*	Diva machka	Wildcat	VU
4.	*Lutra lutra*	Vidra	Otter	VU
5.	*Miniopterus schreibersii*	Dolgokrilest lilyak	Schreibers' Bat	VU
6.	*Myotis capaccinii*	Dolgoprst noknik	Long-fingered Bat	VU
7.	*Myotis emarginatus*	Troboen noknik	Geoffroy's Bat	VU
8.	*Nannospalax leucodon*	Slepo kuche	Lesser mole Rat	VU
9.	*Ovis ammon*	Muflon	Mouflon	VU
10.	*Rhinolophus blasii*	Blasiev potkovichar	Blasius' horseshoe Bat	VU
11.	*Rhinolophus euryale*	Yuzhen potkovichar	Mediterranean horseshoe Bat	VU
12.	*Rhinolophus ferrumequinum*	Golem potkovichar	Greater horseshoe Bat	VU
13.	*Rhinolophus hipposideros*	Mal potkovichar	Lesser horseshoe Bat	VU
14.	*Rhinolophus mehelyi*	Meheliev potkovichar	Mehely's horseshoe Bat	VU
15.	*Spermophilus citellus*	Stobolka	European Souslik	VU
16.	*Vormela peregusna*	Sharen tvor	Marbled policat	VU

Total number of Threatened Species of Mammals	16

Threatened Vertebrate Species

Total number of Threatened Fish Species	30
Total number of Threatened Reptile Species	1
Total number of Threatened Bird Species	66
Total number of Threatened Mammal Species	16

Total number of Threatened Vertebrate Species	**113**

ANNEX 5

Gene fund of Angiosperm plants in the flora of the Republic of Macedonia

No.	Family	Genus	Species	2n
1.	*Amaryllidaceae*	*Galanthus*	*G. graecus* Orph.	24
2.			*G. nivalis* L.	24
3.		*Leucojum*	*L. aestivum* L.	22
4.		*Narcissus*	*N. poeticus* L.	14
5.		*Sternbergia*	*S. colchiciflora* W.K.	22
6.			*S. lutea* L. Ker.	22
7.	*Apiaceae*	*Bupleurum*	*B. commutatum* B. & B.	16
8.		*Daucus*	*D. carota* L.	18
9.			*D. guttatus* S.& S.	22
10.		*Eryngium*	*E. campestre* L.	14
11.		*Malabaila*	*M. aurea* (Sibth. & Sm.) Boiss.	20
12.		*Orlaya*	*O. grandiflora* (L.) Hoffm.	14
13.		*Tordylium*	*T. maximum* L.	20
14.		*Torilis*	*T. anthriscus* (L.) Gmel.	12
15.			*T. leptophylla* (L.) Reichenb.	12
16.			*T. nodosa* (L.) Gaertn.	24
17.	*Araceae*	*Arum*	*A. maculatum s.l.*	30
18.		*Biarum*	*B. tenuifolium* (L.) Schott var. *abbreviatum* (Schott) Engl.	26
19.	*Asparaginaceae*	*Asparagus*	*A. tenuifolius* Lam.	20
20.	*Asteraceae*	*Achillea*	*A. ageratifolia* (Sibth. & Sui.) Boiss. subsp. *arozon* (Griseb.) Heim.	18
21.			*A. coarctata* Poir. (Syn.*: A. compacta* Willd.)	18
22.			*A. fraasii* Schultr.	18
23.			*A. holosericea* S.& S.	18
24.			*A. nobilis* L. ssp. *nobilis*	18
25.			*A. setacea* Waldst. & Kit.	18
26.		*Anthemis*	*A. arvensis* L.	18
27.			*A. carpatica* Willd. var. *macedonica* (Griseb.) Hay.	36
28.			*A. ruthenica* M.B.	18
29.			*A. tinctoria* L.	15; 18
30.		*Arctium*	*A. lappa* L.	36
31.		*Bellis*	*B. perennis* L.	18
32.		*Carduus*	*C. acanthoides* L.	22
33.			*C. armatus* Boiss et Heldr.	22
34.		*Carlina*	*C. acanthifolia* All.	20
35.			*C. vulgaris* L. subsp. *intermedia* (Schur) Hayek	20
36.		*Carthamus*	*C. dentatus* Vahl.	20
37.			*C. lanatus* L.	44
38.		*Centaurea*	*C. cyanus* L.	24
39.			*C. deusta* Ten.	18
40.			*C. grbavacensis* (Rohlena) Stoj.& Acht.	20
41.			*C. jacea* L.	22
42.			*C. napulifera* Rochel.	20
43.			*C. salonitana* Vis.	40
44.			*C. solstitialis* L.	16
45.			*C. stenolepis* A. Kerner subsp. *stenolepis*	22

46.		*Chondrilla*	*Ch. juncea* L.	15
47.		*Cichorium*	*C. intybus* L.	18
48.		*Cirsium*	*C. cannum* (L.) All.	34
49.			*C. lanceolatum* (L.) Scop.	68
50.			*C. ligulare* Boiss.	34
51.		*Crepis*	*C. biennis* L.	40
52.			*C. foetida* L.	10
53.			*C. foetida* L. subsp. *rhoeadifolia* (Bieb.) Cel.	10
54.			*C. sancta* (L.) Babc.	10
55.			*C. setosa* Hall.	8
56.			*C. viscidula* Froel.	12
57.		*Crupina*	*C. crupinastrum* (Moris) Vis.	28
58.			*C. vulgaris* Cass.	30
59.		*Erigeron*	*E. acer* L.	18
60.			*E. bonariensis* L.	54
61.		*Galinsoga*	*G. ciliata* (Rafin.) Blake	32
62.			*G. parviflora* Cav.	16
63.		*Helichrysum*	*H. plicatum* DC	28
64.		*Hypochoeris*	*H. cretensis* (L.) Ch. & B.	6
65.			*H. glabra* L.	10
66.			*H. maculata* L.	10; 20
67.			*H. radicata* L.	8
68.		*Inula*	*I. verbascifolia* (Willd.) Hausskn. ssp. *aschersoniana* (Janka) Tutin	16
69.			*I. conyza* DC	32
70.			*I. ensifolia* L.	16
71.			*I. germanica* L	16
72.			*I. oculus-christi* L.	32
73.			*I. spiraeifolia* L.	16
74.		*Jurinea*	*J. consanguinea* DC subsp. *arachnoidea* (Bunge) Kozuharov	32
75.		*Lactuca*	*L. quercina* L.	18
76.			*L. saligna* L.	18
77.			*L. serriola* Torner.	18
78.		*Lapsana*	*L. communis* L.	16
79.		*Leontodon*	*L. cichoraceus* (Ten.) Sanguinetti	12
80.			*L. crispus* Vill. subsp. *asper* (W.K.) Rohl.	8
81.			*L. hispidus* L.	14
82.			*L. hispidus* L. subsp. *hispidus*	11
83.		*Onopordon*	*O. acanthium* L.	34
84.		*Picnomon*	*P. acarna* Cass.	32
85.		*Picris*	*P. echioides* L.	10
86.			*P. hieracioides* L.	10
87.			*P. pauciflora* Willd.	10
88.		*Pulicaria*	*P. vulgaris* Gaertn.	18
89.		*Scorzonera*	*S. austriaca* Willd.	14
90.			*S. hispanica* L. var. *strictiformis* Domin	14
91.			*S. laciniata* L.	14
92.			*S. lanata* (L.) Hoffm	12
93.			*S. mollis* M. B.	28
94.			*S. purpurea* L. subsp. *peristerica* Form.	14
95.			*S. rumelica* Vel.	14; 15
96.		*Senecio*	*S. carpatica* Herb.	40
97.			*S. jacobaea* L.	40
98.			*S. vernalis* W.K.	20

99.			*S. vulgaris* L.	40
100.		*Solidago*	*S. virgaurea* L. subsp.*alpestris* var.*vestita* Hall.	18
101.		*Tanacetum*	*T. corymbosum* (L.) Schultz Bip.	36+3B
102.			*T. parthenium* (L.) Schultz.	18
103.			*T. vulgare* L.	18
104.		*Taraxacum*	*T. officinale* Veber.	24
105.		*Tragopogon*	*T. balcanicus* Vel.	12
106.			*T. dubius* Scop. subsp.*campestris* (Bess.) Hayek	12
107.			*T. majus* Jacq.	12
108.			*T. porrifolius* L	12
109.			*T. pratensis* L.	12
110.			*T. pterodes* Panc.	12
111.		*Xeranthemum*	*X. annuum* L.	12
112.			*X. cylindraceum* Sibth. & Sm.	20
113.	*Boraginaceae*	*Anchusa*	*A. officinalis* L	16
114.		*Echium*	*E. italicum* L.	16
115.		*Onosma*	*O. visiani* G.C.Clem	18
116.		*Pulmonaria*	*P. officinalis* L	14
117.		*Symphytum*	*S. officinale* L.	48
118.	*Campanulaceae*	*Jasione*	*J. heldreichii* Boiss. & Orph.	12
119.			*J. orbiculata* Gris.	12
120.	*Caryophyllaceae*	*Agrostemma*	*A. githago* L.	48
121.		*Dianthus*	*D. gracilis* Sibth. & Sm.	30
122.			*D. haematocalyx* Boiss.& Heldr.	30
123.			*D. prilepensis* Micev.	30
124.		*Lychnis*	*L. coronaria* (L.) Desr.	24
125.		*Petrorhagia*	*P. velutina* (Guss) P.W.Ball. & Heyw.	30
126.		*Silene*	*S. alba* E.H.L.	24
127.			*S. armeria* L.	24
128.			*S. bupleuroides* L. subsp. *staticifolia* (Sibth. & Sm) Chowdhuri	24
129.			*S. conica* L. subsp.*subconica* (Friv.) Gavioli	20
130.			*S. cretica* L.	24
131.			*S. dichotoma* Ehrh.	24
132.			*S. frivaldskyana* Hampe	24
133.			*S. italica* (L.) Pers.	24
134.			*S. nutans* L.	24
135.			*S. otites* (L) Wibl.	24
136.			*S. paeoniensis* Bornm.	24
137.			*S. venosa* Aschers. et Graebn.	24
138.			*S. viscariopsis* Bornm.	24
139.			*S. viridiflora* L.	24
140.			*S. vulgaris* (Moench.) Garcke subsp. vulgaris	24
141.	*Cistaceae*	*Fumana*	*F. procumbens* (Dunal) Gren.	32
142.		*Helianthemum*	*H. aegyptiacum* (L.) Miller	20
144.			*H. canum* (L.) Baumg. subsp.*canum*	22
145.			*H. hymettium* Boiss. & Heldr. in Boiss.	22
146.			*H. nummularium* (L.) Mill. subsp.*nummularium*	20
147.			*H. salicifolium (L.)* Mill.	20
148.		*Tuberaria*	*T. guttata* (L.) Fourr.	24
149.	*Cucurbitaceae*	*Bryonia*	*B. alba* L.	20

150.	*Dipsacaceae*	*Pterocephalus*	*P. papposus* (L.) Coulter	18
151.		*Scabiosa*	*S. rotata* Bich.	18
152.			*S. trinifolia* Friv.	16
153.	*Euphorbiaceae*	*Euphorbia*	*E. barrelieri* Savi. subsp. *thessala* (Form.) K. Maly	18
154.			*E. cyparissias* L.	40
155.			*E. graeca* L.	28
156.			*E. niciciana* Borbas ex Novak	19
157.			*E. rupestris* Friv.	18
158.			*E. taurinensis* All.	28
159.	*Fabaceae*	*Anthyllis*	*A. aurea* Welden.	14
160.			*A. vulneraria* L.	12
161.		*Astragalus*	*A. hamosus* L.	48
162.			*A. mariovensis* Micev.	16
163.			*A. onobrychis* L. var. *chlorocarpus* (Griseb.) Stoj. & Stef.	32
164.			*A. parnasii* Boiss.	16
165.			*A. vesicarius* L.	16
166.		*Biserrula*	*B. pelecinus* L.	16
167.		*Coronilla*	*C. emeroides* Boiss. & Sprun.	14
168.			*C. scorpioides* (L.) Koch.	12
169.			*C. varia* L.	24
170.		*Cytisus*	*C. nigricans* L.	48
171.		*Dorycnium*	*D. herbaceum* Vill.	14
172.			*D. hirsutum* (L.) Ser.	14
173.		*Galega*	*G. officinalis* L.	16
174.		*Genista*	*G. sessilifolia* DC.	22
175.		*Hippocrepis*	*H. ciliata* Willd.	14
176.			*H. comosa* L.	28
177.		*Lathyrus*	*L. aphaca* L.	14
178.			*L. cicera* L.	14
179.			*L. digitatus* (M.B.) Fiori	14
180.			*L. grandiflorus* Sibt. & Sm.	14
181.			*L. hirsutus* L.	14
182.			*L. inconspicuus* L.	14
183.			*L. laxiflorus* (Desf.) O.Kuntze	14
184.			*L. niger (*L.) Bernh.	14
185.			*L. nissolia* L.	14
186.			*L. pratensis* L.	14
187.			*L. saxatilis* (Vent.) Vis.	14
188.			*L. setifolius* L.	14
189.			*L. sphaericus* Retz.	14
190.			*L. tuberosus* L.	14
191.			*L. venetus* (Mill.) Vohlf.	14
192.		*Lens*	*L. nigricans* (M.B.) Godr.	14
193.		*Lotus*	*L. corniculatus* L.	24
194.		*Medicago*	*M. arabica* (L.) Huds.	16
195.			*M. lupulina* L.	16
196.			*M. minima* (L.) Bartl.	16
197.			*M. rigidula* (L.) All.	14
198.		*Melilotus*	*M. alba* Medik	16
199.			*M. officinalis* (L.) Med.	16
200.		*Onobrychis*	*O. alba* (W.K) Desv.	14
201.			*O. hypargyrea* Boiss. f. *spinuligera* Bornm.	14
202.		*Ornithopus*	*O. compressus* L.	14

203.		*Trifolium*	*T. angustifolium* L.	16
204.			*T. arvense* L.	14
205.			*T. balansae* Boiss.	16
206.			*T. campestre* Schreb.	14
207.			*T. cherleri* L.	10
208.			*T. hirtum* All.	10
209.			*T. incarnatum* L.	14
210.			*T. micranthum* Viv.	16
211.			*T. nigrescens* Viv.	16
212.			*T. scabrum* L.	10
213.			*T. sylvaticum* Gerar. Ex oiss.	14
214.			*T. striatum* L.	14
215.			*T. strictum* L.	16
216.			*T. subterraneum* L.	16
217.			*T. tenuifolium* Ten.	12
218.		*Vicia*	*V. articulata* Hornem.	14
219.			*V. barbazitae* Ten. et Guss.	14
220.			*V. bithynica* (L.) L.	14
221.			*V. cracca* L.	14
222.			*V. dalmatica* A.Kern.	12
223.			*V. ervilia* (L.) Willd.	14
224.			*V. grandiflora* Scop.	14
225.			*V. hirsuta* (L.)S.F.Gray	14
226.			*V. hybrida* L.	12
227.			*V. incana* Gouan	12
228.			*V. lathyroides* L.	12
229.			*V. loiseleurii* (M.B.)Litv.	14
230.			*V. melanops* Sibth. & Sm.	10
231.			*V. narbonensis* L. (agg.)	14
232.			*V. onobrychoides* L.	14
234.			*V. peregrinus* L.	14
235.			*V. sativa* L. subsp. *nigra* (L.) Her.	12
236.			*V. sepium* L.	14
237.			*V. serratifolia* Jacq.	14
238.			*V. striata* (M.) Bieb.	12
240.			*V. tenuifolia* Roth.	12
241.			*V. tetrasperma* Moench.	14
242.			*V. villosa* Roth.	14
243.	*Geraniaceae*	*Geranium*	*G. columbinum* L.	18
244.			*G. cinereum* Cav. subsp. *subcaulescens* (LHer ex DC) Hayek	56
245.	*Globulariaceae*	*Globularia*	*G. punctata* Lapaeyr. (Syn.: *G. willkommii* Nym*; G. elongata* Heg.)	16
246.	*Iridaceae*	*Crocus*	*C. adamii* Gay (Syn*: C. biflorus* Mill.)	18
247.			*C. alexandri* Nicic et Velenovski	8
248.			*C. cancellatus* Herb	16
249.			*C. chrysanthus* Herb.	8
250.			*C. chrysanthus* Herb. var.*citrinus*	8; 20
251.			*C. cvijicii* Kosanin	22
252.			*C. dalmaticus* Visiani	26
253.			*C. flavus* Weston (Syn: *C. moesiacus* Ker.& Gawl.)	8
254.			*C. heuffelianus* Herb.	22
255.			*C. hybridus* Petr.	13
256.			*C. kosaninii* Pulevic	14
257.			*C. nubigenoides* Randjelovic	18

258.			*C. olivieri* J. Gay.	6
259.			*C. pallasii* Goldb. f. *pallasii*	14
260.			*C. pallasii* Goldb. f. *albidus* Siehe	16
261.			*C. pallidus* Kitanov & Drenkovski	8
262.			*C. pelistericus* Pulevic	34
264.			*C. pulchellus* Herb.	12
265.			*C. reticulatus* Steven	14
266.			*C. scardicus* Kosanin	34; 35; 36
268.			*C. speciosus* M. B.	14
269.			*C. sublimis* Herbert	20
270.			*C. tommasinianus* Herbert.	16
271.			*C. veluchensis* Herb	26
274.			*C. weldenii* Hoppe & Furnohr.	8
275.		*Iris*	*I. attica* Boiss et Heldr.	16
276.			*I. germanica* L	44
277.			*I. mellita* Janka	24
278.			*I. pseudacorus* L.	34
279.			*I. pumila* L.	16
280.			*I. reichenbachii* Heuft.	24
281.			*I. rubromarginata* Baker	16
282.			*I. sintenisii* Janka	32
283.			*I. variegata* L.	24
284.	*Lamiaceae*	*Acinos*	*A. hungaricus* (Simon.) Silic	18
285.		*Ajuga*	*A. genevensis* L.	32
286.			*B . nigra* L.	22
287.		*Betonica*	*B. alopecuros* L.	16
288.			*B. scardica* Griseb.	16
289.		*Clinopodium*	*C. vulgare* L.	20
290.		*Leonurus*	*L. cardiaca* L.	18
291.		*Nepeta*	*N. cataria* L.	34
292.		*Prunella*	*P. vulgaris* L.	28
293.		*Salvia*	*S. aethiopis* L.	22
294.			*S. jurisici* Kosanin	22
295.			*S. ringens* S.S.	12
296.			*S. verticilata* L.	16
297.			*S. viridis* L.	16
298.		*Scutellaria*	*S. orientalis* L.	22
299.		*Sideritis*	*S. montana* L.	16
300.		*Stachys*	*S. angustifolia* M.Bieb.	34
301.			*S. annua* (L.) L.	34
302.			*S. horvaticii* Micevski	34
303.			*S. iva* Griseb.	34
304.			*S. macedonica* Micev.	34
305.			*S. plumosa* Griseb.	34
306.		*Teucrium*	*T. montanum* L.	26
307.			*T. polium* L.	26
308.		*Thymus*	*T alsarensis* Ronn.	28
309.			*T. ciliatopubescens* (Hal.) Hal. var.*bistrae* Micev. et Matev.	28
310.			*T. ciliatopubescens* (Hal.) Hal. var. *poliothrix* (Ronn.) Micev.	28
311.			*T. grisebachii* Ronn.	28
312.			*T. jankae* Cel.	56
313.			*T. karadzicensis* Matev. et Micev.	28
314.			*T. karadzicensis* Matev. et Micev. var. *doerfleri* (Ronn.) Matev. et Micev.	56

315.			*T. Longidens* Vel. var. *lanicaulis* Ronn.	28
316.			*T. macedonicus* (Deg. et Urum.) Ronn.	28
317.			*T. moesiacus* Vel.	28
318.			*T. pseudo-atticus* Ronn.	52
319.			*T. skopjensis* Micev. et Matev.	28
320.			*T. tosevii* Vel.	28
321.			*T. tosevii* Vel. subsp. *heterotrichus (*Griseb.) Matev.	28
322.			*T. tosevii* Vel. subsp. *substriatus* (Borb.) Matev.	28
323.			*T. tosevii* Vel. subsp. *tosevii* var. *cerasitifolius* Ronn.	28
324.			*T. tosevii* Vel. subsp. *tosevii* var. *longifrons* Ronn.	28
325.			*T. tosevii* Vel. subsp. *tosevii* var. *tosevii*	28
326.		*Ziziphora*	*Z. capitata* L.	16
327.	*Liliaceae*	*Allium*	*A. ampleloprasum* L.	32
328.			*A. carinatum* L.	24
329.			*A. cupani* L.	16
330.			*A. flavum* L.	16
331.			*A. flavum* L. *var.minus* Boiss.	16
332.			*A. margaritaceum* Sibth et Sm.	16; 24
333.			*A. meteroricum* Heldr. et Hayek	16
334.			*A. moschatum* L.	16
335.			*A. nigrum* L.	32
336.			*A. oleraceum* L.	32
337.			*A. paniculatum* L.	16
338.			*A. pulchellum* Don.	16
339.			*A. rotundum* L.	16; 32
340.			*A. schoenoprasum* L.	16
341.			*A. sphaerocephalum* L.	16
342.			*A. ursinum* L.	14
343.			*A. vineale* L.	32
344.		*Anthericum*	*A. liliago* L.	48
345.		*Asphodeline*	*A. liburnica* Reichenb.	28
346.			*A. lutea* Reichenb.	28
347.			*A. taurica* (Pall.) Kunth.	28
348.		*Asphodelus*	*A. albus* Mill.	28
349.		*Colchicum*	*C. autumnale* L.	63, 74
350.			*C. doerfleri* Hal.	36; 45; 46; 48; 50; 52;
351.			*C.macedonicum* Kos.	36; 42; 45; 48; 52
352.		*Fritillaria*	*F. tenella* M.B.	18+6B
353.		*Gagea*	*G. arvensis* (Pers) Dumort.	48
354.			*G. bohemica* Roem. et Schult.	48
355.			*G. fistulosa* (Ram.)Ker.-Gawl.	48
356.			*G. lutea* (L.) Ker.-Gawl.	24, 72
357.			*G. minima* (L.) Ker.-Gavl.	24
358.			*G. pratensis* (Pers.) Dumort.	24
359.			*G. pusilla* (F.W.Sch) J.A. et J.H.Schult.	24; 48; 60
360.		*Leopoldia*	*L. comosa* Parl.	18
361.			*L. comosa* Parl. var. *scorpillii* (Vel.) Hay.	18
362.			*L .tenuiflora* (Tausch) Heldr.	18
363.		*Lilium*	*L. albanicum* Griseb.	24

364.			*L. candidum* L.	24
365.			*L. martagon* L.	24
366.		*Merendera*	*M. sobolifera* C. A. Meyer in Fischer & C.A. Meyer	43; 45; 54
367.		*Muscari*	*M. botryoides* Mill.	18
368.			*M. botryoides* Mill. var.*kerneri*	18
369.			*M. racemosum* Mill.	18
370.			*M. tenuiflorum* Tausch.	54
371.			*M. vandasii* Vel.	18
372.		*Ornithogalum*	*O. comosum* L.	18
373.			*O. gussonii* Ten.	16; 18; 20
374.			*O. montanum* Cyr.	14; 16
375.			*O. nanum* Sibth. et Smith.	18
376.			*O. nutans* subsp. *prasandrum* Grisb.	14
377.			*O. oligophyllum* Clarke	18
378.			*O. pyrenaicum* L.	16
379.			*O. pyrenaicum L.* var. *sphaerocarpum*	17
380.			*O. refractum* Kit.	14
381.			*O. umbellatum* L.	20; 54
382.		*Polygonatum*	*P. latifolium* (Jacq) Desf.	20
383.			*P. officinale* All.	20+2
384.		*Ruscus*	*R. aculeatus* L.	40
385.		*Scilla*	*S. autumnalis* L.	28
386.			*S. bifolia* L.	18; 36
387.		*Tulipa*	*T. mariannae* Lindtn.	24
388.			*T. scardica* Bornm.	24
389.			*T. sylvestris* L.	24
390.			*T. sylvestris* L. subsp. *celsiana* DC.	24
391.		*Convallaria*	*C. majalis* L.	38
392.		*Erythronium*	*E. dens-canis* L.	24
393.	*Linaceae*	*Linum*	*L. austriacum* L.	18
394.			*L. perenne* L. subsp. *exstraaxillare* (Kit.) S.& S.	30
395.	*Malvaceae*	*Lavatera*	*L. thuringiaca* L.	44
396.	*Paeoniaceae*	*Paeonia*	*P. corallina* Retz.	10
397.			*P. decora* Anders	10; 20
398.	*Papaveraceae*	*Chelidonium*	*Ch. majus* L.	12
399.		*Corydalis*	*C. solida* (L.) Smith	10
400.		*Papaver*	*P. argemone* L.	14
401.	*Plantaginaceae*	*Plantago*	*P. arenaria* W.K.	12
402.			*P. argentea* Chaix	12
403.			*P. atrata* Hoppe	12; 24
404.			*P. atrata* Hoppe subsp.*atrata* var.*atrata* Pilger.	12
405.			*P. bellardi* All. subsp. *bellardi*	12
406.			*P. coronopus* L. subsp. *commutata* (Guss.) Pilger	20
407.			*P. gentianoides* Sibth. et Smith	12
408.			*P. holosteum* Scop. subsp. *holosteum*	12
409.			*P. holosteum* Scop. var. *depauperata*	12
410.			*P. indica* L.	12
411.			*P. lanceolata* L. (s.l)	12
412.			*P. major* L.	12
413.			*P. media* L.	24
414.	*Plumbaginaceae*	*Armeria*	*A. rumelica* Boiss.	18
415.			*A. rumelica* f. *temskyana* Boiss.	18

416.	*Poaceae*	*Aegilops*	*A. biuncialis* Vis.	28
417.			*A. cylindrica* Host.	28
418.			*A. neglecta* Req. & Bertol.	28
419.			*A. triaristata* Willd.	28
420.		*Agropyron*	*A. cristatum* Auct.	28
421.		*Anthoxantum*	*A. aristatum* Boiss.	10
422.		*Avena*	*A. clauda* Durand	28
423.			*A. fatua* L.	28
424.		*Briza*	*B. maxima* L.	14
425.		*Bromus*	*B. arvensis* L.	14
426.			*B. hordeaceus* L.	28
427.			*B. japonicus* Thunb.	14
428.			*B. squarrosus* L.	14
429.			*B. squarrosus* L. var.*villosus* (Gmel.) Geor.	14
430.			*B. sterilis* L	14
431.			*B. tectorum* L.	14
432.		*Cynosurus*	*C. echinatus* L.	14
433.		*Echinaria*	*E. capitata* Desf.	18
434.		*Festuca*	*F. valesiaca* Schleicher ex Gaudin	14
435.		*Haynaldia*	*H. villosa* (L.) Schur.	14
436.		*Hordeum*	*H. asperum* (Smk.) Deg.	14
437.			*H. bulbosum* L.	28
438.			*H. maritimum* With.	14
439.			*H. murinum* L.	28
440.		*Melica*	*M. ciliata* L.	18
441.			*M. ciliata* L. var. *transilvanica* Schur.	18
442.		*Micropyrum*	*M. tenellum* (L.) Link	14
443.		*Phalaris*	*P. canariensis* L.	12
444.		*Poa*	*P. bulbosa* L.	28
445.			*P. bulbosa* L. f. *vivipara* Koel.	28
446.		*Taeniatherum*	*T. caput-medusae* (L.) Nevski	14
447.		*Trisetum*	*T. flavescens* L.	28
448.		*Vulpia*	*V. myurus* (L.) Gmel.	42
449.	*Ranunculaceae*	*Aconitum*	*A. variegatum* L.	16
450.			*A. lamarckii* Reichenb.	16
451.		*Actea*	*A. spicata* L.	16
452.		*Adonis*	*A. vernalis* L.	16
453.		*Anemone*	*A. apennina* L. subsp. *apennina*	14
454.			*A. apenina* L. subsp. *blanda* (Sch.& Kots) Hay.	16
455.			*A. blanda* Schott. et Kotschy.	14
456.			*A. narcissiflora* L. var. *narcissiflora*	14
457.			*A. nemorosa* L. f. *nemorosa*	30
458.			*A. pavonina* Lam. *var. purpureoviolacea* (Boiss.) Hay.	16
459.			*A. ranunculoides* L. f. *biflora*	48
460.		*Caltha*	*C. palustris* L.	32
461.		*Clematis*	*C. vitalba* L.	16
462.		*Consolida*	*C. regalis* S. F. Gray.	16
463.		*Delphinium*	*D. balcanicum* Pawl.	16
464.			*D. fissum* Waldst. et Kit.	16
465.			*D. halteratum* Sibth. & Sm.	16
466.		*Helleborus*	*H. odorus* Waldst. & Kit.	32
467.		*Hepatica*	*H. nobilis* Miller	14
468.		*Nigella*	*N. arvensis* L.	12

469.			*N. arvensis* L. f. *tuberculata* (Gris.) Simk.	12
470.			*N. damascena* L.	12
471.		*Pulsatila*	*P. halleri* (All) Willd.	16
472.			*P. vernalis* (L.) Mill.	16
473.		*Ranunculus*	*R. acris* L.	14
474.			*R. arvensis* L.	32
475.			*R. bulbosus* L.	16
476.			*R. cacuminis* Strid. et Papan.	16
477.			*R. carinhiacus* L.	16
478.			*R. crenatus* W. K.	16
479.			*R. degenii* Kumm et Jav.	16
480.			*R. demissus* D. C.	16
481.			*R. ficaria* L. subsp. *bulbifer* (Marsden-Jones) L.	32
482.			*R. ficaria* L. subsp. *calthifolius* Rchb.	16
483.			*R. ficaria* L. subsp. *ficariformis* Rony et Fouc.	32
484.			*R. illyricus* L.	32
485.			*R. lanuginosus* L.	28
486.			*R. millefoliatus* Vahl.	16
487.			*R. montanus* Willd.	16; 32
488.			*R. montenegrinus* (Hal. ex Bald.) Lindtner	40
489.			*R. neapolitanus* Ten.	16
490.			*R. nemorosus* D. C.	16
491.			*R. oreophilus* Berb.	32
492.			*R. oxyspermus* Ross.	16
493.			*R. pedatus* Waldst. & K.	16
494.			*R. platanifolius* L.	16
495.			*R. polyanthamos* L.	16
496.			*R. psilostachys* Grsb.	16
497.			*R. repens* L.	32
498.			*R. rumelicus* Gris.	16; 32
499.			*R. sardous* Crantz	16
500.			*R. sartorianus* Boiss. et Heldr.	16
501.			*R. sceleratus* L.	16; 32
502.			*R. serbicus* Vis.	28
503.			*R. sprunerianus* Boiss.	16
504.			*R. velutinus* T.	14
505.		*Thalictrum*	*Th. aquilegifolium* L.	14
506.		*Trollius*	*T. europaeus* L.	16
507.	*Rosaceae*	*Dryas*	*D. octopetala* L.	16
508.		*Potentila*	*P. detomasii* Ten.	14
509.		*Sanguisorba*	*S. minor* Scop.	28
510.	*Rubiaceae*	*Asperula*	*A. aristata* L.	22
511.		*Crucianella*	*C. graeca* Boiss.	22
512.		*Galium*	*G. divaricatum* Lam.	22
513.			*G. kerneri* Deg.	22
514.			*G. plebeium* Boiss. & Heldr.	22
515.		*Sherardia*	*Sh. arvensis* L.	22
516.	*Scrophulariaceae*	*Veronica*	*V. austriaca* L.	32
517.			*V. dillenii* Crautr.	16
518.			*V. jacquini* Baumg	16
519.			*V. kindlii* Adam.	16
520.			*V. officinalis* L.	16
521.	*Valerianaceae*	*Valeriana*	*V. tuberosa* L.	16
522.	*Violaceae*	*Viola*	*V. aetolica* Boiss. & Heldr.	16

523.			*V. allchariensis* G. Beck	20
524.			*V. arsenica* G. Beck	20
525.			*V. babunensis* Erben	18
526.			*V. bornmuelleri* Erben	20
527.			*V. doerfleri* Degen.	20
528.			*V. eximia* Form.	36
529.			*V. gostivariensis* (W. Beck & Bornm.) Bornm.	20
530.			*V. grisebachiana* Vis.	22
531.			*V. herzogii* (W. Becker) Bornm.	20
532.			*V. hymettia* Boiss. & Heldr.	16
533.			*V. ivonis* Erben	18
534.			*V. latisepala* Wettst.	26
535.			*V. macedonica* Boiss. & Heldr.	26
536.			*V. orphanidis* Boiss.	22
537.			*V. schariensis* Erben.	20
538.			*V. slavikii* Form.	20
539.			*V. aetolica* Boiss. & Heldr. *X V. eximia* Form.	17; 20; 27; 30
540.			*V. babunensis* Erben. *X V. macedonica* Boiss.& Heldr.	19; 20; 22
541.			*V. babunensis* Erben. *X V. herzogii* (W.Becker) Bornm.	20
542.			*V. bornmuelleri* Erben *X V. hymettia* Boiss. & Heldr.	19
543.			*V. bornmuelleri* Erben. *X V. orphanidis* Boiss.	21
544.			*V. ivonis* Erben *X V. schariensis* Erben.	19
545.			*V. latisepala* Wettst. *X V. schariensis* Erben.	19; 20; 21; 22; 23; 24
546.			*V. eximia* Form. *X V. velutina* Form.	24
547.			*V. orphanidis* Boiss. *X V. velutina* Form.	19; 20
548.			*V. velutina* Form.	18
	30	171	548	

ANNEX 6
Agrobiodiversity

Table 1. Share of individual crops in field and garden production (ha).

Wheat	114,000	Peas	1100
Rye	6,300	Lentil	288
Barley	50,000	Cabbage plants	3,537
Oats	2,800	Tomato	6,750
Corn	39,000	Pepper	7,520
Rice	4,200	Watermelon	7,900
Sugar beet	2,300	Clover	2,710
Industrial pepper	770	Alfalfa	19,000
Sunflower	10,000	Vetch	4,100
Poppy	160	Fodder peas	1,800
Onion	4,300	Fodder corn	2,100
Garlic	1,325	Fodder beet	520
Beans and green beans	7,000	Grapevine	31,000

Table 2. Share of individual fruit plants in fruit production (productive fruit trees).

Cherry	155,000	Pear	553
Sour cherry	655,000	Plum	1,387,000
Apricot	24,200	Peach	586,000
Pomegranate	53,000	Walnut	175,000
Apple	311,4000	Almond	213,000

Table 3. Varieties registered in Macedonia.

No.	Scientific name	Macedonian common name	Domestic recognized varieties	Foreign approved varieties	Domestic and domesticated foreign varieties
1.	*Agropyron* Gaertn. Spp.	Pirej		4	
2.	*Agrostis sp.*	Polevica		3	1
3.	*Allium cepa* L.	Kromid	4	20	22
4.	*Allium cepa* L. var. *viviparum* Proch.	Rokambol			1
5.	*Allium fistulosum* var. *viviparum* Makino	Zimski kromid, alma			1
6.	*Allium porrum L.*	Praz	1	1	5
7.	*Allium sativum L.*	Luk		2	16
8.	*Alopecurus sp.*	Opashka		2	
9.	*Apium graveolens* L. var. *dulce* (Mill.)	Rebrest gerevis			3
10.	*Apium graveolens* L. var. *rapaceum* (Mill. Gaud.)	Korenest gerevis		3	3
11.	*Apium graveolens* L. var. *secalinum* Alef.	Listen gerevis			1
12.	*Arachis hypogaea L.*	Kikiriki			2
13.	*Armoratia rusticana* Ph. Gartn, B. Mey.et Scherb	Ren			1
14.	*Arrhenatheum elatius* (L.) P. Beauv. ex J.S. et K.B. Presl.	Francuska treva		3	1

15.	*Asparagus officinalis* L.	Shpargla			3
16.	*Astragalus cicer* L.	Kozinec gravolik		1	
17.	*Atriplex hortensis* L.	Loboda			3
18.	*Avena sativa* L.	Oves		23	3
19.	*Beta vulgaris* L. subsp. *saccharifera* Lange	Shekerna repa		76	
20.	*Beta vulgaris* L. subsp. vulgaris	Blitva			3
21.	*Beta vulgaris* L. subsp. *vulgaris* subvar. *rubra* Alef. et Helm.	Cveklo		2	2
22.	*Beta vulgaris* L. var. *crassa* Alef.	Dobitochna repka		22	2
23.	*Brassica napus* L. var. *biennis* Scuhbl. et Mart. Reichb.	Dobitochna repa			1
24.	*Brassica napus* L. var. *napobrassica* (L.) Rchb.	Broskva, brikva			2
25.	*Brassica napus* L. var. *napobrassica* (L.) Rehb.	Brikva		3	
26.	*Brassica napus* L. var. oleifera D.C.	Maslodayna repka		22	1
27.	*Brassica nigra* (L.) Koch.	Sinap crn			1
28.	*Brassica oleracea* L. convar. *acephala* (DC.) Alef. var. *planitolia* DC	Kel lisnat			1
29.	*Brassica oleracea* L. convar. *acephala* (DC.) Alef. var. *sabellica* L.	Kel kadrav			1
30.	*Brassica oleracea* L. convar. *acephala* DC. var. *gongylodes*	Alabas			9
31.	*Brassica oleracea* L. *convar. botrytiscymosa Duch.*	Brokoli		2	1
32.	*Brassica oleracea* L. convar. *oleracea* var. *gemmifera* DC.	Kel pupcar		9	3
33.	*Brassica oleracea* L. var. *botrytis* (L.) Alef.	Karfiol		23	10
34.	*Brassica oleracea* L. var. *sabauda* L.	Kel		2	9
35.	*Brassica oleracea L.* var. *capitata* f. *alba* Duch, f. *rubra*	Zelka		63	19
36.	*Brassica pekinensis* (Lour.) Rupr.	Kineska zelka		2	1
37.	*Brassica rapa* L. var. *oleifera* D.C.	Krmna repka ogrstica			1
38.	*Brassica rapa* L. var. *rapifera* Metz.	Bela repka, turneps			2
39.	*Bromus inermis* Leyss.	Bezosilest vlasen			1
40.	*Cannabis sativa* L.	Konop		4	2
41.	*Capparis spinosa* L.	Kapra			3
42.	*Capsicum anuum* L.	Piperka	5	51	18
43.	*Carthamus tinctorius* L.	Shafranika			1
44.	*Cicer arietinum* L.	Naut			2
45.	*Cichorium endivia* L.	Endivija			17
46.	*Cichorium inthybus* L. var. *foliosum* Bisch.	Cikoria		3	
47.	*Cichorium intybus* L.	Cikoriya		2	1
48.	*Citrullus vulgaris* L.	Lubenica		15	4
49.	*Cucumis melo* L.	Dinya		7	9
50.	*Cucumis sativus* L.	Krastavica		45	14
51.	*Cucumis sativus* L. var. *kornishon*	Kornishoni		8	2
52.	*Cucurbita ficifolia* Pangalo	Tikva smokvolisna			1
53.	*Cucurbita maxima* Duch.	Tikva pechenka			3
54.	*Cucurbita mixta* Duch.	Tikva zimska			1

55.	*Cucurbita moschata* Duch.	Tikva muskatna			1
56.	*Cucurbita pepo* L. convar. *melo pepo* L. provar. *patissonina* Gred.	Patishon		1	1
57.	*Cucurbita pepo* L. *var. maxima* (Duchesne ex Lam.) Del.	Tikva stambolka			1
58.	*Cucurbita pepo* L. var. *oblonga* Willd.	Tikvica		5	13
59.	*Cucurbita pepo* L. var. *oleifera* P.	Maslodayna tikva		4	
60.	*Cynara cardunculus* L.	Kardon			1
61.	*Cynara scolymus* L.	Artichoka			1
62.	*Dactylis glomerata* L.	Ezevka		9	
63.	*Daucus carota L.* subsp. *sativus* (Hoffm.) Hayek	Dobitochen morkov			2
64.	*Daucus carota* L. subsp. *sativus* Hoffm.	Morkov		19	13
65.	*Fagopyrum esculentum* Moench.	Elda		2	1
66.	*Festuca arundinacea* Schreb.	Visoka vlasatka	2	14	
67.	*Festuca pratensis* Huds.	Livadska vlasatka		5	3
68.	*Festuca rubra* L.	Crvena vlasatka		10	
69.	*Foeniculum vulgare* P. Mill. var. *dulce*	Anason			4
70.	*Glycine hispida* (Moench) Max.	Soya		77	
71.	*Gossypium hirsutum* L.	Pamuk	3	1	1
72.	*Helianthus annuus* L.	Sonchogled		39	2
73.	*Helianthus tuberosus* L.	Cicoka		2	
74.	*Helianthus tuberosus* L.	Krkushka			1
75.	*Hibiscus esculentus* L.	Bamya			2
76.	*Hordeum vulgare* L. var. *distichon* Alef	Jachmen	6	65	1
77.	*Hordeum vulgare* L. var. p*olystichon Haller f.*	Jachmen		24	1
78.	*Humulus lupulus* L.	Hmel		14	2
79.	*Lactuca sativa* L.	Salata		25	23
80.	*Lens esculenta* Moench.	Leka			3
81.	*Lepidium sativum* L.	Kres salata			2
82.	*Linum usitatissimum* L.	Len		7	
83.	*Lolium italicum* L. *(multiflorum)*	IItalianski raygras		16	
84.	*Lotus corniculatus* L.	Zholt zvezdan		7	1
85.	*Lotus perenne* L.	Angliski raygras		18	1
86.	*Lupinus albus* L.	Bela lupina		3	
87.	*Lycopersicon licopersicum* (L.) Karsten	Domat	4	76	18
88.	*Medicago lupulina* L.	Hmelovidna lucerka		1	
89.	*Medicago sativa* L. subsp.*sativa*	Lucerka	1	53	
90.	*Melilotus albus* Desr.	Bela komuniga		1	
91.	*Nicotiana tabacum* L.	Tutun	29	23	17
92.	*Onobrychis viciifolia* Scop.	Esparzeta	1		
93.	*Oryza sativa* L.	Oriz	5	7	2
94.	*Panicum miliaceum* L.	Proso		3	2
95.	*Papaver somniferum* L.	Afion	2		2
96.	*Pastinaca sativa* L.	Pashkanat	1	2	1
97.	*Petroselinum crispum* P. Mill.	Magdanos			5
98.	*Phaseolus vulgaris* L.	Grav		21	8
99.	*Phaseolus vulgaris* L. var. *communis*	Boraniya visoka		8	2
100.	*Phaseolus vulgaris* L. var. *nanus* (Jusl) Aschers f. sine fibris	Boraniya	2	40	3

101.	*Phleum pretense* L.	Machkina opashka		9	1
102.	*Pisum sativum* L. convar. *axiphium* Alef. Mend C.O. Lehk.	Grashok shekeren			2
103.	*Pisum sativum L. subsp. arvense* Poir.	Dobitochen grashok		8	
104.	*Pisum sativum* L. subsp. *sativum* (*partim*)	Grashok		54	8
105.	*Poa pratensis* L.	Prava livadarka		6	1
106.	*Portulaca oleracea* L. subsp. *sativa* Haw.	Portulak, tucnica			2
107.	*Raphanus sativus* L. *oleiformis* Pers.	Maslodayna trupka		1	
108.	*Raphanus sativus L.* var. *niger* Mil. S. Kerner	Repa (rotkva)			4
109.	*Raphanus sativus* L. var. *radicola* DC.	Repichka (rotkvica)		6	7
110.	*Rheum rhabarbarum* L.	Reven			2
111.	*Ricinus communis* L.	Ricinus		1	
112.	*Rumex acetosa* L.	Kiselec			1
113.	*Rumex patientia* L.	Zelye			1
114.	*Scorzonera hispanica* L. convar. e*dulis* Moench	Crn koren			1
115.	*Secale cereale* L.	Rzh	3	8	4
116.	*Sesamum indicum* L.	Susam			2
117.	*Setaria italika* L. P. Beauv	Brenica			2
118.	*Sinapis alba L.*	Sinap		2	2
119.	*Solanum melongena* L.	Patlidzan		9	2
120.	*Solanum tuberosum* L.	Kompir		80	13
121.	*Sorghum sudanense* (Piper) Stapf	Sudanska treva		3	1
122.	*Sorghum vulgare* L.	Sirak		9	
123.	*Sorghum vulgare* Pers.	Dobitochen sirak		10	
124.	*Spinacia oleracea* L.	Spanak		14	4
125.	*Taraxacum officinale* Wiggers	Maslachok, gluvarche			1
126.	*Tetragonia tetragonioides* (Pall.) O. Kuntze	Spanak novozelandski			1
127.	*Tragopogon porrifolius* L.	Bel koren, Kozina Shpanska			1
128.	*Trifolium alexandrinum* Juslen	Aleksandriska detelina		1	
129.	*Trifolium hybridum* L.	Shvedska detelina		1	
130.	*Trifolium incarnatum* L.	Inkarnatska detelina		1	1
131.	*Trifolium pratense* L.	Crvena detelina		16	1
132.	*Trifolium repens* L.	Bela detelina		7	1
133.	*Trifolium resupinatum* L.	Persiska detelina		1	
134.	*Trifolium subterraneum* L.	Podzemna detelina			1
135.	X *Triticale*	Tritikale	3	6	
136.	*Triticum aestivum* L.	Meka pchenica	22	300	1
137.	*Triticum durum* Desf.	Tvrda pchenica	28	1	1
138.	*Valerianella locusta* (L.) Laterr. Em. Betcke	Motovilec			2
139.	*Vicia faba* L.	Bakla		5	2
140.	*Vicia pannonica* Crantz	Panonski graor		2	
141.	*Vicia sativa* L.	Graor	3	3	
142.	*Vicia sativa* L.	Graor			1
143.	*Vicia villosa* Roth.	Movlest graor		3	1
144.	*Zea mays* L.	Pchenka za zrno	4	604	3

145.	*Zea mays* L. subsp. *aorista* var. *oleifera*	Maslodayna pchenka		7	
146.	*Zea mays* L. subsp. *ceratina* Kulesch.	Pchenka amilopektinska		8	
147.	*Zea mays* L. var. *everta* Sturt.	Phenka za pukanki		5	
148.	*Zea mays* L. var. *saccharata* Sturt.	Pchenka shekerna		11	

Table 4. Fruit species in wild and domesticated forms used for food and rootstocks.

1.	*Amygdalus communis* L.	Div badem, Gorchliv badem
2.	*Castanea sativa* Mill.	Kosten
3.	*Cornus mas* L.	Dren
4.	*Corylus avellana* L.	Div leshnik, domestic tipes
5.	*Corylus colurna* L.	Div leshnik, Mechkina leska
6.	*Crataegus oxycantha*	Glog
7.	*Cydonia oblonga* L.	Dunya
8.	*Dyospiros lotus*	Divo yaponsko yabolko, Lotus
9.	*Dyospiros virginiana*	Divo yaponsko yabolko
10.	*Ficus carica* L.	Diva smokva, domestic tipes
11.	*Fragaria vesca* L.	Shumska yagoda
12.	*Juglans regia* L.	Orev, domestic tipes
13.	*Malus pumila* Mill.	Nisko rano yabolko, Petrovka
14.	*Malus silvestris* Miller	Divo yabolko
15.	*Mespilus germanica* L.	Mushmula
16.	*Morus alba* L., *Morus nigra* L.	Crnica, domestic tipes
17.	*Pistacia terebinthus* L.	Div fistak, Smrdulka
18.	*Poncirus trifoliata* (L.)Raf.	Div limon, Trolisten limon
19.	*Prunus armeniaca* L.	Diva kaysiya, Zerdeliya
20.	*Prunus avium* L.	Diva cresha, Vrapcharka
21.	*Prunus cerasifera* Ehrh.	Diva sliva, Dzanka
22.	*Prunus insititia* (L.) Bonnier & Layens	Magareshki slivi
23.	*Prunus persica* L.	Diva praska, Lozarska praska
24.	*Punica granatum* L.	Kalinka, domestic tipes
25.	*Pyrus amygdaliformis* Vill.	Gornica krusha
26.	*Pyrus communis* L.	Diva krusha
27.	*Rosa canina* L.	Shipka
28.	*Rubus idaeus*	Malina
29.	*Rubus spp.*	Kapina
30.	*Sorbus aucuparia* L.	Oskorusha
31.	*Vaccinium myrtillus* L.	Borovnica
32.	*Ziziphus jujuba* Mill.	Kineska urma, Sirka

Table 5. Wild species found in natural meadows and pastures.

1.	*Achillea millefolium* L.	Ajduchka treva
2.	*Agropyron cristatum* (L.) Geartner	Cheslest zhitnik
3.	*Agrostis capillaris* L.	Obicna polevica
4.	*Agrostis stolonifera* L.	Bela polevica
5.	*Alopecurus pratensis* L.	Lisichina opashka
6.	*Astragalus spp.*	Kozinec
7.	*Beta vulgaris* L. var. *crassa* Alef.	Dobitochna repa
8.	*Brassica oleraceae* L. var. *acephala* DC.	Dobitochen kel
9.	*Brassica* spp.	Repici
10.	*Bromus inermis* Leyss.	Bezosilest vlasen
11.	*Cynosurus cristatus* L.	Petlova kikiritka
12.	*Dactylis glomerata* L.	Ezevka
13.	*Dichanthium ischaemum* (L.) Roberty.	Kokoshkina noga
14.	*Ervum ervilia* L.	Urov

15.	*Festuca arundinacea* Schreb.	Visoka vlasatka
16.	*Festuca ovina* L.	Ovcha vlasatka
17.	*Festuca paniculata* (L.) Schinz & Thell.	Ostrika
18.	*Festuca pratensis* Huds.	Livadska vlasatka
19.	*Festuca rubra* L.	Crvena vlasatka
20.	*Glycine hispida* (Moench.) Maxim.	Soya
21.	*Helianthus tuberosus* L.	Cicoka
22.	*Lathyrus sativus* L.	Sekirche
23.	*Lotus corniculatus* L var. *tenuis* L..	Tesnolisen zvezdan
24.	*Lotus corniculatus* L.	Zholt zvezdan
25.	*Lotus uliginosus* Schk.	Barski zvezdan
26.	*Lupinus spp*.	Lupina
27.	*Malva verticillata* var. *crispa* L.	Dobitochen slez
28.	*Medicago arabica* (L.) Huds.	Tochkesta lucerka
29.	*Medicago falcata* L.	Zholta lucerka
30.	*Medicago lupulina* L.	Hmelovidna lucerka
31.	*Medicago orbicularis* (L) Bartal.	Konchesta lucerka
32.	*Medicago sativa* L.	Lucerka
33.	*Melilotus albus* Desr.	Bela komuniga
34.	*Melilotus officinalis* (L.) Pallas	Zholta komuniga
35.	*Nardus stricta* L.	Krtul
36.	*Onobrychis sativa* Lam.	Esparzeta
37.	*Pisum sativum* L. var. *arvense* (L.) Poiret	Dobitochen grashok
38.	*Plantago major* L., *P. media* L., *P. lanceolata* L.	Tegavec
39.	*Poa pratensis* L.	Vistinska livadarka
40.	*Poa trivialis* L.	Obicna livadarka
41.	*Rumex* spp.	Shtavelyi
42.	*Sanquisorba officinalis* L., *S. minor* Scop.	Dinka
43.	*Taraxacum officinale* Wiggers.	Gluvarche
44.	*Trifolium alexandrinum* Juslen	Aleksandriska detelina
45.	*Trifolium fragiferum* L.	Yagodesta detelina
46.	*Trifolium incarnatum* L.	Inkarnatska detelina
47.	*Trifolium montanum* L.	Planinska detelina
48.	*Trifolium patens* Schreb.	Zholta detelina
49.	*Trifolium pratense* L.	Crvena detelina
50.	*Trifolium repens* L.	Bela detelina
51.	*Trifolium resupinatum* L.	Persiska detelina
52.	*Trifolium subterraneum* L.	Podzemna detelina
53.	*Trisetum flavescens* (L.) P. Beauv.	Zlatnozholt oves
54.	*Vicia faba* L.	Bakla
55.	*Vicia pannonica* Crantz.	Panonski-ungarski graor
56.	*Vicia sativa* L.	Obichen proleten graor
57.	*Vicia villosa* Roth.	Vlaknest graor -glusina
58.	*Vigna unguiculata* (L.) Walpers.	Vigna

Table 6. Medicinal and ornamental plants.

No.	Scientific name	Macedonian common name
1.	*Achillea millefolium* complex*	Ayduchka treva
2.	*Aconitum divergens*	Volchyi chemer
3.	*Acorus calamus**	Lirot
4.	*Adonis vernalis**	Gorocvet
5.	*Aesculus hippocastanum*	Div kosten
6.	*Agrimonia eupatoria*	Petrovec, kamshik
7.	*Agropyrum repens**	Pirevina

8.	*Alchemilla vulgaris*	Rosnik, arslanska shepa
9.	*Allium cepa*	Kromid
10.	*Allium sativum*	Luk
11.	*Allium ursinum**	Mechkin luk
12.	*Althaea officinalis**	Bel slez
13.	*Althaea rosea*	Crven slez
14.	*Anacmptis spp.**	Salep
15.	*Anethum graveolens*	Kopar
16.	*Angelica archangelica*	Blag boz, angelika
17.	*Angelica pancicii*	Blag boz, angelika
18.	*Apium graveolens*	Celer
19.	*Aquilegia vulgaris*	Kandilka
20.	*Arbutus andrachne*	Gol chovek
21.	*Arctium lappa**	Cicok
22.	*Arctostaphylos uva-ursi**	Mechkino grozye
23.	*Aristolochia clematitis*	Volchyo yabolko
24.	*Artemisia absintium*	Pitom pelin
25.	*Artemisia vulgaris*	Pelin
26.	*Arum maculatum*	Zmisko grozye
27.	*Asparagus acutifolius*	Asparagus
28.	*Asperula odorata*	Lazarka
29.	*Atropa belladona*	Pomamnica
30.	*Avena sativa*	Oves
31.	*Bellis perennis*	Pariche
32.	*Berberis vulgaris*	Kisel trn
33.	*Betula pendula**	Breza
34.	*Borago officinalis*	Volski yazik
35.	*Brassica alba*	Bel sinap
36.	*Brassica nigra*	Crn sinap
37.	*Bryonia alba*	Diva tikva
38.	*Calamintha grandiflora*	Shumski chay
39.	*Calendula officinalis*	Neven
40.	*Capsela bursa-pastoris**	Ovcharska torbichka
41.	*Carlina acaulis**	Vilino sito
42.	*Castanea sativa*	Kosten
43.	*Celtis australis*	
44.	*Centaurium umbelatum**	Crven kantarion
45.	*Cetraria islandica*	Islandski chay
46.	*Chamomilla recutita**	Kamilica
47.	*Chelidonium majus*	Zmiysko mleko, rusa
48.	*Chenopodium bonus-henricus**	Cuen
49.	*Chenopodium botrys*	
50.	*Cichorium intyibus**	Cukorija
51.	*Clematis vitalba*	Povit
52.	*Cnicus benedictus*	Pitom trn
53.	*Armoracia rusticana*	Ren
54.	*Colchicum autumnale**	Mrazovec
55.	*Conium maculatum*	Bucumis, kukut
56.	*Convallaria majalis**	Momina solza
57.	*Coriandrum sativum*	Korijander
58.	*Cornus sanguinea*	Crn dren
59.	*Corylus avellana*	Leska, leshnik
60.	*Cotoneaster melanocarpa*	Crna mushmula
61.	*Crategus monogyna**	Glog

62.	*Crategus oxyacantha**	Glog
63.	*Dactylorhiza spp.**	Salep
64.	*Datura stramonium*	Tatula
65.	*Daucus carota*	Morkov
66.	*Digitalis spp.*	Butin
67.	*Ecballium elaterium*	Luda krastavica
68.	*Echium vulgare*	Volcya opashka
69.	*Ephedra spp.*	Efedra
70.	*Equisetum arvense**	Konysko opavche, preclika
71.	*Erodium cicutarium*	Zdral
72.	*Eryngium campestre*	Vetrogon
73.	*Euphrasia officinalis*	Vidova treva
74.	*Ficus carica*	Smokva
75.	*Foeniculum vulgare**	Makedonski anason
76.	*Fragaria vesca**	Yagoda
77.	*Frangula spp.*	Krushina
78.	*Fraxinus ornus*	Crn yasen
79.	*Fumaria officinalis*	Dimarka
80.	*Galega officinalis*	Zdralka
81.	*Galeopsis dubia*	Smrdliva kopriva
82.	*Galium verum*	Ivansko cveke
83.	*Gentiana lutea**	Lincura
84.	*Gentiana punctata**	Lincura
85.	*Geranium spp.*	Zdravec
86.	*Geum urbanum*	Zayachko stopalo
87.	*Gymnadenia spp.**	Salep
88.	*Glaucium flavum*	Zholt afion
89.	*Gleditchia triacanthos*	Glaedice
90.	*Glycyrrhiza glabra*	Sladok koren
91.	*Gnaphalium uliginosum*	Bel smil
92.	*Gypsophila paniculata*	Belo sapunche
93.	*Hamamelis virginiana*	Hamamelis
94.	*Hedera helix*	Brshlen
95.	*Helleborus sp.*	Kukurek
96.	*Helichrysum plicatum**	Smil
97.	*Herniaria glabra**	Sitnica gola, Zelena kilavica
98.	*Herniaria hirsuta**	Sitnica vlaknesta, Bela kilavica
99.	*Humulus lupulus*	Hmely
100.	*Hyoscyamus niger*	Bunika
101.	*Hypericum perforatum**	Kantarion
102.	*Hyssopus officinalis*	Izop
103.	*Inula helenium*	Oman, Volsko oko
104.	*Iris germanica**	Perunika
105.	*Iris palida**	Perunika
106.	*Juglans regia**	Orev
107.	*Juniperus communis**	Smreka
108.	*Juniperus oxycedrus*	Smreka
109.	*Lamium album*	Bela kopriva
110.	*Lavandula sp.*	Lavanda
111.	*Leonorus cardiaca*	Srcenica, gyavolsko uste
112.	*Levisticum officinale*	Mil duh, Selen
113.	*Lilium sp.*	Krin
114.	*Linaria vulgaris*	Div len
115.	*Lonicera xylosteum*	Anamska raka

116.	*Loranthus europaeus*	Zholta imela
117.	*Malva sylvestris**	Crn slez
118.	*Marrubium vulgare*	Gorcica, pchelnik
119.	*Melilotus officinalis*	Konyska detelina
120.	*Melissa officinalis**	Matochina, materka, pchelnik
121.	*Mentha spp.**	Nane
122.	*Menyanthes trifoliata*	Gorchliva detelina
123.	*Morus alba*	Bela crnica
124.	*Morus nigra*	Crnica
125.	*Ocimum basilicum*	Bosilek
126.	*Olea europaea*	Maslinka
127.	*Ononis spinosa**	Zayacki trn, grmotrn
128.	*Onopordon acanthium*	Magareshki trn
129.	*Ophrys spp.**	Salep
130.	*Orchis spp.**	Salep
131.	*Origanum vulgare**	Planinski chay
132.	*Oxalis acetosela*	Kisela detelina
133.	*Papaver rhoeas*	Bulka
134.	*Papaver somniferum**	Afion
135.	*Paris quadrifolia*	
136.	*Pastinaca sativa*	Pashkanat
137.	*Peonia mascula**	Bozhur
138.	*Periploca greca*	Grchka grpka
139.	*Petasites hybridus**	Lopushnik
140.	*Petroselinum sativum*	Magdonos
141.	*Physalis alkekengi*	Zrneshnik, pluskavec
142.	*Phytolacca americana*	Krmus
143.	*Pimpinella anisum**	Anason
144.	*Pinus sylvestris*	Bel bor
145.	*Pinus spp.*	Borovi
146.	*Plantago lanceolata**	Mashki tegavec
147.	*Plantago major**	Zhenski tegavec
148.	*Polypodium vulgare**	Slatka paprat
149.	*Polygonum aviculare**	Troskot
150.	*Polygonum hydropiper*	Voden piper
151.	*Populus nigra*	Crna topola
152.	*Potentila anserina*	Petoprst
153.	*Potentila erecta*	Treva od srce, Petoprst
154.	*Primula veris**	Yaglika, Petoprst
155.	*Prunus amygdalus*	Badem
156.	*Prunus laurocerasus*	Zeleniche
157.	*Prunus spinosa*	Trnika
158.	*Prunus spinosa**	Trnika
159.	*Pulmonaria officinalis*	Velikdenche
160.	*Punica granatum*	Kalinka
161.	*Evernia prunastri**	Dabov lishay
162.	*Quercus spp.*	Dabovi
163.	*Raphanus sativus*	Repka
164.	*Rhamnus catarica*	Pasdren, Gorchliv dren
165.	*Cotinus coggygria*	Ruj
166.	*Ribes spp.*	Ribizla
167.	*Ricinus communis*	Ricinus
168.	*Robinia pseudoacacia**	Bagrem
169.	*Rosa cannina**	Shipka

170.	*Rosmarinus officinalis*	Rozmarin
171.	*Rubia peregrina*	Div bros
172.	*Rubus caesius*	Plava kapinka
173.	*Rubus fruticosus* agg.*	Kapina
174.	*Rubus ideaus**	Malina
175.	*Rumex acetosa*	Kiselec
176.	*Ruscus aculeatus*	Bodlika, Diva shimshirka
177.	*Ruta graveolens*	Sedvce
178.	*Salix alba*	Bela vrba
179.	*Salvia officinalis*	Zhalfija
180.	*Salvia sclarea*	
181.	*Sambucus nigra**	Bozel
182.	*Sanguisorba officinalis*	Krvavce
183.	*Saponaria officinalis*	Sapunche
184.	*Satureja hortensis*	Chubrica, Chebrika
185.	*Satureja montana*	Planinska chubrica, Chebrika
186.	*Sempervivum spp.*	Pazikukya
187.	*Sideritis raeserii**	Sharplaninski chay
188.	*Sideritis scardica**	Sharplaninski chay
189.	*Silybum marianum*	Mlecen trn
190.	*Symphytum officinalis*	Gavez
191.	*Solanum dulcamara*	Pesyi trn
192.	*Solanum nigrum*	Zrnec
193.	*Solidago virga aurea*	Zlatica
194.	*Sorbus aucuparia*	Ofika, Divo grozye
195.	*Syringa vulgaris*	Yorgovan
196.	*Tamus communis*	Bluzhd
197.	*Taraxacum officinale**	Gluvarche, Mlechna kozica
198.	*Taxus baccata*	Tisa
199.	*Teucrium montanum*	Planinski dupchec, Podubec
200.	*Teucrium polium*	Bel dupchec, Podubec
201.	*Teucrium scordium*	
202.	*Thymus spp.**	Majchina dushichka
203.	*Tilia cordata**	Lipa
204.	*Tilia platyphylos**	Lipa
205.	*Tribulis terestris*	
206.	*Trigonela foenum graecum*	Grchko seme
207.	*Tropaeolum majus*	Latinka, Lazi bube
208.	*Tussilago farfara*	Podbel
209.	*Urtica dioica**	Kopriva
210.	*Vaccinium myrtillus**	Borovinka
211.	*Vaccinium uliginosum**	Borovinka
212.	*Vaccinium vitis-idaea*	Crvena borovinka, Brusnica
213.	*Valeriana officinalis*	Mace treva
214.	*Veratrum album**	Chemerika
215.	*Verbascum tapsiforme**	Mopen
216.	*Verbena officinalis*	Merbena
217.	*Veronica officinalis*	Modrichica, Nevestinska solza
218.	*Viburnum tinus*	
219.	*Vinca minor*	Zelenice
220.	*Viola odorata*	Mirisliva temyanushka
221.	*Viola tricolor**	Sharena temyanushka
222.	*Viscum album*	Bela imela
223.	*Zizyphus jujuba*	

Table 7. Area of forest reserves as classified by predominant tree cover species.

Forest Tree Species Group	Forest Area (ha) (1994 Inventory)
Pure coniferous forests	81,905
Mixed coniferous forests	9,610
Pure broad-leaved forests	545,047
Mixed broad-leaved forests	277,341
Other forests, broad-leaved and coniferous	52,038
Total	965,941

Table 8. Forest ownership structure over different years.

Year	Forest Resource ha	Ownership					
		State-owned		Privately-owned		Total	
		ha	%	ha	%	ha	%
1939	551,000	469,000	*85.27*	81,000	*14.73*	550,000	*100*
1961	888,000	817,000	*92.00*	71,000	*8.00*	880,000	*100*
1993	964,000	858,000	*89.00*	106,000	*11.00*	964,000	*100*
1999	965,650	859,427	*89.00*	106,223	*11.00*	965,650	*100*

ANNEX 7
List of Acronyms

BERCEN - Balkan Environmental Regulatory Compliance and Enforcement Network
BIOECO - Society for the Investigation and Conservation of Biodiversity and the Sustainable Development of Natural Ecosystems
CARDS - Community Assistance for Reconstruction
CFC - Chloro-fluorocarbon
CITES - Convention on International Trade in Endangered Species of Wild Fauna and Flora
CORINE - CO-oRdination of INformation on the Environment (EU CORINE Biotopes Programme)
DAD - Domestic Animal Diversity (FAO)
DNA – Deoxyribonucleic acid
EAR - European Agency for Reconstruction
EIONET - European Environment Information and Observation Network
EPC - Environmental Press Center
EU - European Union
FAO - Food and Agriculture Organization of the United Nations
FCI - Federation Cynologique International
GDP - Gross Domestic Product
GEF - Global Environmental Facility
GNP - Gross National Product
GRIN - Germplasm Resources Information Network
GTZ - Deutsche Gesellschaft für Technische Zusammenarbeit (German Society for Technical Cooperation)
IPGRI - International Plant Genetic Resources Institute (FAO)
IUCN - International Union for Conservation of Nature
KAM - Kinological Association of Macedonia
KFOR - Kosovo Force (NATO)
LEAP - Local Environmental Action Plan
MANU - Macedonian Academy of Science and Arts
MEIC - Macedonian Environmental Information Center
MoEPP - Ministry of Environment and Physical Planning
NATO - North Atlantic Treaty Organisation
NEAP - National Environmental Action Plan
NGO - Non-governmental organisation
POP - Persistent Organic Polluter
REPC - Regional Environmental Press Center
REReP - Regional Environmental Reconstruction Programme for South Eastern Europe
RM - Republic of Macedonia
SEEENN - South Eastern European Environmental NGOs Network
SFRY - Socialist Federal Republic of Yugoslavia
UN - United Nations
UNDP - United Nations Development Programme
UNEP - United Nations Environment Programme
UNESCO - United Nations Educational, Scientific and Cultural Organization
UNIDO - United Nations Industrial Development Organization

UNPROFOR - United Nations Protection Force
USEPA - United States Environmental Protection Agency
VAT - Value-added tax
WCMC - World Conservation Monitoring Centre

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