The Natural Environment

The system of mountain ranges of Dinarids, Albanid–Hellenids, Carpathians and Balkanids form the backbone of South East Europe, and enclose several large depressions: basins and lowlands (e.g. Thracian Basin, Pannonian or Hungarian, Lower Danubian or Romanian lowlands). The ancient core of the Balkans is the Thracian–Macedonian Massif, which includes Rhodope, Rila, Pirin, Šar Mts., is located in between. The highest peaks of the region: Musala (2,925 m) and Vihren (2914 m) are to be found in these mountains. *Figure 2* shows the physical map of the region and *Table 1* illustrates the altitude categories of the countries.

The Main Physical Regions

Dinaric Alps (Croatian, Serbian *Dinaridi, Dinarsko gorje,* Slovenian *Dinarsko gorstvo*): mountain system, extending ca 640 km along the east coast of the Adriatic Sea from the Soča (Ital. *Isonzo*) River, western Slovenia–northeastern Italy, through Slovenia, Croatia, Bosnia and Herzegovina, Serbia, and Montenegro, to the Drin River, north of Albania. The highest peak is Jezerce (2,694 m) in Albanian Alps (Prokletije, Albania). The system, linked to the main Alpine group by the Julian Alps, consists of the Slovenian, Croatian, Bosnian, Herzegovinian, Montenegrin Karst (e.g. Kras, Velebit, Dinara, Durmitor) and the Albanian Alps. The partially submerged west-

Table 1. ***Topography of South East European Countries according to Altitude Zone Categories***

Country, *province*	Total area (km²)	Altitude zone category (m a.s.l.)				
		0–200	200–600	600–1,000	1,000–1,500	1,500 <
		%				
Albania	28,748	23	26	23	20	8
Bosnia and Herzegovina	51,129	13	33	29	22	3
Bulgaria	110,928	31	41	15	9	4
Croatia	56,538	53	29	14	4	0
Macedonia	25,713	3	31	35	22	9
Montenegro	13,812	10	11	22	39	18
Romania	238,391	38	35	17	6	4
Serbia	88,361	37	30	18	13	2
Voivodina	*21,506*	*98*	*2*	*0*	*0*	*0*
Central Serbia	*55,968*	*20*	*41*	*25*	*13*	*1*
Kosovo	*10,887*	*0*	*29*	*50*	*13*	*8*
Slovenia	20,253	9	52	27	9	3
South Eastern Europe	633,873	32	34	19	11	4

Source: Statistical Yearbooks of SEEC 2003–2005.

ern part of the system forms the numerous islands and bays (harbours) along the Croatian (Dalmatian) coast. The rugged mountains thrown up in parallel ranges, composed of limestone and dolomite, are a barrier to travel from the coast to the interior. Sinkholes and caverns dominate the landscape. The region is sparsely populated and forestry and mining are the chief economic activities. The Mesozoic limestone ranges and plateaus of the Dinarids make up the most extensive mountains of this kind in Europe. The eponym of these limestone territories also can be found here, the Karst (Slovenian *Kras*, Ital. *Carso*) limestone plateau (southwestern Slovenia) extending ca 80 km southeast of the lower Isonzo (Soča) valley between the Bay of Trieste and the Julian Alps. It is characterised by deep gullies, caves, sinkholes, and underground drainage — all the result of carbonation-solution. The best-known caves are at Postojna and Škocjan. The barren nature of the plateau deters human settlement. Rough pasture or forest covers much of the surface, and there is little arable land. The term karst is used to describe any area where similar geological formations are found.

The Carpathians (Slovak, Czech, Polish, Ukr. *Karpaty*, Rom. *Carpații*, Hung. *Kárpátok)* with an area of ca 190,000 km² is the second most extensive mountain system of Europe (after the Alps). The ring of the Carpathians which is separated from the Alps by the Danube near Bratislava (*Pozsony*, *Pressburg* in Slovakia) continue into Romania by the Eastern Carpathians and the Transylvanian Alps (or Southern Carpathians): southern branch of the Carpathian Mts., extending ca 360 km eastward across central Romania from the Danube River at the Iron Gate. Moldoveanu (2,544 m) and Negoiu (2,535 m) are the highest peaks. The range is mostly composed of crystalline massifs, which is densely forested and covered partly by alpine meadows. The Carpathians are rich in minerals, coal and timber. The mountain range is a barrier to the southward movement of cold air masses, whereas numerous low passes facilitate overland travel between the densely populated areas that flank the system. Turnu Roşu is the most important of several passes linking Transylvania with Wallachia to the south.

An extension of the Carpathians, the Balkanids are the central mountain range system of South Eastern Europe and Bulgaria, extending ca 560 km from the Danube in east Serbia through central Bulgaria to the Black Sea. They consist of the East Serbian, Balkan, Fore-Balkan, Sredna Gora and Istranca Mts. Sometimes the East Serbian Mts. (between the Danube, Velika Morava and Timok rivers) is considered part of the Carpathians. The eponym of the Balkanids and the peninsula, the Balkan Mts. (Bulg. *Stara Planina*) rises to 2,376 m at Botev Peak. The forested range is sparsely populated and rich in a variety of minerals.

The ancient core area of the Balkans, the Thracian–Macedonian Massif is bordered by the Dinarids and the Balkanids. The area covered mostly by crystalline rocks is strongly broken up into mountain blocks of various extention: the Šar (Alb. *Sharr*) – Korab Massif, East Macedonian blocks, Rila, Pirin, Rhodopes. The latter rugged ranges have few passes and have long hindered communications between the upper Maritsa valley and the Greek coastal plain. Rila is the highest mountain of South Eastern Europe (Musala Peak 2,925 m) and famous for its national park and the Rila Monastery. Most of the Pirin Mts. in southwestern Bulgaria (rising to 2,914 m at Vihren) is also protected as a national park. The Rhodopes (Bulg. *Rodopi, Rodopa planina*) are spread over nearly 15,000 km² (83% of it in Bulgaria, the rest in Greece) Its length is ca 220 km, with an average altitude of nearly 800 m.

Dobruja (Rom. *Dobrogea*) a small and low crystalline block with an area of ca 23,300 km², in southeastern Romania and northeastern Bulgaria, between the lower Danube River and the Black Sea. It comprises a low coastal strip and a hilly and forested inland.

Overview by Countries

In spite of the small size of the country, a wide variety of landscapes can be found in **Slovenia** (20,253 km²) where the Alps, the Dinarids, the Pannonian (Carpathian) Basin and the Mediterranean meet. Metamorphic, sedimentary and magmatic rocks are represented and range in age from Precambrian to Cenozoic. The oldest rocks in Slovenia are found in the metamorphic complex of Pohorje Mts., Kobansko and Strojna Mt. (Eastern Alps) and are represented by gneisses, mica schists, amphibolites, eclogites, marbles, quartzites, greenschists and phyllites. The Mura Depression originated as a deep trough on the southwestern border of the Pannonian Basin. It subsided in the Neogene to be filled subsequently with sediments. The Dinarids and the Alps occupy the greatest part of the Slovenian territory. The most important tectonic units include the Pohorje Unit (Middle Austroalpine) in the Eastern Alps, the overthrust units of phyllitic rocks and the North Karawanken overthrust. The southern border of the geotectonic unit is the Periadriatic Lineament. The Dinarids extend southward of the Periadriatic Lineament. This territory includes the Julian Alps and may be considered as part of the Dinarids. The megaunits of this area include the Southern Alps, the Inner and Outer Dinarids. The overthrust build-up and strong disintegration by younger faulting are characteristic features of all the mentioned units.

Croatia (56,538 km²) forms part of South Eastern Europe between the Adriatic Sea and the Pannonian (Carpathian) Basin. According to geographic and geologic features, four main regions can be distinguished.

a) The coastal area of the Adriatic Area consists predominantly of Mesozoic and Palaeogene carbonate sediments partly covered by Eocene flysch deposits. It exhibits small karst features. The islands are without surface water courses, while the coastal part of the mainland is crossed by some rivers.

b) The Main Dinaric Ridge is characterised by predominant Mesozoic carbonate rocks accompanied by Palaeozoic clastics either as inliers or as overthrust units. Karst topography consists of karst poljes (interior valleys), smaller closed depressions, lost rivers, etc. Along the ridge, the watershed extends between the catchment areas of the Adriatic Sea and the Black Sea.

c) The Inner Hinterland exhibits a combination of hills and plains composed of Mesozoic carbonate rocks covered in places by Senonian–Paleocene flysch or Paleozoic clastic overthrusts. The topography is characterized by fluvio-karst features in which shallow karst areas are in exchange with non-karst terrains. Several rivers cross the structures toward the north–northeast.

d) The Pannonian Basin is composed of several single basins and graben filled up by Neogene deposits. Isolated hills consist predominantly of Paleozoic and Mesozoic crystalline rocks, clastics and carbonate rocks. There is a dense network of surface waters.

Bosnia and Herzegovina (B&H, 51,129 km²), which belongs to the West Balkan region, consists of two natural and historical en-

tities: Bosnia, its northern and larger part, and Herzegovina, its southern and smaller part. In the north, west and south it is surrounded by Croatia through which it has a corridor to the Adriatic Sea. Its eastern neighbour is Serbia. B&H is a typical mountain area and the highest ranges, mostly about 2,000 m height a.s.l., stretching along the watershed between the Black Sea and Adriatic Sea. Geographically the area can be divided into three parts: (1) North (Pannonian) Bosnia: the northern mainly flat and water-rich area south of the River Sava; (2) Lower Herzegovina: the southern and southwestern, water-poor karst area and (3) Central–West Bosnia and Upper Herzegovina: the largest mountainous water-rich area with several hydroelectric power stations located between these two areas. The area of B&H covers the middle and largest parts of the Dinarids located on the northeastern flank of the Adriatic (or Apulia) microplate. The Dinarides are a complex fold, thrust and imbricate belt characterised by a regular pattern in the spatial distribution of the characteristic Mesozoic–Paleogene (Alpine) lithologies.

About 15% of the territory of **Serbia** (88,361 km²) has an altitude over 1,000 m, some 48% lies between 1,000 and 200 m, and 37% is flatlands, mostly in the Pannonian Plain. The Dinaridic mountain chain lies between the Sava River and Adriatic Sea, with mountain ranges striking essentially northwest–southeast. The northern part of the system is lower, and the highest mountains in Serbia are in the south (in Kosovo) the Prokletije (Djeravica 2,656 m) and the Šar-planina (Crni vrh 2,585 m). The backbone occupies the Serbian–Macedonian Massif, as an old Precambrian to Hercynian trunk. The Carpatho–Balkan mountain ranges strike mostly north–south, being convex toward the east. Toward the north they are cut by the Danube Gorge (Djerdap), up to 80 m deep. The highest mountains there are Stara Planina (2,169 m), Suva Planina (1,808 m), and Ruj (1,706 m). The block mountains are situated between the Dinarids and the Carpatho–Balkans. These are mostly horsts striking west–east, with medium height including Besna Kobila (1,923 m), Kukavica (1,442 m) and Jastrebac (1,491 m). The northern lowlands (mostly in the Voivodina province) as part of the Pannonian (Carpathian) Basin have altitudes between 70 and 90 m on the average, with the Fruška Gora (538 m) as the sole mountain range.

The surface area of Republic of **Montenegro** (Serb. *Crna Gora*) is 13,812 km². The highest peaks of the Dinaric Mountains in Montenegro are the Bobotov kuk (2,522 m, Durmitor Mts.) and the Kom kučki (2,487 m, Komovi Mts.). The territory of Montenegro consists of the following units: The Adriatic Coast Belt (Dinaridic affinity), which have some 1,700–1,800 m high peaks and the only one lowland of the country, Shkodra Basin. The purely Dinaridic zone is the Durmitor–Visitor range. It corresponds to the "Old Montenegro Overthrust". Towards the northeast it is thrust under the Sarajevo Sigmoid along the "Kuči Overthrust". The unit shows the flysch or limestones, a thin volcano-sedimentary formation followed by Upper Triassic carbonate platform and thick Jurassic carbonates, with some breaks in deposition. These pass into very thick Cretaceous shelf carbonates with diastems, topped by the Paleocene–Eocene limestone.

The territory of **Albania** (Alb. *Shqipëria*, 28,748 km²) is predominantly mountainous, with 51% of the country lying 600 m or more above sea level. The most elevated mountains are the Albanian Alps (Alb. *Alpet e Shqipërisë*, Serb. *Prokletije*, 2,694 m) to the north and the Korab Group (Alb. *Vargu Lindor I Korabit*, 2,751 m) to the east. Several transverse valleys run through the mountains towards the alluvial coasts which, together with the Internal Troughs, constitute the only plains of the country. Its low, indented coasts are bathed by the Adriatic and Ionian Seas. Albania represents an important part of the Alpine–Mediterranean orogen, with Albanids constituting the link between the Dinarids and Hellenids orogenic belts. A system of tectonic domains may be identified from east to west: the Korab, Mirdita, Krasta–Cukali, Albanian Alps, Kruja, Ionian and Sazan Zones.

The territory of Republic of **Macedonia** covers an area of 25,713 km². The area immediately along the Vardar river valley known as the Vardar Zone represents relatively the lowest relief and divides the territory of Macedonia into West and East Macedonia. The western part of Macedonia represents the most pronounced, highly uplifted mountainous relief, characterised by mountain massifs and ranges rising to over 2,000 m (Golem Korab, 2764 m) running in a meridional direction, while in the northern part, they turn to the northeast. The area referred to as the Vardar Zone is characterised

by a very differentiated relief; isolated mountain massifs uplifted to 1,500–2,000 m (Kožuf, 2,165 m) and plateaus, including Vitačevo, 800 m and Ovče Pole, 400–500 m, divided by valleys with an altitude varying between 100 and 300 m a.s.l. Orographically, eastern Macedonia represents a system of isolated block mountain massifs uplifted to about 2,000 m, divided by valleys with east–west orientation, including the Kriva, Bregalnica and Strumica valleys.

Bulgaria covers 110,928 km² and is situated on the western side of the Black Sea. The country includes within its borders a great variety of plutonic, volcanic and sedimentary rocks of various ages. Geologically, the region is particularly interesting, for the Balkan Mountains contain the eastern extremity of the Alpine–Carpathian chain, which is finally cut off by the Black Sea. Bulgaria is divided into seven main natural morphotectonic units. The Thracian Massif (eg. the Rhodopes) is comparable to the Variscan (Hercynian) massifs of Western Europe, which is composed mainly of Archean, Proterozoic and Cambrian metamorphic rocks and granites. The Moesian Platform in the north extends across the Danube into Romania and is part of the Eurasian Plate. It consists of a stable zone of dislocated early Paleozoic rocks, covered transgressively by Mesozoic and early Tertiary epicontinental sediments. The Kraištide Belt is a comparatively narrow belt of very complex Alpine structure; it parallels the border between Bulgaria and Serbia, along the western side of the Thracian Massif. The Balkan Mts. have complex structures, although not of Alpine complexity; there are overthrusts, large overturned folds and small nappes. In places, older rocks crop out through the Mesozoic cover. An example of this outcropping is seen west of Šipka Pass, near the centre of the range, where ancient granite from the Sredna Gora Zone was thrust from the south (about 12 km) over Mesozoic limestones.

The Republic of **Romania** is the largest of the South East European states with an area of 238,391 km². Natural resources include oil, natural gas, coal and iron ore. Romania's relief ranges from 2,544 m at the Moldoveanu Peak (Southern Carpathians, Făgăraş Mts.) to the level of the Black Sea; the topography is represented by the following zones of altitudes: 0–200 m, about 38% of the territory; 200–600 m, 35%; 600–1,500 m, 23%; and about 4% over 1,500 m.

The general relief has two basic characteristics.

a) There is a concentric arrangement of the main morphological belts (mountains, hills and plains), shown by elevation, corresponding to the principal structural-tectonic units, and a radial dissection of the mountains, as determined by faults and stream erosion. The Carpathians represent the primary element followed by other morphological units. They enclose in a ring the Transylvanian Depression, passing to the belts of hills and then plains to the east and west. An exception to this concentric structure is the Hercynian elevations of Dobruja (467 m) situated between the River Danube and the Black Sea.

b) There is a symmetry and zonality of the main geomorphological units in relation with the Carpathians. Against the background of this harmonious geomorphological architecture, there is a great variety of relief, from the point of view of both geomorphology and origin. The latter includes volcanic, structural–tectonic, karstic, glacial, periglacial, fluvial, and littoral types of relief. The topography also reflects age, some areas having retained landforms continuously since at least the end of the Mezozoic period.

Climate

Greater part of Europe is situated in the temperate zone; only the southernmost regions are in the subtropical zone. The atmospheric circulation is determined mainly from the Maximum of Azores and the Minimum of Iceland. A zonal transport from west to east is dominating almost during the whole year. The influence of the Atlantic Ocean is strongest in West Europe and decreases eastwards. These factors determine Europe's climate as relatively homogeneous – the one of the temperate latitudes.

The Balkan Peninsula is well connected to Europe and naturally is also part of the temperate latitudes. At the same time, there are a number of specific impacts. In South Eastern Europe the west–east transport is well pronounced, that leads to relatively frequent changes of weather. During the winter the polar front as set by the climate is situated to the south of the Balkan Peninsula and during the summer it passes trough it. During the winter the frontal processes are more pronounced and dominant, whereas during summer the weather is more often defined by convective processes. The great distance to the ocean is the reason for the atmospheric processes to manifest the specific features of continental climate. The severity of the continental climate is extenuated in the areas near to the Mediterranean, Adriatic and Black seas. During the year there are no climatic periods of similar type of weather with marked limits – the change of temperatures is gradual and the differences between the monthly precipitation sums are relatively small.

The most important changes of macroweather occur with the change of different types of atmospheric circulation. The polar front cyclones, especially Mediterranean cyclones, are those with the biggest influence on the weather. The Azores highs and these with arctic origin are also an essential impact.

The winter Mediterranean cyclonic centre is activated when cool air penetrates over the Mediterranean Sea. The cold advection is usually realized in the western regions. Forming big temperature contrasts between cold land and relatively warm waters of Mediterranean Sea is the main cause for pushing on the cycloning activity. Depending on the trajectory of the cyclones a different kind of weather is formed – from dry and relatively warm to cold with intensive snowfalls. In the summer in the Mediterranean Sea area the high forms prevail whereas in the north situated regions the frequency of the cyclonic forms increase. The Atlantic cyclones rather seldom reach the Balkan Peninsula and their influence is stronger in its northern regions. They mostly result in cloudiness and rainfalls in May and June. The intensity of the summer cyclones in Europe is usually smaller than that of winter cyclones, but the fre-

quency of cyclones in summer is much higher. Depending on the atmospheric circulation the Atlantic air reaches the Balkan Peninsula more or less transformed. During the cold seasons of the year the ocean air masses are getting cooler while during the warm period they are getting warmer and more humid because of the evaporation from the land surface.

Ocean air masses from arctic and moderate latitudes, moving from north and west on highs reach the Balkan Peninsula considerably transformed because of the remoteness from the formation place. These processes are typical mostly in late spring and early summer. The location of South Eastern Europe is favourable also for the ultra-polar invasion from north and northeast. On the other hand, the Balkan Peninsula is a compact area with complex orography.

The prevalence slight-gradient baric fields is favourable for forming local air masses. The area has five climatic regions, notably continental, transitional continental, Mediterranean, transitional Mediterranean and mountain climate (*Figure 3*).

The continental climatic region has longer, hot and dry summer period with the average of 20–24°C in July (*Table 2*, Belgrade). The winter is cold and relatively short. The average temperature of the coldest month is between -4 and +1°C. The annual precipitation cycle reaches its maximum at the beginning of summer, and its minimum during winter.

The characteristics of transitional continental climate are the hot, dry summer (24–25°C) and cool winter. The winter temperature in average is above 0°C. Typical area for this climate is the northern part of Macedonia (*Table 2*, Skopje). The annual precipitation cycle is similar to the continental climate's, but its driest period occurs at the end of summer.

The transitional Mediterranean climate appears in the southern areas of the Balkans and in the northern Adriatic region. Its summer is alike to the Mediterranean type and the winter is warmer than in the continental regions (*Table 2,* Rijeka and Burgas). Compared to the transitional continental climate, this area has its amount of maximum

Table 2. ***Some Climatic Data on South East European countries***

Country, *province*	City	Mean air temperatures (°C)			Precipitation (mm)	Number of rainy days
		Annual	January	July	Annual	Annual
Albania	Tiranë	15.2	6.8	25.1	1,219.1	98
	Vlorë	16.4	..	..	879.6	82
Bosnia and Herzegovina	Sarajevo	9.6	-0.9	18.9	932.4	114
Bulgaria	Sofia	10.0	-1.5	19.8	576.0	69
	Varna	12.0	1.9	22.0	464.0	90
	Sandanski	14.0	2.4	24.6	483.0	56
Croatia	Zagreb	11.3	0.2	21.2	882.8	99
	Split	15.8	7.4	25.4	824.6	85
Macedonia	Skopje	12.6	0.7	23.4	474.0	66
Montenegro	Podgorica	15.3	5.0	26.0	1,660.9	101
Serbia	Beograd	11.8	0.4	21.7	684.2	95
Voivodina	*Novi Sad*	*11.0*	*-1.5*	*22.3*	*620.0*	..
Central Serbia	*Niš*	*11.8*	*-0.5*	*22.7*	*555.0*	..
Kosovo	*Priština*	*10.2*	*-1.5*	*20.7*	*576.0*	..
Romania	Bucureşti	10.6	-2.4	22.0	595.0	76
	Cluj-Napoca	8.2	-3.4	18.2	548.0	91
	Omu Peak	-2.6	-10.5	5.1	1,053.0	141
	Constanţa	11.5	0.5	22.0	396.0	59
Slovenia	Ljubljana	9.8	-1.1	19.9	1,393.1	115

Remark: .. no data.
Source: WMO – NOAA National Climatic Data Center, 1961–1990 Global Climate Normals [CLINO]

precipitation during winter, and receives more precipitation at the beginning of summer.

The Mediterranean climatic region has the hottest and driest, 3–5 months long summer (26–28°C) with 8–11 °C average January temperature (*Table 2*, Tirana and Podgorica). The summer precipitation amount is about 10–20% of the total annual precipitation. Typical areas are the Southern Adriatic and the Aegean coastal regions.

The mountain climate typifies the region with high precipitation values (around 1000 mm) and much lower temperature values in summer and winter than all the other climatic regions (*Table 2*, Omu Peak). At higher altitudes the temperature decreases and the distribution of the precipitation gets more even as well. Owing to the frequent temperature inversions at winter, vertical temperature gradients are considerably higher during summer than in winter.

Waters

The Danube, Drava, Sava, Morava, Vardar and Maritsa are the largest *rivers*. The Morava and Vardar river valleys form the chief corridor across the peninsula. Rivers of the territory mostly belong to the Black Sea Basin, as tributaries of the Danube. These rivers are the Drava /Mura/, Sava /Kupa, Una, Vrbas, Drina/ (Slovenia, Croatia, Bosnia and Herzegovina, Serbia), Tisa, Timiş–Tamiš, Jiu, Olt, Siret, Prut (Serbia, Romania), Isker and Jantra (Bulgaria). A smaller part of the area drains (Cetina, Neretva, Drin, Shkumbin, Vjosa) into the Adriatic Sea, and some portion (Vardar, Struma, Mesta and Maritsa) belongs to the Aegean Sea basin.

The underground drainage system is very important in the region. These are mainly connected to karst phenomenon. Groundwater flow in karst aquifers is significantly different from that of other aquifers because of the solutionally enlarged conduits. In porous media aquifers, groundwater moves very slowly as laminar flow, (usually only a few feet per year), but in karst aquifers, turbulently flowing underground streams have velocities approaching those of surface streams. The nature of the groundwater flow system causes karst areas to be extremely vulnerable to groundwater contamination. Other serious hydrogeologic problems include sinkhole flooding and sinkhole collapse. Some rivers have karst springs for its source like the Sava in Slovenia. Other amazing phenomenon are rivers like the Reka (Slovenia) which disappears from the surface, flowing subterranean (40 km) in the Škocjan Cave system and appears as the Timavo River in Italy.

The most important *lakes* of the region are Shkodra (Shkodër) on the Albanian–Montenegrin border, Ohrid (Ohër) and Prespa on the Albanian–Macedonian–Greek border. The biggest lake is Shkodra Lake with the area of 356–370 km² and a depth of only 12 m. Its length is 50 km; the width 5–18 km. Ohrid Lake has the area of 350 km²; length is 35 km, width 10–12 km. Lake Prespa lies on 853 m a.s.l. Its area is 275 km², depth 54 m. The dimensions of the lake are: 30 km in length, 8–15 km width. The deepest lake is the Red Lake (Croatian *Crveno jezero*) of Imotsko polje in Dalmatia (Croatia), which is more than 500 m deep. The second is Ohrid Lake with its 286 m depth. There are many reservoirs all around the region which are backwaters bounded by a dam utilising the stream's power. Big oxbow lakes can be found on the Romanian Plain along the Danube. Lagoon lakes (e.g. Razim, Goloviţa, Zmeica, Sinoie) lie south from the Danube Delta and several smaller ones (e.g. Taşaul, Siutghiol, Techirghiol, Mangalia) are along the Black Sea coast.

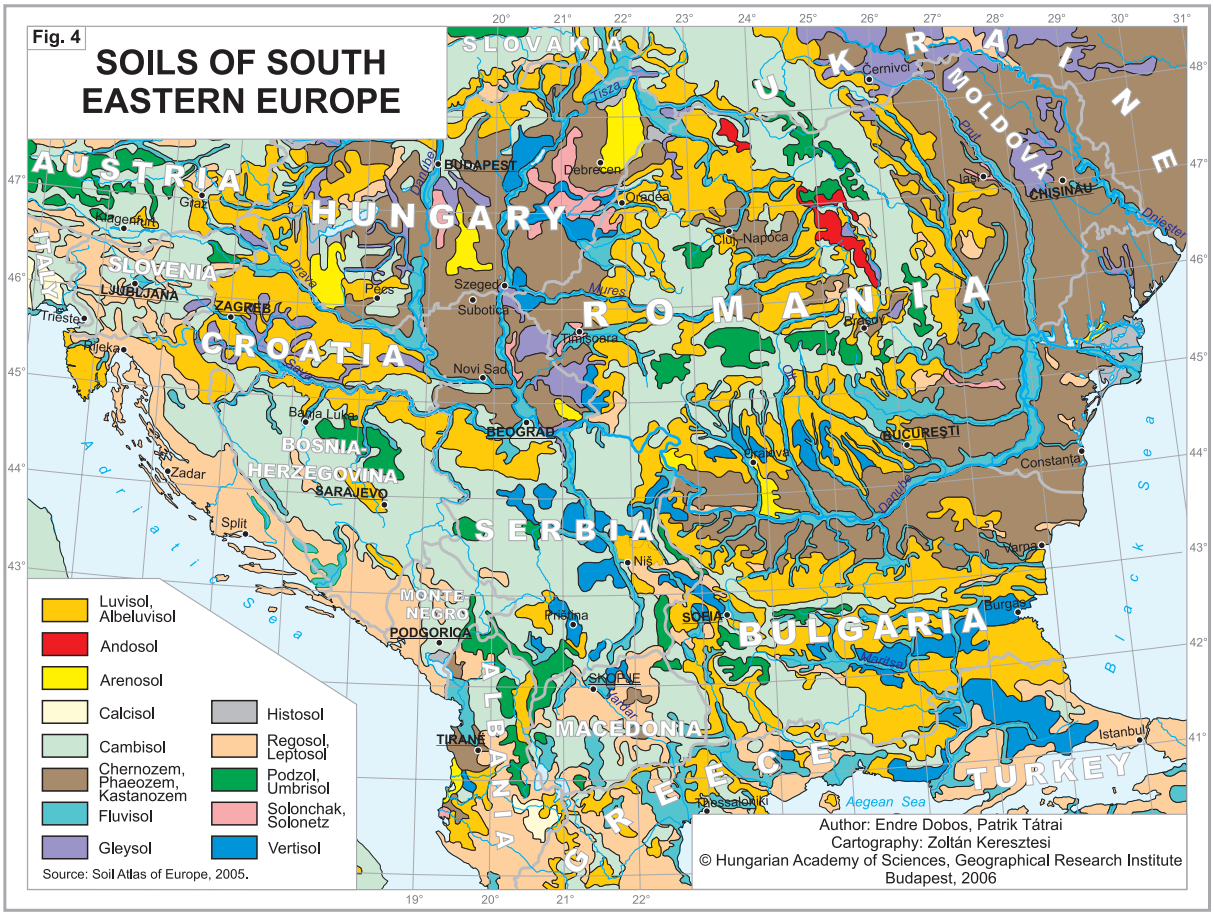
The most famous of all lakes are the Plitvice Lakes, which is a national park in Croatia. The Plitvice Lakes are situated on the karstic Plitvice plateau, between the mountains of Mala Kapela, Plješevica and Medveđak. The 16 lakes are separated by travertine dams into an upper and lower cluster formed by runoff from the mountains, descending from an altitude of 636 m to 503 m over a distance of some 8 km, aligned in a south–north direction. The lakes collectively cover an area of about 2 km², with the water exiting from the lowest lake to form the Korana River.

Soils

Soils of the region show great diversity (*Figure 4*). The most important factors of the soil formation are the topography, the parent material and the climate, parallel with the anthropogenic factor, which has become the major one in the last 2–3 thousands years.

The area, especially the coastal region was one of the most favorable for the developing human civilization, due to its mild, pleasant Mediterranean climate and the natural resources supporting human life through agriculture, and timber based industry. However, the increasing need for timber and agricultural production induced a strong deforestration and the removal of the natural vegetation.

The changing land and soil use has accelerated erosion and caused a great loss of soil material. Despite of this loss, soil resources are still among the most important means for supporting human life of the area.



Explanation of soil types

Luvisol, Albeluvisol = Soils with clay illuviation horizon
Andosol = Volcanic soils
Arenosol = Sandy soils
Calcisol = Soils of the semi-arid regions, with high calcium-carbonate accumulation
Cambisol = Weakly developed, young soils
Chernozem, Phaeozem, Kastanozem = Soils conditioned by steppe climate
Fluvisol = Alluvial soils
Gleysol = Soils of areas with high ground water table
Histosol = Organic soils
Regosol, Leptosol = Shallow, weakly developed soils of high relief
Podzol, Umbrisol = Acid soils under cool, humid climates
Solonchak, Solonetz = Salt affected soils
Vertisol = Heavy clay soils

The coastal belt of Croatia, Bosnia and Herzegovina and partly Montenegro, and a significant part of Macedonia are characterized by Rendzic *Leptosols*, the so called Rendzina. This soil is strongly used for agriculture and forestry, despite of its shallowness and small water holding capacity. It often has quite a significant amount of stone pieces in varied sizes, which makes land cultivation difficult. The stones are often removed by the farmers and collected in stone walls separating the land parcels, and indicating that we step on Rendzina soils.

North and east of the Rendzina region, the inland of Bosnia and Herzegovina, Serbia, Montenegro and Albania, where the major parent material are still limestone, shale and sandstone, different types of *Cambisols* (in other names Braunerde, Brunizems, Ramann-type brown forest soils) and *Regosols* are formed on the unconsolidated regolith over hardrock. The solum is deeper here, but only weakly expressed soil formation is evident due to the actively forming and rejuvenating surfaces (erosion and deposition) of the mountainous environment. Cambisols are young soils, only weathering, limited clay formation, and iron oxidation are shown by the developing reddish color. Neutral, high base-saturated Cambisols, like the Eutric Cambisols are fertile agricultural soils, especially under moderate climate. However, Dystric Cambisols, which can be quite acidic and cover an extensive area in South Eastern Europe, are much less productive and mainly used for forests. Leptosols and Regosols are the main associated soils to the Cambisols in the mountains. These soils are formed on eroded surfaces and are mainly forest soils. The removal of the forest accelerates erosion and completely destroys the potential to reuse the area. More stable and less sloping surfaces with wet climate have *Luvisols*, soils having clay illuviation into the deeper horizon. *Terra rossa*, the most typical Mediterranean soil, is one of the examples of this soil type.

The eastern part of the area, mainly Romania and Bulgaria, is more continental, and has a slightly different combination of soils. The undulating rangeland of the Transylvanian Basin and the foothills of the Carpathians, the Balkan Mts. and the Rhodopes are characterized with *Luvisols*. These soils are widely used for farming and forestry as well. When farmed, its eluvial horizon is often completely eroded and the reddish-brown colored horizon appears on the surface. *Cambisols* (mainly acid ones) cover the higher relief areas of the major mountain ranges, with inclusions of Podzol areas under coniferous vegetation of the higher ridges of the Carpathians and the Apuşeni (Bihor) Mts.

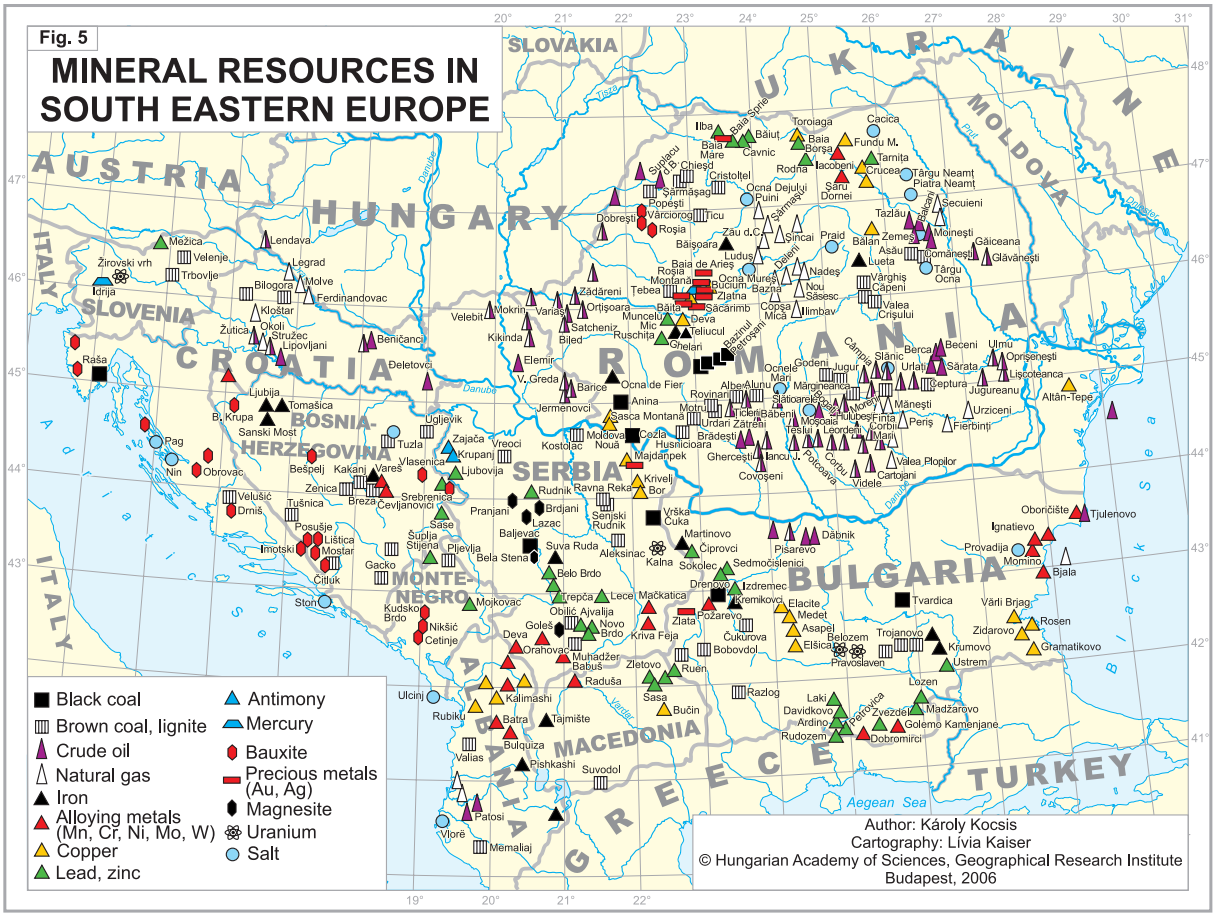
The Lower Danubian Basin between the two mountain ranges of the Carpathians and the Balkanids is the most fertile region of the entire area. *Chernozem*, a deep, dark-colored, nutrient rich soil, the most famous farm-soil covers the majority of the area, except the alluvial plains of the major rivers, where Fluvisols are most abundant types. The plain area between the Balkan Mts. and the Rhodopes, the Maritsa Basin East from Plovdiv up to the Burgas Basin, the lower lying areas of the Drina valley, and some part of the foothills of the Carpathians are the areas of *Vertisols*. These are heavy clay soils, with often good chemical characteristics for agricultural use. However, their physical characteristics, primarily water management problems make the life on these soil types quite difficult. Adopted cultivation is crucial for their successful use.

Natural Resources

Sources of energy are scarce in the region (*Figure 5*). Metal ores occur more frequently in the Balkans than other raw materials do.

Slovenia has some mercury and uranium near Idrija whilst lead and zinc can be found in Mežica. Energy resources like brown coal, lignite are mined in the hills between the Sava and Drava rivers (Hrastnik, Trbovlje, Velenje), the crude oil and natural gas are extracted in the Mura depression (near Lendava).

From the most important energy resources of **Croatia** the crude oil and natural gas are accumulated in the Neogene of the Pannonian area, mostly near the Drava and Sava rivers (e.g. Beničanci, Molve, Legrad, Žutica, Stružec, Lipovljani). The exploitable coal beds are in the



Paleocene of Istria and in the Bilogora. Other occurrences of coal and lignite have rather limited economic importance. Bauxites are the main metallic resource. They occur on carbonate platforms at several unconformity horizons ranging from the Triassic to the Neogene (mostly in Istria and Dalmatia). There are also many occurrences of endogenetic ore deposits (iron, lead, zinc, etc.), but not of economic importance.

Bosnia and Herzegovina a typical mining country in which numerous mineral deposits and countless occurrences of various metallic and non-metallic mineral raw materials are found. The country has a long mining tradition which started in the Illyric and Roman periods and continued in the Middle Ages. Hematite–magnetite (iron) deposits are mostly found in Paleozoic complexes (e.g. Ljubija, Tomašica, Vareš). In the Central Bosnian Paleozoic Complex are found the largest barite deposits associated with variable concentrations of mercury-bearing tetrahedrite (Banovići). In the same host rocks, antimony–zinc and gold-bearing pyrite deposits are found. The carbonate platform includes numerous and very significant bauxite deposits (Vlasenica and West Herzegovina). The workable reserves of brown coal and lignite are concentrated mostly in Central and Northeast Bosnia (e.g. Kakanj, Zenica, Tuzla, Ugljevik).

The most important metal to be found in **Serbia** is copper. The Majdanpek deposit in East Serbia was exploited in Roman times for limonite, in the 19th century as a deposit of pyrite, and from the middle of the 20th century for copper. The Bor deposits nearby, exploited from 1903, possess massive supplies of copper ore. Lead and zinc were, together with or mostly because of silver mined from the Middle Ages (the Novo Brdo mine was one of the most famous in the 14th and 15th centuries). The majority of the extraction is concentrated in Kosovo, the Trepča mine together with adjacent deposits, mined since 1930. Also important are Ljubovija and Lece outside of Kosovo. Before World War II, Yugoslavia produced some 40% of the world's antimony, but now substantially less. The main occurrences are situated in West Serbia (Zajača, Krupanj), accompanied by lead. In Serbia, coal is mostly of the lignite and soft brown type (e.g. Vreoci, Kostolac), and to a much lesser extent

black (Vrška Čuka). Crude oil and natural gas occur in the Pannonian Basin (mostly in the Banat), with over 60 fields, many of which are situated along the western flank of the Kikinda structural high.

Non-metallic minerals are represented mostly by bauxite (in the Nikšić region) in **Montenegro**. The lead and zinc mines are also remarkable (e.g. Šuplja Stijena, Mojkovac).

The wide variety of geological situations and lithological associations makes **Albania** one of the most interesting countries from the metallogenic point of view. In fact 35 economic minerals have been found, among these copper and alloying metals (Cr, Ni) in Central and North Albania (e.g. Batra, Bulquiza, Rubiku, Kalimashi). Coal, crude oil and natural gas can be found in the Mediterranean areas (e.g. Memaliaj, Patosi).

The ore resources in **Macedonia** are represented by deposits and occurrences of metals, non-metals and caustobioliths (organic rocks). Throughout the past years, numerous formations of all kinds of these mineral resources have been discovered and investigated. Some of them were exploited in the past (Cr, Fe, Sb, clays, diatomites, perlites, marbles), while some are being exploited at present Pb–Zn, Cu, Fe–Ni.

In **Bulgaria** the most valuable lead–zinc mineral deposits can be found in the Rhodopes, the copper mines are first of all in the Sredna Gora. From the metallogenic point of view the Balkan Mts. coincides more or less with the Balkan metallogenic province in which in the west there are early Paleozoic iron deposits (Martinovo, Kremikovci), accompanied by gold, and some polymetallic ores, exploited since Roman times. South of Vratsa, in the Triassic carbonate sediments lead and copper deposits crop up (Sokolec, Sedmočislenici). Brown coal fields occur in the Western and the Maritsa basins, the crude oil and gas can be found mostly in the northwest of the country and in South Dobruja. In central Stara Planina, quantities of black coal of a late Cretaceous age are exploited (Tvardica).

During the long geological history of **Romania**'s territory (from the Precambrian to the Neogene) different types of mineral deposits of very different sizes accumulated: iron ore deposits (in the South Carpathians); polymetallic ore deposits (Cu, Zn, Pb) of sedimentary origin (East Carpathians, Apuşeni Mts.); gold–silver ore deposits (volcanic arcs in the East Carpathians and Apuşeni Mountains); copper ore deposits (calcalkaline arcs of the South Carpathians and Apuşeni Mountains); non-metallic accumulations of kaolin and sulphur (East Carpathians volcanic arc). Crude oil and/or natural gas accumulated in a different geological framework (Moesian and Scythian platforms, Outer Moldavides in the East Carpathians, East and South Carpathians, Transylvanian and Pannonian depressions). Black coal mines are found mostly in the heart of the South Carpathians (Petroşani basin) and in South Banat, brown coal in the Comăneşti intramountain depression in Moldova. The largest lignite fields extend along the border line of the South Carpathians and the Getic Hills.

Environmental Protection and Nature Conservation

The South East European countries missed their chance in the seventies to start to intensively apply techniques for environmental protection, together with more developed European countries. At that time, they had a cleaner environment, essentially owing to lower levels of industry. The air, water and nature outside cities were relatively less polluted in comparison to countries where the industrial revolution was at a peak. Whilst South East European countries reached their current levels of pollution from the seventies onwards, the environment of developed European countries, at that time, was already greatly polluted. By conquering new and less aggressive technologies early and applying them in industry these developed countries are today far ahead of this region and technologies include water treatment as well as treatment and recycling of technological and urban waste.

Fortunately, in recent years, a growing attention has been being paid in South East European countries to the protection of the environment. New laws were adopted and applied in terms of protecting the environment when

exploiting or processing mineral resources, or in any other way when creating a new industrial facility. Rivers possess the characteristic to clean themselves by dissociation of harmful and dangerous substances and by mineralisation of organic substances if the pollution in the water is reduced.

To prevent leaks of wastewater and tailings from mineral processing plants it is necessary, most of all to build stable tailing ponds. This will prevent uncontrolled leakage of wastes from the latter to surface and underground waters as well as uncontrolled spills of solid waste onto nearby soil. Examples of poorly designed tailing ponds are found in the Copper Mine Majdanpek (Serbia) and that of the Gold Mine Baia Mare (Romania). The first large tailings spill occurred at Majdanpek in 1974 and resulted in all of the wildlife being destroyed in the river of Veliki Pek and the soil around the river becoming badly contaminated. It took two decades to partially restore the flora and fauna in the river. The tailing pond at Baia Mare containing cyanide from the gold treatment plant spilled over in 1999 and contaminated the international River Tisa, and through this river the cyanide reached the Danube as well. Large quantities of fish and other river organisms were destroyed.

Waste disposal is a serious problem that has a hugely negative impact on water resources, especially in karstic areas which have a low capacity for auto-purification. Organic, inorganic and hazardous waste is often disposed in karst pits and caves and locating the pollution source in cases where groundwater flow is not traced is virtually impossible. A clear strategy for groundwater tracing is needed in the near future, as well as education of the local community concerning the consequences of illegal waste disposal.

In South Eastern Europe, only Slovenia is an EU member (since May 2004), whilst Bulgaria and Romania are considered as pre-accession countries and will join the EU in 2007. For the rest of the region, the possible dates of accession is not defined and coverage of Protected Areas (PA) are considerably underrepresented.

There are currently two major effective transboundary programmes in the region – the Danube and the Mediterranean ones. However they emphasise the preservation of the alluvial and coastal/marine ecosystems and do not consider to the same extent the typical Balkan landscape as a unit consisting of a mix of mountains varying in their origin and altitude, karst phenomena, (glacial) lakes, rivers and coastal areas. Other related programmes focus only on the participating countries, which makes transboundary co-operation difficult.

The list of unique and well preserved natural areas is long, covering many types of habitat from coastal lagoons (Danube Delta) to the high altitudes of the Dinaric Alps and Rhodopes. During the last ice age, the Balkan Peninsula was a refuge for many species. They have survived there, due to the presence of suitable habitats in the great variety of landscapes. The Balkan Peninsula is particularly rich in wetlands, with 31 internationally designated Ramsar sites currently classified in the region (*Table 3*). The fact that most of them are situated

Table 3. ***Ramsar Sites in the South East European Countries***

Country	Number of Ramsar sites			Size of Ramsar sites (ha)
	Total	Of them		
		In the border areas	On the coast	
Albania	2	1	2	33,500
Bosnia and Herzegovina	1	1	1	7,411
Bulgaria	10	3	7	20,306
Croatia	4	3	1	80,455
Macedonia	1	1	0	18,920
Montenegro	1	1	0	20,000
Romania	5	1	3	683,628
Serbia	4	2	0	20,837
Slovenia	3	1	1	8,205
Total	31	14	15	893,262

along national borders, or along the coastal areas, demonstrates the need for the development of international cooperation. Of particular interest are sensitive wetlands, the "karst polje" areas which are situated in the chain of the Dinaric Alps. These are vast, flat plains, covered periodically with water coming from subterranean rivers and the surrounding mountains. The loss of wetlands has not been quantified for the region, except for the Danube floodplains, where 80% of them have been drained. This has led to a general loss of biodiversity, but also to a loss of highly productive forests, retention capacities in cases of floods, and as a consequence a reduction in the self-purification mechanism of the rivers.

Parts of the interior waters which could sustain a rich biological diversity are polluted and the Danube brings from upstream countries a pollution level with a negative impact upon the river's biological diversity, as well as that of the Delta and Black Sea. The high nutrient load of the Danube River has caused eutrophication in the Danube Delta lakes where macrophyte, molluscs, benthic and fish species have consequently been reduced. This is particularly damaging to the fish population and also to marine mammals. But above all these problems, it is lucky the region has more than 50 national parks and many more natural parks and reserves besides (*Figure 6* and *Table 4*).

Table 4. ***National and Natural Parks of South East European Countries***

Country	**National park** (year of foundation)		**Natural park** (year of foundation)	
Albania	Mali I Dajtit (1960, 1966) Thethi (1966) Lura (1966) Pisha e Divjakes (1966) Llogara (1966) Bredhi I Drenoves (1966) Lugina e Valbones (1996)	Mali I Tomorrit (1996, 1940) Bredhi I Hotoves (1996) Qafe Shtama (1996) Zall Gjocaj (1996) Parku I Prespes (1999) Butrint (2000)		
Bosnia and Herzegovina	Sutjeska (1965)	Kozara (1967)	Hutovo Blato (1995)	Blidinje (1995)
Bulgaria	Central Balkan (1991) Pirin (1969)	Rila (1992)	Persina Rilski Manastir Rusenski Lom Sinite Kamani Šumensko Plato	Strandža (1995) Vitoša Vračanski Balkan Zlatni Pjasaci Bulgarka
Croatia	Plitvice Lakes (1949) Paklenica (1949) Risnjak (1953) Mljet (1960) Kornati (1964)	Brijuni (1983) Krka (1985) Sjeverni Velebit (1999) Lastovo (2006)	Kopački rit Papuk Lonjsko polje Medvednica Žumberak–Samoborsko gorje	Učka Velebit Vransko lake Telašćica Biokovo
Macedonia	Pelister (1948) Mavrovo (1949)	Mount Galičica (1958) Jasen forest (1958)		
Montenegro	Durmitor (1952) Lovćen (1952)	Biogradska Gora (1952) Lake Skadar (1983)		
Romania	Danube Delta (1991) Călimani (1990) Ceahlău (1971) Retezat (1935) Rodna (1980) Cheile Bicazului–Hăşmaş (2000)	Cheile Nerei–Beuşniţa (1990) Cozia (2000) Domogled–Valea Cernei (1990) Măcin Mts. (2000) Piatra Craiului (1938) Semenic–Cheile Caraşului (2003)	Apuşeni Mts. (2001) Balta Mică a Brăilei (1998) Bucegi (1990) Grădiştea Muncelului–Cioclovina	Porţile de Fier (1973) Vânători Neamţ (1938) Putna–Vrancea Lunca Mureşului
Serbia	Djerdap (1972) Kopaonik (1981) Tara (1981)	Šar Mts. (1986) Fruška Gora (1960)	Gornje Podunavlje Grmija Ivlje Ozrenske livade Palić Ponjavica	Prugovo Rajac Resava Stara Planina Subotica forest Vršac Mts.
Slovenia	Triglav (1924)		Kozjansko regional park	Škocjan Caves regional park (1986)