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Iron Gates Natural Park

Monograph

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Iron Gates Natural Park is one of Romania's most spectacular and popular protected areas. The Danube and the low-elevation mountains sustained the development of an economy based on agriculture, navigation, fishing, mining, and logging. These activities transformed the landscape but maintained a high ecological diversity (APNPF 2020). Being a border region, economic activities were always low intensity, sometimes even ceased. For example, during the communist era, when Romania experienced accelerated industrialization, the Iron Gates region was marginally transformed, e.g., near the mining areas and harbors, maintaining the general characteristics of a rural area with an agricultural-based economy (Pătroescu and Rozylowicz 2000, Manea 2003, Niculae et al. 2014).

Tourists visiting Iron Gates Natural Park get in contact with forests and pastures, rarely interrupted by settlements scattered on the heights and valleys of the Locvei and Almăjului Mountains. The human-modified landscape is also present, such as the riverbed of the Danube, significantly changed by the construction of Iron Gates I Reservoir (Fig. 1, 2), the long lines of hotels and guest houses on the river shore, sterile deposits, and traces of the mining activities in Moldova Nouă, Cozla and Baia Nouă (APNPF 2013).

A trip to Iron Gates Natural Park is a multi-millennial history lesson, better understood if you start from the Iron Gates Region Museum in Drobeta Turnu-Severin and Iron Gates Natural Park Information Center in Orșova. Visiting these two information centers, we learn that many artifacts of the Upper Palaeolithic (11500 - 10500 B.C.) were discovered in this area, and several traces of Lepenski Vir - Schela Cladovei Mesolithic culture are still well preserved (APNPF 2013). The Dacians built only secondary fortifications in the Iron Gates;

Fig. 1 View of the Iron Gates Gorges before 1896. Between 1890 and 1896, several navigation channels were constructed in the cataracts area

Fig. 2 Iron Gates Gorges after the construction of Iron Gates I Reservoir. The photo was taken in 2018 (the current water level was met after 1972)

however, the Romans granted the region greater strategic importance. Thus, they have established extended military facilities, among which we mention the military road through the Danube gorges on the Serbian side, a strategic bridge (Traian Bridge), and a network of Roman castra (e.g., Drobeta, Dierna, Pontes, Lederata) (APNPF 2013). The emblematic sculpture of Decebalus (in Mraconia, between Eșelnița and Dubova) immortalizes the border status between Dacia and the Roman Empire. Following the Roman retreat from Dacia, it is the Byzantine Empire's turn to establish several fortifications (e.g., Tricule, Coronini). Later, the Iron Gates region was administrated by the First Bulgarian Tsardom and the Kingdom of Hungary, and the area became a military province with a defensive role. When the Ottoman Empire conquered Timișoara (1522), the Iron Gates area was incorporated into the Eyalet of Timișoara (*eyalet*, a primary administrative division of the Ottoman Empire), being the turn of ottomans to influence the region. From 1716, the Habsburg Empire controlled the area and became a military border region, again the Banat military border (until 1872) (APNPF 2013).

Iron Gates Natural Park hosted several significant events in modern Romanian history. When coming to Romania to access the throne of Romanian Principalities, Carol I traveled by train from Düsseldorf to Baziaș without disclosing his identity. He spent a night in the harbor hotel (its ruins are still visible today), met on the boat with Ion C. Brătianu (the prime minister of the United Principalities of Moldavia and Wallachia), and continued his travel to Turnu-Severin, where he disclosed his identity and was welcomed with honors. Also, Baziaș was the terminal station of the Baziaș–Oravița railway (built between 1847 and 1856), the first narrow-gauge railway of Romania (APNPF 2020).

Military history strongly influenced the ethnic structure of the local communities. Along with the settlements where Romanians and Serbians were dominant (for example, Svinița, Coronini, Măcești, Pojejena, Belobreșca, and Divici), new settlements were established for the Czech population arriving from Bohemia, called *pemi* by the local population. The Czechs arrived in three main migration waves (1823, 1827, and 1862), establishing the Banat Czech ethnic community, still present today in several villages such as Bigăr (Berzasca town), Ravensca (Şopotu Nou town), Gârnic (Gârnic town), Eibenthal (Dubova town) (Preda 2010).

Iron Gates Natural Park is a large outdoor geological museum with „exhibits” over 450 million years old (Popa 2003). The Danube River creates a transversal section of the tectonic units of the Southern Carpathians, from their metamorphic fundament to the most recent Neogene and Quaternary sediments. Here we will find Permian rhyolite lava domes (Trescovăț peak being the most spectacular one, near Svinița), cuestas from Svinița (Zeliște and Veligan ridges) and Cioaca Borii (Tricule), the Munteana-Dumbrăvița suspended fold, the spectacular valley of Sirinia, and palaeontological reservations at Svinița and Bahna. The Danube River looks like a slow-flowing river (Fig. 2), but before constructing the reservoir lock, it was studded with spectacular cataracts (Fig. 1) and small islands that disturbed navigation. Today, cataracts disappeared below the water, and upstream of the Iron Gates I dam, and we can only admire the islands Calinovăț and Moldova Veche (APNPF 2020).

Iron Gates Natural Park hosts a large biological diversity, being one of Romania's most important protected areas (Rozylowicz et al. 2019). The high species and ecosystems diversity are a consequence of the climate generated by the contact between the wet continental and Mediterranean climates, landform diversity and lithological substrate, and particularities of economic life (Manea 2003).

Within the Iron Gates Natural Park, we can admire thermophilic oak woods, beech and coniferous species forests, relict forests of Banat black pine trees, and spectacular grasslands maintained by manual mowing and low-intensity grazing. Vegetation varies mainly because of the frequent changes in lithological substrate. Thus, the park reunites large surfaces of limestone, silica rocks, or alluvial vegetation. In these areas, we can discover the Banat peony (*Paeonia officinalis* subsp. *banatica*), the greater pasque flower (*Pulsatilla grandis*), the endemic Danube feather grass (*Stipa danubialis*), or the famous Danube tulip (*Tulipa hungarica*, Fig. 3) (Matacă 2005, APNPF 2020).

Wildlife diversity is no less spectacular. The Danube River and the low-altitude mountains favor the presence of numerous habitats suitable for birds. On Danube River, we can identify species such as the red-crested pochard (*Netta rufina*), the ferruginous duck (*Aythya nyroca*), the black stork (*Ciconia nigra*), the white stork (*Ciconia ciconia*), the pygmy cormorant (*Phalacrocorax pygmeus*), and the little egret (*Egretta garzetta*). The forests and grasslands are populated by eagles (*Aquila* spp.), hawks (*Accipiter* spp.), the common buzzard (*Buteo*

Fig. 3 The Danube tulip (*Tulipa hungarica*). An emblematic species of the Iron Gates Natural Park present on the slopes of Iron Gates Gorges

buteo), the gray-headed woodpecker (*Picus canus*), the black woodpecker (*Dryocopus martius*) and the common kestrel (*Falco tinnunculus*). Many bat species are also present in Iron Gates Natural Park, including rare species for Romanian wildlife, such as the Blasius's horseshoe bat (*Rhinolophus blasii*) and the serotine bat (*Eptesicus serotinus*). Terrestrial and aquatic mammals are not missing either, such as the European ground squirrel (*Spermophilus citellus*), found in the grasslands from Gura Nerei, the Eurasian otter (*Lutra lutra*), present along the Danube River, the gray wolf (*Canis lupus*), and the Eurasian lynx (*Lynx lynx*). Brown bears (*Ursus arctos*) are also present in the protected area, for example, in the upper part of the Mraconia, Plavișevița, Tisovița, and Sirinia valleys (APNPF 2020).

In Iron Gates Natural Park, we have the privilege to observe two emblematic species of reptile: the Hermann's tortoise (*Testudo hermanni boettgeri,* Fig. 4) and the long-nosed viper (*Vipera ammodytes*) (Pătroescu 2004, Rozylowicz and Dobre 2010). Both species are vulnerable and require protection; people should observe animals in nature without chasing them away, hitting them, or capturing them. We often deal with situations where tourists collect tortoises from nature and take them home. They soon realize that tortoises are not

Fig. 4 Hermann's tortoise (*Testudo hermanni boettgeri*) after hatching. The species, emblematic for Iron Gates Natural Park, is present in Southwestern Romania and Southern Dobrogea. It does not survive the winter outside these areas

suitable pets and abandon them. If they are not returned to their habitat in time, tortoises will not survive the winter. Also, vipers must not be perceived as an enemy by humans. A viper's bite is fatal only if major health problems are present, similar to a bee's sting. In the last decades, vipers have caused no fatalities in Iron Gates Natural Park. If you meet long-nosed vipers on trails, please do not provoke them. For safety, wear suitable clothing: long pants, boots, and long socks. Be careful where you step and avoid touching bushes and places you cannot assess visually. Follow these simple rules and you will be safe.

We hope our invitation convinced you to visit Iron Gates Natural Park. Also, we hope your visit will be a relaxing stay surrounded by nature, helping you better understand the spectacular and complex history, geology, and biodiversity of the Southern Banat.

Iron Gates Natural Park. Administrative and legal aspects

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A protected area represents a territory with well-defined limits that aim to protect and maintain biological diversity, nature, and cultural resources (IUCN 2013). In Romania, protected areas are established through legal documents (laws, government decisions, ministries orders). Their management follows the national or European legal framework (Guvernul României 2007b).

Iron Gates Natural Park is a protected area of national importance established through Law no 5/2000 concerning the approval of the Plan for National Territory Planning, Section III Protected areas (APNPF 2020). The boundaries of this protected area are detailed in Government Decision no 230/2003 regarding the delimitation of the biosphere reserves, national and natural parks, and the establishment of their administrations, and Order 55/2003 of the Ministry of Agriculture, Forests, Water, and Environment regarding internal zonation of national and natural parks.

Iron Gates Natural Park covers approximately 128000 ha (Parlamentul României 2000, MAPAM 2003, MMDD 2008, Guvernul României 2007a, APNPF 2013, APNPF 2020).

In the International Union for Conservation of Nature (IUCN) classification, the status of a natural park corresponds to Category V Protected Landscape (IUCN 2013). According to the national classification, natural parks are protected areas designed to protect and conserve landscape structures where the interaction between human activities and nature over time resulted in a distinct area with significant landscape and/or cultural value, often with high biological diversity. The management of natural parks aims to maintain a balance between man and nature by protecting habitats and landscape diversity, promoting traditional use of land, and encouraging and developing traditional activities, practices and culture of the local population. In addition, it provides the public with leisure and tourism opportunities and encourages scientific and educational activities.

History of nature protection in Iron Gates Natural Park

Because of the exceptional biological diversity present in the region, the first initiatives regarding the declaration of protected areas in the area started in the 1950s. These past initiatives covered a smaller area due to restrictions prescribed by the communist regime. However, after 1965, several nature reserves were established, e.g., Cazanele Mici și Mari Reserve, Valea Mare Reserve (near Moldova Nouă), Gura Văii–Vârciorova Reserve, Fața Virului Nature Reserves, and Svinița and Bahna Fossil Points (Matacă 2005, Matacă 2000b).

Scientific works performed in the 1960s by the Iron Gates Research Group of the Romanian Academy before constructing the Iron Gates I dam in Gura Văii also resulted in the proposal to create a protected area overlapping the Iron Gates Gorges. This proposal aimed to create a German-style natural park, which would protect biodiversity and cultural heritage, and exploit the area's tourist potential (Necșuliu 2007, Pătroescu and Necșuliu 2008). Two versions of the limits of the protected area were submitted to authorities, both including part of actual national parks, Cheile Nerei – Beușnița and Domogled – Valea Cernei, and also the existing Geopark Platoul Mehedinți. Both alternatives had the Danube River as the southern border, with differences existing only for the northern limit (Manea, 2003).

The boundary of the first version started from Moldova Nouă and generally followed the heights delimiting the small rivers' watersheds tributaries of Danube, Nera, and Cerna rivers. This version excluded the wetlands between Gurile Nerei and Pojejena. The second proposal included only a 7-15 km strip north of the Danube riverbank, excluding all important tributaries and not including important areas such as Sirinia gorges and Gârnic and Bigăr villages. However, a regional legal protection regime was awarded later only to a smaller area (Iron Gates Gorges) when the Decision 18/1980 was adopted by Mehedinți County Council. The legal status was updated in 1990, guaranteeing the Iron Gates Gorges a local protection regime (Manea, 2003).

Another key step was achieved in 1998 when the Minister of Water, Forests, and Environmental Protection signed Order 84/1998, which foresaw the establishment of the Iron Gates Natural Park within the current boundaries. However, as a consequence of the resignation of the government, the order was not published in the Official Gazette of Romania, so no legal consequences were produced. Between 1993 and 2000, several public authorities and researchers supported the establishment of a large protected area named Iron Gates Natural Park, as it was in the short-lived Order 84/1998. The efforts were successful, and the parliament adopted Law no 5/6.03.2000, nominating Iron Gates Natural Park as a nature area of national importance. Law no 5/2000 is the "birth certificate" of Iron Gates Natural Park. Several meetings with representatives of the Djerdap National Park, established in 1974, also took place, with the intention of creating a transboundary protected area (Necșuliu, 2007), with no results until now.

Iron Gates Natural Park Administration was established in 2003 as a division of the National Forest Administration - R.N.P. Romsilva R.A. (first as a subunit of the Mehedinți Forestry Department and then as a division of the National Forest Administration Romsilva). Park administration was the subject of multiple discussions among the two counties, suggesting establishing the headquarter in Moldova Nouă or Orșova. Although the institutions of Caraș-Severin County played a more active role during the the establishment of the (mainly Caraș-Severin Environmental Protection Agency and the Caraș-Severin County Council), a decision was made for the park to go to the Mehedinți Forestry Department, as the Caraș-Severin Forestry Department already administrated three more parks (Necșuliu, 2007).

Protected areas that overlap the Iron Gates Natural Park

Due to its ecological and cultural importance, Iron Gates Natural Park is an umbrella protected area that includes between its borders other categories of protected areas: nature reserves, special protection areas (SPAs), sites of community importance (SCIs), wetlands of international importance (APNPF 2013, APNPF 2020).

Protected areas of national importance overlapping Iron Gates Natural Park

Iron Gates Natural Park includes 18 nature reserves, corresponding to IUCN Category IV - areas managed to protect certain species or habitats, protected areas managed especially for conservation (APNPF 2020). Nature reserves can

Tab. 1 Nature reserves overlapping Iron Gates Natural Park (APNPF 2020)

No.	Name of nature reserve	Surface (ha)	Category
1	Balta Nera - Dunăre	10	Complex
2	Baziaș	171	Complex
3	Insula Calinovăț	24	Wetland
4	Râpa cu lăstuni din valea Divici	5	Complex
5	Divici – Pojejena	498	Wetland
6	Valea Mare	1179	Complex
7	Peștera cu Apă din valea Polevii	3	Speleology
8	Ostrovul Moldova Veche	1627	Wetland
9	Locul fosilifer Svinița	95	Paleontology
10	Cazanele Mari și Cazanele Mici	215	Complex
11	Locul fosilifer Bahna	10	Paleontology
12	Dealul Duhovnei	50	Flora
13	Gura Văii - Vârciorova	305	Flora
14	Fața Virului	6	Flora
15	Cracul Crucii	2	Flora
16	Dealul Vărănic	350	Flora
17	Valea Oglănicului	150	Flora
18	Cracul Găioara	5	Flora

have specific characteristics such as botanical, zoological, forestry, geological, palaeontological, landscape, and speleological (Fig. 5, Tab. 1).

These nature reserves were designated in different years, the first being created after 1965, while the most recently was created in 2004 (Manea 2003, Matacă 2005, APNPF 2013, APNPF 2020). The procedures for their establishment were also different. Initially, nature reserves were established based on local initiatives (protected areas of county importance). For example, Valea Mare Nature Reserve was established through Caraș-Severin County Council Decision no 556/1973, reconfirmed by Decision no 499/1982. Similarly,

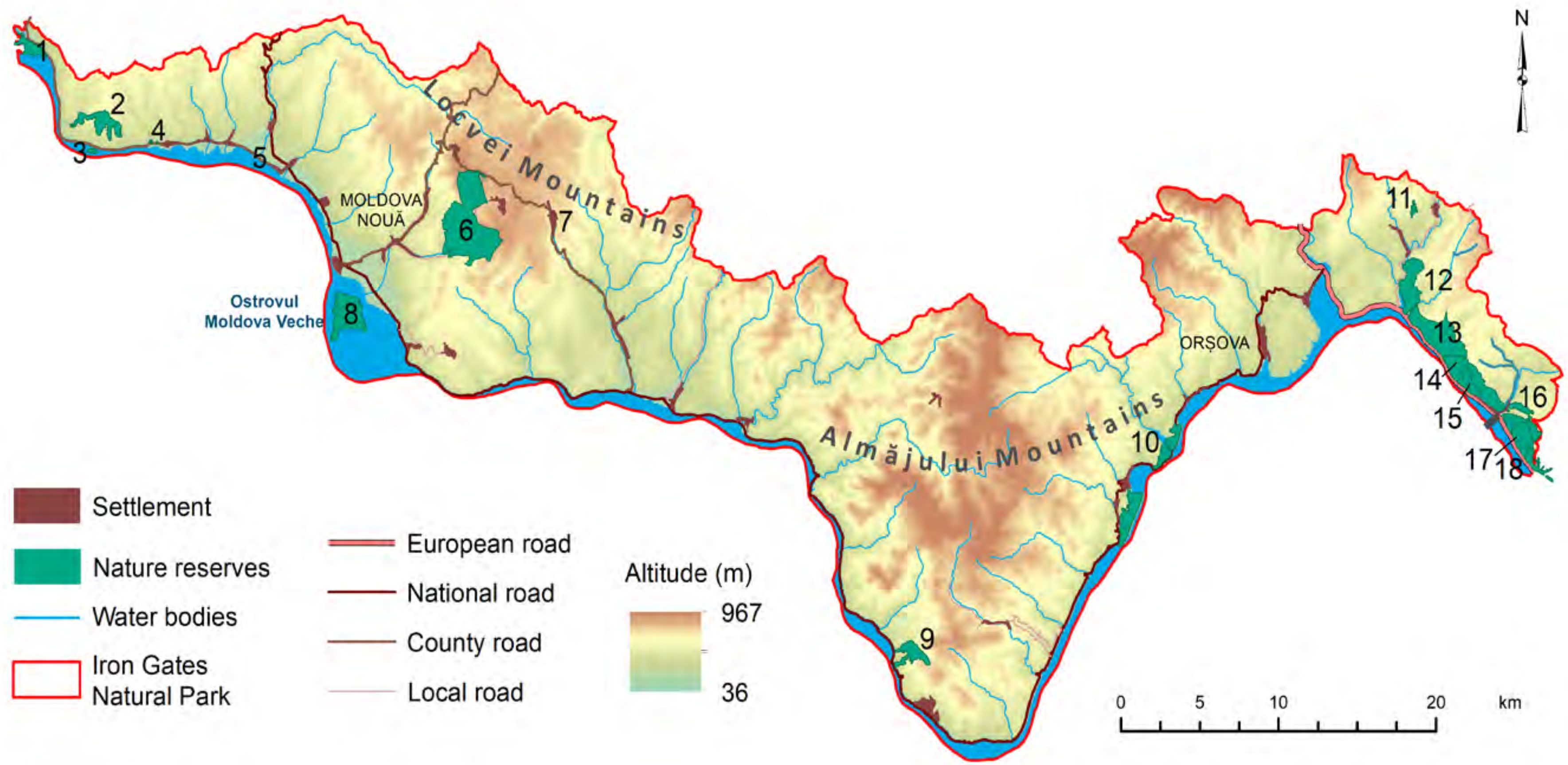

Fig. 5 Protected areas of national importance (nature reserves) that overlap Iron Gates Natural Park. Numbers represent the reserve ID according to Table 1

Decision 8/1994 of Caraș-Severin County Council foreseen the establishment of Râpa cu Lăstuni and Balta Nera-Dunăre nature reserves (Matacă 2005). Later, the local decisions were confirmed at the national level by Law no 5/2000 concerning the approval of the Plan for National Territory Planning, Section III - Protected areas. Furthermore, this law established several other new nature reserves, such as the Baziaș Nature Reserve. Finally, several protected areas of national importance were created through Government Decision no 2151/2004, for example, Moldova Veche and Calinovăț islands (APNPF 2013, APNPF 2020).

Protected areas included in the Natura 2000 network

Starting in 2007, Iron Gates Natural Park includes protected areas of European importance that are part of the Natura 2000 network. Natura 2000 is a European network of protected areas where management measures are applied for wildlife and natural habitats of Community (EU) interest (Manolache et al. 2017).

Natura 2000 network is managed according to the Habitats and Birds European Directives. These directives include lists of species and habitats of interest for the European Union and regulate how Natura 2000 sites are selected, designated, and protected. Species and habitats of community interest are protected through Sites of Community Importance (SCIs, for species and habitats protected through the Habitats Directive) and Special Protection Areas for bird species (SPA, for bird species included in the Birds Directive) (Manolache et al. 2017).

In Iron Gates Natural Park area, two Special Protection Areas for bird species - **ROSPA0026 Cursul Dunării-Baziaș-Porțile de Fier** and **ROSPA0080 Munții Almăjului-Locvei** - have been established through Government Decision no 1284/2007. They were designated to protect bird species included in the Birds Directive – Council Directive 2009/147/EC, respectively 13 bird species mentioned in Annex I for Cursul Dunării-Baziaș-Porțile de Fier and 21 bird species for Munții Almăjului-Locvei, plus several other species of migrating birds (MMAP 2021a, MMAP 2021b).

The Site of Community Importance (SCI) ROSCI0206 Porțile de Fier was created through the Ministry of Environment and Sustainable Development Order no 1964/2007. It aimed to protect 29 habitats of Community importance and a high number of species (other than birds) included in the annexes of Habitats Directive 92/43/CEE (15 species of mammals, 4 amphibian and reptile species, 13 fish species, 17 species of invertebrates, 13 species of plants) (MMAP 2021c).

International recognition

Since 2009, Iron Gates Natural Park has international recognition, being declared a **wetland of international importance (Ramar site)**, with a total surface of 115566 ha (APNPF 2020).

Ramsar sites are established by the Secretariat of The Ramsar Convention on Wetlands of International Importance, which is part of UNESCO (United Nations Educational, Scientific, and Cultural Organization). Declaring a wetland as a Ramsar site is a recognition of the natural and economic value of the area, especially as a habitat for aquatic birds. Ramsar sites can include ponds, swamps, natural or artificial water bodies, permanent or temporary, stagnant or flowing, freshwater or salt water.

Romania joined the Ramsar Convention in 1991. To date, the Ramsar Convention secretariat has recognized 20 sites in Romania as of international importance. These areas have a total surface of 1175881 ha, representing about 5% of the country's surface (https://www.ramsar.org/wetland/romania).

Iron Gates Natural Park Administration

The Iron Gates Natural Park administration is the responsibility of the National Forest Administration (R.N.P. Romsilva R.A.), based on the management contract signed with environmental authorities. Aministration is performed through a specially created structure, **R.N.P. Romsilva Iron Gates Natural Park Administration R.A.** (Fig. 6) (APNPF 2020).

Iron Gates Natural Park Administration headquarter is in Orșova municipality, Mehedinți County. The National Forest Administration Romsilva provides the financial resources required for implementing the Protected Area Management Plan, supplemented with income generated by providing services to third parties (e.g., issuing permits for various activities, fees for tourism).

Iron Gates Natural Park Administration staff includes rangers for field activities, education, biology, IT, financial, and legal experts. The structure is coordinated by a director, assisted by a Directory Committee, including some of the staff mentioned above.

Fig. 6 Iron Gates Natural Park, managed by RNP Romsilva Iron Gates Natural Park Administration RA, is a wetland of international importance (Ramsar site) and a protected area of European importance (part of the Natura 2000 network)

Following the Government Emergency Order (OUG) no 57/2007, Article 19, Line 4, Iron Gates Natural Park Administration is coordinated by a Scientific Council, with the role of scientific authority on the protected area territory. The scientific council is appointed by the Ministry of Environment, Water and Forests and includes renowned in the fields of Geography, Geology, Sociology, Forestry, Biology, and also representatives of Iron Gates Natural Park.

The other body supporting the Iron Gates Natural Park Administration is the Consultative Council, appointed by Government Emergency Order no 57/2007, Article 19, Line 2. The council structure is appointed in the Ministry of Environment order no 45/2013 regarding the approval of the structure and organization and functioning regulations. It includes representatives of institutions, economic organizations, NGOs, public authorities, and local communities, owning or administrating lands, goods, or have interests in the area or the close vicinity of the protected area or are involved or interested in implementing measures for protection, conservation or sustainable development of the area. According to the law, the experts participating in the two councils that support the Iron Gates

Natural Park Administration act in the public interest, not the institutions they represent.

Iron Gates Natural Park was divided into **functional areas** for efficient management and to support biodiversity conservation and the local economy. Internal zonation is included in Order no. 552/2003 of the Ministry of Agriculture, Forests, Water, and Environment, Government Decision no 2151/2004, Law no 345/2006, OUG 57/2007, and Iron Gates Natural Park Management Plan. The following functional areas have been established in Iron Gates Natural Park (Fig. 7, Guvernul României 2007b, Guvernul României 2003):

a) strictly protected areas, which can host scientific and educational activities, ecotourism (which do not involve constructions), mowing, pasture, ecological restoration activities, etc.

b) sustainable management areas, transitory among strictly protected areas, and sustainable development ones. Within these areas, low-impact activities can be performed, such as fishing, crop cultivation, and forestry works.

c) sustainable development areas, where development activities are allowed if they comply with the principles of sustainable use of natural resources and preventing any negative effects on biodiversity.

The internal zonation and the explicit rules to be enforced in each area are described in the Iron Gates Natural Park Management Plan (APNPF 2013, APNPF 2020).

In 2021, according to the Management Plan, the park includes 54 strictly protected areas (APNPF 2020), as follows: special conservation areas, created by the Ministry of Agriculture, Forests, Water and Environment Order no 552/2003, special protection areas for bird species Ostrov Moldova Veche wetland, Calinovăț Island wetland and Divici – Pojejena, established through Government Decision no 2151/2004, nature reserve Peștera cu apă from Poleva valley, created through Government Decision no 2151/2004, nature reserves established through Law no 5/2000 (Balta Nera-Dunăre, Valea Mare, Baziaș, Gura Văii-Vârciorova, Valea Oglănicului, Dealul Duhovnei, Dealul Vărănic, Cazanele Mari și Cazanele Mici, Locul fosilifer Svinița, Locul fosilifer Bahna, Cracul Găioara, Cracul Crucii, Fața Virului), ruins of the Tricule medieval fortress, natural amphitheatre NW of Svinița, Glaucina geological structure, Trescovăț rhyolitic lava dome, Zamonița cave, Babacaia rock, ruins of Ladislau

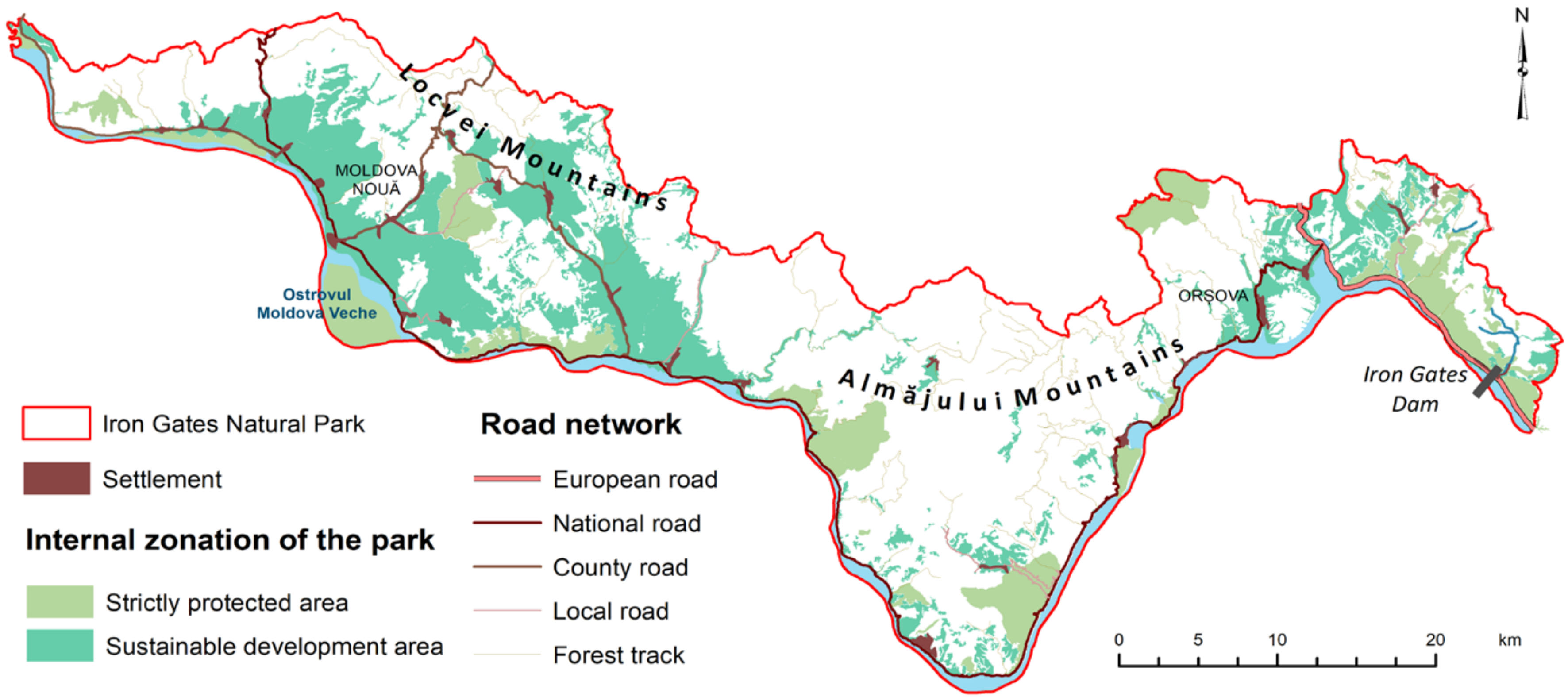

Fig. 7 Internal zonation of Iron Gates Natural Park. The areas designed for sustainable management are represented in white on the map (APNPF 2020)

fortress, Chindiei cave, natural limestone bridge from Ceuca valley in Sfânta Elena and Gaura cu Muscă cave. The surface of these strictly protected areas is approximately 12371 ha, representing 9.7% of the surface of the Iron Gates Natural Park.

In the field, the boundaries of strictly protected areas can be recognized after the waymarks illustrating a 10 cm-blue square framed by a 5 cm-white line (those established through Order no 552/2003, geological structures and historical monuments) or a 10 cm-yellow square, framed by a 5 cm-white line (natural reserves).

More than 86000 ha are under a sustainable management regime, representing 67% of the park's total surface, most surrounding the strictly protected areas and acting as a buffer for the human impact. Localities were included in sustainable development areas. These represent about 29600 ha, approximately 23% of the park's total surface.

The Geography of Iron Gates Natural Park

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Iron Gates Natural Park overlaps over the southern part of the Locvei Mountains (from Nera valley near Socol to the Camenița valley near Sichevița), and the Almăjului Mountains (from the Camenița valley to the Cerna Valley near Orșova), the western part of the Mehedinţi Mountains (west of the Cerna valley to Bahna), and a small area of Mehedinți Plateau (from the Cerna valley to Breznița-Ocol). Elevation varies between 40 m (downstream of Iron Gates I dam) and 968 m (Teiul Moșului peak, Almăjului Mountains, Eșelnița watershed) (Fig. 8, APNPF 2013).

The Danube River between Baziaș and Iron Gates, the backbone of Iron Gates Natural Park, creates complex structures with narrow sectors and depressions. This area, 134 km long, is known as the Iron Gates Gorges or simply Iron Gates (Iancu 1976, Iancu and Glăvan 1976, Velcea and Ilie 1976, Coteț 1982). Locally, the Iron Gates Gorges are also known as "Clisura Dunării" (from Coronini to Eșelnița), Gherdap or Đerdap.

From west to east, the Danube River stretch across several narrow sections and wider depression-like areas (Iancu 1976, Iancu and Glăvan 1976, Iancu and Popovici 1976, Posea et al. 1976, Pătroescu 2004):

- Nera valley – Ribiș valley river section (about 4 km long);

- Moldova Nouă Depression, on about 30 km (a sector where the Danube River has the largest width on park territory);

- Coronini – Alibeg river section (a limestone area of 6 km long);

- Liubcova (a wide area of the Iron Gates Gorges);

- The narrow section Berzasca – Greben, with steep slopes on both sides of the Danube River, spanning about 18 km;

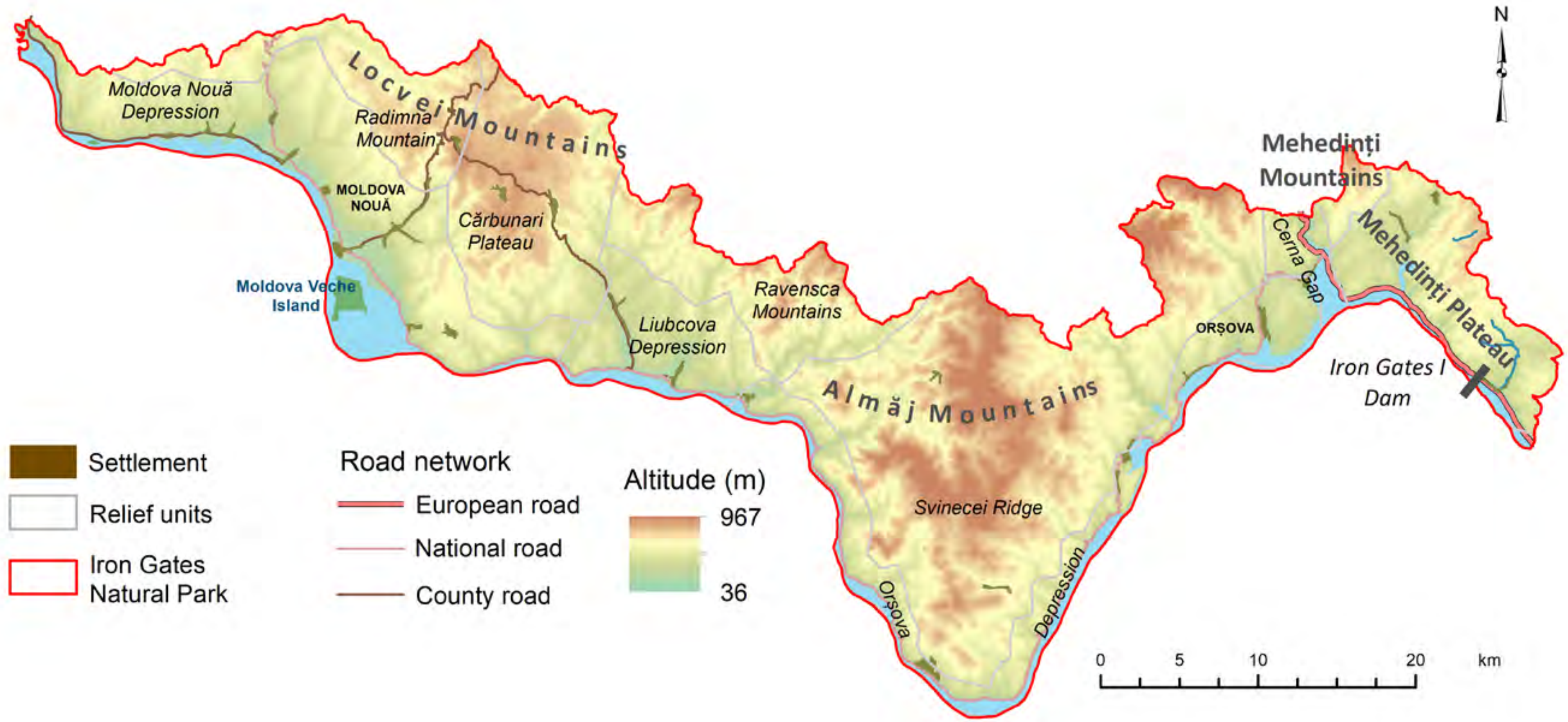

Fig. 8 Landforms overlapping Iron Gates Natural Park (after Posea and Badea 1984)

Fig. 9 Iron Gates Gorges – Cazanele Mici and Cazanele Mari of the Danube River

- Greben – Plavișevița river section (a wider valley of 25 km length);
- Cazanele Mari (a gorge-like section of about 3.5 km);
- Dubova and Cazanele Mici depression (5.5 km long, Fig. 9);
- Ogradena – Orșova depression;
- Vârciorova – Gura Văii, a narrow section of 9 km length, where the Iron Gates I dam was built.

Except for Cerna, the Danube's tributaries within the Iron Gates Natural Park are small rivers and streams. Thus, theirs influence on the Danube's flow is minimal, and some rivers and streams are dry during summer (ABAB 2015).

The Nera River between Socol and the confluence with Danube River represents the park's western border. Also, Nera forms the state border with Serbia. Other significant rivers are Ribiș (located between Baziaș and Divici), Belobreșca, Radimna (a 24 km long river that follows DN57 between Radimna and the northern limit of the park, towards Oravița city), Boșneag (12 km long, crosses Moldova Nouă and Moldova Veche), Liborajdea, Camenița (passes through Sichevița town), Orevița (crosses Liubcova town), Berzasca (passes

Fig. 10 Calinovăț island near Divici village, Pojejena town

through the town of Berzasca, it has a length of 46 km), Sirinia (following the road to Bigăr town), Mraconia (a river with a 19 km length, its confluence with the Danube River is near Decebalus statue), Mala, Eșelnița (a 26 km long river), Cerna (Danube's largest tributary from the area, with an average multiannual flow exceeding 22 m^3/s), Bahna and Jidoștița. At the confluence with Danube River, Cerna forms a baylike section (Orșova Bay), which emerged after Iron Gates dam construction because of a significant rise in water level (Iancu 1976, Iancu and Glăvan 1976, Iancu and Popovici 1976, Zaharia 2008, Zaharia 2010, APNPF 2013).

Three small islands still exist in the Iron Gates Natural Park, in the Romanian sector of the Danube River, after the construction of the Iron Gates dam: Calinovăț (Fig. 10), Moldova Veche, and Banului (Golu) islands (Osaci-Costache and Armaș 2016). Calinovăț island is located near the town of Divici, 8 km downstream of the Danube River entering Romania. It is an expanding island with a surface of approximately 12 ha. It hosts wetland vegetation with both native species (white willow) and invasive species (false indigo-bush, bitter willow) (APNPF 2013). Moldova Veche Island is located near the city of Moldova Nouă and has a surface of over 340 ha. It is divided into two main sections:

high soil humidity (south) and a more arid one with weedy grasslands (north). The northern part of Moldova Veche Island overlaps the former tailing ponds for the sterile resulted from nearby mining. The tailing ponds became small lakes used by aquatic birds. The luxuriant vegetation developed around these ponds, including willow and false indigo, is used by birds for nesting (APNPF 2013). In the 2000s, several horses were abandoned on this island and became feral. Although feral horses attract tourists, overpopulation increases water pollution (nitrate) and fish mortality, degrades soil, and destroys vegetation. Golu Island (Banului Island) is located downstream of Iron Gates I dam. It is an island strongly influenced by the dam operation. It has 4 ha in surface and arborescent vegetation, mainly willow.

Because of the high frequency of Mediterranean and tropical air masses, the the climate of the Danube valley is continental with Mediterranean influences. The climate is characterized by mild and moist winters (Vulcănescu 1972, Rey et al. 2007, Ciocănea et al. 2014, APNPF 2013). The average multiannual temperature is 11.2 °C in Moldova Veche and 11.6 °C in Drobeta-Turnu Severin. The lowest average temperature in the Danube corridor is recorded in January (-1°C), while the highest is in July and August (about 22 °C). The maximum values have been around 43 °C (Orșova, Svinița, Drobeta-Turnu Severin). The Iron Gates area has 115 days of summer, 40-50 tropical days (temperatures over 30 °C), and approximately 75 days of frost annually. Frost may appear from the last decade of September up to the first part of April (APNPF 2013). The area receives about 700 mm of rainfall per year, with higher values, up to 1000 mm, in the high mountainous area. During winter, the amount of precipitation is slightly lower. The highest amount of rainfall is recorded in June. Rarely, the amount of rainfall is very high, as in Eșelnița, in September 2014, when 200 mm fell in 24 hours (Grecu et al. 2015). Snow is rare in this region, with less than 20 days recorded in a year and only 30 to 40 days with snow layers. (Manea 2003).

In high elevation areas, dominant winds blow from southern (20%), northern (17%) and north-western (16%) directions. Nearby the Danube River, the winds blow to the west (23%) and east (25%). Locally, mountain breezes appear (during the day, blowing from lower regions to higher ones, and the opposite during the night). Other winds are valley breezes (because of the temperature differences between river water and dryland), Coşava (cold wind blowing with more than 20 m/s in the SE-NW direction, causing a significant drop in temperature) and Gorneacul. The last wind is specific to the Moldova Nouă depression and blows NE-SW, with a maximum speed that might exceed 100 km/h (Vulcănescu 1972, Rey et al. 2007, Ciocănea et al. 2014, APNPF 2013).

To avoid flooding of the areas located upstream of Iron Gates dam and the safe operation of the dam, the maximum level of the Danube River is controlled according to the stipulations of the Convention between the Romanian and Serbian governments regarding the operation and maintenance of the hydroenergetic and navigation systems Iron Gates I and Iron Gates II (Bondar 2008, Crețan et al. 2017). The water level in the Iron Gates I Reservoir is inversely proportional to the flow rate of the Danube River when it enters Romania. If the flow rate at the confluence with Nera has high and very high values, a larger amount of water will overflow through the Iron Gates I dam spillways as a precaution to lower the level of Danube River and to avoid exceeding the 70.90 m compared with to the Adriatic Sea (mdMA) near the dam, even with the risk of flooding the areas downstream of the hydroelectric powerplant. The average annual flow rate of Danube River is 5480 m^3/s at Baziaș and 5570 m^3/s at Orșova. The dam is operated safely even for very high flow, as in April 2006, when the historical maximum maximum flow rate of Danube River was recorded in Baziaș, a value of over 15800 m^3/s. When Danube River has very low rates, the water level in the reservoir increases to a maximum; thus, water level fluctuations of up to 7 m may appear in front of the dam. The fluctuations are reduced in Baziaș, less than 0.5 m. The lowest flow rate at Baziaș was 1040 m^3/s in October and November 1949 (Bondar 2008, Zaharia 2010, Zaharia et al. 2011).

Because of the flooding of the former meadow, Danube River usually exhibits low depths a few meters from the riverbank (the former meadow) and suddenly goes deep. The depth of Danube is about 58 m in Baziaș (km 1072 on the Danube), 57 m in Moldova Veche (km 1048), 37 m in Coronini (km 1040), 58 m in Drencova (km 1016), 61 m in Svinița (km 995), 36 m in Tekija (km 956, prior to entering Cerna bay), 45 m in Orșova (km 957, after leaving the Cerna bay), and 37 m at Iron Gates I (km 943). Downstream of the dam, in Drobeta-Turnu Severin (km 931), Danube is about 31 m deep. At Cazane (Iron Gates Gorges),

Fig. 11 Iron Gates I Dam, located at km 943 of Danube River. Its construction changed the flowing regime of Danube upstream, from river to lake-like (reservoir). This lake-like regime is evident up to Belgrade (Serbia)

Danube is about 53 m deep (Rădulescu and Ilie 1976, Trufaș and Simion 1982, Bondar 2008, APNPF 2013, ABAB 2015).

Iron Gates I Reservoir was constructed between 1964 and 1972 by damming the Danube River between Vârciorova and Sip (km 943 on Danube) with a dam 60 m high and 1278 m long (Fig. 11). The dam includes two powerplants with six hydraulic aggregates with Kaplan turbines each, which can produce 5.24 TWh for the Romanian side (approximately 10% of the energy produced in Romania in 2019) and 5.65 TWh annually for the Serbian side. The water is released through an overflow dam with 14 overflow channels (7 in Romania, 7 in Serbia). The shipping is ensured through two sluices and locks of 310 m × 34 m (Bondar 2008, Zaharia 2010).

The lake-like regime is present up to over 227 km upstream of the dam, the "official limit" of the Iron Gates I Reservoir being at km 1169+300 m, in Belgrade. At very low levels of the river flow, the water level in the reservoir increases, and the influence of water retention manifests up to Novi Sad, km 1255+100 m. After dam construction, the water level increased with 30 m in Vârciorova, with

Fig. 12 Winter events on Danube River in Coronini (Babacaia Rock)

over 20 m in Orșova and with approximately 5 cm in Baziaș (Trufaș and Simion 1982, Bondar 2008, Zaharia 2010, ABAB 2015).

The milder climate and lake-like regime make make water freezing episodes in the Danube River water extremely rare. In the past, in the fast-flow sections (such as the Coronini area, Fig. 12, where Danube River exits the Moldova Nouă depression and enters the gorges sector), ice blocks piles were formed and determined an increase in the water level (Trufaș and Bagrinovschi 1984, APNPF 2013, ABAB 2015). The phenomenon of ice bridges was observed on few occasions, especially when Danube River exhibits a larger width and slow flow, such as in Dubova, Eşelnița and Orșova. More frequent are ice shove and ice jam events.

Introduction to the Geology of Iron Gates Natural Park

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Iron Gates Natural Park is one of the European regions recording a high geodiversity. This is not by chance, it results from long geotectonical, biological, and climate evolution with roots in the deep time, counting over 450 million years. Geologists define geodiversity as the diversity of minerals, rocks, fossils, geological structures, and processes in a region. The high geodiversity of mountain ranges also implies high biodiversity for montane ecosystems. Geodiversity results from tectonic plate movements, such movements being divergent, resulting in the opening of oceans, and convergent, forming mountain chains (i.e., ranges).

Within Iron Gates Natural Park, the Danube River crosses transversally the Carpathian chain outcropping all tectonic units (Fig. 13), from their metamorphic basement, passing to the Palaeozoic and Mesozoic sedimentary covers, and up to the youngest, Neogene and Quaternary sediments. The Geology of the Danube river banks, Locvei and Almăj Mountains, the Iron Gates Gorges, and the Djerdap Mountains represents the backbone of the regional biotopes, also reflected by the high biodiversity mirroring such a remarkable geodiversity.

The Danube valley is a true geological and biological museum, unique in Europe through its geodiversity and biodiversity. The uniqueness and the significance of the Iron Gates Natural Park are clearly underlined, with minerals, rocks, fossils, fauna and flora, most often endemic, worthy of a proper national park or a Biosphere reserve.

The modern history of geological research related to the South Carpathians, including the Danube valley, is marked by the discovery of the Getic Nappe by Gheorghe Munteanu-Murgoci (1905). The Supragetic Nappe was discovered in 1934 by Albert Streckeisen, while in 1940, the first geological synthesis of the South Carpathians was published by Alexandru Codarcea,

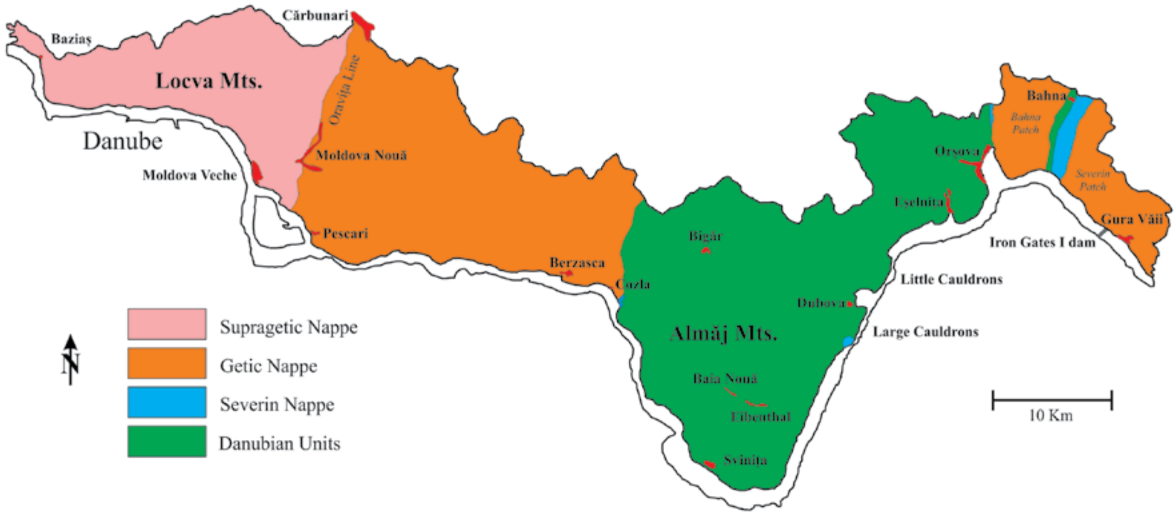

Fig. 13 Tectonic sketch of Iron Gates Natural Park. Tectonic units (Supragetic, Getic, Severin Nappes, and the Danubian Units) are illustrated without their post-tectonic (Mio-Pliocene) sedimentary fillings. The colors are correlated with those in Fig. 14, and 15

including the term Danubian Autochthonous as a tectonic unit (Codarcea 1940). Grigore Răileanu contributed with the first geological monography of the Almăj Mountains, followed by a French abstract including a detailed geological map next to essential geological sections of the Almăj Mountains (Răileanu 1953, 1960). Later syntheses followed, such as those of Codarcea et al. (1961) and Năstăseanu et al. (1981), with the occasion of the Carpathian-Balkan congresses. In 1973, the first synthesis of Romanian Carpathians was published based on Plate tectonics concepts, with precise references to the structure of the South Carpathians (Rădulescu and Săndulescu 1973). Berza and Drăgănescu (1988) and Berza et al. (1984 a, b) contributed fundamentally to understanding the Danubian Units. Pop et al. (1997) contributed with a field guide of the Iron Gates Gorges. Grigore Răileanu, Sergiu Năstăseanu (Năstăseanu et al. 1988), Grigore Pop, Ion Stănoiu, Emil Avram (Avram 1995), Ioan Bucur (Bucur 1997), Cornelia Bițoianu contributed substantially to the understanding of the stratigraphy of sedimentary formations belonging to the Reșița and Sirinia basins, while the Supragetic, Getic and Danubian igneous basements were detailed by Tudor Berza, Viorica Iancu (Iancu et al. 1988), Antoneta Seghedi, Marin Șeclăman, Oscar Maier, Iosif Bercia, Marcel Mărunțiu and Mihai Conovici, including here the ophiolitic complex of the Tișovița serpentinites and of the Iuți gabbro, pieces of a disappeared Palaeozoic ocean. The banatitic magmatism was detailed by Alexandru Codarcea, Ioana Gheorghiță, Marian Șeclăman, Tudor Berza, Emil Constantinescu and Doina Russo-Săndulescu, while the Permian volcanism was studied by Grigore Pop, Nicolae Stan, Ioan Seghedi (Seghedi 2011) and Mihai Tatu. Significant contributions to the understanding of the coal bearing Carboniferous and Jurassic formations from Almăj Mountains were brought by Ion Mateescu, Dumitru Anescu, Traian Balabaș, Vasile Ștreangă, Iustinian Petrescu, Zeno Oarcea, while the Carboniferous and Jurassic floras of the region were studied by Alexandru Semaka, Răzvan Givulescu, Cornelia Bițoianu, Ion Maxim, Emanuel Antonescu, Ion Preda and Mihai Emilian Popa. The first palaeontological synthesis regarding to the Middle Jurassic ammonite fauna from Svinița (Saraorschi creek) was published by Johann Kudernatsch, revealing to the world the diversity and the significance of the Svinița fauna (Kudernatsch 1852). Palaeozoological studies were published especially by Emil Tietze, Grigore Răileanu, Magdalena Iordan, Elisabeta Popa, Emil Avram, Florian Marinescu and Ioana Pană. A first geological correlation between Romania and Serbia was published by Sergiu Năstăseanu and Borislav Maksimovici (Năstăseanu and Maksimovici 1983).

The Carpathian chain is an Alpine orogen that started its genesis in the middle Cretaceous when the first significant tectonic movements influenced the rise of the Romanian Carpathians. In the South Carpathians, the beginning Alpine paroxysmal tectonic phase was Austrian (Mesocretaceous), followed by the Laramian Alpine phases from the Late Cretaceous and continuing through the Tertiary. The South Carpathians include and remobilize tectonically also older formations, Palaeozoic in age, formed especially after certain Palaeozoic paroxysmal phases, pre-Alpine, called Hercynian or Variscan.

A tectonic paroxysmal phase is a collision between two tectonic (lithospheric) plates, especially continental ones. Such a collision induces the tectonic disappearance (subduction) of an oceanic plate (slab) occurring between them, with the folding and the rising of oceanic and marine sediments caught in between through this collision. The disappearance of the slab implies its sinking below the obducted plate (the plate above the subduction plane), within the upper part of the terrestrial mantle called the asthenosphere. Such a tectonic collisional process is described as collisional tectonics, as opposed to extensional tectonics, which implies the opening and expansion of a new ocean, forming a new oceanic plate between two adjacent continental plates. Both kinds

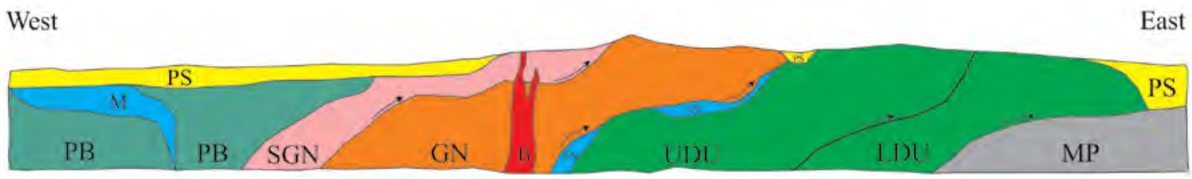

Fig. 14 Simplified West-East section through the South Carpathians, with their defining tectonic units (Supragetic, Getic, Severin Nappes, and the Danubian Units). PB: Pannonian basement; M: Mureș ophiolites; PS: post-tectonic sediments; SGN: Supragetic Nappe; GN: Getic Nappe; SN: Severin Nappe; UDU: Upper Danubian Units; LDU: Lower Danubian Units; MP: Moesian Platform; B: Banatites. Simplified and modified after Iancu et al. (1998). Colors are correlated with those in Fig. 13, and 15

of collisional and extensional tectonics have their own volcanic signature, and both are recorded in the Danube valley in various states during geological time and in its various tectonic units. This tectonic evolution marked by collisional or extensional tectonics affected palaeoecosystems and palaeoclimate, and therefore it represents the key to the remarkable geodiversity of the South Carpathians in general and of the Danube valley in particular.

The tectonic structure of the South Carpathians is complex, marked by stacked, large rock bodies called nappes (Figs. 14, 15). These nappes were stacked during Alpine paroxysmal phases, and they represent well defined tectonic units with their own evolution, corresponding to continental or oceanic microplates (Fig. 15). This stack of nappes representing the structure of the South Carpathians is perfectly revealed along the Danube valley, the Iron Gates Gorges becoming exceptional from a geological perspective: tectonic, petrographic, palaeontologic and stratigraphic.

Erosion occurred simultaneously and after the uplift of the South Carpathians during the Alpine orogenesis, producing and accumulating continental and shallow marine sediments, many yielding significant mineral resources. Such sediments are known as molassic; they are deposited through erosion, evaporation, or biogenic processes, especially post-tectonic, after paroxysmal phases. To get things even more complicated, the South Carpathians also yield Hercynian molasse formations (Variscan, late Palaeozoic in age), remobilized during the Alpin tectonic cycle, well represented in the Iron Gates Gorges. During the geotectonic evolution of the Alpine chain also occurred extensional episodes, fragmenting continental plates and opening new oceans. Such oceanic realms, such as the Severin Ocean, were later subducted, caught, and sunk in the upper mantle, between neighboring Getic

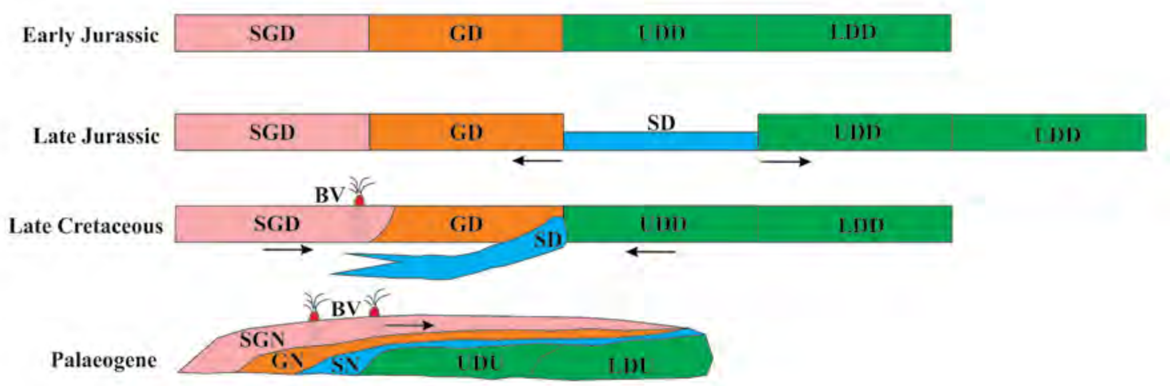

Fig. 15 Tectonic evolution of the South Carpathians, with four time intervals arranged in chronological order: 1. Early Jurassic; 2. Late Jurassic; 3. Late Cretaceous – Palaeogene; 4. Palaeogene – Neogene. SGD: Supragetic domain; GD: Getic Domain; SD: Severin Domain (oceanic plate); UDD: Upper Danubian domain; LDD: Lower Danubian domain; SGN: Supragetic Nappe; GN. Getic Nappe; SN. Severin Nappe; 4. UDU: Upper Danubian Units; 5. LDU: Lower Danubian Units; BV: Banatite volcanism. Reinterpreted and modified after Mutihac (1990)

and Danubian continental plates, after the deposition of sintectonic formations known as turbidites or flysch. Both subduction and ocean floor spreading generated typical volcanic processes, also recorded in the South Carpathians.

The Hercynian and Alpine tectonics, perpetual volcanism, the alternation between continental and marine sedimentation, and paleoclimate and palaeoecological variations influenced the geotectonic architecture of today's Danube valley, a such architecture having a highly complex and sometimes enigmatic geometry. The same tectonic unrest and its associated processes induced significant and diverse mineral resources, from coal and copper ore to building materials and mineral water (Fig. 16). The geology of Banat and that of Locva and Almăj mountains meant structuring the regional human social fabric throughout its history, deeply influencing the distribution of human settlements, economy, political and military history. Evidently, geology controls and influences relief, hydrogeology, biotic fabric (flora, fauna, and humans), and local climate as fundamental factors worldwide.

The nappes included in the structure of the South Carpathians were overthrusted (stacked) from the West towards East during the Alpine orogenesis, especially during the Austrian (Mesocretaceous) and Laramian phases. The collisional movement between these tectonic units took place through a gigantic lateral push (Fig. 15). The nappes of the South Carpathians, also outcropped along the Danube valley, are the following from West to East

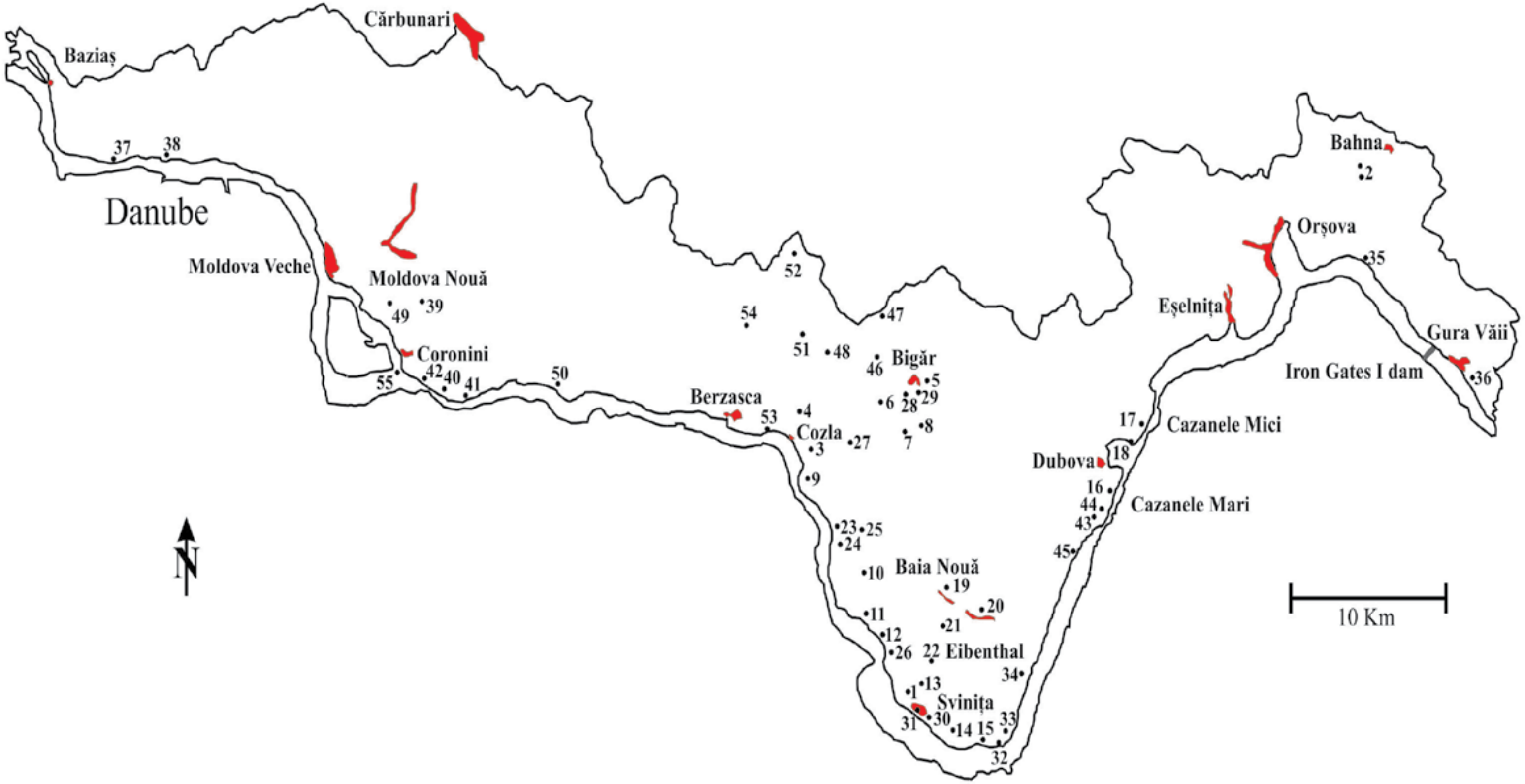

Fig. 16 Significant geological sites in the Danube valley, modified and updated after Popa (2003). 1. Saraorschi (Svinița) SSSI; 2. Bahna SSSI; 3. Cozla Mine; 4. Camenița Pit; 5. Palașca mines (Bigăr, two galleries); 6. Buschmann Mine; 7. Stanca Mine; 8. Pietrele Albe Mine; 9. Munteana-Dumbrăvița profile and suspended fold; 10. Trescovăț Peak; 11. Stariștea valley; 12. Romanian Greben; 13. Zeliște and Veligan peaks; 14. Tricule cuesta; 15. Selschi creek; 16. Large Cauldrons (Cazanele Mari); 17. Small Cauldrons (Cazanale Mici); 18. Small Cauldrons Urgonian outcrops; 19. Baia Nouă (Nove Doly) Mine; 20. Eibenthal; 21. Cucuiova; 22. Povalina; 23. Outcrops between Ielișova and Stariștea valleys; 24. Ielișova valley; 25. Ielișova Mine; 26. Povalina valley; 27. Sirinia valley; 28. Bigăr Formation outcrops; 29. Sirinca valley; 30. Outcrops between Boștița Mare valley and Svinița; 31. Svinița; 32. Outcrops between Iuți and Selschi valleys; 33. Iuți valley; 34. Tișovița valley; 35. Vârciorova; 36. Outcrops between Gura Văii and Schela Cladovei; 37. Outcrops between Baziaș and Belobreșca; 38. Divici valley; 39. Vărănic Quarry; 40. Coronini 1 Quarry; 41. Coronini Two Quarry; 42. Gaura cu Muscă cave; 43. Gura Ponicovei cave; 44. Veterani cave; 45. Grăniceri bridge; 46. Dragosela valley; 47. Zamonița cave; 48. Dragosela valley; 49. Moldova Nouă Quarry; 50. Sichevița valley; 51. Tulinibreg; 52. Ielova valley; 53. Drencova; 54. Berzasca valley, outcrops between Debelilug and Berzasca; 55. Babacaia

Fig. 17 Simplified morphological sketch of the Danube valley, with significant tectonic bodies, modified after Codarcea et al. (1961) and Mutihac (1990)

(Fig. 13, 14): Supragetic Nappe, Getic Nappe, Severin Unit and the Danubian Units (separated at their turn into the Upper and Lower Danubian Units), with the Supragetic and Getic units having the uppermost position, Severin Units having an intermediary position, and the Danubian Units having the lowermost (autochthonous) position. Each unit represents tectonic microplates, the Supragetic, Getic, and Danubian units, along the sedimentary cover and metamorphic basement, while the Severin unit represents only a cover nappe, lacking a metamorphic basement. The kinematics of these microplates, their collisional or extensional stands, rotation, collision, or overthrusting finally sealed the tectonic architecture and geodiversity of the South Carpathians (Fig. 16, 17). While the erosion continued even during the Carpathian uplift, post-tectonic, molasse basins were formed along the Danube valley the Sicheviţa, Dubova, Cerna (Orşova), and Bahna Neogene basins continued northwards by larger basins, such as Mehadia, Lugoj, Caransebeş, and Bozovici. Westwards, the Tertiary history recorded the Pannonian Basin as a part of the Western Tethys, and eastwards, the Getic (Dacian) Basin as a part of the Paratethys Tethyan realms, becoming separated by the Carpathian chain. The Western Tethys and the Paratethys communicated sporadically through these basins. The southern Palaeo-Mesozoic basins of the South Carpathians crossed by the Danube valley are Reşiţa Basin (Reşiţa-Moldova Nouă sedimentary Zone) of the Getic Nappe, Severin Basin, corresponding to the Severin Nappe, Sirinia Basin (Sviniţa – Svinecea Mare sedimentary Zone) and Presacina Basin (Presacina sedimentary Zone) corresponding to the Upper (Internal) Danubian Units.

The erosional activity of the Danube River began in early Tertiary times. The Danube functioned as a connecting system between Western Tethys (Pannonian Basin) and Paratethys (Getic Basin), next to the Sicheviţa, Cerna, and Bahna Neogene basins. The Danube River crossed the Carpathians along a regional, deep crustal faults system to which belongs Porecka – Cerna system. The Western Tethys and the Paratethys represent late Tertiary marine relics of the Mesozoic Tethys (Neotethys) Ocean, a defining oceanic realm for the geology of Europe. The Recent Black Sea, Caspian Sea, and Aral Sea basins represent Paratethyan relics.

The geotectonic evolution of the Carpathian units is complex, as well as that of the Danube valley, including the Iron Gates Gorges, the 145 km long mountain segment of the Danube valley (Fig. 15). Simplifying, this evolution is marked by Hercynian (late Palaeozoic) and Alpine (Mesozoic and Tertiary) events. During the Hercynian orogeny, the Supragetic, Getic and Danubian units were included in the great Central Pangean (Transpangean) Mountains, a chain that resulted from the collision between Gondwana and Eurameria supercontinents during the Late Carboniferous. The Reșița and Sirinia basins include Upper Carboniferous coal-bearing formations, aged between 330 and 300 million years, and Permian sedimentary and magmatic rocks, ages between 300 and 250 million years. These formations were deposited as sequences of the Variscan molasse, generated in intra-mountain depressions of the great Central Pangean chain. At Sasca, Triassic sediments were recorded within the Sasca-Gornjak nappe, a tectonic subunit between the Getic and Supragetic nappes. This subunit represents the southern equivalent of the Reșița Nappe, between Anina and Reșița, recording the single Triassic occurrence in Banat. During the Early and Middle Jurassic times, the Supragetic-Getic and Danubian domains evolved as a single continental plate, recording terrestrial, coal-bearing sediments during the Early Jurassic and shallow marine sediments during the Middle Jurassic (Fig. 15). During the Late Jurassic, the Severin Ocean opened, separating the Supragetic-Getic Units from the Danubian Units, influencing the Reșița, Severin, and Sirinia-Presacina basins. This oceanic opening occurred through the break-up (rifting) of the Supragetic-Getic-Danubian single plate, and through installing a deep, oceanic sedimentation with flysch (called Sinaia Beds or Severin Flysch), between Getic and Danubian plates (Fig. 15). The Getic and Danubian plates gradually approached later, during the Late Cretaceous Austrian phase (also traditionally known as the first Getic Phase), closing through subduction (suturing) into the Severin Ocean. Sedimentation continued during the Late Cretaceous in the Danubian Units, with sintectonic sequences called wildflysch. These sequences include large, older rock bodies such as the Cozla olistolith, with Jurassic deposits, especially Lower Jurassic, coal-bearing strata. The overthrusting (stacking) of the Carpathian nappes happened mainly during the Tertiary, during the Laramian phases (Fig. 15), traditionally known as the Secon Getic Phase, with the occurrence of subsequent, post-collisional volcanism which generated the banatitic volcanic bodies, with significant, industrial grade mineral ores, such as those from Moldova Nouă, Sasca, and Oravița.

The tectonic units of the South Carpathians can be followed along the Danube valley, from Baziaș downstream to Orșova and Drobeta-Turnu Severin. The Locva Mountains correspond to the Supragetic Nappe, while the segment from Moldova Nouă downstream to the confluence between Sirinia and Danube corresponds to the Getic Nappe (Fig. 13, 14, 16). The Severin Nappe outcrops in several locations, at the confluence between Sirinia and the Danube River, at Grăniceri bridge, upstream of the Large Cauldrons (Cazanele Mari), at Dubova, or between Orșova and Drobeta-Turnu Severin. The Danubian Units outcrop excellently between Sirinia valley and Orșova.

The Locva Mountains, between Baziaș, Moldova Nouă, and Sasca Română, include metamorphic rocks (Fig. 18), Hercynian, and even Caledonian in age, represented by gneisses, micashists crossed by sub-volcanic, banatitic bodies, extracted for copper ores at Sasca Montană and Moldova Nouă, where the Locva and Lescovița metamorphic series are dominant. Patches of Miocene sediments occur at Râpa Roșie creek, close to Moldova Nouă, along the Danube valley, between Ribiș and Radimna outcropping also Quaternary loess sequences. The loess sequences represent a high-quality host for martin nests within a preserved site towards Divici (Martins Ravine). The mild relief of the Locva Mountains is highly picturesque, with localities such as Baziaș, Divici, Belobreșca, Șușca, Radimna, Pojejena, and Măcești, confined to the Danube valley.

In Iron Gates, the Getic Nappe outcrops with its metamorphic basement and sedimentary cover represented by the Reșița Basin. The Upper Jurassic and Lower Cretaceous limestone of the Reșița Basin open the Iron Gates Gorges from the southern tip of the Coronini (former Pescari) village, with a high relief energy and large outcrops (Fig. 19). The Ladislau Fortress, close to Coronini, occurs on the limestone height, across the Golubăț Fortress from the

Fig. 18 Outcrop with micashists of the Supragetic Nappe basement, Locva Mountains, DN57A road, left bank of the Danube

Serbian bank, also occurring on Mesozoic limestone (Fig. 19). Along the Iron Gates Gorges, the Palaeozoic formations of the Reșița Basin do not outcrop, as they are well developed in the northern part of the basin, where they were exploited for coals at Secu and Lupac or for Uranium, at Lișava, Jitin, Gârliște, and Ciudanovița. On the other hand, the Mesozoic limestone generates a typical karstic relief, highly visible from Sfânta Elena, along the Danube River, where they also generate the Babacaia erosional patch (Fig. 19), a Turkish name meaning ”father of stone”. In general, the geology of the Romanian bank of the Iron Gates Gorges is ideally observed from the right (Serbian) bank, an advantage of the grand perspective offered by the gorges. Limestone extraction was undertaken through the Vărănic quarries, as well as through the quarries along the gorges close to Coronini. The Mesozoic sedimentary succession of the Reșița Basin includes a coal bearing, continental sequence (Steierdorf Formation, exploited at Anina and Doman), Lower Jurassic, overlain by black, bituminous shales (Uteriș Formation, exploited at Anina, the reason for constructing the great electric powerplant from Crivina), also overlain by Middle Jurassic marls (Tâlva Zânei Formation), by Upper Jurassic limestone (Gumpina, Tămașa, Valea Aninei, Brădet formation) and by Lower Cretaceous limestone (Marila, Crivina, Plopa, Valea Nerei, and Valea Minișului formations). They are overlain by the Cretaceous (Albian) Gura Golumbului

Fig. 19 Cretaceous limestones of the Reșița Basin, Getic Nappe, outcropping downstream from Coronini, where the Danube enters the Iron Gates Gorges. The ruins of the Ladislau fortress (center) and Babacaia (right)

sandstone Formation, ending the Mesozoic sedimentation as an effect of the Austrian (Mesocretaceous, intra-Aptian) paroxysmal phase. Considering the lithological diversity, the Middle Jurassic sequences are marly, strongly fossiliferous, with bivalves, belemnites, and crustaceans, while the Upper Jurassic includes limestone successions with siliceous interlayers (Gumpina and Valea Aninei formations), nodular limestone, also strongly fossiliferous, with ammonites, belemnites, bivalves, echinoderms (Brădet Formation) and reef, fossiliferous, Upper Jurassic – Lower Cretaceous limestone, typical for a carbonate (calcareous) platform. The Upper Jurassic – Lower Cretaceous formations induce the high relief energy of the limestone occurring downstream from Coronini, this limestone opening the Iron Gates Gorges (Fig. 19). The karstic processes are also frequent, with caves such as Gaura cu Muscă (Fig. 16, 20) linking its name with that of the dove fly, and Gaura Chindiei, with Palaeolithic cave drawings. The Lower Cretaceous limestone succession of the Reșița Basin, especially the Aptian limestone generating the Miniș Gorges, were described as Urgonian, a term also used for the limestone generating the Large and Little Danube Cauldrons (Cazanele Mari and Cazanele Mici) belonging to the Sirinia and Presacina basins.

Between Sasca Montană, Cărbunari, and Moldova Nouă, Triassic (Scythian – Anisian), fossiliferous limestone was recorded with well-preserved calcareous algae, associated with the Sasca – Gornjak Nappe. The tectonic contact between the Supragetic and Getic nappes is known as the Oravița Fault (or Line), representing a complex fault system North-South oriented, identified even North of Dognecea. Along the Danube River, the limestone of the Reșița Basin is strongly folded and faulted, caught in a succession of synclines and anticlines, strongly compressed laterally during the Alpine paroxysmal phases.

The sedimentary cover of the Reșița basin is unconformably overlaying the Getic metamorphic basement, which is outcropping along the gorges from upstream Crușovița downstream to the confluence with Sirinia, close to Cozla. Initially, the distribution of the Getic basement in the Iron Gates Gorges was considered to end downstream to Liubcova, next to the Rudăria tectonic line. This line represents a significant overthrusting plane that continued to the North-East from Liubcova, Rudăria, and Lăpușnicel up to Armeniș is traditionally considered the tectonic contact between the Getic Nappe and Severin – Danubian units. Nevertheless, the discovery in 1997 by Grigore Pop of the Severin Flysch at the confluence between the Danube River and Sirinia

Fig. 20 Gaura cu Muscă cave in Cretaceous limestone of the Reșița Basin, Getic Nappe

Fig. 21 Outcrop at the Sirinia and Danube confluence, next to the Ida Pit of the Cozla Mine. The Severin Flysch (Sinaia Beds, Severin Nappe; to the upper part of the image) gets into contact with the Upper Cretaceous wildflysch (Sirinia Basin, Danubian Units, to the lower part of the image). This tectonic contact was discovered in 1997 by Grigore Pop, a geologist. The outcrop has a significant geotectonic value, explaining the Getic origin of the Drencova gneisses having an upper position related to the Severin Flysch, such gneisses being previously considered as Danubian

(Fig. 21) demonstrated the contact between Getic – and Severin-Danubian to occur much more eastwards. The metamorphic basement of the Getic Nappe includes gneisses and micashists belonging to the Sebeș-Lotru Group, to which the Drencova gneisses and the Ielova metamorphic sequences were added in 1997. Towards Sichevița, these sequences include Palaeozoic or Proterozoic granitoids. In the Sichevița – Liubcova zone, the metamorphic basement is unconformably overlain by the Miocene lignite bearing sequence. Between Berzasca, Weirauf, and Sirinia valley outcrop weakly metamorphosed slates with basic magmatic interlayers, known as the Drencova Formation, Devonian in age.

The metamorphic basement of the Getic Nappe is also recorded eastwards, between Orșova and Drobeta-Turnu Severin, where the so-called Bahna and Severin erosional patches occur, continued northwards by the Godeanu erosional Patch. These patches represent traces of the Getic Nappe overthrusting the Danubian Units and the Severin Nappe and resisting the general erosion that outcropped the latter units. Such an outcropping area of the units underlying the Getic Nappe is described as a tectonic or erosional

Fig. 22 Cretaceous limestone from Gura Văii, outcropped in the open cast mine with the same name, unconformably overlaying the metamorphic basement of the Getic Nappe, Severin patch. To the right, the Iron Gates I dam

window. Sediments of the Getic Nappe also occur at Gura Văii, with Cretaceous limestone unconformably overlaying the metamorphic basement of the Getic Nappe. The limestone is extracted at the Gura Văii quarry (Fig. 22).

The Severin Nappe yields ophiolites, which are basic magmatic rocks formed at the bottom of oceans, including typical structures called pillow-lavas, outcropping north of the Danube valley, at Obârșia Cloșani and Mărășești, overlain by deep oceanic sedimentary rocks called Severin Flysch. Along the Prahova valley, an identical succession yields the Azuga Beds (metamorphosed) and Sinaia Beds (flysch). The Severin Flysch includes argillitic and sandstone successions with millimetric and rhythmical lamination, strongly folded and faulted, many of such folds being sin-depositional. The age of this flysch is Late Jurassic (Tithonian) – Early Cretaceous (Neocomian). The Severin Nappe corresponds to an oceanic realm opened at the beginning of the Late Jurassic or even since the late Middle Jurassic through the break-up of the Supragetic-Getic-Danubian Plate through the individualization of the Supragetic-Getic Plate and the Danubian Plate. This oceanic realm was relatively short lived, closed towards the middle Cretaceous through the collision of neighboring plates, Supragetic-Getic and Danubian, during the first Getic Phase (Mesocretaceous

Fig. 23 The Severin Flysch, Severin Nappe, outcropped at the Grăniceri bridge, upstream of the entrance in the Large Cauldrons. View from the right bank of the Danube

or Austrian). This opening of the Severin Ocean influenced the marine sedimentation from the Getic realm in the Reșița Basin and the Danubian realm in the Sirinia and Presacina basins.

In contrast, the sedimentation of limestones with siliceous interlayers took place, and the deepening of these basins on both sides of the Severin Ocean occurred. The Severin Flysch outcrops at the confluence between Sirinia and the Danube River (Fig. 21), next to the Grăniceri bridge (Fig. 23), at Dubova, or between Orșova and Drobeta-Turnu Severin, although along the last segment, the outcrops of DN6 road were covered with concrete for road safety, as it is the case of the outcrops next to Slătinicu Mare and Oreva bridges. The fossils of the Severin Flysch are represented by calpionellids, such fossils also dating these oceanic sequences. A unique outcrop for the geology of the Iron Gates Gorges is Vârciorova, 6 km downstream from Orșova (Fig. 24), where Alexandru Codarcea discovered the contact between the Severin Nappe and the Danubian Units. Vârciorova is also a classic outcrop with historical significance, as it was not covered with concrete (gunite), and it can be studied even today. Here, the Danubian, Upper Cretaceous (Senonian) Vârciorova wildflysch sandstone occurs in contact with the black shales of the Severin Nappe. A contact between the Getic and Severin nappes was also described at Slătinicul Mare bridge.

The Danubian Units largely outcrop along the Iron Gates Gorges downstream from the confluence between Sirinia and the Danube River. The metamorphic, Danubian basement includes the Mraconia gneisses, the Tișovița serpentinites, and the Iuți gabbro. The basement rocks begin outcropping around Iuți valley, where, upstream from the bridge, a spectacular outcrop

Fig. 24 The Vârciorova outcrop, between Orșova and Drobeta-Turnu Severin, along DN6, showing the contract between the Danubian Units and the Severin Nappe, a classic outcrop in Romanian Geology

Fig. 25 The Iuți gabbro with faulted intrusions of plagiogranite, in a spectacular outcrop upstream of Iuți valley, Iron Gates Gorges, the metamorphic basement of the Danubian Units

reveals gabbro with plagiogranite veins, fragmented by well exposed faults (Fig. 25). The Iuți gabbro also yields chromite nests, well outcropped in the Iuți quarry. The Tișovița serpentinites are at least pre-Carboniferous in age and they represent ultrabasic rocks transformed by the hydration of peridotites (Fig. 26). The contact between gabbros and serpentinites is considered as the Mohorovicic Discontinuity (boundary), abbreviated as Moho, a fundamental discontinuity for the Earth's structure occurring between the Earth's crust and the upper layer of the asthenosphere, known as the B' layer, within the lithosphere. Such a discontinuity was rarely described in the world, such being the case of the Troodos massif in Cyprus.

The Danubian sedimentary cover along the Danube valley belongs to the Sirinia (Svinița – Svinecea Mare sedimentary Zone) and Presacina basins. The Palaeozoic unmetamorphosed sequence begins with the continental, coal bearing Cucuiova Formation, Upper Carboniferous (Westphalian – Stephanian) in age. Its coals are bituminous and bituminous-anthracitic; they were exploited at the Baia Nouă mine (Fig. 27), while exploration works for coals were undertaken along Dragosela valley and at Cucuiova. The Carboniferous flora is particularly interesting, with horse-tails (*Calamites carinatus*, *Sphenophyllum cuneifolium*), lycopsids (*Lepidophloios acerosus*, *Sigillaria tesselata*, *Stigmaria ficoides*) and pteridosperm gymnosperms (*Neuralethopteris rectinervis*, *N. schlehanii*). The Baia Nouă flora is considered a marker flora, with stratigraphic significance,

Fig. 26 The Tișovița serpentinites, outcropped next to the bridge over Tișovița valley, metamorphic basement of the Danubian Units

Fig. 27 Baia Nouă (Nove Doly) Mine for Late Carboniferous anthracitic bituminous coals, Cucuiova Formation. The coal mine was closed in 2006 following a major mining accident

with endemic Carboniferous elements for some of the intra-mountainous basins of the great Central Pangean chain. This flora is also a very good indicator of a wet climate which allowed the development of lush, tropical flora. The Late Carboniferous time interval is also an antracolitic interval (with coal genesis significance) related to a peculiar climate, to a palaeogeography announcing the Pangea supercontinent, and to an explosive evolution of tracheophytes. Baia Nouă (Fig. 27) was an important mining enterprise with significant bituminous-anthracitic coal reserves, closed in 2006. The Permian includes the Lower Permian Povalina Formation, with the black shales of the Staricica Member and the red sandstone with palaeosoils and lacustrine limestone interlayers of the Ielișova Member. The black shales of the Staricica Member were exploited for uranium at Ielișova mine, along the valley with the same name. The red beds of the Permian Ielișova Member outcrop, especially upstream Iuți valley, close to Selschi (Red) creek, where they are crossed by a basaltic dyke (magmatic structure, Fig. 28), as well as at Stariștea, next to the parking lot, where the red beds yield lacustrine limestone lenses (Fig. 29) and calcareous concretions (caliches).

The Permian sedimentary sequence with black, lacustrine shales at its base, followed by red palaeosoils rich in iron oxides, demonstrates a gradual drying of the Permian climate. This gradual drying was linked to the emergence of the Pangea supercontinent. This emergence was prepared during the Carboniferous through the collision between Gondwana and Euramerica

Fig. 28 Permian red beds of the Povalina Formation, Ielișova Member, crossed by a basaltic dyke (magmatic intrusion) at Selschi creek, upstream from Iuți valley, DN57 road. The outcrop is large, with basal breccias and conglomerates recording the Permian transgression over the Iuți gabbro of the Danubian metamorphic basement. The succession is also visible from the right (Serbian) bank of the Danube, illustrated in Fig. 38 and 40

Fig. 29 Permian red beds of the Povalina Formation, Ielișova member, a faulted succession with red palaeosoils, calcareous concretions (caliche) and lacustrine limestone lenses, downstream of the Stariștea valley, DN57 road, Sirinia Basin, Danubian Unit

Fig. 30 Permian rhyolites of the Trescovăț Formation, Stariștea valley, DN57 road, Sirinia Basin, Danubian Units

(Eurameria) and through the subsequent collision between Eurameria and Angarida, to the end of the Permian, when the Uralian chain was uplifted, as the last (youngest) Hercynian orogen. The build-up of the last Pangea, a giant, unique landmass, induced the massive reduction of continental precipitations. Such a drying trend continued until the Carnian Pluvial Event, during the Middle Triassic, about 232 million years ago. The massive aridization of Pangea is also recorded along the Iron Gates Gorges, with its outcrops with red palaeosoils, rich in iron oxides (Fig. 28, 29).

The Povalina Formation is conformably overlain by the Trescovăț Formation, represented by various volcanic tuffs and by rhyolites (Fig. 30, 31). The Romanian bank of the gorges yields several rhyolitic lava domes, with the Trescovăț peak as the most spectacular, a symbolic peak for the Iron Gates Gorges (Fig. 32), between Stariștea and Ielișova valleys. Old cataracts Great and Little Tachtalia, today covered by the Iron Gates Reservoir, were related to the Trescovăț Formation's rhyolites, close to the confluence between Stariștea and the Danube River. The volcanic tuffs are varied, with colors ranging from grey to red, violet, and green (fig. 33), frequently yielding lapilli (Fig. 31) and volcanic

Fig. 31 Lapilli from the Permian tuffs of the Trescovăț Formation, Sirinia Basin, Danubian Units. Iron Gates Gorges, at the confluence with Povalina valley

Fig. 32 The Trescovăț Peak, a Permian, rhyolitic lava dome, Trescovăț Formation, one of the symbols of the Iron Gates Natural Park, Sirinia Basin, Danubian Units. Its flanks are covered by Lower Jurassic sediments. Volcanic tuffs illustrated in Fig. 33 and 31 outcrop along DN57 road

Fig. 33 Permian volcanic tuffs of the Trescovăț Formation, Sirinia Basin, Danubian Units, Ielișova valley

bombs, in a typical surtseyan volcanic sequence that began with underwater eruptions and continued with sub-aerial eruptions. These volcanic successions are almost completely preserved, from their beginning to the erosion of the top volcanic sequence, outcropping massively along the Iron Gates Gorges, especially downstream from Dumbrăvița (downstream from the confluence with Sirinia) towards the Ielișova (Fig. 34), Glaucina, Stariștea and Povalina (Fig. 31) valleys. From Povalina, the Permian succession touches the Mesozoic limestone formations of the Sirinia basin (Fig. 34), while eastwards from Selschi creek, the Permian red beds are unconformably overlying the igneous basement represented by the Iuți gabbros. From Selschi creek eastwards, the Permian transgression overlying the Iuți gabbros is well outcropped, beginning with basal breccias and conglomerates, including basement fragments continued upwards with red sandstones and clays, with frequent palaeosoils.

The central area of the Sirinia Basin, outcropping along the Danube River between Dumbrăvița and Povalina valleys, is represented by the Hercynian sedimentary and magmatic core of the Carboniferous and Permian formations. This core had a tough geomechanical reaction during the Alpine Orogeny, uplifting the Palaeozoic deposits and supplementary folding the Mesozoic sedimentary formations from both sides of the Sirinia Basin. The folded Mesozoic formations are visible between: a. the Sirinia confluence with the Danube River and Dumbrăvița – Ielișova (Fig. 35), where these formations occur in a tectonic contact with the Permian deposits; and b. eastwards from Povalina valley towards the Selschi creek and Iuți valley. The compression of the Mesozoic sequences led to the formation: *a*) of the Munteana monocline and of the Munteana-Dumbrăvița suspended fold (Fig. 36), in the western part of the basin, *b*) of the folds of the Saraorschi creek (Fig. 37), Țiganului (Gipsy) creek (Fig. 37), *c*) of the Svinița cuesta (Zeliște and Veligan peaks, Fig. 39), and *d*) of the Cioaca Borii cuesta (Tricule, Fig. 38, 40), towards the Selschi creek, in the eastern part of the basin.

The Mesozoic sedimentary succession of the Sirinia Basin is marked by a series of facial (lithological and palaeontological), lateral changes, with different, coeval formations deposited in different zones of the basin, facies changes occurring especially between the central-northern part and the southern part. The facies, lateral changes of the Mesozoic formations are linked to different sedimentary conditions within the frame of the Sirinia Basin.

Fig. 34 The tectonic contact between the Palaeozoic core and the eastern, Mesozoic margin of the Sirinia Basin, viewed from Trescovăț Peak eastwards, Danubian Units. Povalina valley (center of the image) is a Danube's tributary, the first Mesozoic outcrops occurring immediately downstream of the confluence, towards Saraorschi creek

Fig. 35 The tectonic contact between the Palaeozoic core and the western, Mesozoic margin of the Sirinia Basin, viewed from Trescovăț Peak, Danubian Units. In the background, along the Romanian bank, occurs the Munteana monocline, upstream from the suspended fold and from Stariștea and Ielișova valleys

Fig. 36 The suspended fold with white, mesozoic limestone (Upper Jurassic – Lower Cretaceous) from Munteana-Dumbrăvița, viewed from the right bank (Serbian) of the Danube, Sirinia Basin, Danubian Units

Fig. 37 Nodular, folded Middle and Upper Jurassic limestone, Saraorschi creek, Sirinia Basin, Danubian Units. The anticline was partially destroyed during repairs for the DN57 road

Fig. 38 The Cioaca Borii cuesta, Tricule area and the unconformity between the Povalina Formation (Lower Permian) and Cioaca Borii Formation (Lower Jurassic). View from the right (Serbian) bank of the Danube. Along the Danube are visible the Selschi creek bridge with the Permian red beds crossed by a basaltic dyke illustrated in Fig. 28

Fig. 39 The natural amphitheater of the Țiganului (Gipsy) creek, between Zeliște and Veligan peaks, outcropping the Lower Jurassic Cioaca Borii Formation with alluvial, cross-bedded, quartzitic conglomerates lacking fossils, Sirinia Basin, Upper (Internal) Danubian Units

Fig. 40 The Romanian bank of the Danube viewed from the right (Serbian) bank of the Danube. The Cioaca Borii cuesta, ruins of the Tricule fortress and the Selschi creek bridge are visible, Sirinia Basin, Danubian Units

The Mesozoic successions begin with the continental coal bearing Cioaca Borii Formation (Fig. 38, 40), also known as the Glavcina Formation, Lower Jurassic (Hettangian – Sinemurian) in age. This terrestrial formation is coeval with the Schela Formation from the Presacina, Cerna-Jiu and Coșuștea basins, and with the Steierdorf Formation of the Reșița Basin, Getic Nappe. These continental realms were connected during the Early Jurassic as parts of the same continental realm. In the base of the Cioaca Borii Formation occurs the Omerșnic Member (also traditionally known as the Cioaca Borii conglomerates), including basal conglomerates with large, rounded, quartzitic elements outcropping spectacularly at Cioaca Borii (over Tricule, Fig. 38, 40) and in the amphitheater between Zeliște and Veligan peaks, over Svinița village (Fig. 39). In both occurrences, the Omerșnic Member is unconformably overlaying the Povalina and partially Trescovăț formations, generating spectacular cuestas (Fig. 38, 40). The basal Omerșnic member is conformably overlain by the Pregheda Member, represented by sandstone, mudstone, and coal beds, with an interesting Early Jurassic flora. The palaeoflora is a coal flora (coal generating flora), including compressions and impressions belonging to sphenopsids (*Equisetites* sp., *Neocalamites* sp.), ferns (*Thaumatopteris brauniana*, *Cladophlebis* sp.) and bennettitalean gymnosperms (*Otozamites molinianus*), among many others, next to fossil spores such as *Cyatheites australis*. The diverse Early Jurassic flora of the Sirinia Basin indicates a subtropical palaeoclimate that was influenced by megamonsoons, with an extreme seasonality induced by the palaeogeographic position of the Romanian Lower Jurassic (Liassic) basins occurring on the northern frame of the Tethys Ocean. The palaeoflora and the sedimentology of all the Lower Jurassic formations from the South Carpathians finely record this extreme, megamonsoonal seasonality, marked by monsoons with an un-equaled intensity at today's levels. The coals of the Cioaca Borii

Fig. 41 Buschmann coal mine for Lower Jurassic bituminous coals of the Cioaca Borii Formation, Pregheda Member, Sirinia Basin, Danubian Units, Sirinia valley at the confluence with Sirinca

Fig. 42 *Belemnitina* sp., an Early Jurassic belemnite, Munteana Formation at Munteana, DN57 road. Scale bar: 10 mm.

Fig. 43 The Munteana monocline along DN57 road, Sirinia Basin, Danubian Units. In 1870, the renowned palaeontologist U. Schloembach died at Munteana during field work. A memorial tablet occurs today below the surface of the Iron Gates Reservoir. The geological profile from Munteana is continuous for the Lower Jurassic – Lower Cretaceous succession

Formation are bituminous, coking coals and they were exploited at Cozla, Buschmann (Fig. 41), Pietrele Albe, Stanca, Palașca 1 and 2 and north of Iron Gates Natural Park, at Chiacovăț, Ostreșu, Tâlva cu Rugi, Șopot and Pregheda (close to Svinecea Mare peak), the latter representing the only open cast mine for Lower Jurassic coals of the Sirinia Basin. This quarry is still open today.

The Munteana Formation outcrops in southern Sirinia Basin, along the Iron Gates Gorges, it is also Lower Jurassic up to Middle Jurassic (?Sinemurian – Pliensbachian – Toarcian – Aalenian), but it has a marine origin, represented by ferruginous, fossiliferous sandstone with bivalves (e.g., *Cincta numismalis*, *Gryphaea gigantea*, *Entolium liasinum*, *Pleuromya jouberti*, *Ceromya infraliasica*, *Greslya petersi*, *Pecten equivalvis*), belemnites (*Belemintina* sp., Fig. 42), ammonites (*Becheiceras bechei*, *Phylloceras heterophyllum*, *Phylloceras* sp., Fig. 39) and brachiopods (e.g., *Tetrarhynchia tetraedra*, *Spiriferina tumida*, *S. alpina*, *Lobothyris subovoides*, *L. grestenensis*), well preserved and highly diverse. The Munteana Formation outcrops ideally within the Munteana monocline, downstream from the confluence between Sirinia and the Danube River (Fig. 43). In the central-northern area of the basin occur the following formations: Sirinia (Pliensbachian, with grey and black, strongly fossiliferous marls), Lespezi (Lower Toarcian, with white, quartzitic sandstone), Zamonița (Upper Toarcian, with marls and ammonites such as H*ildoceras bifrons* and *Lytoceras jurense*), Moșnic (Aalenian, with quartzitic sandstone and microconglomerates), Sirinca (Bajocian, with detrital and spathic limestone with brachiopods such as *Rhynchonella quadriplicata* and *Terebratulla bullata*), Seretina (Bathonian – Callovian, with ferruginous, oolithic limestone), Bigăr (Upper Bathonian – Callovian – Lower Oxfordian, with grey, fossiliferous marls, with bivalves and ammonites), Zeliște (Oxfordian, with fossiliferous limestone with jaspers and belemnites), Greben (Upper Kimmeridgian – Lower Tithonic, with red, nodular limestone with the ammonite *Aspidoceras acanthicum*) and Murguceva (Upper Tithonian – Lower Hauterivian, calcareous, biomicritic, grey, in Majolica facies, with *Tintinopsella carpatica*). In the southern zone, the Cioaca Borii Formation is overlain by the following formations: Munteana, Seretina, Zeliște, Greben, Murguceva (Fig. 44) and Svinița (Upper Hauterivian – Barremian – Lower Aptian, fossiliferous, with ammonites). The Upper Cretaceous, post-Austrian (post-Mesocretaceous) sediments are represented by the Nadanova Formation (Upper Albian – Lower Turonian) with marls yielding planktonic

Fig. 44 The Murguceva Formation, Jurassic – Cretaceous in age (Upper Tithonian – Lower Hauterivian) with grey, biomicritic (fine) limestone, Sirinia valley, the Hoțului (Thief) bridge

foraminifera and by the Wilflysch Formation (Upper Turonian – Senonian), with sandstone, polymictic conglomerates, and mudstones. The wildflysch includes olistolithic blocks, some of them very large (olistostromes).

All these mesozoic formations are exquisitely developed along the Iron Gates Gorges at Munteana, Dumbrăvița, Svinița (from Povalina and Saraorschi valleys downstream to Selschi creek), where they are strongly folded and faulted. At Munteana and Dumbrăvița, the Munteana Formation and younger formations generate a monocline with the same name, with a complete succession of the entire Jurassic and Lower Cretaceous, in a unique, European class outcrop (Fig. 43). Between Munteana, Dumbrăvița downstream to Ielișova valley, the Mesozoic formations generate a spectacular fold which is suspended along the Romanian bank, called the Munteana – Dumbrăvița suspended fold, visible from the Romanian bank but much better visible from the Serbian bank (Fig. 36).

Eastwards from the Palaeozoic core of the Svinița Basin, within the Romanian Greben and along the Saraorschi creek (Fig. 37), the Seretina Formation distinguishes through its exceptional Upper Bathonian – Lower Callovian fossils. A fossiliferous level of this age is represented by a ferruginous, oolithic bed, closely resembling the Alpine Klaus Beds, with more than 60 species (Fig. 45) of ammonites, bivalves, brachiopods, and belemnites, described for

Fig. 45 *Phylloceras* sp., a Middle Jurassic ammonite, Seretina Formation, Saraorschi creek, Svinița SSSI, Sirinia Basin, Danubian Units. Prof. I. Simionescu collection, Laboratory of Palaeontology, Department of Geology, Faculty of Geology and Geophysics, University of Bucharest, hand specimen no. 7. To the left: external view of the spiral shell; to the right: section of the same specimen, viewing the shell inner septae. Scale bar: 10 mm

Fig. 46 The fold with a red core from Sirinia, with red, nodular limestone and white limestone. The succession of folds continues over the outcrop, in a picturesque landscape marked by the high relief energy and folding tectonics of Jurassic and Cretaceous limestone from the central and southern part of the Sirinia Basin

Fig. 47 Middle Jurassic stromatolites (organic-sedimentary structures), Saraorschi SSSI, close to Svinița, Sirinia Basin, Danubian Units

the first time by Johan Kudernatsch in 1852. The fossiliferous level and the sedimentary, stromatolite (Fig. 47) bearing succession are officially preserved as the Svinița Site of Special Scientific Interest (SSSI).

The Sirinia valley, between the confluence with the Danube River and Buschmann (at the confluence between Sirinia and Sirinca), is dominated by the Upper Jurassic – Lower Cretaceous limestone, with spectacular outcrops of the Seretina, Zeliște and especially of the Greben formations (Fig. 44, 45, 46). The source of the Sirinia valley outcrops the Permian rhyolite up to the divide, as opposed to the Mraconia valley and south of the Scaunul Ieremiei (Ieremia's Chair), the old refuge of Danube's brigands. The Mesozoic formations are strongly folded and faulted, offering a lacy, extremely picturesque landscape as is the case of Sirinia river and its right hand tributaries: Sirinca, Stânei, Cozilele and Gredița valleys. About 10 km upstream from the Danube confluence, the Sirinia valley hosts the red cored fold (Fig. 46), an unusual anticline with red, nodular limestone of the Greben Formation in the core of a fold dominated by the white, well layered limestone of the Murguceva Formation. The folds and faults succession continues along the valley, over the red cored fold, unique in the Alpine landscapes of the Carpathians.

The caves of the Almăj Mountains occur in Mesozoic limestone, such as Zamonița, Moșnic, Socolovăț, Pepa, Dumbrăvița Mică and Gaura Cernii caves.

Fig. 48 The Large Cauldrons (Cazanele Mari), left bank of the Danube, with stratified, fossiliferous, Urgonian limestone having high relief energy

We can add the caves of Ciucarul Mare (Cazanele Dunării), such as Veterani and Gura Ponicovei caves (Fig. 16, 49), which are more visited and better known by tourists.

The Ielișova, Glaucina, and Stariștea valleys are dominated by Permian tuffs and rhyolites, with excellent Palaeozoic and even Mesozoic outcrops (Fig. 33). The Permian succession outcrops almost entirely along the Povalina valley, continued towards the Cucuiova and Drena hills, with rare Carboniferous outcrops (Fig. 34). The stratotype of the Povalina Formation was described here. The Saraorschi creek outcrops Jurassic limestone, including the fossiliferous limestones of the Palaeontological Site of Special Scientific Interest (SSSI, Fig. 47). The Țiganului (Gipsy) creek, close to Svinița, outcrops at its source the Cioaca Borii conglomerates (Fig. 39) and downstream, the Cretaceous, highly fossiliferous marls (Upper Hauterivian – Barremian) of the Svinița Formation. The Selschi creek outcrops the Permian red beds and the Cioaca Borii conglomerates (Fig. 28), while along the Iuți valley outcrop the gabbros with the same name. The Tișovița (Fig. 26) and Plavișevița valleys outcrop serpentinites and other elements of the pre-Alpine, Danubian metamorphic basement. Downstream from the confluence between Plavișevița and the Danube River, close to Grăniceri bridge, outcrops the Severin Flysch (Fig. 23), followed by the

Fig. 49 Gura Ponicovei cave, Danube entrance, in Urgonian, Cretaceous limestone. The entrance occurs along a local fault plane which is transversal to the limestone strata

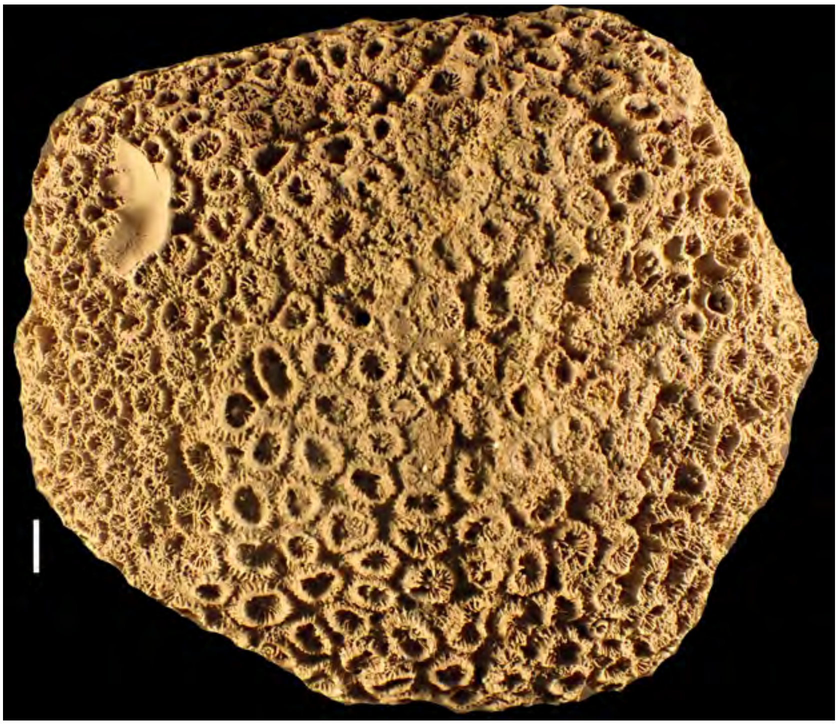

Fig. 50 *Plesiastrea* sp., Miocene (Badenian) colonial corals, Curchia valley, Bahna SSSI, Bahna Basin. Hand specimen no. 415, Collection of the Laboratory of Palaeontology, Department of Geology, Faculty of Geology and Geophysics, University of Bucharest. Scale bar: 10 mm

Fig. 51 Husnicioara open cast mine, close to Drobeta-Turnu Severin, for Pliocene (Dacian – Romanian) lignite, Dacian Basin

sedimentary succession of the Presacina Basin, including a large part of the Danube Cauldrons (Cazanale Dunării), Dubova Gulf and Mraconia valley.

The Large and Little Cauldrons (Cazanele Mari and Cazanele Mici), separated by the Dubova Gulf, represent the most spectacular segment of the Iron Gates Gorges (Fig. 48), marked by their karstic relief offered by the Cretaceous, Urgonian, fossiliferous limestone with pachyodonts (fossil bivalves) and corals. The profile of the Little Cauldrons (Cazanele Mici), as seen from the Dubova Gulf, includes Danubian basement (with granitoids and metamorphic rocks) and Getic basement (with metamorphic rocks), sequences of the Severin Flysch, Danubian wildflysch of the Sirinia Basin and the massive, and the Urgonian sequence which generates both Little and Large Cauldrons (Cazanele Mari and Cazanele Mici). The entire succession is strongly tectonized, with deep faults associated with the Porecka – Cerna fault system. The Ciucarul Mare plateau is marked by numerous dolinas, parts of a complex karstic system (Fig. 49).

Downstream of the Little Cauldrons (Cazanele Mici), close to Ogradena, outcrop granitoids of the Danubian basement, covered by the Miocene

(Badenian) sedimentary succession of the Orșova – Bahna area. Between Bahna and Ilovița, along Curchia, Racovăț and Lespezi valleys, occurs a Miocene succession with highly fossiliferous limestones preserved in a palaeontological Site of Special Scientific Interest (SSSI), the second SSSI of Iron Gates Natural Park. These Miocene limestones yield diverse and well preserved corals (e.g. *Plesiastrea* sp., Fig. 50), bivalves, and gastropods. The Miocene succession also covers parts of the Getic basement of the Bahna Patch. Downstream of the Bahna valley occurs the classical Vârciorova outcrop (Fig. 24), between the Bahna and Iron Gates patches. Downstream of Gura Văii occurs the Mio-Pliocene sediments of the Dacian Basin, beginning with sandstones and sands deposited within a palaeo-delta. The Pliocene (Dacian – Romanian) sediments are also very well outcropped in the lignite open cast mine from Husnicioara (Fig. 51), occurring immediately out of Iron Gates Natural Park. This quarry outcrops fluviatile and lacustrine, strongly fossiliferous successions, with diverse, well preserved flora and fauna.

In conclusion, the geology of Iron Gates Natural Park can be assessed as a profound X-ray image of the South Carpathians' anatomy, spectacularly outcropped along both banks of the Danube River, Romanian and Serbian. The geological reality represents the backbone of regional biotopes, the geodiversity and the geotectonic evolution influencing the local biodiversity and microclimate. A geological field trip in the majestic landscape of Iron Gates Natural Park represents an exceptional natural history narrative revealing episodes of the deep time. For the educated traveler, exploring Iron Gates Natural Park is a rare privilege from geological, biological, and climatological perspectives.

Glossary of terms

- Ammonites: marine and oceanic cephalopods with external shells, with diverse shapes and ornamentations, extinct at the end of the Cretaceous. e.g., *Phylloceras* sp., Saraorschi creek (Fig. 45).

- Anisian: time interval (age) of the Middle Triassic, ranging between 247-242 million years ago.

- Anticline: geological structure including folded strata with their convexity pointing upwards.

- Aptian: time interval (age) of the Early Cretaceous, ranging between 125-113 million years ago.

- Badenian: time interval (age) of the Middle Miocene.
- Barremian: time interval (age) of the Early Cretaceous, ranging between 129-125 million years ago.
- Basement: body of metamorphic and magmatic rock generating the support or the bottom of a sedimentary basin, where sediments are deposited.
- Belemnites: marine and oceanic cephalopod mollusks with internal shell, extinct at the end of the Cretaceous. e.g. *Belemnitina* sp., Munteana Formation (Fig. 42).
- Biotope: abiotic part of an ecosystem.
- Bivalves: marine or freshwater mollusks with two valves (lamellibranchiates, pelecypods).
- Caliche: calcareous concretions in palaeosoils, calcrete.
- Calpionellids: marine and oceanic, planktonic and microscopic organisms, with a calcareous shell. They represent useful fossils for identifying the Jurassic-Cretaceous boundary in the Danube valley.
- Carbonate platform: calcareous large scale structure generated by massive carbonate sedimentation, with bioconstructed and bioaccumulated limestones.
- Cuesta: a ridge where harder strata outcrop along a steep slope, overlying softer strata. E.g. Cioaca Borii cuesta, close to Svinița.
- Flysch: sintectonic, fine, sedimentary sequence, rhythmic, deposited on the abyssal plain of an ocean by deep oceanic currents carrying muds (turbidites).
- Gabbros: plutonic (intrusive), basic (dominated by black or dark minerals) magmatic rocks, with minerals visible with naked eyes (phanerocrystalline).
- Gastropods: mollusks with outer, usually spiraled shells, snails.
- Folds: folded strata.
- Hauterivian: time interval (age) of the Early Cretaceous, ranging from 132 to 129 million years ago.
- Hettangian: first time interval (age) of the Early Jurassic (Liassic), immediately after the Late Triassic (Rhaetian) – Early Jurassic boundary, it began 201 million years ago and ended 199 million years ago.
- Lapilli: solidified lava drops ejected by a volcano during an eruption.
- Loess: eolian sedimentary rocks, wind transported dust.
- Monocline: planar, dipping strata.
- Ocean floor spreading: tectonic process generating new oceanic crust along a mid-ocean ridge.

- Olistolith: body of rocks with variable dimensions, sedimented within a younger, sintectonic sedimentary sequence.

- Olistostrome: body of large rocks, fallen or slumped in a younger, sintectonic, sedimentary sequence.

- Palaeosoil: fossil soil.

- Paroxysmal phase: a collisional phase between two tectonic plates. A succession of paroxysmal phases represents an orogenesis.

- Post-tectonic: after a paroxysmal tectonic phase.

- Scythian: time interval equivalent of the Early Triassic.

- Serpentinite: hydrated, metamorphic rocks resulted from magmatic, basic rocks.

- Syncline: folded structure with downward facing convexity.

- Sinemurian: time interval (age) of the Early Jurassic, ranging between 199-190 million years ago.

- Sintectonic: coeval with a paroxysmal tectonic phase.

- Stratotype: a succession of rocks formally defining a stratigraphic sequence.

- Supercontinent: large sized landmass, including all or almost all continental cores (cratons). A supercontinent is fragmented later in smaller continental plates.

- Urgonian: Barremian-Aptian limestone facies.

- Wildflysch: sedimentary succession generated sintectonic during a paroxysmal phase, yielding large rock bodies.

Iron Gates Natural Park landscape

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The landscape of Iron Gates Natural Park would not be as spectacular without the long-term contribution of human communities in this area. Danube River represented an easy communication path; the banks and islands provided fertile land and favorable conditions for establishing communities. In case of danger, caves and forests provided shelter; therefore, the inhabitation of this space was continuous (Niculae et al. 2014).

The *settlements in Iron Gates Natural Park* have a predominantly rural profile. From an administrative point of view, they belong to two counties (Caraș-Severin and Mehedinți, Figs. 52 and 53, Tab. 2). The main localities are the city of Moldova Nouă and municipality of Orșova, both harbor cities, having about 13000 inhabitants (Fig. 54, Fig. 55). The second municipality part of the park is Drobeta-Turnu Severin, included with Gura Văii and Dudașu Schelei villages (Dumbrăveanu 2004, Necșuliu 2007).

The largest rural localities are Eşelniţa (more than 3000 inhabitants), Berzasca, Dudașu Schelei, Sichevița, Pojejena, Coronini, Liubcova, Svinița, and Padina Matei (among 1000 and 2000 inhabitants). The rest of the settlements are small (among 500 and 1000 inhabitants) and very small (less than 100 inhabitants) (Necşuliu 2007).

The construction of the Iron Gates I reservoir led to the relocation or disappearance of some localities that were covered by water (APNPF 2013, Nistor et al. 2021, Mihai et al. 2016). Thus, Tisovița, Plavișevița, and Ogradena disappeared, their inhabitants were relocated to Eșelnița and Dubova, the Vârciorova village was flooded, its inhabitants were relocated to Drobeta-Turnu Severin and Ilovița, and Drencova locality disappeared, only a small harbor

Tab. 2 Localities included in Iron Gates Natural Park

Administrative unit	Localities in park	Percent of surface in park
Socol	Baziaș	19%
Pojejena	Divici, Belobreșca, Șușca, Radimna, Pojejena	100%
Moldova Nouă	Măcești, Moldovița, Moldova Nouă, Moldova Veche	100%
Cărbunari	-	39%
Gârnic	Padina Matei, Gârnic	100%
Coronini	Coronini, Sfânta Elena	100%
Șopotu Nou	Cârșa Roșie, Valea Roșie, Urcu, Valea Răchitei	26%
Sichevița	Sichevița, Brestelnic, Camenița, Cârșie, Cracu Almăj, Crușovița, Curmătura, Frăsiniș, Gornea, Liborajdea, Lucacevăț, Martinovăț, Ogașu Podului, Streneac, Valea Orevița, Valea Ravensca, Valea Sicheviței, Zănou, Zăsloane	83%
Berzasca	Berzasca, Liubcova, Bigăr, Cozla	86%
Topleț	-	9%
Svinița	Svinița	100%
Dubova	Dubova, Eibenthal, Baia Nouă	91%
Eșelnița	Eșelnița	59%
Orșova	Orșova	100%
Ilovița	Ilovița, Bahna	67%
Breznița-Ocol	Breznița-Ocol	20%
Drobeta-Turnu Severin	Gura Văii, Dudașu Schelei	60%

remaining of it – Drencova Harbour. Few inhabitants of this settlement were relocated to neighboring villages. In addition, the scenic locality Ada-Kaleh disappeared after the flooding of the namesake island, its inhabitants, mainly Turkish, migrating to the big cities. Orșova, Dubova, Sviniţa, Eşelnița, and Gura Văii were also relocated and partially or completely reconstructed in areas without flooding.

All settlements with houses built on the Danube River bank were influenced by the construction of the Iron Gates I dam, with numerous households being

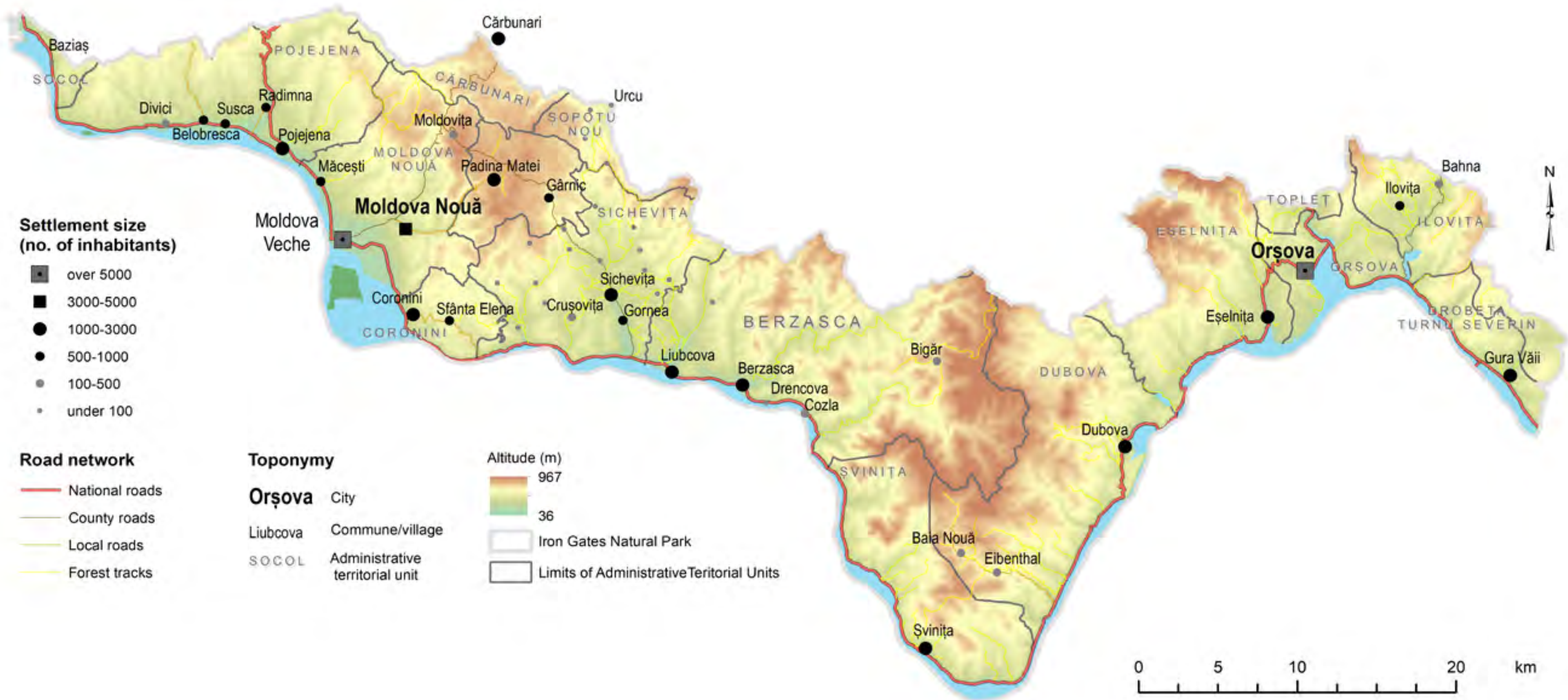

Fig. 52 Administrative territorial units and localities in Iron Gates Natural Park

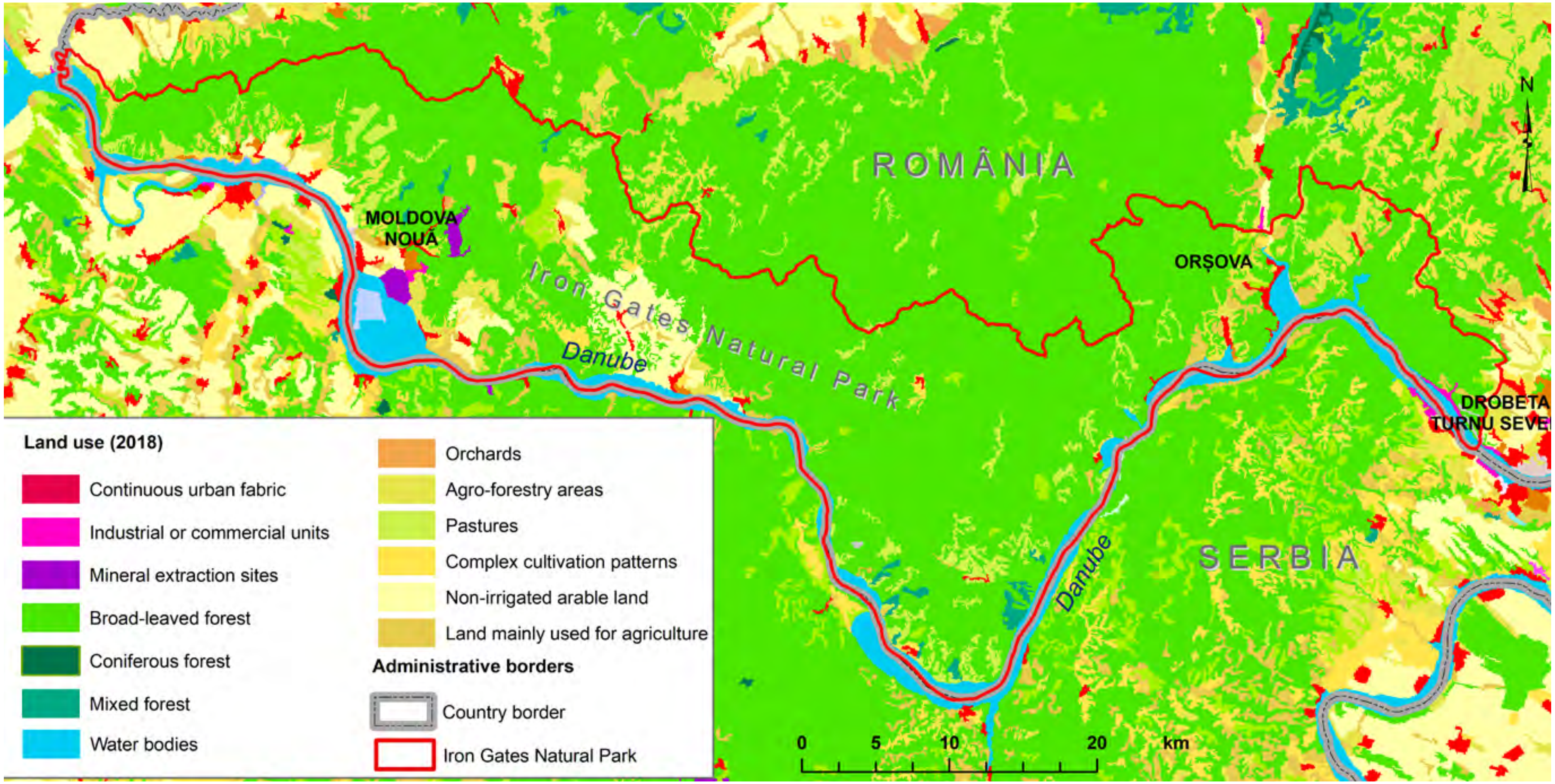

Fig. 53 Land use in Iron Gates Natural Park (CORINE Land Cover 2018)

Fig. 54 Orșova City was displaced in 1968 in the existing location. The old city was covered by water in 1971

Fig. 55 Moldova Nouă harbour was in the past an important transit point for ores exploited in the area. Today, it is used mainly for cereals

transferred to the higher grounds (APNPF 2013, Juan-Petroi 2006, Osaci-Costache and Armaș 2016, Thorpe 2011).

Currently, the communities of Iron Gates Natural Park include more than 430000 inhabitants, a decrease compared to the 1990s, when the population was approximately 60000. This decrease is a consequence of migration of the rural population, but also the collapse of the mining industry (APNPF 2013). Until the 1960s, the number of inhabitants was relatively small, with only Orșova and Moldova Nouă having more than 6000 inhabitants, followed by Pojejena, Berzasca and Sichevița, settlements with more intense agricultural activities. Newly opened mining activities, especially in Moldova Nouă, have determined an increase in urban population, a phenomenon that lasted until the 1980s. The decline after the 1980s was also determined by the region's isolation during the communist regime; because of the border with Yugoslavia, a country open to Western Europe, severe traffic restrictions were enforced. Thus, the inhabitants travelling to other localities have suffered severe checks from the border police at several control points, and the mobility of the non-resident population was banned and strictly enforced (APNPF 2013, Manea 2003, Necșuliu 2007).

The *ethnic structure of Iron Gates Natural* is highly diverse. The inhabitants are mainly Romanians (80%), but in numerous localities, there are important communities, sometimes majorities of Serbians and Czechs. This ethnic diversity represents one of the park's cultural riches, the result of the proximity with Serbia, economically motivated migrations, or political changes. In localities such as Baziaș (Fig. 56), Pojejena, Moldova Veche, Belobreșca, Radimna, Divici, Liubcova and Svinița, the Serbian population has high percentages, from 15% (Moldova Veche) to 80% (Belobreșca). The Serbian population, which represents approximately 11% of the park population, migrated here not only from the neighbouring areas, but also to more distant ones, a consequence of the restrictions enforced by the Ottoman Empire in Serbia (APNPF 2013, Necșuliu 2007, Ștefănucă 2010, Stan 2013, Simic and Mitrovic 2020, Văran and Crețan 2018).

Another important ethnic group is represented by Czechs, convinced to migrate to the area by the Habsburg administration from southern Bohemia for mining, logging, or as border guards. In the past, the Czechs represented a majority, up to over 90% of the inhabitants in localities such as Bigăr (Fig. 57), Eibenthal (Fig. 58), Baia Nouă, Sfânta Elena, and Gârnic. The disappearance

Fig. 56 Entry to Baziaş village (Bazijaš, Socol town), the first town on Danube in Romania

Fig. 57 Bigăr village (Bígr, Berzasca town) is the most isolated locality in the park. It was established by Czechs coming from South Bohemia

Fig. 58 Hayfield in Eibenthal village (Tisové Údolí, Dubova town). Agriculture, mining, and logging were, in the past, the main occupations for the inhabitants living here

of the Habsburg monarchy, decline of mining, and, more recently, border opening led to the decline of this ethnic group to less than 5%. Practically, some villages founded by the Czechs have lost almost all their inhabitants of Czech origins, many of their houses being transformed into holiday houses by their descendants living in other countries (Preda 2010). Of smaller percentages and no majority in any of the park localities live Roma, Hungarian, and German communities (APNPF 2020).

The *history of the area that overlaps Iron Gates Natural Park* is complex. Traces of prehistoric habitation have been well documented during archaeological works carried out before the construction of the Iron Gates I dam and subsequent research works after completion of this construction. Historians found traces of habitation from the Upper Palaeolithic (11500 - 10500 BC), attributed to hunters-gatherers, for example, in Cuina Turcului (small cave in Ciucaru Mare), Climente cave, and Veterani Cave in Iron Gates Gorges. Also, important artefacts belonging to Lepenski Vir – Schela Cladovei culture have been discovered in Iron Gates Natural Park. Lepenski Vir – Schela Cladovei is a culture complex formed in the Mesolithic and continued up to Pottery Neolithic (10500 - 6500 BC), when it is slowly replaced by Starčevo-Criș culture. Artifacts

Fig. 59 Tabula Traiana was located on the military road constructed by the Romans between Lederata and Drobeta castra. Initially, the memorial plaque and the ancient road were 30 m below the water

of the Lepenski Vir-Schela Cladovei culture were discovered in Cuina Turcului, Climente cave, Veterani cave, Schela Cladovei, Căunița Hill, etc. (Bonsall and Boroneaț 2018, Boroneaț and Dinu 2006, Mărgărit et al. 2018, Radanovici 1996, Stîngă 1996, Sasel 1973). Because many archaeological sites were flooded by the water accumulated in the reservoir lock, today, they can be "explored" only by visiting the Iron Gates Region Museum in Drobeta-Turnu Severin.

The Iron Gates region was strategically important for the Romans, being a border area that must be defended; thus, several fortifications were built (Stîngă 1996). Among the first documented settlements are the Roman castrum Dierna (which means split in Latin), today Orșova, used for defending the road leading through the Cerna Valley to Tibiscum. Another important infrastructure influencing the entire Roman and post-Roman life is the Bridge of Apollodorus over the Danube River, built in 105, at the request of Emperor Traian, connecting the castra Pontes (Kladovo) and Drobeta (Fig. 59). This bridge, although functional for less than 170 years, demonstrated its capital importance, being used for moving the Roman troops in Dacia during the Second Dacian – Roman war and for bringing colonists to extract the gold ores. The construction of the bridge determined an increase in the habitation of the area, with several localities being developed after its construction (e.g., Drobeta, Dierna, Possesena, Lederata – castrum developed facing Baziaș, on the Serbian bank of the Danube River).

Subsequently to the Roman retreat during Aurelian's reign (271/273), the area became once more a border area, passing slowly under the Byzantine Empire's military control. Three defense towers resisted from the 13th to 14th centuries in Tricule, 4 km from Svinița. They were constructed with construction debris resulting from the destruction of the Svinița fortress. An interesting point for the park is the archaeological site from Coronini. The history of this site starts with a Dacian fortified settlement and continues with the Ladislau fortress, its ruins being visible today (APNPF 2013, Radanovici 1996, Stîngă 1996, Sasel 1973).

The region moves from the administration of the First Bulgarian Empire (9^{th} –11^{th} centuries) to the Hungarian administration. In 1233 joins the Severin Province, a military division with a defensive role within the Hungarian Kingdom. In 1522, the province went under the Ottoman Empire administration following the conquest of Timișoara by Ottoman soldiers (Temeşvar Eyalet). The Ottomans administrated the area overlapping the park from Moldova Veche (Mudava sanjak beg – a sanjak beg is a territorial administrative unit in Ottoman administration, smaller than eyalet) and Orșova (Irșova sanjak beg). Orșova remained for a long time a border town between Banat and Wallachia, the border passing through an area near Vârciorova (APNPF 2013, Radanovici 1996, Stîngă 1996, Sasel 1973).

As the Ottoman Empire got weak because of the conflict with the Austrians, the eyalet of Timișoara faced a series of uprisings that reduced the Ottoman authority over Banat, although the Karlowitz treaty confirmed the Turkish supremacy on the province. Starting in 1716, the Austrian Empire held *de jure* control of the area, which is once again included in the military border area. This remains until 1872. The Coronini settlement is established in this period by the Governor of Voivodeship of Serbia and Banat of Temeschwar, Johann Baptist Alexius Conte Coronini de Cronberg.

For the military consolidation of the border and the exploitation of resources (wood, coal), the migration of Czech population groups from Bohemia was encouraged. They have established new villages or communities in the old settlements. Thus, the Czech community in Banat was formed through three major migration waves (1823, 1827 and 1862).

The first colonists appeared in Elisabethfeld (Svatá Alžběta), a village that has now disappeared, its inhabitants establishing the village of Sfânta Elena (Svatá Helena) between 1824 and 1825, near Coronini (about 200 families from Klatov and Plzen that came for logging and charcoal production). A larger group arrived between 1827 and 1828, over 2000 people, a migration also coordinated by the military authorities. They have established the villages Bigăr (Bígr, town of Berzasca), Ravensca (Rovensko, town of Şopotu Nou), Gârnic (Gerník, town of Gârnic), Eibenthal (Tisové Údolí, Dubova town). The third migration wave did not lead to the establishment of new settlements, but consolidated existing ones. In time, the Czechs moved to other localities, such as Moldova Nouă, Berzasca, Liubcova, Orșova (Preda 2010, Stan 2013). The region was slowly demilitarized and moved in 1881 to civil administration as Krassó-Szörény (Caraș-Severin) County, which functioned until the union with Romania in 1918. The current border between Caraș-Severin and Mehedinți counties was established through the administrative division in 1968 (Ștefănucă 2010, Juan-Petroi 2016).

The *economy of Iron Gates Natural Park* has undergone a dramatic transformation, from an area where agriculture, logging, fishing and mining were dominant to one focused on hospitality. The mining industry has a centuries-old tradition; the first activities date back to the Roman Empire, which brought mine workers from Dalmatia (the eastern shore of the Adriatic Sea, in Croatia and part of Montenegro). After being overtaken by the Austrians, mining was resumed (copper, silver, gold, coal), even opening a mining school in Moldova Nouă. In 1833, a road between Orșova and Moldova Nouă was opened (currently partially flooded), and in 1854, the infrastructure was completed with a railway between Baziaș and Oravița (the coal way). This was the first railway with a standard gauge in Romania (Fig. 60). The remains of the railway embankment can still be seen today in Baziaș. After 1860, the mining activities suffer a decline, and until the 1950s we can speak of economic activities only in Orșova (shipyard, textile and food industry, wood processing, small oil refinery) and Moldova Nouă (iron and copper mining, food industry, ores transportation port). In addition, bituminous coal was exploited in Cozla – Bigăr, Eibenthal – Baia Nouă, and iron and copper between Plavișevița and Eșelnița.

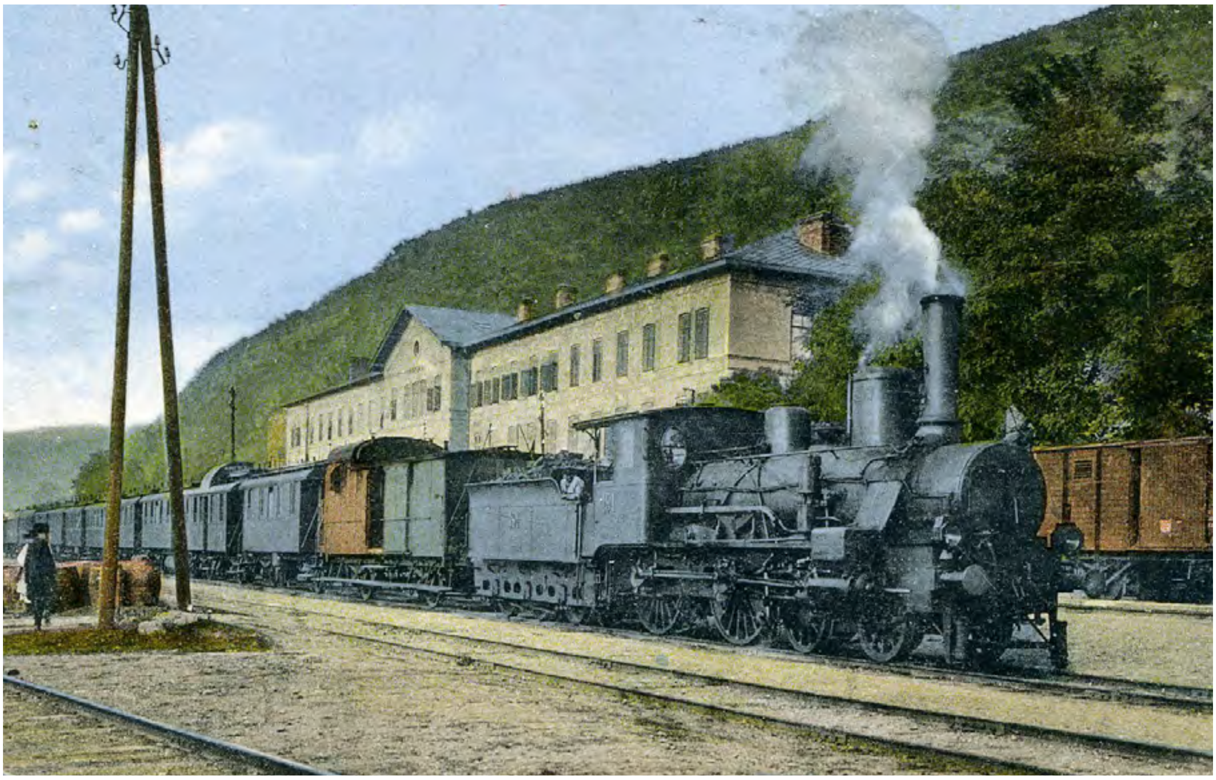

Fig. 60 Baziaș train station, final destination of the first railway on normal gauge in Romania. Only a small part of the embankment is still visible today

After World War II, other economic activities rose, especially related to the mining industry: serpentinite in Berzasca, Iuți, Svinița, Eibenthal and Tisovița, amphibolite in Tisovița, Eibenthal, and Plavișevița, quartz in Orșova, crystalline limestone in Mraconia, bentonite in Tufări (Orșova), coal in Bigăr and Cozla, copper and nonferrous ores in Moldova Nouă (both surface exploitation and mine exploitation), uranium in Ilișova – Grabetina (Glăvan 2002, Grecu and Iosif 2014, Popa 2003).

Almost all of these mining activities have ended, but some still represent significant pollution sources, for example, the ores processing facilities and mines from Cozla, Ilișova-Grabetina, and Moldova Nouă. In Moldova Nouă region, several sources of pollution are beyond the control of Iron Gates Natural Park or local authorities, such as the ores exploitation and procession areas, as well as sterile deposits near Moldova Veche island (Matache et al. 2013, Matache et al. 2003, Matache et al. 2002). The tailing ponds are uncovered; thus during the dry and windy periods, the fine fraction of the sterile covers the entire region (Fig. 61). Authorities during the communist era also aimed to create tailing ponds on Moldova Veche Island, but they faced protests from the

Fig. 61 Sterile deposit located near Moldova Nouă, remains of copper exploitation. Today, it is a major pollution source of the environment

Fig. 62 Ponds in Moldova Veche Island. These were constructed as sterile settling ponds, but the solution was abandoned due to the high risk of transboundary pollution

Yugoslavian authorities, so the plan was unsuccessful. Traces of this attempt still exist today, for example, the unfinished bridge between the river bank of the Danube and the island and the ponds on the island (Fig. 62).

Landscape protection represents one of the the main goals of Iron Gates Natural Park. It aims to maintain the harmonious interaction between man and nature and ensure habitats and landscape diversity. To achieve this goal, the park administration promotes the traditional use of land and encourages the local population to continue traditional activities. Several categories of landscapes have been identified within Iron Gates Natural Park, considering physical-geographical, ecological, historical, economic, and socio-cultural elements (CCMESI 2014, Niculae et al. 2014).

The natural landscape is the one resulted from the action of nature, being perceived as such by the local population and tourists.

Within Iron Gates Natural Park, the physical – geographical component leads to many natural landscapes, where people did not contribute to changing their structure and functionality. The park area overlaps three mountain subunits, Locvei, Almăjului, and Mehedinți Mountains, and a plateau unit, the Mehedinţi Plateau. We can delimit several subtypes of relief characteristics induced landscapes depending on the characteristics of the environmental components.

Mountain ridges landscape. Crystalline, sedimentary, and magmatic rocks characterise the mountainous units within the protected area. This lithological structure determines a series of landscapes characteristic of the Iron Gates Natural Park. In the Locvei Mountains, exhibiting lower altitudes, the mountainous ridges are wide, alternating with karst table lands, especially in the areas where limestone rocks are dominant. Magmatic rocks, present as intrusions, generate specific landscapes, especially in Moldova Nouă. The Almăjului Mountains, present by two massifs in the park - Ravensca and Svinecea - are shaped by limestone and volcanic rocks, creating gorge-like sectors and pseudo-volcanic relief (e.g., Trescovăț peak). In the southern sector of the Mehedinţi Mountains and Mehedinți Plateau, the landscape is dominated by soft ridges and wide tablelands. This landscape subtype is completed by steep slopes, especially along rivers and streams carved in limestone and crystalline structure.

Depression-like landscape. There are two types of depression-like structures in Iron Gates Natural Park: sedimentary and tectonic. They are individualised

Fig. 63 Nera wetland formed at the confluence of the Nera river with Danube. In this area, Nera river represents the state border with Serbia

in landscapes through a hilly aspect, having mainly agricultural use and a high density of rural and urban settlements. Among the small mountain depressions within the park, we mention the Moldova Nouă depression, Liubcova (Miocene sedimentary basin), Dubova, and the Ogradena-Orșova depression (tectonic basin). These allowed the development of some retention basins, for example, the Radimna, Valea Mare, Camenița and Liborajdea river mouths.

Floodplain and terraces landscape. The park area is characterised by a dense hydrographic network. The presence of depression-like structures, along with the lithological diversity, allowed the formation and development of floodplain units and terraces. The floodplains have formed mainly along the main rivers (e.g., Nera - Fig. 63, Radimna, Liborajdea, Berzasca), at the confluence with Danube River, where bay-like structures appeared. The terraces supported the development of rural settlements and crop establishment, leading to a specific landscape that was easily visible in the field. Such examples are the terraces formed in the Liubcova basin, where intensive crop farming is present.

Valley landscape. The dense hydrographic network determines the high fragmentation of the land. Therefore, in upstream river valleys, the landscape has narrow valleys and steep slopes (e.g., Berzasca, Sirinia, Eșelnița, Tisovița). Along Danube River, the valley's aspect changes in the sector overlapping the park; the narrowed sectors alternate with the small mountain depressions. Examples of narrowed sectors are the Nera Valley—Ribiș Valley, Coronini-Alibeg, Berzasca-Greben, Iron Gates Gorges, and Vârciorova-Gura Văii. In alternate with the narrowed sectors, a series of enlargement sectors are visible (depressions), such as Moldova Nouă depression (between Belobreșca and Coronini), Liubcova depression, Greben-Plavișevița enlargement area, Ogradena-Orșova depression.

Outcrops and bare rocks landscape. The complex lithological structure is well individualised in the landscape by the presence of bare rocks and multiple outcrops along the roads and valleys. Many of them represent landmarks and geological and palaeontological reserves: the suspended fold from Munteana-Dumbrăvița, Bahna and Svinița, Cozla, Baia Nouă reserves, Severin Nappe outcrops between Vârciorova and Slătinic Valley. In areas where quaternary loess deposits are predominant, steep banks formed, becoming nesting areas for several species of birds.

Another category of natural landscape is determined by the main vegetation formations of the Iron Gates - *vegetation induced landscape*.

Forest landscape. Forest occupies a large surface within the protected area. They usually include broadleaf forests and mixtures of broadleaf and coniferous species. Although most of the forest surfaces were plantations, they represent a subcategory of natural landscapes, as they show a high degree of naturality. The forest landscape is dominated by broadleaf species such as beech, sessile oak, and thermophilic species (pubescent oak, Hungarian oak, Turkey oak).

Grasslands landscape. Grasslands occupy smaller surfaces in the park compared to forests. They are located between forest surfaces and agricultural fields, suffering significant changes induced by human activities. Natural grasslands are, together with forest areas, the main element to be considered when assessing the degree of naturality of a certain area. Grasslands appear in the landscape through xeromesophilic associations (on sun-exposed slopes) and xerothermic associations (on limestones and shales).

Southeastern deciduous thickets landscape. The southeastern deciduous thickets grow mainly on steep slopes within the park. This landscape occupies large surfaces in the Almăjului Mountains and includes several sub-Mediterranean species such as the oriental hornbeam, south European flowering ash, lilac, smoke tree, and mahaleb cherry. This landscape resulted as a secondary landscape after logging thermophilous forests (Matacă, 2005).

Anthropic landscapes emerged due to changes induced in the initial natural landscapes by the expansion of human settlements, intensification of agricultural activities, densification of transportation networks, changes in land use, and industry development (Niculae et al. 2014).

Industrial landscape. Industrial activities do not occupy large surfaces in Iron Gates Natural Park. After 1989, the industrial decline in Romania also affected the activities in the region. No matter if we speak about the exploitation of the ore from Moldova Nouă or the coal exploitation from Cozla (Fig. 64), Baia Nouă or Eibenthal, or other resources explored in the past (kaolin, serpentinite, clays), today, these activities are almost stopped and induced a residual industrial landscape. In addition to those activities mentioned above, we can add the quarries (e.g., Sereacova, Stariște), rock aggregate processing plants (e.g., Ponicova, Liborajdea, Orșova) and storage facilities (e.g., Svinița). Several activities are still active, focusing mainly on the extraction of sands, gravel, and construction rocks, the last ones mainly exploited in quarries (e.g., Gura Văii). The harbors and the activities of the harbor complete the industrial landscape. The most important are those in Orșova and Moldova Veche. Some other harbors and docks exist, their naval transportation infrastructure being in the state public ownership, with a much lower activity (e.g., Drencova, Pojejena, Baziaș, Svinița, Tisovița, Dubova) (APNPF 2013). Another important industrial activity, well developed within the park, is represented by the electric power industry, which also creates a specific landscape. We mention the Iron Gate I Hydroelectric Power Station, which has existed since 1964. Renewable energy sources complement this type of landscape, respectively, the wind farms in Sfânta Elena (Fig. 65) and Toplleț.

Agricultural landscape. Agricultural use of land leads to the identification of several landscapes: landscapes determined by arable land, covered by cereal crops, orchard landscapes, and landscapes determined by hayfields and grasslands. These have a wider development within floodplains and low areas, but also in karstic tablelands and soft mountainous ridges.

Fig. 64 Cozla pond, formed behind a dam part of the mining facilities

Social-demographic characteristics made their mark in outlining the urban and rural anthropogenic landscape. Thus, the number of inhabitants within the localities and the occupied surface determine specific landscapes. Urban landscapes are represented by the cities of Orșova (Fig. 66) and Moldova Nouă. The rural landscape is specific to the more than 50 villages within the park territory, belonging to 17 administrative units.

Settlements with a larger number of inhabitants are located in low-altitude areas along the Danube River and in other valleys where the floodplain is well developed. Their distribution follows the transportation network. Those settlements with fewer inhabitants are on plateaus and soft mountain ridges, while those with a larger number of inhabitants are in floodplains. Several types of rural landscapes were delimited depending on the number of inhabitants. The landscape of small and very small villages includes villages below 500 inhabitants, that is, more than 28 villages in Iron Gates Natural Park (e.g., Eibenthal, Cârșie, Brestelnic, Valea Ravensca, Bigăr - Fig. 67). The landscape of average-sized villages is characteristic to the villages with a population between 500 and 1000 (for example, Gornea). The landscape of large and

Fig. 65 Sfânta Elena Wind Farm constructed near Coronini town

Fig. 66 Orșova seen from Alion Hill

Fig. 67 Agricultural landscape characteristic to small villages in Banat. Hayfields and crops in Bigăr (Berzasca town)

very large villages includes settlements with more than 1000 inhabitants (e.g., Eșelnița, Berzasca, Pojejena, and Sichevița) (APNPF 2020).

From a structural point of view, most villages are compact and crowded along the valleys and transportation network. Furthermore, there are many dispersed villages characterized by very small populations, less than 100 inhabitants (very small villages).

Iron Gates Natural Park area is famous for its culture and historical heritage. This grants a remarkable value compared to other protected areas in Romania. The cultural-historical landscape includes two types of heritage elements: tangible cultural heritage and intangible cultural heritage (Grigorovschi et al. 2007).

The *tangible heritage* represents what is visible and can be easily identified within the landscape by an observer, representing a key component of the historical cultural heritage. This category includes buildings classified as historical monuments, museums (e.g., Village Museum in Gornea, Iron Gates Hydroelectrical Power Plant Museum), ruins of certain fortresses, and other historical artifacts (e.g., ruins of the fortresses Ladislau, Drencova, Tricule),

Fig. 68 The Mraconia Monastery was constructed on a former observation point of the Danube navigation

buildings of high architectural value, traditional households (e.g., traditional households within villages with Czech dominant population - Eibenthal, Gârnic, Sfânta Elena and with dominant Serbian population - Belobreșca, Svinița), archaeological sites (dating from Palaeolithic and Neolithic such as the archaeological sites from Sichevița, Gornea, Schela Cladovei), religious monuments and buildings, respectively churches, monasteries (monasteries Vodița, Sfânta Ana, Mraconia (Fig. 68), Baziaș, Roman – Catholic Church in Orșova), various craft objects and traditional products (Fig. 69).

The tangible heritage is completed by a series of elements offering a specific identity to Iron Gates Natural Park, known in the literature as the elements of local heritage, e.g., water mills, statues, and commemorative plaques. Another component of tangible heritage is represented by the elements of private space that define the local identity of the natural park, for example, photos, furniture and different documents of historical value.

The *intangible heritage* specific to local communities in Iron Gates Natural Park aims to complement the cultural-historical landscape. Intangible heritage is defined by intangible components (goods), which can also be present in the

Fig. 69 The mild climate allowed the growth of figs in the Iron Gates area. Traditional products prepared from figs are available for purchase in villages along Danube

landscape. This category includes local customs, holidays, festivals, and fairs. For example, here we mention the Danube Villages Festival, The Fig Festival (Svinița), the patronal festivals named *Nedeia* (Eşelnița, Dubova) and *Ruga* (Sichevița, Pojejena), *Farsane* (a holiday of the Czech community in Eibenthal) and Iron Gates Natural Park Days.

Iron Gates Natural Park biodiversity

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Iron Gates Natural Park is a biodiversity hotspot in Romania (Rozylowicz et al. 2019) due to its unique local climate generated by the coupling of humid continental and Mediterranean climates and the high diversity of landforms and geological structures. Furthermore, local communities contributed to the presence of high biodiversity by promoting nature-friendly activities over centuries (APNPF 2013).

The biodiversity of the Danube valley between Baziaș and Drobeta-Turnu Severin is well studied, mostly because of the extensive research performed before the construction of the Iron Gates I hydroelectric power system (1960) and after 2000. Because forests and grasslands ecosystems far from the Danube River were less studied, there is a tendency to consider the Iron Gates Natural Park as a synonym of Iron Gates Gorges, although its largest part is occupied by beech and oak forests and hayfields. Among the most important surveys performed here, we mention those of the Iron Gates Complex Research Group of the Romanian Academy in the 1960s, Iron Gates Region Museum in Drobeta-Turnu Severin, Banat National Museum in Timișoara, University of Bucharest and Babeș-Bolyai University (Matacă 2003, Drăgulescu 2014, Iana and Petcu 1976, Ionescu 1975, Iancu and Popovici 1976, Milanovici 2012, Goia et al. 2017, Goia and Oprea 2014, Goia et al. 2014).

From a biogeographical perspective, Iron Gates Natural Park includes habitats specific to the Continental and Alpine European biogeographical regions (Tab. 3, APNPF 2020), with a slight Mediterranean influence favoured by the air masses movement along the Danube valley. These characteristics contributed to the development of forests, shrubs, and grasslands specific to Central Europe (e.g., Medio-European and Dacian beech forests) and the

Tab. 3 Habitats of Community importance in Iron Gates Natural Park (APNPF 2020)

Vegetation	Natura 2000 habitat
Aquatic vegetation	3140 Hard oligo-mesotrophic waters with benthic vegetation of *Chara* spp. 3150 Natural eutrophic lakes with Magnopotamion or Hydrocharition -type vegetation 3160 Natural dystrophic lakes and ponds 3260 Water courses of plain to montane levels with the Ranunculion fluitantis and Callitricho-Batrachion vegetation 3270 Rivers with muddy banks with Chenopodion rubri pp and Bidention pp vegetation
Riparian and swamp vegetation	6430 Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels 6440 Alluvial meadows of river valleys of the Cnidion dubii
Steppic, mesophilous grasslands and hayfields	6110* Rupicolous calcareous, basophilic grasslands of the Alysso-Sedion albi 6190 Rupicolous Pannonian grasslands (Stipo-Festucetalia pallentis) 6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco-Brometalia) (* important orchid sites) 6240* Sub-Pannonic steppic grasslands 6250* Pannonic loess steppic grasslands
Low altitude scrub	40A0* Subcontinental peri-Pannonic scrub 40C0* Ponto-Sarmatic deciduous thickets
Riparian forests	91E0* Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (Alno-Padion, Alnion incanae, Salicion albae) 92A0 *Salix alba* and *Populus alba* galleries
Oak, oak and beech forests	9160 Sub-Atlantic and medio-European oak or oak-hornbeam forests of the Carpinion betuli 91AA Eastern white oak woods 91L0 Illyrian oak-hornbeam forests (Erythronio-carpinion) 91M0 Pannonian-Balkanic turkey oak–sessile oak forests 91Y0 Dacian oak & hornbeam forests 9170 Galio-Carpinetum oak-hornbeam forests
Beech, Beech and coniferous forests	9150 Medio-European limestone beech forests of the Cephalanthero-Fagion 91K0 Illyrian *Fagus sylvatica* forests (Aremonio-Fagion) 91V0 Dacian Beech forests (Symphyto-Fagion) 9110 Luzulo-Fagetum beech forests 9130 Asperulo-Fagetum beech forests
Black pine	9530* (Sub-) Mediterranean pine forests with endemic black pines
Rocky slopes and screes vegetation	8210 Calcareous rocky slopes with chasmophytic vegetation 8120 Calcareous and calcschist screes of the montane to alpine levels (Thlaspietea rotundifolii) 8220 Siliceous rocky slopes with chasmophytic vegetation 8230 Siliceous rock with pioneer vegetation of the Sedo-Scleranthion or of the Sedo albi-Veronicion dillenii 9180* Tilio-Acerion forests of slopes, screes and ravines

Balkans (e.g., Turkey oak and Sessile oak forests) (Matacă 2005, Matacă 2000a, Matacă 2001, Călinescu 1969, Călinescu and Iana 1964, Boșcaiu et al. 1982, Hurdu et al. 2012, Sanda et al. 2008). Forest dominates the landscape of Iron Gates Natural Park; however, they are mostly young forests, a consequence of past logging for mining activities in Banat (e.g., Cozla, Eibenthal-Baia Nouă, Orșova) (APNPF 2013, APNPF 2020, Matacă 2005).

The main characteristics of Iron Gates Natural Park habitats are detailed below. The scientific nomenclature of taxa is from Natura 2000 Standard Forms.

Aquatic and riparian habitats

The Danube River and the main tributary rivers promoted the presence of several aquatic habitats and plant species protected under European legislation (MMAP 2021a, Goia et al. 2017, Goia and Oprea 2014, Matacă 2002a, Matacă 2005, Donită et al. 2005, APNPF 2020).

The water bodies with slow flow rate, almost stagnant and rich in nutrients (because of vegetation decomposition) are inhabited by floating vegetation, namely natural eutrophic lakes with Magnopotamion or Hydrocharition vegetation. In such areas, one can observe plant species such as common duckweed (*Lemna minor*), floating ferns (*Salvinia natans*, Fig. 70), frogbit (*Hydrocharis morsus-ranae*), or pondweed (*Potamogeton* ssp.). All these species are frequently present in the wetlands located at the end of Iron Gates I reservoir, such as Nera, Divici, Șușca, Pojejena, Belobreșca, or on the Danube riverbank, where the water flow is slow. These plant species can be observed in the bays at the confluence with several rivers such as Slătinic, Vodița, Orșova, Eșelnița, Mala, Dubova, Liubcova, and Tricule).

In areas where the depth of the water does not exceed 2 meters, and the mineralisation is greater due to the decomposition of vegetation, we can distinguish habitats specific to dystrophic natural lakes and ponds. Such habitats can be easily recognised by the water chestnut (*Trapa natans*, Fig. 71) and the white waterlily and yellow waterlily (*Nymphaea alba*, *Nuphar luteum*). In addition to the shallow waters of the Danube River, water chestnuts and waterlilies are found on Moldova Veche island, Calinovăț island, upstream of the Grăniceri Valley, and the confluence of Sirinia with Danube (MMAP 2021a, Goia et al. 2017, Goia and Oprea 2014, Matacă 2005, APNPF 2020, Chira et al. 2012).

Fig. 70 Floating fern (*Salvinia natans*)

Fig. 71 Water chestnut (*Trapa natans)*

Vegetation communities of goosefoots (*Chenopodium* spp.) and *Bidens* spp. (rivers with muddy banks with Chenopodion rubri pp and Bidention pp vegetation) are found along small rivers with muddy banks, tributaries to the Danube, mainly near human settlements. Additionally, these species can inhabit the nonrocky banks of the Danube. For example, Chenopodion rubri pp and Bidention pp vegetation can be seen on Vodița valley, Orșova, Ilovița valley, Liubcova, Sirinia valley, Liborajdea, Dubova, Mraconia valley, on Danube riverbank in Berzasca, and on Cozla wetland (Goia et al. 2017, Goia and Oprea 2014, APNPF, Matacă 2005, 2013).

Shrub habitats

Another group of habitats that are characteristic of this region are the subcontinental peri-Pannonic scrub of blackthorn (*Prunus spinosa)* with European spindle (*Evonymus europaeus*) and common hawthorn (*Crataegus monogyna*) (APNPF 2020, Matacă 2005, Doniță et al. 2005). They grow mainly after oak logging, on areas with compact or less developed soils, along creeks dry in summer, and on the forest edges.

A variation of peri-Pannonic shrubs includes common lilac shrubs (*Syringa vulgaris*), and southern greenweed (*Genista radiata*). This habitat is found in the Iron Gates Gorges (Cazane) and in the hills of the Orșova Gura Văii area. It includes plant species such as the common lilac, the smoke tree (*Cotinus coggygria*, Fig. 72), and many saxicolous species (Matacă 2005, Călinescu 1957, Roman 1974). Another form of peri-Pannonic shrubs includes the common lilac shrubs, and the fern known as wall-rue (*Asplenium ruta-muraria*). This variation, present on Ciucarul Mare peak from Iron Gates Gorges (Cazane), can be identified by the sparsity of shrubs (common lilac, smoke tree, and oriental hornbeam). Furthermore, the peri-Pannonic shrubs' habitats within beech forests on limestone include the colorful rowan (*Sorbus dacica*) and the common hazel (*Corylus avellana*).

Other rare shrubs habitats in Romania but covering significant areas within Iron Gates Natural Park are those with South European flowering ash (*Fraxinus ornus*), Cornelian cherry (*Cornus mas*), and Jerusalem thorn (*Paliurus spina-christi*, Fig. 73) and South European flowering ash with lilac and Montpellier maple (*Acer monspessulanum,* Fig. 74). These two rare habitats are found e.g., near Cărbunari, Jidoștița, Streneacu Mic valley, Nucului Creek, Glodu

Fig. 72 Smoke tree shrubs (*Cotinus coggygria*)

Fig. 73 Jerusalem thorn (*Paliurus spina-christi*)

Fig. 74 Montpellier maple (*Acer monspessulanum*)

Mic Creek, Ilovița, north of Orșova, Eșelnița, Bigăr, Cozla, Liubcova, Gornea Sichevița, Moldova Nouă, between Moldova Veche and Măcești, Pojejena (APNPF 2020, Matacă 2005, Doniță et al. 2005).

Grasslands, screes and rupicolous habitats

Iron Gates Natural Park is also the home of rare grassland habitats, for example, grasslands with stonecrops (*Sedum* spp.) and *Allium montanum*, a species similar to chives. This grassland habitat is present on some screes from calcareous and siliceous areas, for example, on screes and rocky slopes in Cazanele Mari, Saraorschi valley, Baziaș, Fețele Dunării, Coronini, and Svinița.

Seminatural dry grasslands on calcareous substrates are specific in areas with limestones and soft slopes. They are the result of scything the grasslands for hay, resulting in impressive floristic diversity, with numerous species of interest for conservation, such as orchids. Such grasslands, dominated by Volga fescue (*Festuca valesiaca*), are found on forest openings in Sirinia valley, at Măcești, Sfânta Elena and on hills near Eșelnița (APNPF 2020, Matacă 2005).

On soft to moderate slopes and flat areas with better-developed soils, we can observe patches of rupicolous Pannonian grasslands, dominated by herbaceous species such as Volga fescue (*Festuca valesiaca*) and feather

Fig. 75 Needle sunrose (*Fumana procumbens*)

grass (*Stipa* spp.). These grasslands, sometimes used as hayfields, are widely spread in the Iron Gates, being present in Eșelnița, Svinița, Orșova, Ilovița, Cazanele Mari, Saraorschi valley, downstream from Moldova Nouă, Tricule, Oglănic valley, Tisovița (APNPF 2020, Matacă 2005, Roman 1974, Coste 1975).

Grasslands developed on clayey and sandy soils are well represented in Iron Gates Natural Park. These Pannonian loess steppic grasslands have as dominant species the furrowed fescue (*Festuca rupicola*). They are used as hayfields or grazed. Such grasslands are found along Cărbunari creek, Sfânta Elena creek, at Ilovița, between Ilovița and Orșova, north of Dubova, at Plavișevița, north of Eibenthal on Zrovana creek, north of Baia Nouă, on Povalina Mică valley, at Strenica, Brestelnic valley, Podul creek, at Ravensca Mică, east of Moldova Nouă, on Măceștilor valley, on Moara Potoc valley, on Brezasca valley, north of Moldova Veche on Valea Mare, on Cracu Lung creek, north of Belobreșca, on Camenița valley, on Popii valley and north of Baziaș. Sometimes, among the plant species of these grasslands, we can spot the needle sunrose (*Fumana procumbens*, Fig. 75), a species the is usually present on sand dunes near the Black Sea.

Fig. 76 Banat mouse-ears chickweed (*Cerastium banaticum*)

Quite frequently in the park are lowland hay meadows with common meadow-grass (*Poa pratensis*), meadow festuca (*Festuca pratensis*), and meadow foxtail (*Alopecurus pratensis*). These are present around Orșova, in Eșelnița, Dubova, and the western part of the park, mostly near Danube River (APNPF 2020, Matacă 2005, Roman 1974, Coste 1975).

Herbaceous communities with tall herbs appear at the forest edges from low to higher elevations. In these habitats, we can find the heartleaf oxeye (*Telekia speciosa*), the Norwegian angelica (*Angelica archangelica*), the hairy willowherb (*Epilobium hirsutum*), the herb robert (*Geranium robertianum*), the large yellow loosestrife (*Lysimachia punctata*) and the purple loosestrife (*Lythrum salicaria*) (APNPF 2020, Matacă 2005).

Chasmophytic habitats on screes, calcareous and siliceous rock slopes are present on small patches from lowland to higher elevations. In these plant communities, we can find colourful herbaceous species such as Banat mouse-ears chickweed (*Cerastium banaticum*) (Fig. 76), Comosus thyme (*Thymus comosus*), hedge bedstraw (*Galium mollugo*), mountain germander (*Teucrium montanum*), Carpathian bellflower (*Campanula carpatica*), Iron Gates bellflower (*Campanula crassipes*, Fig. 77), lesser Londonpride (*Saxifraga cuneifolia*) and

Fig. 77 Iron Gates bellflower (*Campanula crassipes*)

Fig. 78 Greater pasque (*Pulsatilla grandis*)


Fig. 79 Turkey oak (*Quercus cerris*)

the greater pasque flower (*Pulsatilla grandis*, Fig. 78) (APNPF 2020).

Forest habitats

The forest habitats of Iron Gates Natural Park are also influenced by the geographical position closer to the Balkans, the lower elevation of the Almăj and Locva Mountains, and the chemistry of soils developed on various rocks (calcareous, siliceous, basaltic) (Roman 1974, Coste 1975, Matacă 2005). The most frequent forests in Iron Gates Natural Park (present on over 20000 ha) are oak (e.g., Turkey oak, Hungarian oak, and common oak) and hornbeam forests, named Dacian oak and hornbeam forest habitats. Next as extent are the beech (*Fagus sylvatica*) and hornbeam forests (present on over 17000 ha) and the Illyrian beech forests (present on over 15000 ha). The latter host species of interest for conservation, such as the butcher's broom and the spineless butcher's broom (*Ruscus aculeatus*, *Ruscus hypoglossum*) and the spurge laurel (*Daphne laureola*). Furthermore, over 13000 ha of Iron Gates surface are covered by Pannonian-Balkanic Turkey oak forests (*Quercus cerris*, Fig. 79), i.e., xero-mesophilous forests where Turkey oak, common linden, and European hornbeam are characteristic tree species (APNPF 2020).

Fig. 80 Beech (*Fagus sylvatica*)

Other forest habitats represented in Iron Gates Natural Park occupy reduced surfaces. For example, Luzulo-Fagetum beech forests (beech forests on acidic soils) are patchily present in the park, for example, around Haiducilor cavern, near Gârnic, in Gărâna Mică, and the upper part of Eșelnița watershed.

The beech forests with woodruff (Asperulo-Fagetum beech forests) are present in small areas in Măcești - Purvareca valley, Moldovița, Găurii valley, Ilovița, at the northern border of the park, Slătinicu Mare, Vodița valley, Morilor valley, Berzasca, north of Moldova Nouă, at Padina Brădiceana, Radimnuța valley, Radimna valley, Pojejena, Pârva Reca, Măceștilor valley. Medio-European limestone beech forests of the Cephalanthero-Fagion group are found mainly on dry soils on limestone, such as in Baia Nouă, Popasca Creek, Cârșa Roșie, Fântâna Prisaca, Cremenița. Another type of forest, patchily distributed throughout the park, is the Dacian forest with sessile oak (*Quercus petraea*), beech (*Fagus sylvatica*, Fig. 80) and European hornbeam (*Carpinus betulus*) with Carex pilosa (Galio-Carpinetum oak-hornbeam forests). This type of forest is present in the forest regeneration areas after logging.

More rarely, we may spot forests of slopes, screes, and ravines with linden and sycamore maple (Tilio-Acerion forests of slopes, screes, and ravines), characteristic of the lower area of steep and narrow valleys. Weakly represented, mainly because of disappearance of meadows subsequently to Iron Gates I reservoir construction, are the alluvial forests with European ash (*Fraxinus excelsior*) and black alder (*Alnus glutinosa*) and riparian forests of white willow (*Salix alba*) and white poplar (*Populus alba*). A habitat of high conservation interest, with only a few patches in the park, is that of Mediterranean pine forests with endemic black pines (*Pinus nigra*). This habitat with black pine is present near Moldova Nouă, west of Șvinița, Tisovița and Liubotina watersheds and at "Fețele Dunării" (Matacă 2005, Pătroescu et al. 2007).

Protected plant species of Iron Gates Natural Park

The biodiversity of Iron Gates Natural Park greatly interested botanists and nature lovers, being one of the most studied and visited regions in Romania. Thus, experts have described over 1600 taxa (species, subspecies) of flowering plants, about 200 of which are rare, vulnerable, or endangered (APNPF 2020). Additionally, 14 plant species present here are protected under European legislation, with another 102 being protected through international conventions or are considered rare or vulnerable in Romania (APNPF 2020).

The Natura 2000 sites that overlap the area protect, among other plant species, the ladder spleenwort (*Asplenium adulterinum*), present between Ogradena and Tisovița, the hairy agrimony (*Agrimonia pilosa*), a Rosaceae with yellow flowers found on Slătinic valley, the meadow saffron (*Colchicum arenarium*) that is found only on Moldova Veche island, the red-flowered viper's grass (*Echium russicum*, Fig. 81) a *Boraginaceae* with red flowers found on the grasslands from Schela Cladovei, Svinița and Eibenthal, the rare orchid *Himantoglossum caprinum* (Fig. 82), which grows in the hayfields and forest openings from Svinița, Tisovița, Plavișevița, Vârciorova and Belobreșca, the common peony (*Paeonia officinalis* subsp. *banatica*, Fig. 83), a species present in the forest openings and Oriental hornbeam forests of Baziaș, the greater pasque flowers (*Pulsatilla grandis*, Fig. 69) found at Cracul Găioara, the Danube feathergrass (*Stipa danubialis*), an endemic herbaceous species present only in the Cracul Găioara area together with another rare species, the pennycress (*Thlaspi jankae*). In the ponds of Moldova Veche island, one can discover the four-leaf clover (*Marsilea quadrifolia*, Fig. 84), while in the Iron Gates Gorges (Cazane), we can spot late in the spring the yellow flowers of

Fig. 81 Red-flowered viper's grass (*Echium russicum*)

Fig. 82 Lizard orchid (*Himantoglossum caprinum*)

Fig. 83 Common peony (*Paeonia officinalis* subsp. *banatica*)

Fig. 84 TFour leaves clover (*Marsilea quadrifolia*)

the Danube tulip (*Tulipa hungarica*, Fig. 3) (Roman 1974, Coste 1975, APNPF 2020, Matacă 2005, Milanovici 2014, Matacă 2000).

Protected wildlife from Iron Gates Natural Park

The diversity of wildlife is as that of spectacular as one of the plant species. The park hosts more than 5000 species of invertebrates (for example, molluscs, crustaceans, insects, and spiders), more than 60 fish species, 14 species of amphibians, 17 reptile species, and more than 270 bird species (APNPF 2020, MMAP 2021a, MMAP 2021b, MMAP 2021c).

23 bat species of interest for conservation (that is, protected by the Habitats Directive) live in Iron Gates Natural Park (Tab. 4). They live in colonies or solitary occupying natural (caves, caverns, tree hollows) and artificial habitats (abandoned mine galleries, house attics). Bats, flying mammals important for insects' control, find habitats for reproduction and hibernation in areas such as Grota Haiducească cave, Gaura cu Muscă cave, Gura Ponicovei cave, tunnels from Gura Văii, tunnels from Baziaș, Veterani cave, Padina Matei cave, Peștera cu Apă cave from Ceuca Valley, Baia Nouă mine. (APNPF 2020).

The most frequent species belong to the *Pipistrellus* genus, for example,

Fig. 85 Common pipistrelle (*Pipistrellus pipistrellus*)

Tab. 4 Protected bats in Iron Gates Natural Park (APNPF 2020)

Species	**Common name**
Rhinolophus blasii	Blasius's horseshoe bat
Rhinolophus euryale	Mediterranean horseshoe bat
Rhinolophus ferrumequinum	Greater horseshoe bat
Rhinolophus hipposideros	Lesser horseshoe bat
Rhinolophus mehelyi	Méhely's horseshoe bat
Miniopterus schreibersii	Common bent-wing bat
Barbastella barbastellus	Barbastelle
Plecotus austriacus	Grey long-eared bat
Plecotus auritus	Brown long-eared bat
Eptesicus nilssonii	Northern bat
Eptesicus serotinus	Serotine bat
Nyctalus noctula	Common noctule
Pipistrellus pipistrellus	Common pipistrelle
Vespertilio murinus	Parti-coloured bat
Myotis bechsteinii	Bechstein's bat
Myotis blythii	Lesser mouse-eared bat
Myotis capaccinii	Long-fingered bat
Myotis dasycneme	Pond bat
Myotis daubentonii	Daubenton's bat
Myotis emarginatus	Geoffroy's bat
Myotis myotis	Greater mouse-eared bat
Myotis mystacinus	Whiskered bat
Myotis nattereri	Natterer's bat

the common pipistrelle (*Pipistrellus pipistrellus*, Fig. 85), a species that can eat over 2000 mosquitos in one night, and the common bent-wing bat (*Miniopterus schreibersii*), a species that can form colonies of hundreds and thousands of individuals in underground locations. Also common are the lesser horseshoe bat (*Rhinolophus hipposideros*) and the greater horseshoe bat (*Rhinolophus ferrumequinum*), species with the most sophisticated ultrasound emission system. Barbastelle (*Barbastella barbastellus*, Fig. 86) and the Bechstein bat (*Myotis bechsteinii*) are average-sized bat species that, during the summer,

Fig. 86 Barbastelle (*Barbastella barbastellus*)

Fig. 87 Greater mouse-eared bat (*Myotis myotis*)

Fig. 88 Daubenton's bat (*Myotis daubentonii*)

find shelter in tree hollows of broadleaf forests. The lesser mouse-eared bat (*Myotis blythii*) and the greater mouse-eared bat (*Myotis myotis*, Fig. 87) form colonies of hundreds of individuals in abandoned buildings, church towers, and underground shelters. Other bats, such as the long-fingered bat (*Myotis capaccinii*), the pond bat (*Myotis dasycneme*), and the Daubenton bat (*Myotis daubentonii*, Fig. 88), hunt mostly on water surfaces. Frequently we might notice the common noctule (*Nyctalus noctula*) and the serotine bat (*Eptesicus serotinus*) (APNPF 2020, Bücs et al. 2021).

Of the terrestrial and aquatic mammals present in Iron Gates, other than bats, 10 species are protected by European legislation (Habitats Directive), and other 14 are protected by international conventions (Bern Convention) or are rare or vulnerable in Romania (APNPF 2020).

Among the mammal species protected by EU legislation, representative ones are the European otter (*Lutra lutra*, Fig. 89), found along the Danube and the tributary rivers; the European wildcat (*Felis sylvestris*), a feline that can be found throughout the park; the gray wolf (*Canis lupus*), a species that hunts in small packs; the brown bear (*Ursus arctos*), a species with few individuals in the park, mainly in the Mraconia valley, Plavişeviţa valley, Tişoviţa valley, and

Fig. 89 89 European otter (*Lutra lutra*)

Fig. 90 Hazel dormouse (*Muscardinus avellanarius*)

Fig. 91 Beech marten (*Martes foina*)

Sirinia valley; the Eurasian lynx (*Lynx lynx*), a rare feline present in all forest habitats; the European ground squirrel (*Spermophillus citellus*), found only on the hills of Nera wetland area; the forest dormouse (*Dryomys nitedula*); the hazel dormouse (*Muscardinus avellanarius*, Fig. 90); the European pine marten (*Martes martes*); the beech marten (*Martes foina*, Fig. 91) and the European polecat (*Mustela putorius*) (APNPF 2020, Ionescu 1975).

Compared to other regions in Romania, amphibian species are very well represented in Iron Gates Natural Park, with 15 species out of the 23 present in Romania, a consequence of the mild climate and the variety of ecosystems (lakes, grasslands, forests) (APNPF 2020, Ile and Dumbravă 2020, Fuhn and Vancea 1961, Stănescu et al. 2015).

Amphibian species in the park that are protected by the European legislation are the yellow-bellied toad (*Bombina variegata*) and the European fire-bellied toad (*Bombina bombina*), species living in temporary small-scale ponds, the European tree frog (*Hyla arborea*), a species that also appears in the forest ecosystems, the European green toad (*Bufo virdis*), the agile frog (*Rana dalmatina*) and the common frog (*Rana temporaria*), species appearing mainly close to settlements and agricultural fields, the edible frog (*Pelophylax* kl.

Fig. 92 Fire salamander (*Salamandra salamandra*)

esculentus) and the marsh frog (*Rana ridibunda*). Other amphibians protected by international conventions are the fire salamander (*Salamandra salamandra*, Fig. 92), species present mainly during autumn in the oak and beech forests, the common toad (*Bufo bufo*), and the smooth newt (*Triturus vulgaris*, Fig. 93), present in ponds near the Danube from Bahna, Orșova, and Eșelnița.

The construction of the Iron Gates I dam influenced the distribution of amphibian species; however, some species recovered and were rediscovered, e.g., the common spadefoot toad (*Pelobates fuscus*). This species is now present with small populations in Baziaș, showing a return to the meadow environment in the area (Stănescu et al. 2015).

Iron Gates Natural Park hosts two emblematic reptile species, Hermann's tortoise (*Testudo hermanni boettgeri*, Fig. 94), found in the grasslands nearby Danube (Rozylowicz 2008, Rozylowicz and Pătroescu 2004, Rozylowicz and Popescu 2013) and the long-nosed viper (*Vipera ammodytes*, Fig. 95), present in dry grasslands, open forests, and scrubs area, mainly on limestone (APNPF 2020). Other protected reptiles are the European pond turtle (*Emys orbicularis*, Fig. 96), present with larger densities near Moldova Veche island, the European green lizard (*Lacerta viridis*), the sand lizard (*Lacerta agilis*), the common wall lizard (*Podarcis muralis*, Fig. 97), the Balkan wall lizard (*Podarcis taurica*),

Fig. 93 Smooth newt (*Lissotriton vulgaris*)

Fig. 94 Hermann's tortoise (*Testudo hermanni boettgeri*)

Fig. 95 Long-nosed viper (*Vipera ammodytes*)

Fig. 96 European pond turtle (*Emys orbicularis*)

Fig. 97 Common wall lizard (*Podarcis muralis*)

Fig. 98 Snake-eyed sink (*Ablepharus kitaibelii*)

the Aesculapian snake (*Elaphe longissima*), the smooth snake (*Coronella austriaca*), the Caspian whipsnake (*Coluber caspius*), the dice snake (*Natrix tessellata*) and the snake-eyed skink (*Ablepharus kitaibelli*, Fig. 98). Other species present here are the slow worm (*Anguis fragilis*), the meadow lizard (*Darevskia praticola*) and the grass snake (*Natrix natrix*) (APNPF 2020, Stănescu et al. 2015, Ile and Dumbravă 2020).

The presence of Danube significantly increases the importance of Iron Gates Natural Park for fish fauna (Bănărescu 1971, Bănăduc et al. 2014). However, the changes in the Danube River induced by the construction of the dam modified the local fish fauna. For example, the weatherfish (*Misgurnus fossilis*) currently exhibits low abundance, being close to local extinction, while the ziege, a species that live in the sea and breeds in freshwater, has not been observed in the last decades. Other fish species in decline or probably locally extinct because of the changes of Danube into a reservoir are the European bitterling (*Rhodeus sericeus amarus*), the golden spined loach (*Sabanejewia aurata*), the streber (*Zingel streber*), the zingel (*Zingel zingel*), the mudminnow (*Umbra krameri*), the Balon ruffe (*Gymnocephalus baloni*), and the striped

Fig. 99 Asp (*Aspius aspius*)

ruffe (*Gymnocephalus schraetzer*). However, some species benefitted due to changes in river flow, for example, the asp (*Aspius aspius*, Fig. 99), a raptor fish with relatively high abundance here, the Mediterranean barbel (*Barbus meridionalis*), the European bullhead (*Cottus gobio*), a raptor fish up to 12 cm long, and the and small cyprinid Danube whitefin gudgeon (*Romanogobio vladykovi*). Among the sturgeon species that in the past were present with large populations, nowadays, only the sterlet (*Acipenser ruthenus*) still inhabits the Danube waters; however, with a low abundance due to the construction of the Iron Gates I and II dams (Bănărescu 1971, Bănăduc et al. 2014, APNPF 2020).

Danube River and other aquatic areas host a diverse world of aquatic invertebrates; however, under protection is only stone crayfish (*Austropotamobius torrentium*, Fig. 100). The stone crayfish is present in Romania only in the southwestern mountain area, populating springs and creeks with clear water (Parvulescu et al. 2009).

Protected terrestrial invertebrates are represented by several groups, such as butterflies, moths, dragonflies, and saproxylic insects. The most iconic butterflies and moths present in the park are the Jersey tiger (*Callimorpha*

Fig. 100 Stone crayfish (*Austropotamobius torrentium*)

Fig. 101 Dusky large blue (*Maculinea nausithous*)

quadripunctaria), the scarce fritillary (*Hypodryas maturna*), the large copper (*Lycaena dispar*), the dusky large blue (*Maculinea nausithous*, Fig. 101), the scarce large blue (*Maculinea teleius*), and the eastern eggar (*Eriogaster catax*). Two species of protected dragonflies can be seen here, i.e., *Coenagrion ornatum*, ornate bluet, and *Cordulegaster heros*, Fig. 102. Also, here lives one protected ground beetle species, i.e., *Carabus variolosus*. Saproxylic insects (species that perform part of their life cycle in dead or decaying wood) are well represented in the park, for example, the alpine longicorn (*Rosalia alpina*, Fig. 103), the Great Capricorn beetle (*Cerambyx cerdo*), the gray beetle (*Morimus funereus*), the hermit beetle (*Osmoderma eremita*), and the stag beetle (*Lucanus cervus*) (APNPF 2020, Chira et al. 2012, Brodie et al. 2019).

The Iron Gates I Reservoir, the forest, and grasslands habitats provide food and shelter for many bird species, with over 100 being protected by European legislation (Tab. 5, Fig. 104-123, APNPF 2020).

Influenced by Danube River, the group of protected aquatic birds is dominant (over 85 species). Among aquatic birds, we mention the red-crested pochard (*Netta rufina*, Fig. 105), the common pochard (*Aythya ferina*), the ferruginous duck (*Aythya nyroca*, Fig. 106), the smew (*Mergellus albellus*, Fig. 107), the

Fig. 102 Dragon-fly (*Cordulegaster heros*)

Fig. 103 Rosalia longicorn (*Rosalia alpina*)

pygmy cormorant (*Phalacrocorax pygmeus*, Fig. 108), the little egret (*Egretta garzetta,* Fig. 110), the northern lapwing (*Vanellus vanellus*, Fig. 111), and the black stork (*Ciconia nigra*; Fig. 112). Of the forest and grassland bird species, in Iron Gates, we can observe species such as the European bee-eater (*Merops apiaster*, Fig. 113), the gray-headed woodpecker (*Picus canus*, Fig. 115), the Eurasian scops owl (*Otus scops*, Fig. 116), the only migratory nocturnal raptor in Romania, the common buzzard (*Buteo buteo*, Fig. 117), the peregrine falcon (*Falco peregrinus*, Fig. 118), the common kestrel (*Falco tinnunculus*, Fig. 119), the golden eagle (*Aquila chrysaetos*, Fig. 120), the lesser spotted eagle (*Aquila pomarina*, Fig. 121), a rare migratory species, or the hazel grouse, a species living mainly in coniferous or mixt forests (*Bonasa bonasia*, Fig. 123) (APNPF 2020, Chira et al. 2012, Chișamera 2002, Chișamera 2003).

Tab. 5 Protected bird species in Iron Gates Natural Park (APNPF 2020)

Species	**Common name**	**Species**	**Common name**
Bonasa bonasia	Hazel grouse	*Ardea cinerea*	Grey heron
Cygnus olor	Mute swan	*Egretta garzetta*	Little egret
Cygnus cygnus	Whooper swan	*Egretta alba*	Great egret
Anser anser	Greylag goose	*Ciconia nigra*	Black stork
Netta rufina	Red-crested pochard	*Ciconia ciconia*	White stork
Bucephala clangula	Common goldeneye	*Phalacrocorax carbo*	Great cormorant
Mergellus albellus	Smew	*Phalacrocorax pygmeus*	Pygmy cormorant
Mergus merganser	Common merganser	*Pernis apivorus*	European honey buzzard
Mergus serrator	Red-breasted merganser	*Circaetus gallicus*	Short-toed snake eagle
Anas platyrhynchos	Mallard duck	*Aquila pomarina*	Lesser spotted eagle
Anas acuta	Northern pintail	*Hieraaetus pennatus*	Booted eagle
Anas crecca	Eurasian teal	*Aquila chrysaetos*	Golden eagle
Anas querquedula	Garganey	*Pandion haliaetus*	Osprey
Anas clypeata	Northern shoveler	*Accipiter brevipes*	Levant sparrowhawk
Anas penelope	Eurasian wigeon	*Accipiter nisus*	Eurasian sparrowhawk
Aythya ferina	Common pochard	*Accipiter gentilis*	Northern goshawk
Aythya nyroca	Ferruginous duck	*Circus cyaneus*	Northern harrier
Aythya fuligula	Tufted duck	*Milvus migrans*	Black kite
Tachybaptus ruficollis	Little grebe	*Haliaeetus albicilla*	White-tailed eagle
Podiceps grisegena	Red-necked grebe	*Otus scops*	Eurasian scops owl
Podiceps cristatus	Great crested grebe	*Asio otus*	Long-eared owl
Podiceps nigricollis	Black-necked grebe	*Bubo bubo*	Eurasian eagle-owl

Tab. 5 cont. Protected bird species in Iron Gates Natural Park (APNPF 2020)

Species	Common name	Species	Common name
Cuculus canorus	Common cuckoo	*Strix uralensis*	Ural owl
Gallinula chloropus	Common moorhen	*Phoenicurus ochruros*	Black redstart
Fulica atra	Eurasian coot	*Upupa epops*	Eurasian hoopoe
Vanellus vanellus	Northern lapwing	*Coracias garrulus*	European roller
Limosa limosa	Black-tailed godwit	*Merops apiaster*	European bee-eater
Tringa totanus	Common redshank	*Picus canus*	Grey-headed woodpecker
Larus cachinnans	Caspian gull	*Dryocopus martius*	Black woodpecker
Larus ridibundus	Black-headed gull	*Dendrocopos leucotos*	White-backed woodpecker
Larus fuscus	Lesser black-backed gull	*Dendrocopos medius*	Middle spotted woodpecker
Caprimulgus europaeus	European nightjar	*Falco tinnunculus*	Common kestrel
Apus melba	Alpine swift	*Falco subbuteo*	Eurasian hobby
Gavia stellata	Red-throated loon	*Falco peregrinus*	Peregrine falcon
Lanius collurio	Red-backed shrike	*Turdus merula*	Common blackbird
Alauda arvensis	Eurasian skylark	*Muscicapa striata*	Spotted fly-catcher
Lullula arborea	Woodlark	*Erithacus rubecula*	European robin
Oriolus oriolus	Eurasian golden oriole	*Luscinia megarhynchos*	Common nightingale
Riparia riparia	Sand martin	*Saxicola rubetra*	Whinchat
Ptyonoprogne rupestris	Eurasian crag martin	*Saxicola torquata*	African stonechat
Hirundo rustica	Barn swallow	*Oenanthe oenanthe*	Northern wheatear
Delichon urbica	Common house martin	*Motacilla flava*	Western yellow wagtail
Acrocephalus schoenobaenus	Sedge warbler	*Motacilla alba*	White wagtail
Acrocephalus palustris	Marsh warbler	*Anthus trivialis*	Tree pipit
Acrocephalus scirpaceus	Eurasian reed warbler	*Fringilla coelebs*	Common chaffinch
Acrocephalus arundinaceus	Great reed warbler	*Carduelis carduelis*	European goldfinch
Iduna pallida	Eastern olivaceous warbler	*Carduelis chloris*	European greenfinch
Locustella luscinioides	Savi's warbler	*Carduelis cannabina*	Olivaceous siskin
Sylvia atricapilla	Eurasian blackcap	*Emberiza cirlus*	Cirl bunting
Sylvia borin	Garden warbler	*Emberiza hortulana*	Ortolan bunting
Sturnus vulgaris	Common starling	*Miliaria calandra*	Corn bunting
Turdus philomelos	Song thrush		

Fig. 104 Mallard duck (*Anas platyrhynchos*). The female is brown, and the male is more brightly colored. Present in Iron Gates all year round

Fig. 105 Red-crested pochard (*Netta rufina*). Occasionally present in large groups

Fig. 106 Ferruginous duck (*Aythia nyroca*). Occasionally present in large groups. Some pairs breed in the region

Fig. 107 Smew (*Mergellus albellus*). Present in winter

Fig. 108 Pygmy cormorant (*Phalacrocorax pygmaeus*). Present all year round with greater abundance during the winter season

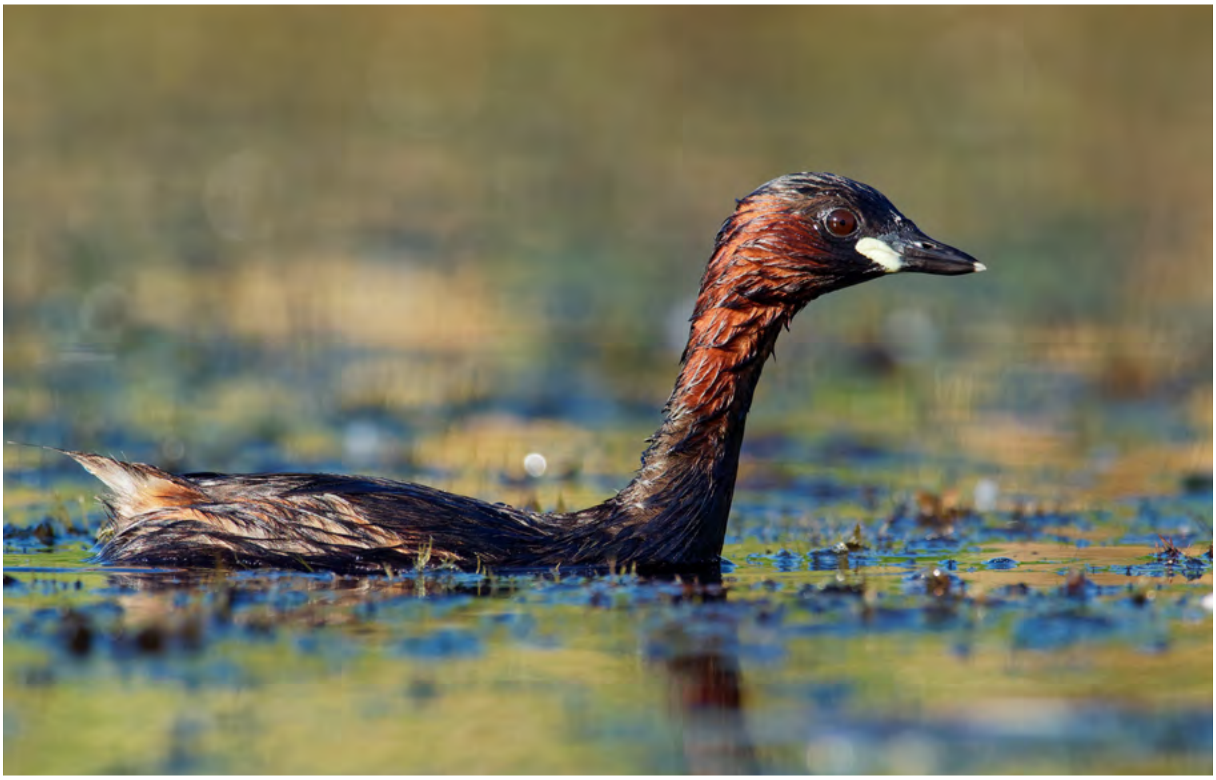

Fig. 109 Little grebe (*Tachybaptus ruficollis*). Occasionally present. Some pairs breed in the area

Fig. 110 Little egret (*Egretta garzetta*). Migratory species. Some pairs breed in the area

Fig. 111 Northern lapwing (*Vanellus vanellus*). A species present all year round

Fig. 112 Black stork (*Ciconia nigra*). Migratory species. Present in Iron Gates Natural Park from March to September

Fig. 113 European bee-eater (*Merops apiaster*). Migratory species. Arrives at the end of April – beginning of May and leaves in August

Fig. 114 Middle spotted woodpecker (*Dendrocopos medius*). Sendentary species

Fig. 115 Grey-headed woodpecker (*Picus canus*). Sedentary species

Fig. 116 Scops owl (*Otus scops*). Present in large numbers in Iron Gates Natural Park

Fig. 117 Common buzzard (*Buteo buteo)*. Sedentary species

Fig. 118 Peregrine falcon (*Falco peregrinus*). Resident in the park but very rare

Fig. 119 Common kestrel (*Falco tinnunculus*). A species frequently identified in Iron Gates Natural Park. Partial migrant species

Fig. 120 Golden eagle (*Aquila chrysaetos*). Resident in the park but very rare

Fig. 121 Lesser spotted eagle (*Aquila pomarina*). Rare migrant species

Fig. 122 European robin (*Erithacus rubecula*). Partial migrant species

Fig. 123 Hazel grouse (*Bonasa bonasia*). Sedentary species present mainly in coniferous and mixt forests

Tourism to Iron Gates Natural Park

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Iron Gates Natural Park is one of the most iconic parks in Romania, famous for its cultural heritage, stunning landscapes, and abundant wildlife. The area became popular in Romania after 1989 because in the past, during the communist era, it was rather inaccessible due to the restrictions enforced by the authorities to reduce the border crossing towards western Europe through former Yugoslavia (Dumbrăveanu 2004, Niculae et al. 2014, Manolache et al. 2020).

After the 1990s, Iron Gates became increasingly popular, leading to the fast development of the hospitality industry. If the first accommodation facilities were only available in Orșova and Moldova Nouă, today tourists can choose from more than 300 accommodation facilities of different sizes and ratings (APNPF 2020). However, the area is not easily accessible, as the local public transport infrastructure is insufficient. Therefore, if you want to explore the area, we recommend that you become informed about the natural and cultural sites that you want to discover and plan your trips carefully. For example, the Iron Gates Natural Park Administration provides tourist programs that allow you to explore the local culture, biodiversity, and landscape.

The natural landmarks in the region (Fig. 124) are approachable to all types of tourists. Thus, you should not miss the unique viewpoints from Cazanele Mari and Cazanele Mici (Ciucarul Mare and Ciucarul Mic peaks, near Dubova), Trescovăț rhyolite dome (6 km upstream of Svinița), the suspended fold of Munteana-Dumbrăvița near Danube – Sirinia confluence, Sfânta Elena karstic plateau, Moldova Veche island, Nera pond, Gura Ponicovei, Veterani, Gaura cu Muscă, Grota Haiducească and Zamonița caves (APNPF, 2013, APNPF 2020). Most of nature's attractions can be discovered following ecotourism trails waymarked by the park administration.

Tourists can also visit many historical, cultural or religious landmarks (Fig. 125). For example, some of Romania's oldest habitation traces from the Upper Palaeolithic are still visible in Iron Gates Natural Park. As the area was a militarised border throughout history, ruins of fortifications are still visible here. The Romans built a complex military infrastructure in the Iron Gates region, for example, the Dierna castrum near Orșova or the bridge over Danube River in Drobeta. From Medieval times, small fortifications are still visible, such as Tricule (Fig. 125.; today, only three isolated towers are still visible, 4 km from Svinița), or Ladislau fortress from Coronini (established after 1428).

Also worth exploring are the localities in Iron Gates Natural Park. Here you can find several multiethnic villages with a mix of Romanian, Serbian, Czech, and Romani inhabitants. Each community has its specificity (architecture, occupation, household objects, clothing, holidays, or habits). Of the most iconic religious sites, we recommend Vodița Monastery, Saint Ana Monastery, the Roman Catholic church in Orșova and the Serbian monastery Saint Sava in Baziaș. One of the top tourist attractions in the park is the colossal sculpture from Mraconia representing the last king of Dacia, Decebalus (APNPF 2020, Stînga 1986, Pătroescu 2004, Necșuliu 2007, Fig. 126).

Several tourist activities are available in Iron Gates Natural Park, which cater to various types of tourists. Visitors can choose scientific tourism, an opportunity popular with those interested in developing knowledge of nature through observing plant and wildlife species in their habitats or exploring geological and speleological sites. Other forms of scientific tourism include forest tourism or birdwatching. Iron Gates Natural Park can be an ideal vacation destination for visitors looking for leisure and rest. The nature here provides optimal conditions for this form of tourism, with a large area accessible for all categories of visitors. The best way to approach this form of tourism is through holiday packages from local hotels, lodges, guest houses, farms, or camping sites. Rural tourism is also possible, and Iron Gates Natural Park provides excellent opportunities to discover the traditional life and habits of the region.

The history, the tangible and intangible heritage, can also be explored through cultural tourism. This form of tourism addresses a wider spectrum of visitors. It is approached by visiting historical sites (archaeological sites, monuments, religious centers, museums, and ethnographic collections) and taking part in cultural events (folklore shows including music and dancing,

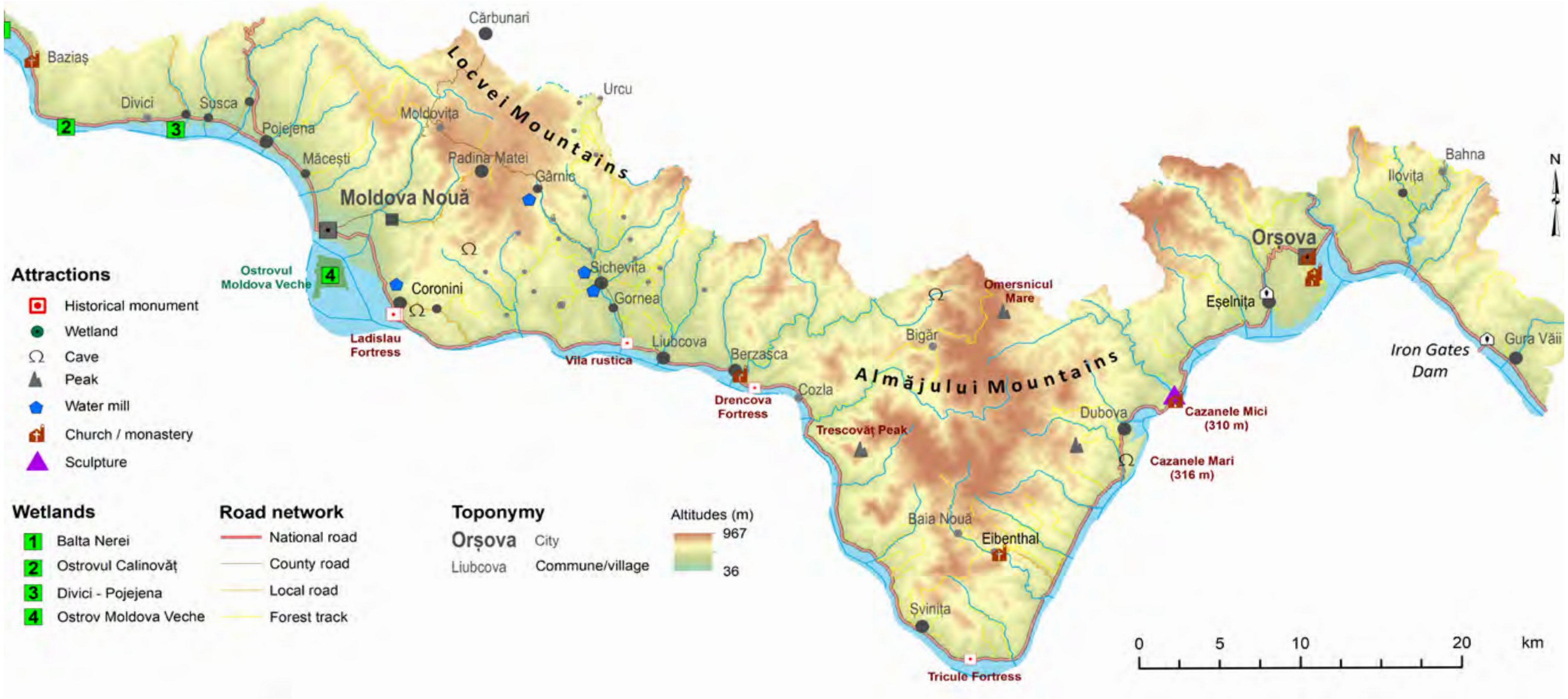

Fig. 124 Tourist attractions in Iron Gates Natural Park

Fig. 125 Tri-Kule fortification (Tricule fortress) with three quadrilateral towers (13th century – 14th century). The foundation of the third tower is visible only when Danube's water level is low

Fig. 126 Contemporary sculpture of the Dacian king Decebalus, located near the confluence of the Mraconia river with the Danube River (between Eșelnița and Dubova)

traditional holidays, exhibitions, and fairs). For this category of tourism, we mention the Dacian settlements remains from Divici and Stenca Liubcovei, the Roman castrum and the Apolodor's bridge in Drobeta, ruins of the fortresses Saint Ladislau, Drencova and Tricule, modern history traces of Veterani cave, and the Hydroelectric power and Navigation Complex Iron Gates I.

Each settlement in Iron Gates National Park has a traditional or modern holiday and festivals, which can represent an excellent occasion to spend time with the locals.

The attractions of the park can be accessed through bicycle tours, mountain biking, or even nautical tourism (for example, from Orșova, Eșelnița, Dubova, Berzasca, Coronini, Moldova Nouă, Pojejena, Baziaș). You can discover many natural and human-made attractions by following the tourist trails waymarked by the Iron Gates Natural Park Administration (Figs. 127-140, http://www.pnportiledefier.ro).

1. Racovăț-Boldovin Ecotourism Trail (11 km)

The entrance to this ecotourist trail is from Ilovița town, about 1.3 km from the town hall, on the way following the Racovăț creek upstream (Fig. 127). The route is waymarked with a red circle with white margins (trail waymarking on trees or rocks). It is a moderate difficulty trail because it is about 11 km long. The average time to cover this route is 5 hours. The trail is a circuit one (loop), starting and ending near the Racovăț fossiliferous site, one of the three fossiliferous sites part of the Bahna palaeontological reserve (Racovăț, Lespezi, Curchia). Bahna palaeontological reserve was Romania's first declared palaeontological reserve, with a fossil fauna of over 16 million years old. The seafloor of the Sarmatian Sea, where 16 million years ago, snails, shells, and corrals lived, is conserved in an amphitheater-shaped outcrop at the edge of Ilovița town.

2. Țarovăț Ecotourism Trail (9.2 km, the starting point is far from the endpoint)

The trail can be accessed from E70 European Road, near the Orșova city limit, 600 m towards Drobeta-Turnu Severin (Fig. 128). The trail exit is on the road connecting the E70 road to the town of Ilovița. The trail starts in the Orșova mine valley and is about 9.2 km long. The average time to cover the trail is 5 hours. Being a route that ends far from the starting point, having someone pick you up by car or bike is recommended.

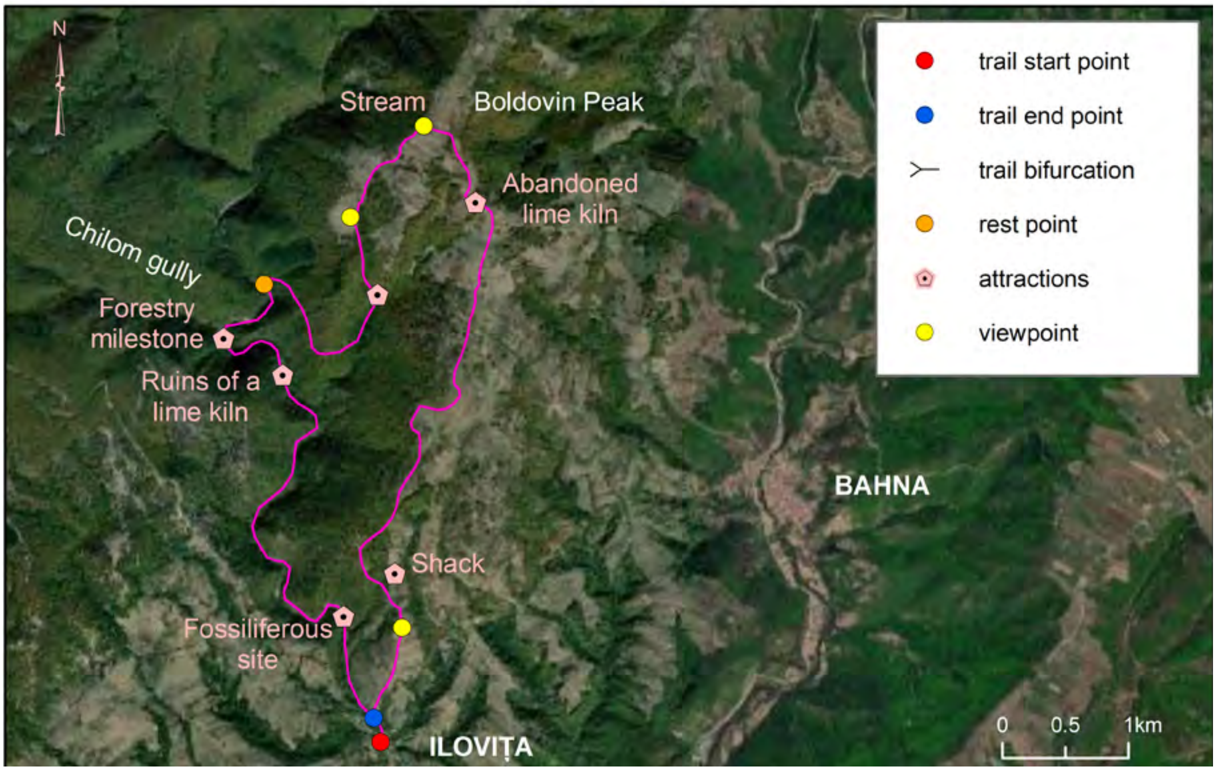

Fig. 127 Racovăț-Boldovin Ecotourism Trail

Considering its length, the trail is of moderate difficulty. The route is waymarked with a blue triangle with white margins (trail waymarking on trees or rocks). It is a trail revealing the specific landscape of the Bahna – Orșova basin, a hilly area without steep relief structures. Part of the Țarovăț trail represented in the past the border between Wallachia and the Austrian – Hungarian Empire (border police path, patrol trail). On this trail, you can observe symbolic elements of the biodiversity (abandoned or active hayfields, orchards or vineyards, thermophilic oak forests, reptiles, birds), shacks, and small rural communities.

3. Crucea Sfântul Petru (St. Peter's Cross) tourist trail (6.6 km, the starting point is far from the endpoint)

The trail can be accessed from E70 European Road, on a communal road crossing near Gura Văii, close to the railroad bridge (Fig. 129). The exit is also on E70, about 2.5 km from the entrance, towards Orșova. The length is 6.6 km, with an average time of 3 hours. The difficulty of the trail is moderate, requiring from time to time intense physical effort due to some sections with ascending or descending slopes. The trail pathmark is a vertical blue line with white margins (trail pathmark on trees or rocks). The route includes several natural elements

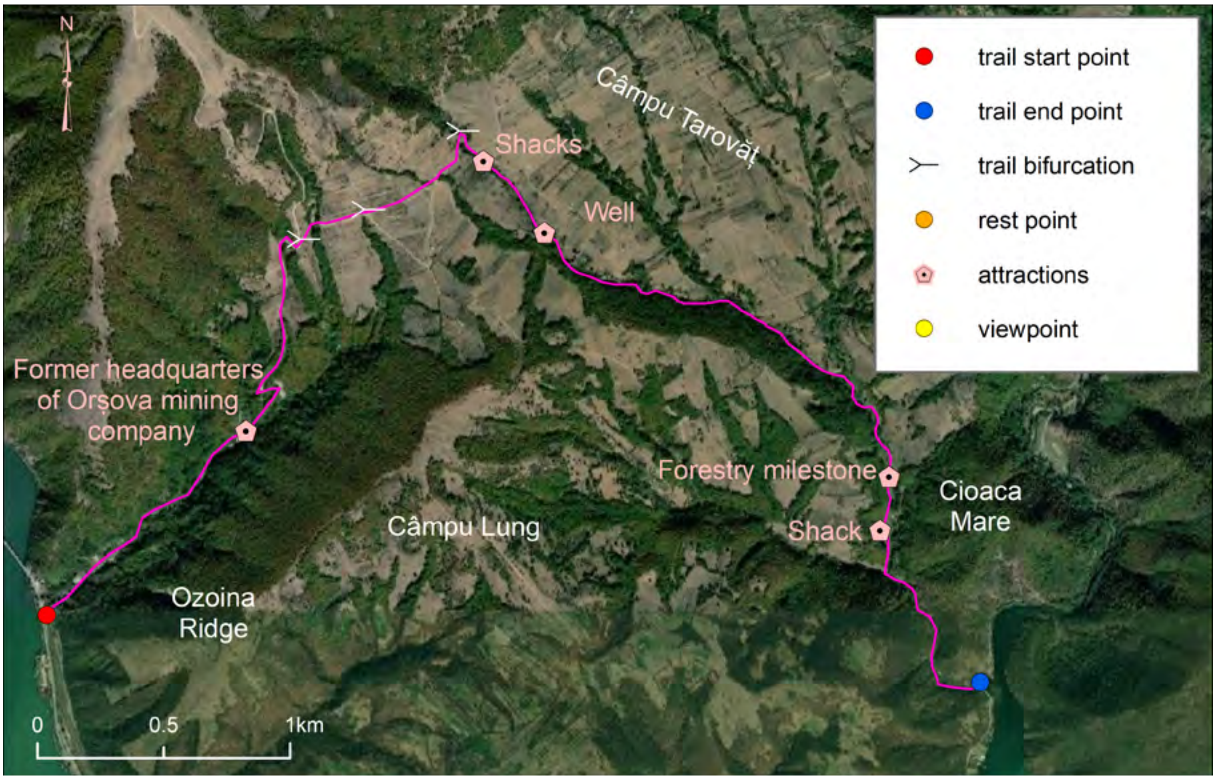

Fig. 128 Țarovăț Ecotourism Trail

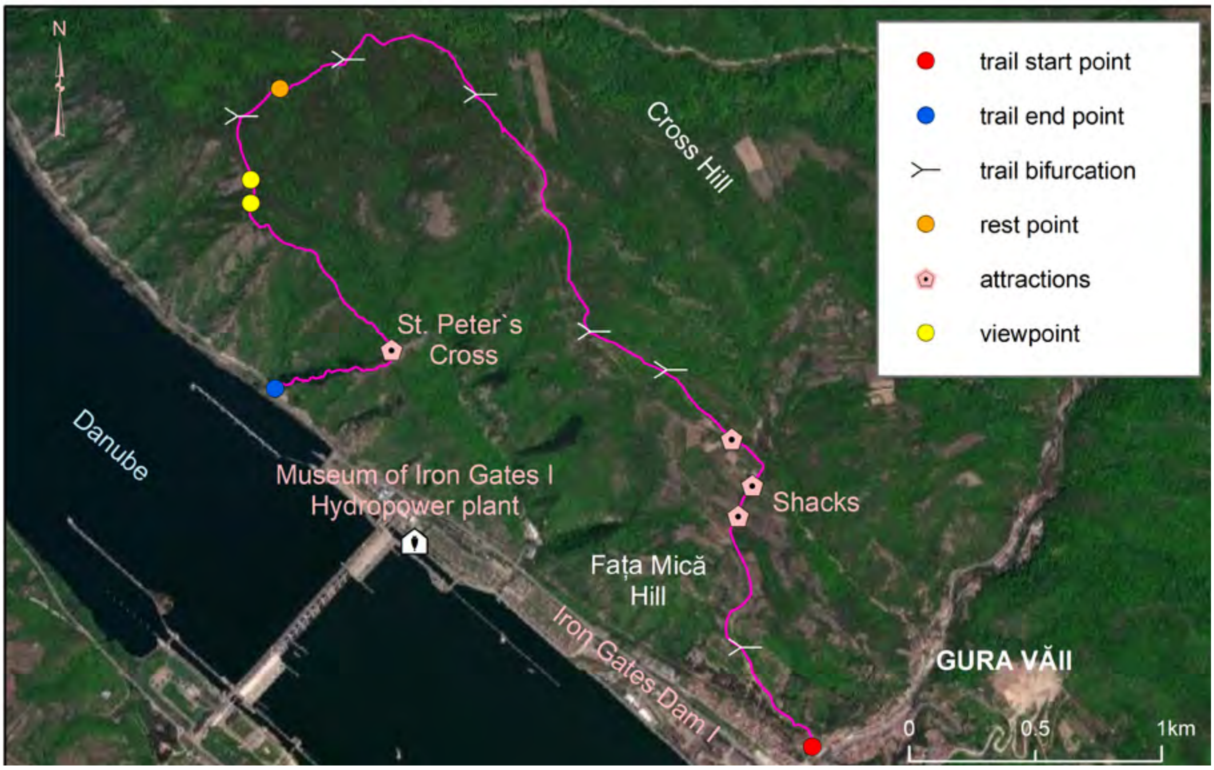

Fig. 129 St. Peter's Cross (Crucea Sfântul Petru) Ecotourism Trail

and viewpoints towards the Danube River. Tourists walk through mixed forest areas (hornbeam, sessile, Hungarian oak, linden).

The slopes toward the Danube River are covered with shrubs such as lilac, European smoke tree, orchids, and pink species. From the viewpoints on Dealul Crucii (Cross Hill), you can notice the Iron Gates I Hydroelectric and Navigation System, Banului Island located downstream of the dam, flora reserves Dealul Vărănic and Dealul Oglănic. At the main belvedere point, three crosses are found, one ancient one (recomposed of fragments), one from 1943, and a monument built on the Great Union Centennial (2018).

4. Vodița Valley – Duhovna Hill Ecotourism Trail (14.5 km)

The trail is accessible from the European Road, nearby Vodița viaduct, approximately 6 km from Orșova and 19 km from Drobeta-Turnu Severin (Fig. 130). The trail length is 14.5 km and can be covered in approximately 6 hours. This tourist trail is moderately difficult and requires sustained physical effort due to its length. It is waymarked with a yellow circle on a white background, on trees and stones along the path. Even from the start, you can visit Vodița Monastery, the first monachal establishment in Wallachia. The route follows the Vodița Valley Scoruș Valley, and returns to the Danube through the Duhovna Hill paths (flora reserve). Before climbing the Vodița Valley, the rocky wall maintains traces of old geological units, hundreds of millions of years old – Getic Nappe, Danubian Autochthonous, Severin Nappe. On Duhovna Hills, tourists can discover open old-growth forests known as "osieci" forests (osieci – tree trunks, especially oaks, which in time, because of years of rain, winds, and sun baking, become white).

5. Cazanele Mari Ecotourism Trail (5 km)

For this trail, access is made directly from National Road DN57, Dubova town centre, 100 m towards Svinița from Dubova Town Hall (Fig. 131). The route is 5 km long and can be covered in 2 hours. It is an easy hiking trail, so no special training is necessary. The route is waymarked with a yellow triangle on a white background. Among the elements of interest on this trail, we mention the Danube tulip, a species that blooms in April on the rocky slopes of the Ciucarul Mare peak. Other species present here are lilac, bellflowers, and the long-nosed viper. The trail is famous for its spectacular views of the Danube.

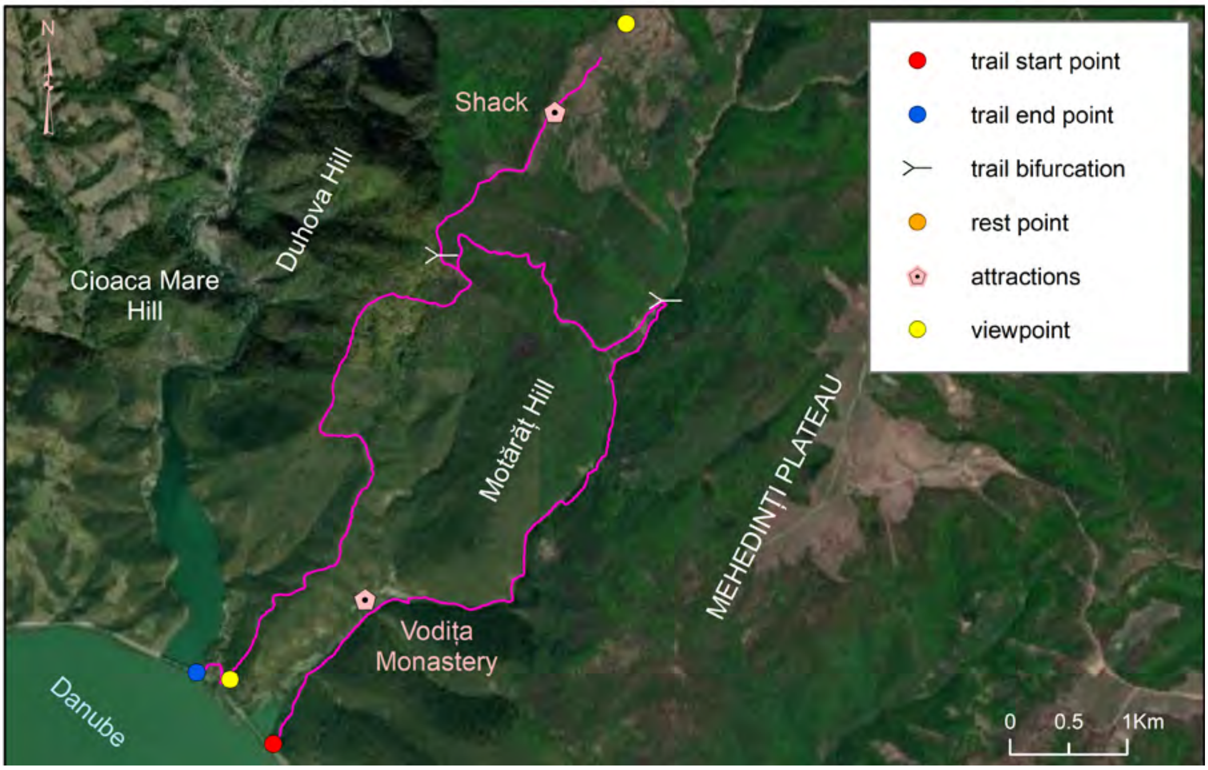

Fig. 130 Vodița valley - Duhovna Hill Ecotourism Trail

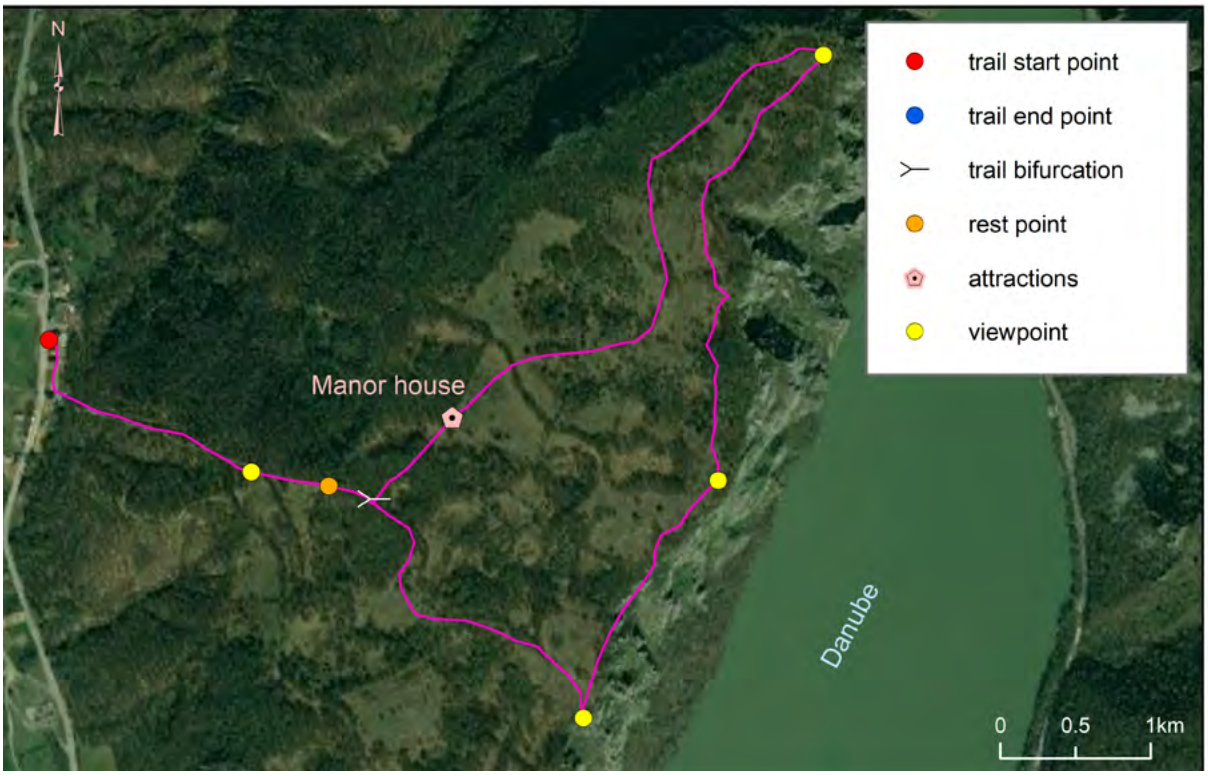

Fig. 131 Cazanele Mari Ecotourism Trail

6. Cazanele Mici Ecotourism Trail (2 km)

Cazanele Mici is one of the most accessible trails in the park. The length of the route is approximately 2 km, and the average time to cover it is 1 hour. Trail access is from DN57, in Dubova, approximately 22 km from Orşova toward Moldova Nouă (Fig. 132). The waymark is a red triangle of a white background on trees and stones along the path. The eco-tourism trail follows a mountain path through oak, beech forests, and grasslands. On the trail, we can discover species such as the dyer's greenweed (Genista tinctoria), a plant that is used to extract vegetable dyes for wool painting. The trail has several viewpoints, where you can discover the Cazanele Mari and Veliki Štrbac peaks on the Serbian side of the Danube. Multiple karstic landforms on the Urgonian (Barremian-Aptian limestone facies, 140 million years old) are also present. The trail is also famous for its vegetation, with lilac, oriental hornbeam, European smoke tree and South European flowering ash, as well as for the Danube tulip on the steep slopes near the Danube.

7. Dubova - Cazanele Mici Ecotourism Trail (9 km, the starting point is far from the endpoint)

The entry point is on DN57, Dubova Bay, approximately 24 km from Orșova towards Moldova Nouă (Fig. 132). The trail is approximately 9 km long, with an average of 5 hours to cover it. This moderate difficulty trail is waymarked with a yellow triangle with a white background on trees and stones along the path. The trail mainly crosses oak and beech forests and hosts several viewpoints to Iron Gates Gorges.

8. Cazanele Mari Ecotourism Trail 2 (1.6 km)

Cazanele Mari 2 trail has a length of 1.6 km and moderate difficulty. The access is from DN57, at the Dubova town limit towards Moldova Nouă, approximately 2 km from the town hall (Fig. 133). The average time to cover the trail is 1 hour, following the blue triangle on white background waymarks on trees and rocks along the path. After 15 minutes on the trail, there is a crossroad with the trail heading to the Cazanele Mari plateau (trail 5), a belvedere point in the direction of Danube River.

9. Alion Ecotourism Trail (4.5 km, the starting point is far from the endpoint)

The ecotourism trail is 4.5 km long and starts from the Târziului viaduct close

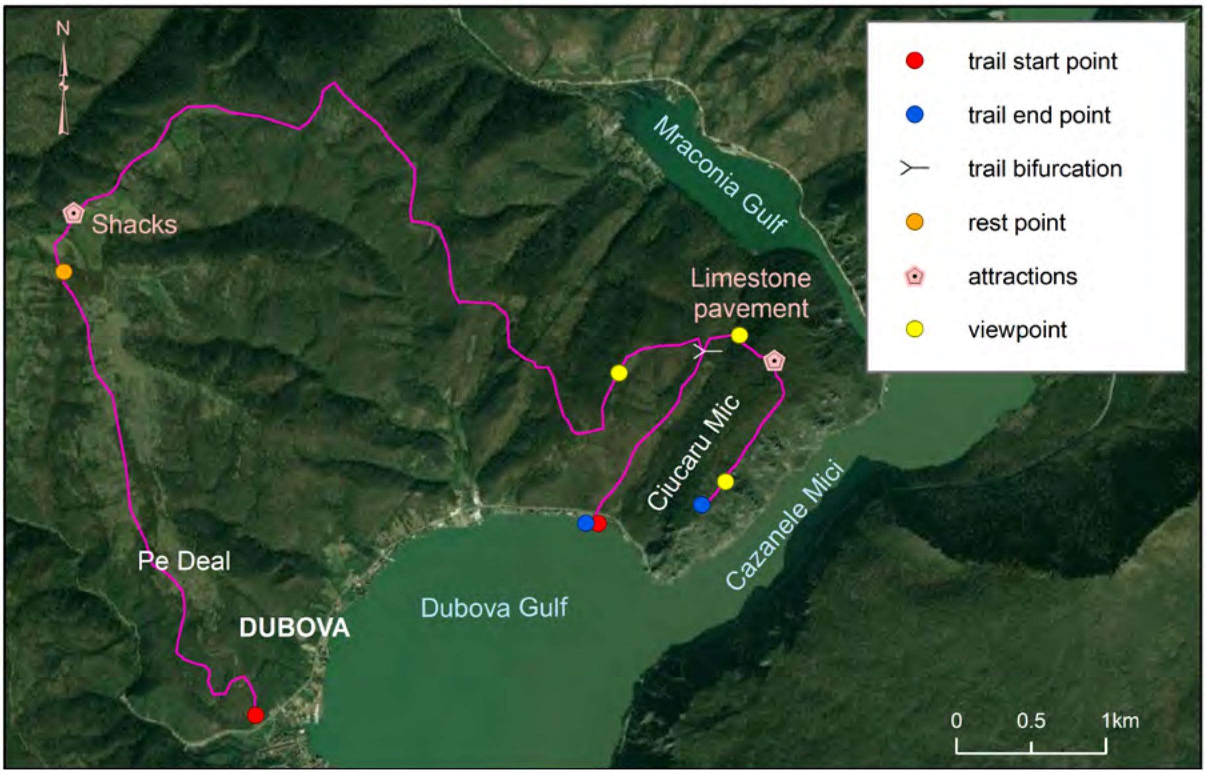

Fig. 132 Cazanele Mici Ecotourism trail and Dubova-Cazanele Mici Ecotourism Trail

to Orșova, on the European road E70 (Fig. 134). The time to cover this route of easy difficulty is 2.5 hours. The trail is marked with a yellow triangle on a white background and starts with a path used to connect the agricultural fields of the local inhabitants of Orşova and Tufări beyond the hill ridge. Then it continues along the Ogașul lui Târziu creek, in an area covered with oak forests. The grasslands and hay fields offer spectacular views of the Danube River, towards the Iron Gates I Hydroelectrical Powerplant, and the city of Kladovo in Serbia. Several beautiful small agricultural fields and grasslands are found between Voicului Peak (289.5 m) and the base of Alion Hill in the Câmpul Lung ridge area. Alion Peak is an excellent belvedere point, especially at sunset, when the Iron Gates I dam is properly illuminated. A spectacular view is open towards Orșova and Cerna Bay at the Alion peak communication tower, especially if the travel is at twilight.

10. Liubotina Valley - Rudina Ecotourism Trail (12 km)

The trail is approximately 12 km long and can be covered in approximately 6 hours. The access to the trail is from DN57, 8 km from Dubova towards Svinița, starting from the Liubotina viaduct, on the forest road in Liubotina Valley (Fig.

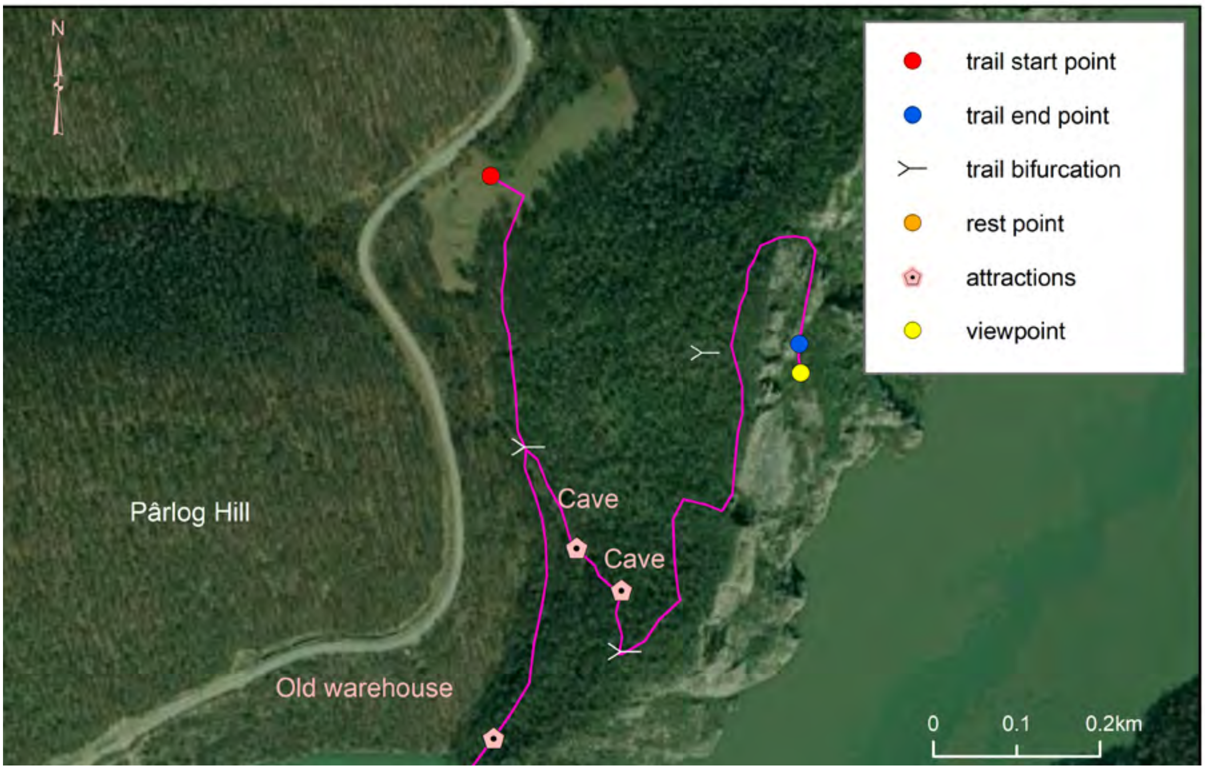

Fig. 133 Cazanele Mari 2 Ecotourism Trail

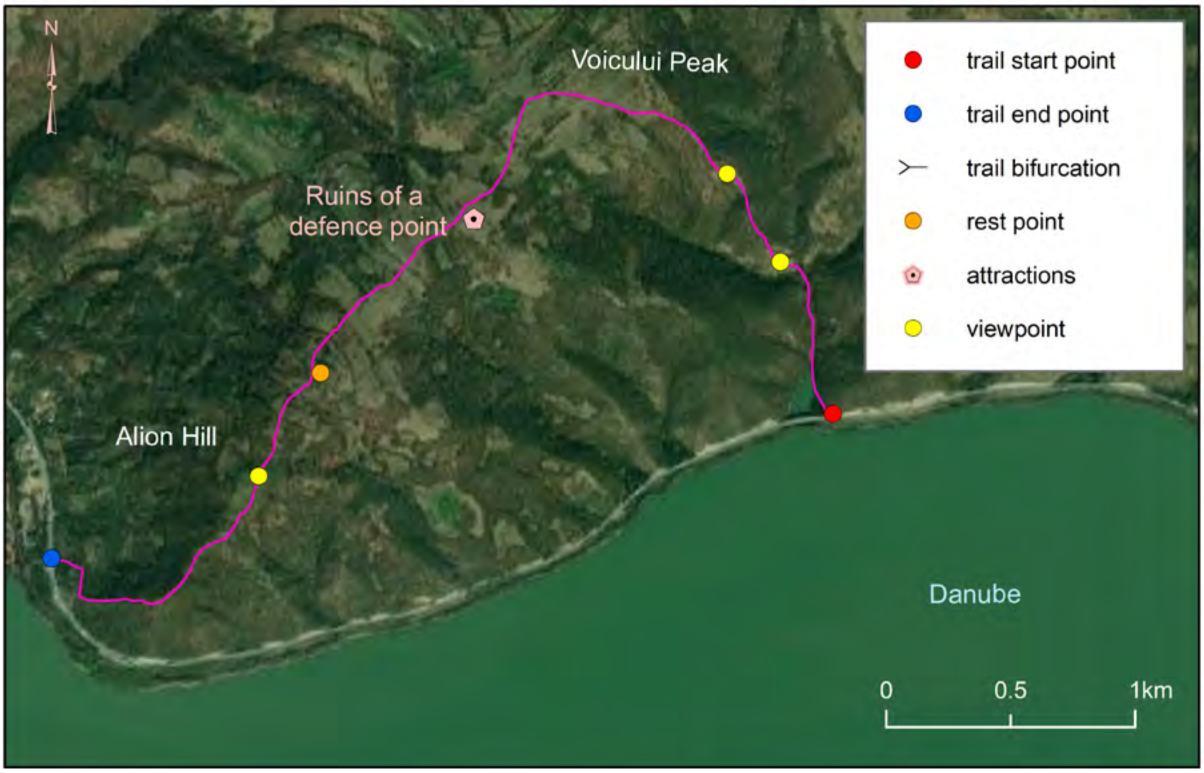

Fig. 134 Alion Hill Ecotourism Trail

135). It is a moderately difficult tourist trail considering its length. It is waymarked with a blue triangle on a white background on the trees and rocks nearby the path. This trail runs through the Liubotina Valley, one of the most scenic tributary valleys of the Danube. The trail crosses patches of beech forests and from time to time, we can spot isolated individuals of English yew (*Taxus baccata*), a protected species in Romania. The value of this coniferous species is given by the wood used for sculpture and fine woodcraft. Other tourist elements to be approached in the Liubotina Valley are the small waterfalls formed by this river, which complete the area's spectacular landscape. From the Rudina plateau viewpoint, you can observe the Danube River, Codicea Mică, and Codicea Mare hills.

11. Cioaca Cremenească-Rudina Ecotourism Trail (8.2 km the starting point is far from the endpoint)

The access is from DN57, 6 km from Dubova toward Svinița (Fig. 136). The tourist trail starts from an old forest road that climbs to Cioaca Cremenească (in Romania: cioacă = peak), upstream of the Plavişeviţa Valley. The trail is 8.2 km long, which you can cover in 4 hours. Due to its length, it is a tourist trail and it is waymarked with a red triangle on a white background on the trees and stones. When following this route, tourists can admire the scenic landscapes of Danube valley but also observe the negative impact of mining activities. There are several sterile deposits here because of the old mining facilities. The trail also allows observation of quartzite deposits (the so-called *cremene*, which also gives the name of this peak), serpentinite deposits from Tisovița and Plavișevita, old bicellular houses (shacks), and forest landscape. The trail is connected with the Liubotina Valley - Rudina Ecotourism trail (trail 10), its shared element being the Rudina plateau, an excellent viewpoint for the landscape of the Danube river banks in Romania and Serbia.

12. Trescovăț Ecotourism Trail (10 km, the starting point is far from the endpoint)

The trail follows the Trescovăț lava dome. The trail can be approached from DN57 in Stariște creek or from a point 3.5 km away from Stariște, towards Berzasca (Fig. 137). There are two alternatives to this trail, depending on the available time and physical conditions. The first alternative is the 6 hours route if you start from Stariște creek and descend to the point located 3.5 km from

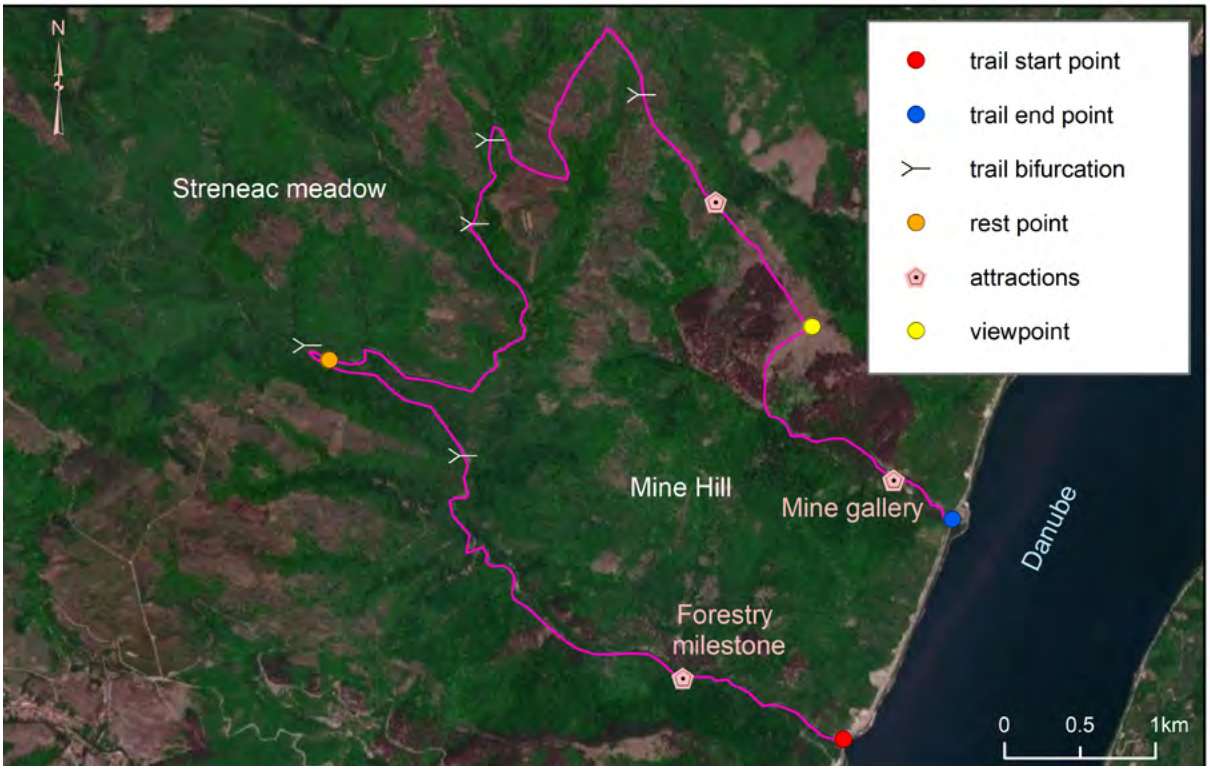

Fig. 135 Liubotina – Rudina Ecotourism Trail

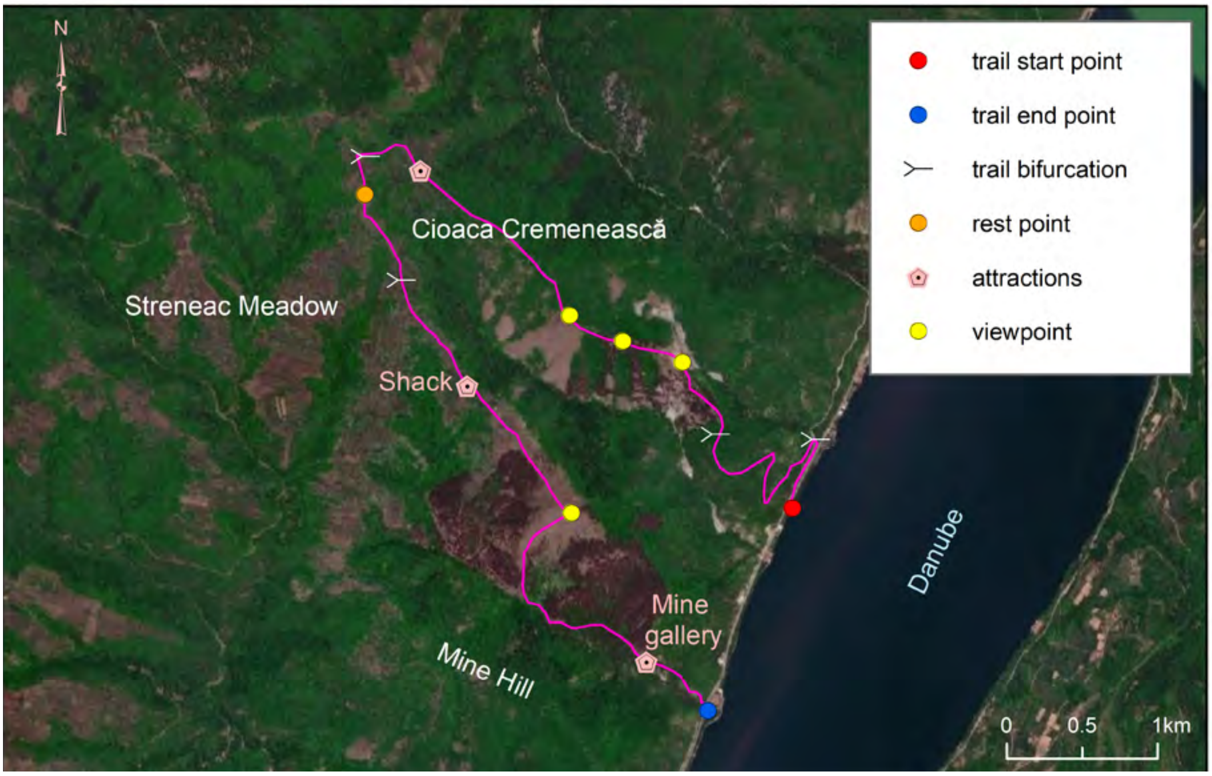

Fig. 136 Cioaca Cremenească – Rudina Ecotourism Trail

Stariște, and a shorter version, 4 hours, if you approach the trail from the point 3.5 km from Stariște and you return on the same route back to DN57. This trail is of moderate difficulty and requires good training, especially for the part where you ascend towards Trescovăț peak. The trail is waymarked with a red triangle on a white background, and you need to follow them carefully in the last sector so that you will not miss the final ascension on Trescovăț peak. The main attraction of this trail is represented by the Trescovăț Permian rhyolitic lava dome Trescovăț (solidified lava inside an ancient volcano). Also of interest are the openings and hayfields where locals' shacks are found, and plant and wildlife species living here. Several viewpoints open spectacular views, including from Trescovăț peak (755 m). If the weather is good and not hazy, you can photograph the Danube, one of the most spectacular landscapes in Iron Gates Natural Park.

13. Svinița-Tricule Ecotourism Trail (9 km, the starting point is far from the endpoint)

The trail is accessible from DN57, about 1 km from Sviniţa towards Berzeasca. It is a 9 km long trail (about 5 hours), waymarked with yellow triangles on a white background. It requires good physical training considering its length (Fig. 138). It is a scenic trail that leads tourists among unique geological and biodiversity elements, traditional rural economic facilities, multicultural architecture, and a charming viewpoint that looks over the ruins of the Tricule fortress. The first part of the trail leads towards Cioca Borii, a cuesta formed in Cioaca Borii conglomerates (basal conglomerates with large, rounded, quartzitic elements), where the Banat black pine grows. After this sector, the path leads to the natural amphitheatre formed by the Zelişte and Veligan ridges near Svinița (the natural amphitheater of Țiganului Creek). Several shacks are found along the ecotourism trail, where tourists can find shelter if the weather is unfavourable. From the steps of the natural amphitheatre, you can admire the still water of the Iron Gates I Reservoir, the town of Svinița, houses with traditional architecture of Serbian influences, and the church from the old Svinița village. From Svinița you can buy figs home-made products.

14. Balta Nera - Moldova Veche Island Educational Trail (34 km, bike trail)

It is a long trail, following the main road connecting Socol and the city of Moldova Nouă (Fig. 139). It is suitable for an 8-10-hour bicycle tour. The access

Fig. 137 Trescovăț Ecotourism Trail

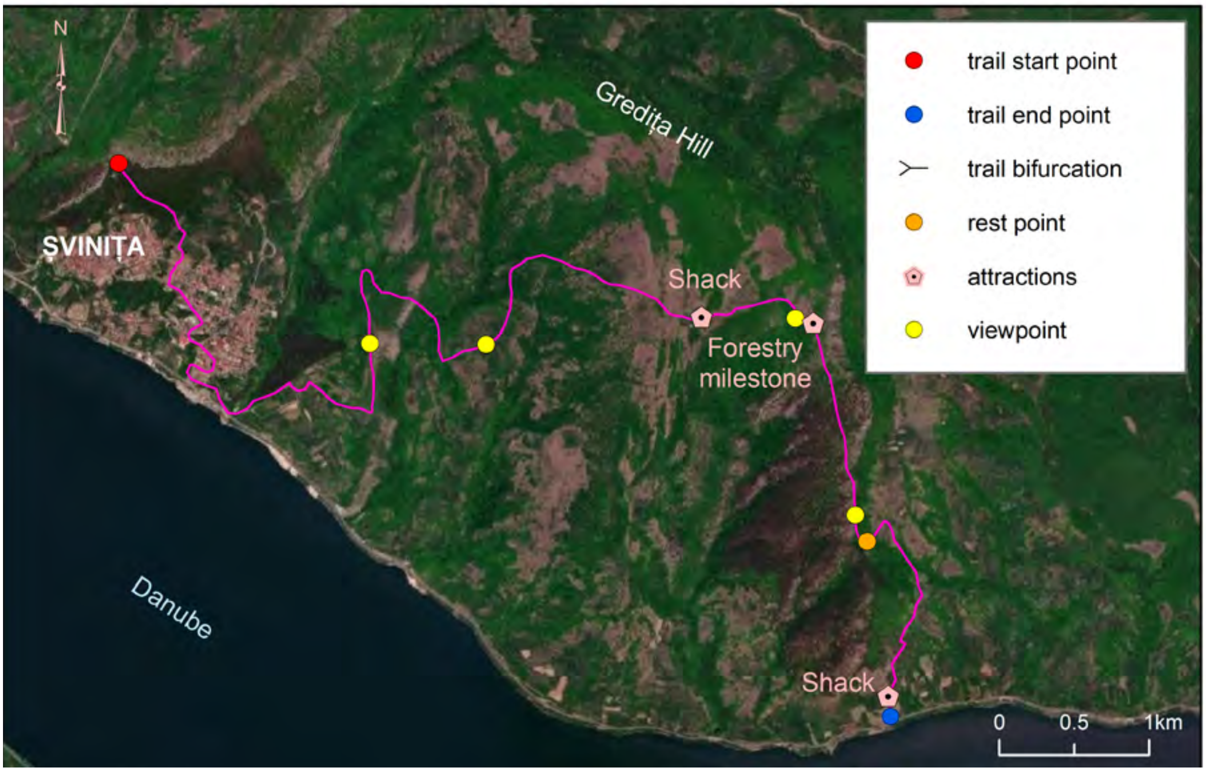

Fig. 138 Svinița-Tricule Ecotourism Trail

from Socol is made from DN57A in Nera Bay. Coronini has a boarding station for visiting Moldova Veche island (it requires advance booking with the Iron Gates Natural Park Administration). The main trail is waymarked with a blue vertical line on a white background, while the secondary route is waymarked with a blue triangle on a white background. Among the interesting elements of the trail, we hint at the following: Balta Nera – Danube Nature Reserve (you can visit the former arm of the Neva River and look towards Danube entering Romania), Saint Sava Monastery in Baziaș, Belobreșca Serbian Cultural Centre, orchid grasslands on the slopes of hills, Divici – Pojejena wetland, martins' ravines of Divici, and Moldova Veche island. A large population of feral horses lives on the Moldova Veche island, descending from the horses abandoned here by the locals in the 2000s.

15. Water Mills valley Educational Trail (22 km, bicycle trail)

The route has a starting point in Liborajdea, DN57, and follows the national road to Gornea. Here, it joins a secondary road to visit the water mills in Gornea, Sichevița, the Gramensca Valley, and the Zăsloane Valley (Fig. 140). The main trail is waymarked with a blue vertical line on a white background, while the secondary trail is waymarked with a blue triangle on a white background, on trees and rocks. Making this trail by car will lead you to Gârnic, where you can descend to Coronini. There are more than 20 water mills in Sichevița, many with closed troughs made of an empty tree trunk called a button. These redirect the water to the bucket and increase the water flow (Iordache, 2002). Some mills are in good condition, functional. In Gramensca and Gârnic, nine water mills can be visited, all similar to those in Sichevița.

If you choose to descend to Coronini by car, you can also visit the mill of Raica, in the center of Coronini town, set in motion by the Bragadiru creek. The trail is also recommended for its scenic landscapes (shacks, traditional agriculture, hayfields). On the way to Gârnic, you will enter the karst plateau, where dolinas of different sizes appear, as well as dry karst valleys and limestone pavements partially buried in red clay. You can also visit the small Vila Rustica archaeological site on DN57 near Liborajdea, the Healing Spring Monastery in Gornea, and the Gornea Ethnographic Museum.

Iron Gates Natural Park hosts several archaeological, ecumenical and cultural institutions on its territory, as well as museums and small collections that might interest tourists (APNPF 2013, Dumbrăveanu 2004).

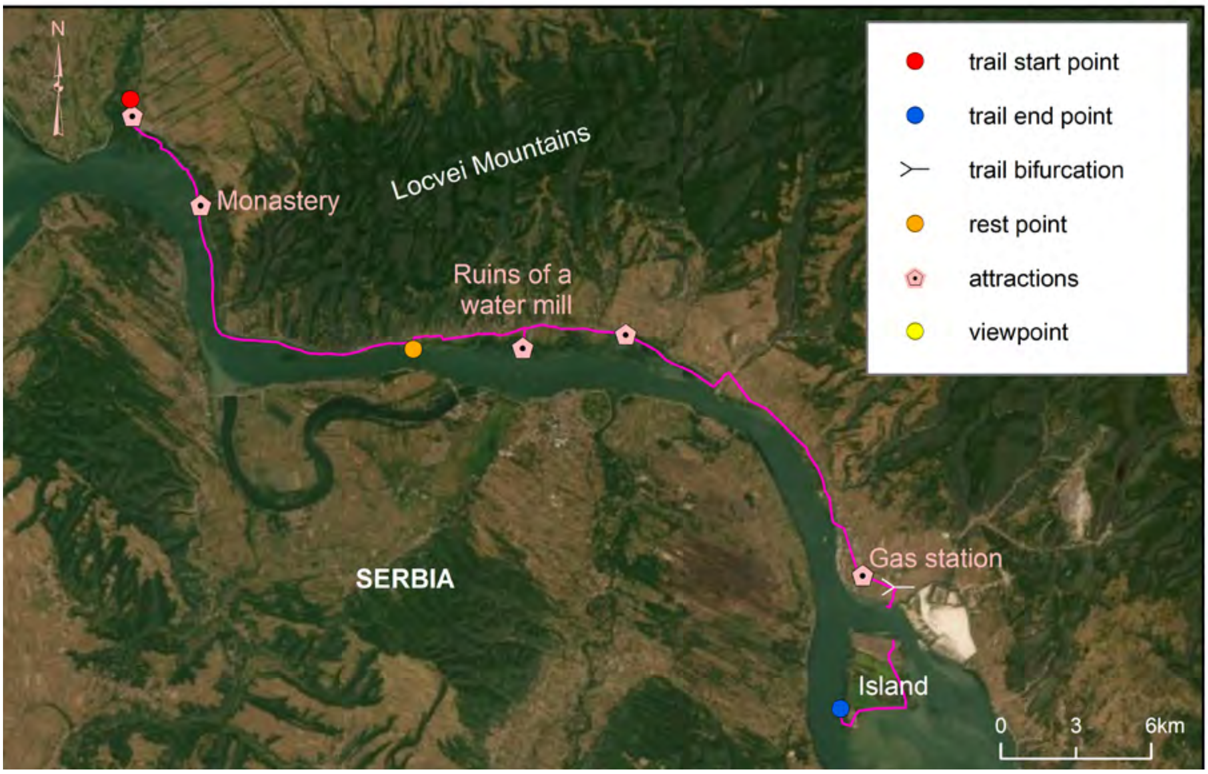

Fig. 139 Educational trail Nera wetland - Moldova Veche Island

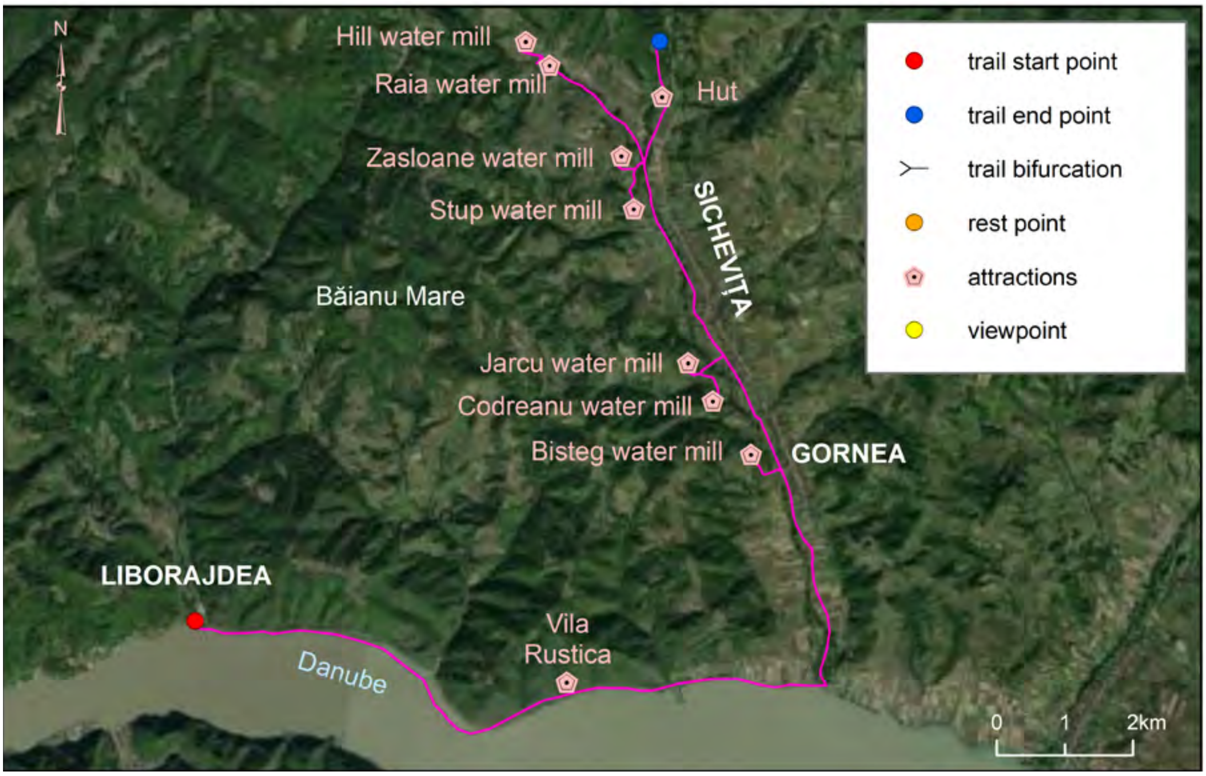

Fig. 140 Educational trail Watermills valley (Valea Morilor de Apă)

Although strictly geographical, it is not entirely located in Iron Gates Natural Park; T**he Iron Gates Region Museum** has three exhibition points (Drobeta-Turnu Severin, Iron Gates I Hydroelectric Power Plant, and Orșova) that are the most important to understanding the region. In Drobeta Turnu-Severin, you can visit the indoor sections (history, ethnography, ecology), the aquarium, the planetarium, and the rich outdoor archaeological park (Roman castrum in Drobeta). The museum holds exhibitions in Orșova (natural sciences, history, archaeology, ethnography) and at the Iron Gates I hydroelectric power plant (history, archaeology, technology museum, turbine room).

The **Vodița Monastery**, in the Vodița Valley, 1 km from Gura-Văii, was built between 1370 and 1372, close to the border between the Austrian-Hungarian Empire and Wallachia. It was the first of its kind in Wallachia, founded by a *voievod* (governor/military leader of a province in eastern Europe) and mentioned in an official document. Its founders were Vlaicu Vodă (Vladislav I) and Saint Nicodim of Tismana. Here, an illustrated Slavonic tetraevangelion (canonical gospels of the Four Evangelists) was copied, the oldest manuscript in Wallachia. The ruins of the old church from 1372 are still visible; a wooden church was erected nearby in 1995.

The **Saint Ana Monastery** was founded by the famous journalist Pamfil Șeicaru, knight of the Mihai Viteazul Order. It is located on the Moșului Hill in Orșova. Construction was completed in 1939. Before 1989, it functioned as a restaurant; its blessing as a monastery occurred only in 1990. The road to Saint Ana Monastery is known as the Heroes Road because it was a combat area during the Great War. Here is a Research Station of the University of Bucharest, the Faculty of Geography, and the headquarters of the Iron Gates Natural Park (under construction in 2022).

Saint Nicholas the Poor Church in Orșova was established at the beginning of the nineteenth century, having simple architecture with Doric, Baroque, and Neo-Classical elements. It is the first Romanian church in Orșova, being first documented in 1660.

The R**oman Catholic Church in Orșova** is located in the central part of the city, next to Market 1800. It has a dominant position, which allows its observation from multiple locations, including the European E70 road (Fig. 141). It was constructed between 1972 and 1976, following the relocation of

Fig. 141 The Roman-Catholic Church in Orșova

old Orșova to its actual location. The church is a construction made of concrete finished by formwork. It has the shape of a cross from any point you are looking at. Architect Hans Fackelmann designed the church, Peter Jecza made the sculptures, and the paintings representing the *Via Dolorosa* (Sorrowful Way) were painted with a modern approach by Gabriel Popa.

Parish Museum Priest Sever Negrescu Eșelnița and the **Ethnographical Collection Doina Olimpia and Teodor Grigore** are two small collections in Eșelnița (about 6 km from Orșova), exhibiting furniture pieces, traditional clothes, ceramics, icons, photographs from the flooded villages Eșelnița, Dubova, Tisovița, Ogradena, Plavișevița.

The statue of the last Dacian king Decebalus is a colossal statue carved in a stone block at the confluence of the Mraconia river with the Danube River (between Eșelnița and Dubova). It is 55 m tall and 25 m wide. The statue representing Decebalus (king of Dacia between 87 and 106) was finalized in 2005. The initial project belonged to an Italian sculptor, the work being executed by a team of Romanian sculptors led by Florin Cotarcea. Close to it, but on the Serbian bank of the Danube River, is the memorial plate *Tabula Traiana*. On the statue representing Decebalus, it is written "*Decebalus Rex - Dragan Fecit*"

(King Decebalus – made by Drăgan), while on **Tabula Traiana** is a text that was translated by the archaeologist Otto Benndorf as follows: "*Caesar The Emperor, son of Divine Nerva, Nerva Traian, Augustus, Germanicus, Pontifex Maximus, invested four times as a Tribune, Father of the Country, Consul for the third time, excavating rocks from the mountains and using wood beams made this bridge*".

The Jan Nepomuk Church in Eibenthal was built in 1912. The organ of the old Catholic church in Orșova was installed here, an organ designed by Master Josef Seyberth from Vienna. Eibenthal and Baia Nouă are two Czech villages that functioned as mining centers. In these settlements, there is a Central European architecture, typical for linear mountain villages.

Mraconia Monastery is a monastery that replaces the old Mracuna sanctuary in front of Tabula Traiana (now flooded by the Danube River). From the old monastery, the Parish Museum in Eșelnița hosts the "Royal Doors" (doors of the altar, usually made of wood) and a candle.

Ruins of the Tri-Kule fortified ensemble (Tricule), near the town of Svinița. The towers were erected in the 13th – 14th centuries, aiming to stop Ottoman expansion. The Tri-Kule fortification, also known as the Tricule fortress, included three towers positioned on the riverbed of the Danube as a triangle. It overlaps the inhabitation from the 11th –13th centuries, Roman and Hallstattian. The complex was subsequently flooded to the construction of the Iron Gates I reservoir, with only two towers visible today, the foundation of the third being visible only when the Danube River is low.

The **water mills of Tiganski, Vodenicki, Povalina, Stariște, Iuțului valley, Ielișeva, Gornea, Sichevița, Gramensca, Zăsloane, Gârnic** (Fig. 142) and **Coronini** represent examples of the past rural economy. Some of these mills are still functional and the local inhabitants still use them.

Archangel's Church in Berzasca is located in the heart of the town, one of the oldest Romanian churches in the Iron Gates. It was constructed in 1836 in the Baroque style and is classified as an architectural monument. From Berzasca, tourists can visit the Berzasca valley, the scenic Sirinia valley, and the isolated village of Bigăr. In Bigăr, a Central European architecture is preserved, is present, typical for linear mountain villages.

Fig. 142 Watermills in Gârnic village

The **ruins of the Ladislau citadel** are located on the left bank of the Danube River, close to Coronini. It is mentioned from the 14th Century as having a strategic role in traffic control on Danube River. It pairs with the Golubac citadel on the Serbian side (Golubački grad), much better preserved than the Ladislau citadel.

Divici – Grad Dacian citadel and settlement, on top of Divici village towards Baziaș, represents a proof of Dacian habitation in this area. The site is considered to be of national importance. The traces of some walls are still visible. Several similar archaeological sites are available in the area, Socol-Palanački Breg in Socol, Coronini-Culă, and Liubcova-Stenca.

The **Saint Sava Serb Monastery (Manastir Bazjaš)** is located in Baziaș, only 3 km from the entrance to the Danube River in Romania. It was destroyed in World War II by German warships, being abandoned until 1980. It was destroyed in World War II by German warships, being abandoned until 1980. It was founded by Serbian despot Jovan Branković. It is patronized by Saint Sava (Rastko Nemanjić), the spiritual father of the Serbians everywhere.

References

ABAB. 2015. Planul de management bazinal actualizat al spațiului hidrografic Banat. Administrația Națională Apele Române. Administrația Bazinală de Apă Banat, Timișoara.

APNPF. 2013. Planul de management al Parcului Natural Porțile de Fier. Administrația Parcului Natural Porțile de Fier, Orșova.

APNPF. 2020. Planul de management al Parcului Natural Porțile de Fier și al siturilor Natura 2000 ROSCI0206 Porțile de Fier, ROSPA0026 Cursul Dunării Baziaș–Porțile de Fier și ROSPA0080 Munții Almăjului–Locvei. Administrația Parcului Natural Porțile de Fier.

Avram, E. 1995. Svinița (Banat), Regiune de Importanță Paleontologică și Biostratigrafică Internațională. Ocrotirea Naturii și Mediului Înconjurător 39:43–49.

Bănăduc, D., A. Bănăduc, M. Lenhardt, G. Guti. 2014. Porțile de Fier/Iron Gates Gorges area (Danube) fish fauna. Transylvanian Review of Systematical and Ecological Research 16:171–196.

Bănărescu, P. 1971. Ihtiofauna afluenților. Monografia zonei Porțile de Fier. Studiul hidrobiologic al Dunării și afluenților ei. Editura Academiei RSR, București.

Berza, T., A. Drăgănescu. 1988. The Cerna–Jiu fault system (South Carpathians), a major Tertiary transcurrent lineament. Dări de Seamă ale Institutului de Geologie și Geofizică 72–73:43–57.

Berza, T., I. Balintoni, A. Seghedi, H.P. Hann. 1994a. South Carpathians. ALCAPA II Field Guidebook. Romanian Journal of Tectonics and Regional Geology 75: 37–50.

Berza, T., V. Iancu, A. Seghedi, I. Nicolae, I. Balintoni, D. Ciulavu, G. Bertotti. 1994b. Excursion to South Carpathians, Apuseni Mountains and Transylvanian Basin: description of stops. ALCAPA II Field Guidebook. Romanian Journal of Tectonics and Regional Geology 75:105–149.

Bondar, C. 2008. Bilanțul morfologic pe Dunăre în sistemul lacurilor de retenție Porțile de Fier 1 și 2 pentru 1971 - 2005, respectiv 1985 - 2005. Geo–Eco Marina 14:35–40.

Bonsall, C., A. Boroneanț. 2018. The Iron Gates Mesolithic–a brief review of recent developments. L'anthropologie 122:264–280.

Boroneanț, A., A. Dinu. 2006. The Romanian Mesolithic and the transition to farming. A case study: The Iron Gates. Studii de Preistorie 3:41–76.

Brodie, B.S., V.D. Popescu, R. Iosif, C. Ciocanea, S. Manolache, G. Vanau, A.A. Gavrilidis, R. Serafim, L. Rozylowicz. 2019. Non–lethal monitoring of longicorn beetle communities using generic pheromone lures and occupancy models. Ecological Indicators 101:330–340.

Bucur, I. I. 1997. Formațiunile mesozoice din zona Reșița–Moldova Nouă. Presa Universitară Clujeană, Cluj–Napoca.

Bücs S.L., I. Csősz, L. Barti, I. Budinski, B. Pejić, J. Bogosavljević, I. Gönczi Vass, M. Szigeti, F. Bodea, G. Crețu, A.R. Dumbravă, M. Jumanca, C. Jére. 2021. Chiropterofauna Banatului: migrație și conservare transfrontalieră. A XIII-a Conferință de Chiropterologie din Ungaria, Lakitelek, Ungaria.

Călinescu, R. 1957. Contribuții la Studiul Șibliacului în RPR. Revista Pădurilor LXX:76–84.

Călinescu, R., S. Iana. 1964. Considerațiuni biogeografice asupra Defileului Dunării. Analele Universității București, Seria geologie–geografie XIII: 151–168.

CCMESI. 2014. Studiu privind întocmirea metodologiei de identificare, caracterizare și clasificare a peisajelor în zona transfrontalieră Parcul Natural Porțile de Fier și Parcul Național Djerdap. Raport final în cadrul proiectului Bioregio. https://bit.ly/3EyZ11y.

Chira, D., D. Stănescu, M. Danciu, N. Patriche, A. Ruicănescu. 2012. Biodiversitatea ariilor protejate din zona Socol–Moldova Nouă. Editura Silvică.

Chișamera, G. 2002. Contribuții la cunoașterea avifaunei Ostrovului Moldova–Veche. Drobeta, Seria Științele Naturii XI–XII:337–342.

Chișamera, G. 2003. Contribuții la cunoașterea avifaunei Parcului Natural Porțile de Fier. Drobeta, Seria Științele Naturii XIII:245–264.

Ciocănea, C.M., A.A. Gavrilidis, V. Bagrinovschi. 2014. Microclimate observation at Hermann's Tortoise (Testudo hermanni boettgeri) habitat in the Iron Gates Natural Park. Case study: Lower Eselnita watershed (Banat, Romania). Transylvanian Review of Systematical and Ecological Research 16:47–58.

Ciocănea, C. M., C. Sorescu, M. Ianoși, V. Bagrinovschi. 2016. Assessing public perception on protected areas in Iron Gates Natural Park. Procedia Environmental Sciences 32:70–79.

Codarcea, A. 1940. Vues nouvelles sur la tectonique du Banat meridional et du Plateau de Mehedinți. Dări de semă ale ședințelor Institutului Geologic Român. 20:1–74.

Codarcea, A., G. Răileanu, L. Pavelescu, N. Gherasi, S. Năstăseanu, I. Bercia, D. Mercus. 1961. Guide des excursions. CBGA Congress V, Excursion Guide C. South Carpathians, București:1–126

Coste, I. 1975. Flora și vegetația Munților Locvei. Teză de doctorat. Universitatea Babeș Bolyai Cluj Napoca, Cluj Napoca.

Coteț, P. 1982. Geomorfologia Defileului Dunării dintre Baziaș si Gura Văii. Terra 14:5–10.

Crețan, R., L. Vesalon. 2017. The political economy of hydropower in the communist space: Iron Gates revisited. Tijdschrift voor economische en sociale geografie 108:688–701.

Doniță, N., A. Popescu, M. Paucă–Comănescu, S. Mihăilescu, I. Biriș. 2005. Habitatele din România. Editura Tehnică Silvică.

Drăgulescu, C. 2014. The current state of phyto–coenological research in the Iron Gates Danube Gorge (Banat, Romania). Transylvanian Review of Systematical and Ecological Research 16: 59–64.

Dumbrăveanu, D. 2004. Zona turistică Porțile de Fier: analiză geografică. Editura Universitară.

Dumitrescu, E., G. Neamu. 1976. Clima. in Ș. Milcu, C.S. Plopșor–Nicolăescu, R. Vulcănescu, M. Ionescu, editors. Grupul de Cercetări Complexe Porțile de Fier. Geografia. Editura Academiei RSR.

Fuhn, J., S. Vancea. 1961. Reptilia (Țestoase, Șopîrle, Șerpi). Fauna RPR XIV fascicula 2. Editura Academiei RPR, București.

Glăvan, V. 2002. Munții Locvei. Studiu de Geografie Fizică. Resursele de sol și potențialul agroproductiv. Editura Constant, Sibiu.

Glăvan, V., N. Florea, R. Bogaci, R. 1990. Solurile. Seria monografică Porțile de Fier. Editura Academiei Române, București.

Goia, I., A. Oprea. 2014. Particularities of the aquatic vegetation from Iron Gates Natura 2000 Site (Banat, Romania). Transylvanian Review of Systematical and Ecological Research 16.87–114.

Goia, I., A. Șuteu, M. Ghindeanu, A. Oprea. 2017. Particularities of the swamp vegetation from Iron Gates Natura 2000 site, Romania. Contribuții Botanice LII:85–104.

Goia, I., C.M. Ciocanea, A.A. Gavrilidis. 2014. Geographic origins of invasive alien species in Iron Gates Natural Park (Banat, Romania). Transylvanian Review of Systematical and Ecological Research 16.115–130.

Grecu, F., D. Iosif. 2014. The geosites from Danube Defile in Romania. The vulnerability to touristic activities. GeoJournal of Tourism and Geosites 14:178–184.

Grecu, F., G. Toroimac–Ioana, D.M. Constantin (Oprea), S. Carablaisa, L. Zaharia, R. Costache, A. Munteanu. 2015. Evenimentul pluvial din 14–16 septembrie 2014 din Defileul Dunării (Romania)– Hazard si risc exceptional. L'Association Internationale de Climatologie.

Grigorovschi, M., M. Dida, M. Gafar, C. Erca, E. Retegan, T. Suler. 2007. Ghid de valorificare a patrimoniului rural. Casa de Presă și Editura Tribuna, Sibiu.

Guvernul României. 2003. Hotărârea nr. 230/2003 privind delimitarea rezervațiilor biosferei, parcurilor naționale și parcurilor naturale și constituirea administrațiilor acestora. Monitorul Oficial, Partea I, 190/26.03.2003.

Guvernul României. 2007a. Hotărârea nr. 1284/2007 privind declararea ariilor de protecție specială avifaunistică ca parte integrantă a rețelei ecologice europene Natura 2000 în România. Monitorul Oficial Partea I. 739/31.10.2007.

Guvernul României. 2007b. Ordonanță de Urgență nr. 57 din 20 iunie 2007 privind regimul ariilor naturale protejate, conservarea habitatelor naturale, a florei și faunei sălbatice. Monitorul Oficial Partea I. 442/29.06.2007.

Hurdu, B.I., M. Puscas, P.D. Turtureanu, M. Niketic, G. Coldea, N.E. Zimmermann. 2012. Patterns of plant endemism in the Romanian Carpathians (South–Eastern Carpathians). Contribuții Botanice 47:25–38.

Iana, S., A. Petcu. 1976. Caracterizare Biogeografică. in Ș. Milcu, C. S. Plopșor–Nicolăescu, R. Vulcănescu, M. Ionescu, editors. Grupul de Cercetări Complexe Porțile de Fier. Geografia. Editura Academiei RSR.

Iancu, M. 1976. Considerații morfometrice și morfografice. in Ș. Milcu, C.S. Plopșor–Nicolăescu, R. Vulcănescu, M. Ionescu, editors. Grupul de Cercetări Complexe Porțile de Fier. Geografia. Editura Academiei RSR.

Iancu, M., I. Popovici. 1976. Din contribuția geografilor la cunoașterea Defileului Dunării. in Ș. Milcu, C.S. Plopșor–Nicolăescu, R. Vulcănescu, M. Ionescu, editors. Grupul de Cercetări Complexe Porțile de Fier. Geografia. Editura Academiei RSR.

Iancu, M., V. Glăvan. 1976. Morfostructura. in Ș. Milcu, C.S. Plopșor–Nicolăescu, R. Vulcănescu, M. Ionescu, editors. Grupul de Cercetări Complexe Porțile de Fier. Geografia. Editura Academiei RSR.

Iancu, V., M. Mărunțiu, V. Johan, P. Ledru. 1998. High–grade metamorphic rocks in the pre–Alpine nappe stack of the Getic–Supragetic basement (Median Dacides, South Carpathians, Romania). Mineralogy & Petrology 63:173–198.

Ile, G. A., A.R. Dumbravă. 2020. A Wall lizard on a Danube Island–Podarcis muralis (Reptilia) in Moldova Veche Island, Iron Gates Natural Park, Romania. Ecologia Balkanica 12: 191–194.

Ionescu, M. editor. 1975. Fauna. Grupul de Cercetări Complexe Porțile de Fier. Editura Academiei RSR, București.

Iordache, C. 2002. Forme tradiționale de utilizare a apei în sudul Munților Locvei. Analele Universității Valahia Târgoviște, Seria Geografie 3:161–166.

IUCN, 2013. Guidelines for applying protected area management categories, IUCN Best Practice Protected Area Guidelines. IUCN.

Juan–Petroi, C. 2006. Strămutarea orașului Orșova pe o nouă vatră (1966–1974). Valorificarea muzeală a moștenirii civilizației sale urbane. Historia Urbana 14:95–117.

Kudernatsch, J., 1852. Die Ammoniten von Swinitza. Abhandlungen der kaiserlich-koniglich geologischen Reichsanstalt 1, 1-16.

Manea, G. 2003. Naturalitate și antropizare în Parcul Natural Porțile de Fier. Editura Universității din București.

Manolache, S., A. Nita, C.M. Ciocanea, V.D. Popescu, L. Rozylowicz. 2018. Power, influence and structure in Natura 2000 governance networks. A comparative analysis of two protected areas in Romania. Journal of Environmental Management 212:54–64.

Manolache, S., A. Nita, T. Hartel, I.V. Miu, C.M. Ciocanea, L. Rozylowicz. 2020. Governance networks around grasslands with contrasting management history. Journal of Environmental Management 273:111152.

Manolache, S., C.M. Ciocanea, L. Rozylowicz, A. Nita. 2017. Natura 2000 in Romania–a decade of governance challenges. European Journal of Geography 8:24–34.

MAPAM. 2003. Ordinul nr. 552/2003 privind aprobarea zonării interioare a parcurilor naționale și a parcurilor naturale, din punct de vedere al necesității de conservare a diversității biologice. Monitorul Oficial Partea I, 648/11.09.2003.

Matacă, S. 2000a. Arondarea fitogeografică a teritoriului Parcului Natural Porțile de Fier. Marisia, Studia Scientiarum Naturale XXVI:155–160.

Matacă, S. 2000b. Protecția florei din Parcul Natural Porțile de Fier (Județul Mehedinți). Drobeta, Seria Științele Naturii X:138–144.

Matacă, S. 2001. Caracterizarea florei Parcului Natural Porțile de Fier. Oltenia, Studii și Comunicări de Științele Naturii XVII:52–56.

Matacă, S. 2002a. Conspectul sistematic al plantelor vasculare din Parcul Natural Porțile de Fier. Drobeta, Seria Științele Naturii XI–XI: 255–245.

Matacă, S. 2002b. Vegetația saxicolă din Parcul Natural Porțile de Fier. Marisia, Studia Scientiarum Naturale XXVI: 319–336.

Matacă, S. 2005. Parcul Natural Porțile de Fier: floră, vegetație și protecția naturii. Editura Universitaria.

Matache, M. L., C. Marin, L. Rozylowicz, A. Tudorache. 2013. Plants accumulating heavy metals in the Danube River wetlands. Journal of Environmental Health Science and Engineering 11:39.

Matache, M. L., L. Rozylowicz, M. Ropota, C. Patroescu. 2003. Heavy metals contamination of soils surrounding waste deposits in Romania. Journal de Physique 4 107:851–854.

Matache, M.L., C. Pătroescu, I. Pătroescu–Klotz. 2002. Evoluția concentrației metalelor grele în sedimente acvifere dunărene pe tronsonul Baziaș–Porțile de Fier I (1996–1999). Revista de Chimie 53:623–626.

Mărgărit, M., A. Boroneant, M. Balint, A. Bălășescu, C. Bonsall. 2018. Interacțiuni om–mediu în situl mezolitic de la Icoana (Porțile de Fier). Studii de Preistorie 14:37–77.

Mihai, B., C. Nistor, L. Toma, I. Săvulescu. 2016. High resolution landscape change analysis with CORONA KH–4B imagery. A case study from Iron Gates reservoir area. Procedia Environmental Sciences 32:200–210.

Milanovic, S. 2014. Orchidaceae L. Family in the Iron Gates Park (Romania). Transylvanian Review of Systematical and Ecological Research 16: 65–86

Milanovici, S. 2012. Orhidee din sudul Banatului. East–West Print Timișoara.

MMAP. 2021a. ROSPA0026 Cursul Dunării - Baziaș - Porțile de Fier. Natura 2000 - Standard Data Form. https://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=ROSPA0026

MMAP. 2021b. ROSPA0026 Munții Almăjului – Locvei - Porțile de Fier. Natura 2000 - Standard Data Form. https://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=ROSPA0080

MMAP. 2021c. ROSCI0206 Porțile de Fier. Natura 2000 - Standard Data Form. https://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=ROSCI0206

MMDD. 2008. Ordinul nr. 1964/2007 privind instituirea regimului de arie naturală protejată a siturilor de importanță comunitară, ca parte integrantă a rețelei ecologice europene Natura 2000 în România. Monitorul Oficial Partea I. 98/07.02.2008.

Munteanu-Murgoci, G. 1905. Sur l'existence d'une grande nappe de recouvrement dans les Carpathes meridionales. Comptes Rendus de l'Academie des Sciences 7:31.

Mutihac, V. 1990. Structura geologică a teritoriului României. Editura Tehnică, București.

Năstăseanu, S., B. Maksimovic. 1983. La correlation des unites structurales alpines de la partie interne des Carpathes Meridionales de Roumanie et de Yougoslavie. Anuarul Institutului de Geologie și Geofizică 60:169–176.

Năstăseanu, S., I. Bercia, V. Iancu, Ș. Vlad, I. Hârtopanu. 1981. The structure of the South Carpathians (Mehedinți – Banat Area). Guide to excursion B 2. Carpathian–Balkan Geological Association, XII Congress, Institute of Geology and Geophysics, Bucharest.

Năstăseanu, S., I. Popescu, E. Negrea. 1988. Alpine structural units in the Almăj Mountains. Dări de Seamă ale Ședințelor Comitetului Geologic 72–73:161–168.

Necșuliu, R. 2007. Gestiunea socială a parcurilor naturale din România: studiu de caz Parcul Natural Porțile de Fier, Teză de doctorat. Universitatea din București.

Niculae, M.I., M.R. Niță, G. Vanău, C.M. Ciocanea, A.A. Gavrilidis. 2014. Spatial and temporal dynamic of rural and urban landscapes Identified in the Iron Gates Natural Park. Transylvanian Review of Systematical and Ecological Research 16:211–224.

Nistor, C., I. Savulescu, B.A. Mihai, L. Zaharia, M. Vîrghileanu, S. Carablaisa. 2021. The impact of large dams on fluvial sedimentation: The Iron Gates Reservoir on the Danube River. Acta Geographica Slovenica 61: 41–55.

Nita, A., C.M. Ciocanea, S. Manolache, L. Rozylowicz. 2018. A network approach for understanding opportunities and barriers to effective public participation in the management of protected areas. Social Network Analysis and Mining 8:31.

Osaci–Costache, G., I. Armaș. 2016. Lost landscapes: in search of cartographic evidence. 35–62 Space and Time Visualisation. Springer.

Parlamentul României. 2000. Legea nr. 5/2000 privind aprobarea Planului de amenajare a teritoriului național – Secțiunea a III–a – zone protejate. Monitorul Oficial al României. Partea I 152/12.04.2000.

Parvulescu, L., C. Paloș, P. Molnar. 2009. First record of the spiny–cheek crayfish Orconectes limosus (Rafinesque, 1817) (Crustacea: Decapoda: Cambaridae) in Romania. North–Western Journal of Zoology 5:424–428.

Pătroescu, M., editor. 2004. Parcul Natural Porțile de Fier. Universitatea din București - CCMESI, București.

Pătroescu, M., I. Chincea, L. Rozylowicz, C. Sorescu, editors. 2007. Pădurile de pin negru de Banat – Sit Natura 2000. Brumar, Timișoara.

Pătroescu, M., L. Rozylowicz. 2000. Natural transborder parks: the direction of biodiversity preservation in Romania. Pages 101–113 Implementing Ecological Integrity. Springer.

Pătroescu, M., R. Necșuliu. 2008. Le Danube dans le secteur du Défilé des Portes de Fer. Vers la création d'une réserve transfrontalière Portes de Fer–Djerdap? Balkanologie. Revue d'études pluridisciplinaires. Balkanologie.391.

Pop, G., M. Mărunțiu, V. Iancu, A. Seghedi, T. Berza. 1997. Geology of the South Carpathians in the Danube Gorges. IGR, Bucharest.

Popa, M.E. 2003. Geological heritage values in the Iron Gates Natural Park, Romania. Pages 742–751 in M. Pătroescu, editor. ICERA 2003. Ars Docendi Publishing House, București.

Posea, G., M. Grigore, N. Popescu. 1976. Trepte morfogenetice din zona Defileului Dunării. in Ș. Milcu, C.S. Plopșor–Nicolăescu, R. Vulcănescu, M. Ionescu, editors. Grupul de Cercetări Complexe Porțile de Fier. Geografia. Editura Academiei RSR.

Posea, G., L., Badea. 1984. România. Unitățile de relief (regionarea geomorfologică), Editura Științifică și Enciclopedică, București.

Preda, S. 2010. Cehii din Banat, migrație și identitate problematică. Pages 247–258 in A.Z. Jakab, L. Peti, editors. Minorități în zonele de contact interetnic. Cehii și slovacii în România și Ungaria. Institutul pentru Studierea Problemelor Minorităților Naționale. Kriterion, Cluj–Napoca.

Radovanovic, I. 1996. The Iron Gates mesolithic. International Monographs in Prehistory. Ann Arbor. Michigan.

Rădulescu, D., M. Săndulescu. 1973. The plate–tectonics concept and the geological structure of the Carpathians. Tectonophysics 16:155–161.

Rădulescu, I., I.D. Ilie. 1976. Geomorfologia fundului văii Dunării. in Ș. Milcu, C.S. Plopșor–Nicolăescu, R. Vulcănescu, M. Ionescu, editors. Grupul de Cercetări Complexe Porțile de Fier. Editura Academiei RSR.

Răileanu, G. 1953. Cercetări geologice în regiunea Svinița–Fața Mare. Buletin Științific. Secțiunea de Științe biologice, agronomice, geologice și geografice 5:307–409

Răileanu, G. 1960. Recherches geologiques dans la region Svinița–Fața Mare. Annuaire du Comite Geologique XXVI–XXVIII:347–383.

Rey, V., O. Groza, M. Pătroescu, I. Ianos. 2007. Atlas de la Roumanie: dynamiques du territoire. Reclus.

Roman, N.G. 1974. Flora și vegetația din sudul Podișului Mehedinți. Editura Academiei.

Rozylowicz, L. 2008. Metode de analiză spațială a distribuției areal-geografice a țestoasei lui Hermann (Testudo hermanni Gmelin, 1789) în România. Studiu de caz: Parcul Natural Porțile de Fier. Editura Universității din București.

Rozylowicz, L., A. Nita, S. Manolache, V.D. Popescu, T. Hartel. 2019. Navigating protected areas networks for improving diffusion of conservation practices. Journal of Environmental Management 230:413–421.

Rozylowicz, L., M. Dobre. 2010. Assessing the threatened status of Testudo hermanni boettgeri Mojsisovics, 1889 (Reptilia: Testudines: Testudinidae) population from Romania. North–Western Journal of Zoology 6:190–202.

Rozylowicz, L., M. Pătroescu. 2004. Dimorfismul sexual la țestoasa lui Hermann (Testudo hermanni boettgeri Mojsisovics, 1889) din Parcul Natural Porțile de Fier. Drobeta, Seria Științele Naturii 14:42–49.

Rozylowicz, L., V.D. Popescu. 2013. Habitat selection and movement ecology of eastern Hermann's tortoises in a rural Romanian landscape. European Journal of Wildlife Research 59:47–55.

Sanda, V., K. Öllerer, P. Burescu. 2008. Fitocenozele din România: sintaxonomie, structură, dinamică și evoluție. Ars Docendi.

Sasel, J. 1973. Trajan's Canal at the Iron Gate. Journal of Roman Studies 63:79–82.

Seghedi, I. 2011. Permian rhyolitic volcanism, changing from subaqueous to subaerial in post–Variscan intra–continental Sirinia Basin (SE Romania–Eastern Europe). Journal of Volcanology and Geothermal Research 201:312–324.

Simić, A., N. Mitrović. 2020. Djerdap through the centuries. Transylvanian Review 29.

Stan, L.S. 2013. The Danube at the Iron Gates. Histories of the Romanian–Serbian border in the 20th century. Studia Universitatis Babeș–Bolyai–Historia 58:46–57.

Stănescu, F., E. Buhaciuc, P. Szekely, D. Szekely, L. Rozylowicz, D. Cogalniceanu. 2015. The impact of dam construction on amphibians and reptiles. Study case – Iron Gates I. Analele Științifice ale Universității Alexandru Ioan Cuza din Iași. Biologie animală LXI:19–24.

Stîngă, I. 1986. Repertoriul arheologic al zonei hidrocentralei Porțile de Fier II, jud. Mehedinți. Materiale și cercetări arheologice 16:9–15.

Streckeisen, A. 1934. Sur la tectonique de Carpathes Meridionales. An. Inst. Geol. 16: 327–481.

Ștefănucă, S. 2010. Granița și grănicerii bănățeni – o abordare socio–istorică. Revista Română de Sociologie 21:129–151.

Teodoru, C., B. Wehrli. 2005. Retention of sediments and nutrients in the Iron Gate I Reservoir on the Danube River. Biogeochemistry 76:539–565.

Tetelea, C. 2014. Morphometric analysis to extrapolate geoecological potential of the rivers in the Iron Gates Natural Park (Banat, Romania). Transylvanian Review of Systematical and Ecological Research 16:29–46.

Thorpe, N. 2011. An aasis on the Danube: Ada Kaleh. Hungarian Review 2:68–73.

Trufaș, V., I. Simion. 1982. Modificarea unor caracteristici hidrologice ale Dunării între Baziaș și Gura Văii. Analele Universității din București. Seria Geografie XXXI: 65–82.

Trufaș, V., V. Bagrinovschi. 1984. Temperatura și înghețul apelor Dunării între Baziaș și Gura Văii. Analele Universității din București. Seria Geografie XXXIII:33–42

Urziceanu, M., P. Anastasiu, L. Rozylowicz, T. E. Sesan. 2021. Local–scale impact of wind energy farms on rare, endemic, and threatened plant species. PeerJ 9:e11390.

Văran, C., R. Crețan. 2018. Place and the spatial politics of intergenerational remembrance of the Iron Gates displacements in Romania, 1966–1972. Area 50:509–519.

Velcea, V., I.D. Ilie. 1976. Procesele Geomorfologice Actuale. in Ș. Milcu, C.S. Plopșor–Nicolăescu, R. Vulcănescu, M. Ionescu, editors. Grupul de Cercetări Complexe Porțile de Fier. Editura Academiei RSR.

Vulcănescu, R., editor. 1972. Atlasul Complex Porțile de Fier. Editura Academiei RSR, București.

Zaharia, L. 2008. Impactul lacului de acumulare Porțile de Fier I asupra morfodinamicii malului și a versantului românesc. Comunicări de Geografie XII:223–228.

Zaharia, L. 2010. The Iron Gates Reservoir – Aspects Concerning Hydrological Characteristics and Water Quality. Lakes, reservoirs and ponds 4:52–69.

Zaharia, L., F. Grecu, G. Ioana–Toroimac, G. Neculau. 2011. Sediment transport and river channel dynamics in Romania–variability and control factors. in Manning A. editor. Variability and Control Factors, Sediment Transport in Aquatic Environments. IntechOpen.

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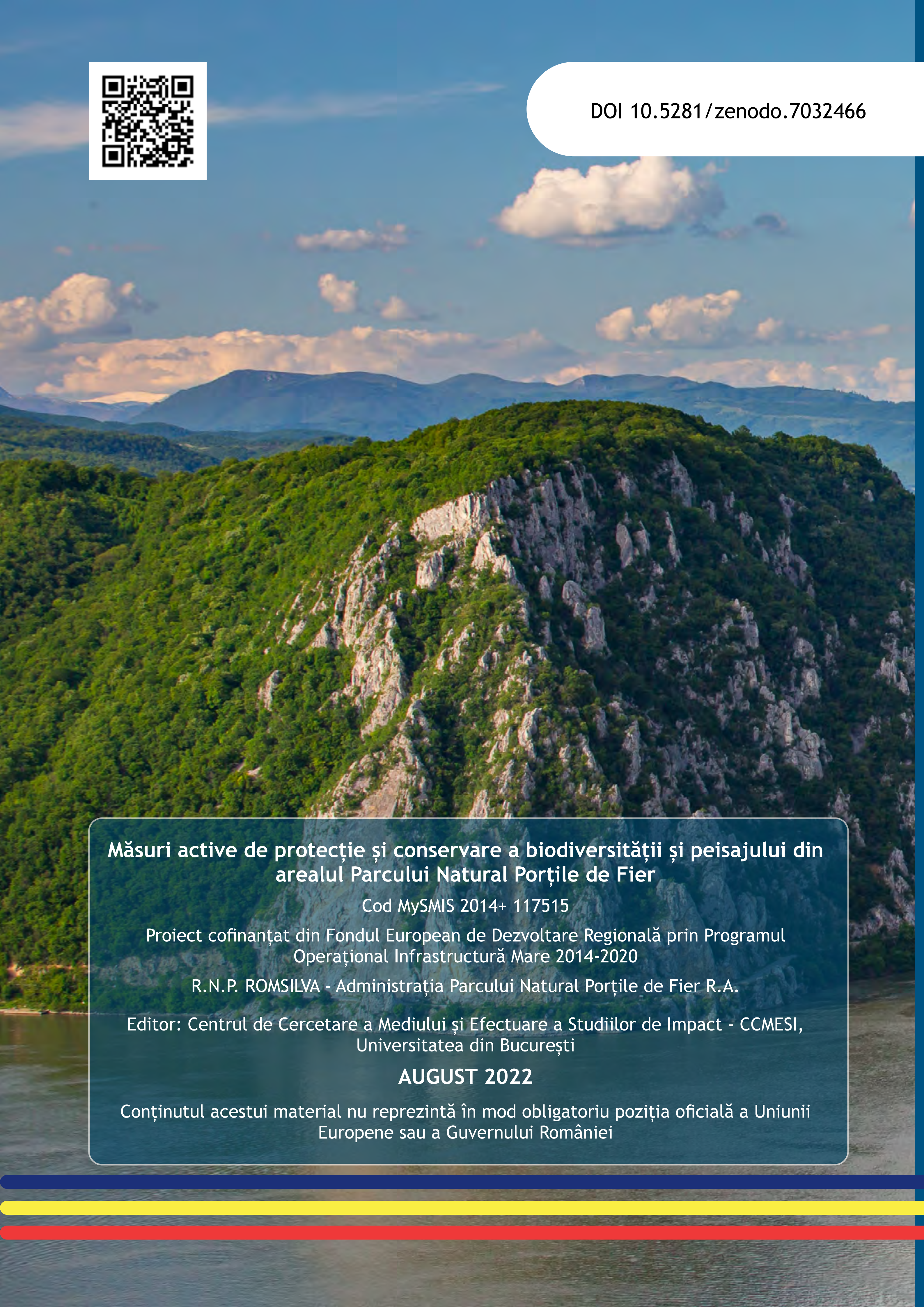

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