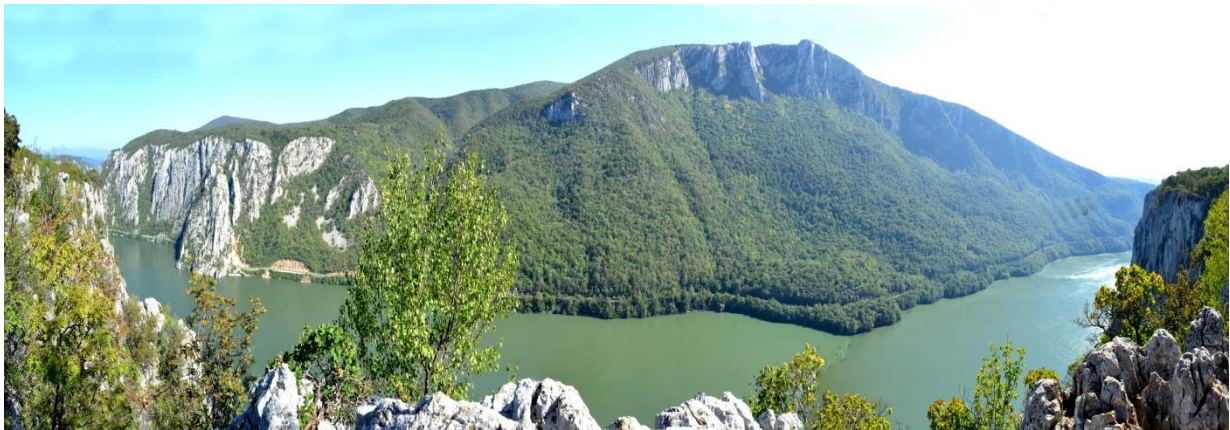


# **Integrated Management Of Biological And Landscape Diversity For Sustainable Regional Development And Ecological Connectivity In The Carpathians (Bioregio Carpathians)**



**Study on the methodology for identification, characterization and  
classification of landscapes from the cross-border area Iron Gates Natural  
Park and Djerdap National Park**

**Study on the methodology for identification, characterization and classification of landscapes from the cross-border area Iron Gates Natural Park and Djerdap National Park**

**Final Report**

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## **Introduction**

The study of landscapes has increasingly become a subject of interest, both for scientist and for public administrations at local, regional or national levels. Landscape elements, frequently a direct result of the synergy between natural conditions and human intervention during centuries of exploitation, represent priorities of modern societies, in which the man rediscovers his millenary connection to the nature.

The importance of landscape study increases in the case of natural protected areas, especially of large sizes, in which different degrees of human pressures lead to a diversity of landscapes with different heritage values of natural, cultural or material elements. Their importance is determined both by the manner in which landscapes generate individuality and identity to the protected areas, as well as the role of protected areas in actively preserving the structure and functionality of the landscapes.

The conceptual approaches of the landscape present a high diversity, expressing the different typologies of landscapes and the scale of their approach. In addition, the landscapes as a legislative element represent a concept of novelty, aimed at demonstrating their increasing importance. The European Landscape Convention, the first international treaty dedicated to landscapes, has been ratified by Romania and Serbia, with the purpose of preserving the identity, their diversity, of terrestrial or aquatic, urban or rural landscapes. The study area of the two parks, presents numerous elements of landscape identity of importance at communitarian level, although the human intervention in them varies. In both of them, an increased knowledge of the landscapes comes with a social utility, as both an indicator of the quality of life, but as an important side of the conservation of natural, cultural and material heritage.

The different degrees of human pressure on the environment in historical times, population and settlements density will impose the development of a specific methodology in the identification, characterization and classification of landscapes, connected to the prognosis of landscapes evolution in structure and functions, in the framework of enforcing European legislation in the Danube Basin.

The geographic landscape represents a central element conferring personality and unicity to the analyzed protected areas, and in the same time an important factor of touristic attractiveness. Identifying the defining elements of the landscapes represents an essential instrument that can be used both for understanding their spatial and temporal dynamic and for establishing their efficient management, either by the administration of the protected areas or by deciders and planners at local or regional scale.

Any classification of the geographic landscapes must start from a balanced quantitative and qualitative presentation of their defining components. These should be whereas possible prioritized according to their patrimonial value, in reflection to their direct contribution to the landscape's structure and functionality. The two protected areas contain a large series and typologies of landscapes, such as natural landscapes induced by the physical and geographical characteristics, or by the physiognomy and distribution of vegetation, rural and urban landscapes, industrial, cultural or historical landscapes. All these landscapes are

found in different stages of their equilibrium or sustaining an increased human pressure and an accelerated dynamic of their elements.

Therefore, the development of an evaluation and classification scheme for geographic landscapes has a special utility as it will allow their logical classification and will sustain a specific methodology for their analysis. Considering the complex and dynamic character of the landscapes is obvious that the methodology should contain a logical and complementary succession of stages, starting from the field work – fundamental to any landscape analysis and based on a strong visual analysis of the landscape. Laboratory stages can concentrate on the analysis of maps and aerial images for the historical dynamic of landscapes, or a comprehensive analysis of scientific literature in sustaining the elements identified in the field.

Even if we consider the significant importance of the two protected areas, their large surface and the diversity of human activities in the past centuries makes it impossible to realize an analysis and classification of landscape elements without an adequate assessment of the possible human impacts on the landscape's structure and functionality. This diagnosis should always be continued with the identification of methods in which the human impact on the landscapes can be reduced.

All these instruments assessing landscape distribution and functions, as well as their classification based on clearly presented methodologies are especially useful in the case of protected areas, where their administrators need both information and specific tools in order to realize an efficient management of geographical landscapes.

## I. CONCEPTUAL AND LEGISLATIVE FRAMEWORK OF THE LANDSCAPE FIELD

### 1.1. Conceptual framework in the landscape field

*The landscape concept* first appeared in the art of the XIV-XV centuries, the starting point of the awareness of landscapes being considered the climbing of Mount Ventoux by the poet Francesco Petrarca in 1336 (Wascher, 2005). As a *scientific term*, Al. von Humboldt who realizes the first landscapes classification according to the homogeneity of vegetation associations (Christians, 1994) introduced the landscape concept in scientific literature. His definition of the landscape represented for a long period an element of reference in landscape studies, for either European or North-American researchers in the field considering social, aesthetic, economic and environmental aspects.

Usually, the landscape represents the part of the territory that can be seen in a single view, including all its natural characteristics. Such a *visual interpretation* interferes with the spatial concepts of the landscapes that have been developed in geography, remote sensing and landscape ecology (Steiner, 1991). This contradiction clarifies in a way the motive for which researchers have for decades reduced the importance of ecologic and environmental objectives to the favor of social and economic aspects of the landscapes, and why these are sometimes in conflict with the individuals' perception and preferences (Ciocănea, 2013). Especially after 1990, researchers felt the need of a holistic approach in landscape analysis (Potschin, 2002), leading to the development of trans-disciplinary approaches.

The landscape represents a result from the *dynamic interaction* in time and space of three main components: *abiotic potential*, for all the non-living elements; *biotic potential*, for the vegetation and animal communities and *human impact* interfering with the first two (Pătroescu et al., 2000; Pătru, 2001). The notion of *geographical landscape* represents not only a sum of visual elements, as they appear to the common individual or the artist, but a synthesis of concrete representations, of the conditionality between natural elements intermingling in a larger or smaller scale with elements resulting from the human intervention (Tufescu & Tufescu, 1981).

The landscape represents and *inter and trans-disciplinary* concept between different fields such as geography, ecology, geology, biology, agronomy, forestry, plastic arts, architecture, urbanism, landscaping, tourism, history, ethnography, ethnology, sociology, mathematic, informatics, GIS. The field interconnects these seemingly different domains in a generic notion of *Landscape – image of a territory*, generating a new approach for a holistic research (Fig. 1). All the above fields of study have considered especially the spatial dimension of the landscape and its functional and aesthetic aspects (Tudora, 2009).

The landscape concept follows the *stages* of landscape formation (Dincă, 2005; Ciocănea, 2013):

1. The stage in which the landscape was represented by the nature itself (initial natural landscape);
2. The stage with firsts human footprints on the landscape, determined by the first forms of agriculture;
3. The stage of establishment and development of human settlements and human activities;

#### 4. The modern stage with the development of industry and other economic fields.

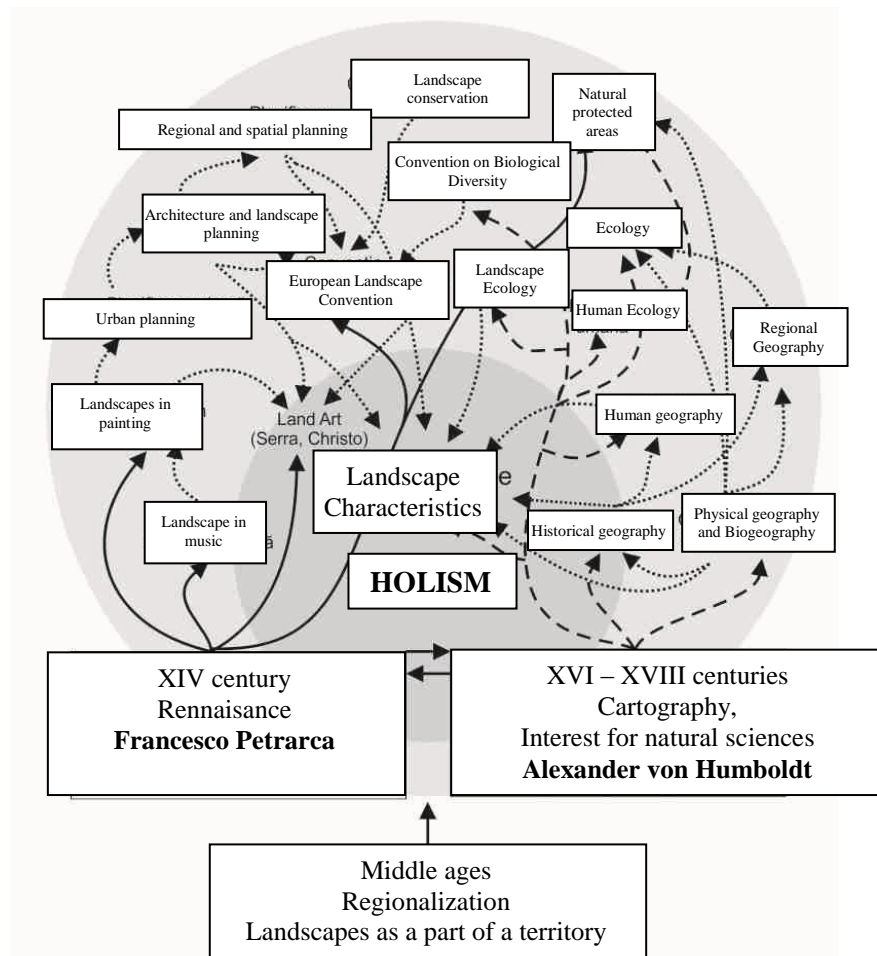


Fig. 1 Pluridisciplinarity and landscape characteristics (after Wascher et al. 2005, quoted by Ciocănea, 2013)

According to the *European Landscape Convention*, signed at Florence in 2000, the landscape designates a part of the territory perceived by the population; its character is resulted from the action and interaction between natural and/or human factors (L451/2000). Defined as a cultural and social construction corresponding to a social and economic requirement, the human impact on the landscape represents the spatial inscription of a culture. The landscape participates in an important manner to the general interest in the field of culture, ecology, environmental and social, representing a favorable resource for the economic activity, and its protection, management and improvement contributes to job creation.

In the same time, the landscape represents a *complex of the environment and territorial planning*, presenting a series of functions of general interests in different fields (cultural, ecologic, social), being in the same time an economic resource that can in the end improve the quality of life (Pătroescu & Cenac – Mehedinți, 1999; Pătroescu et al., 1999-2000). The landscape represent a fundamental component of the natural and cultural heritage, at local, regional, national and European level, including in this definition natural, historical, ethnographical, agricultural values that define the European human identity (CCMESI, 1996). It can be affirmed that the landscape “*integrates natural elements with social ones, the human*

modifying or replacing natural ecosystems according to their needs, their organization or the development of human collectivities” (Dumitrașcu, 2006), being in the same time a dynamic combination between elements in a certain geographical space and with a defined time unit (Mac, 1990; Dincă, 2005).

An important factor in understanding the landscape is represented by the *limits between different landscape types*. These are determined not by lines, but by several transition elements, with different composition and in a continuous movement (Stan, 2009). *Landscape classification* is based on classes and types directly connected to the influence and activity of humans: the cultural landscapes, rural and urban landscapes (Mac, 2000; Pătroescu et al., 2000; Pătru-Stupariu, 2011).

Landscapes can be *classified* according to a series of *characteristics* (Dincă, 2005) according to their: *stability or balance* of relations between the components and results (stable landscapes, relatively balanced and instable landscapes), *territorial relations* between landscapes (clearly individualized, with elements of interference, integrated landscapes), *self-regulation capacity* (landscape with normal self-regulation, with precarious self-regulation and landscapes regulated artificially), *after the artificial degree* (landscapes with artificial modifications in the hydrography, topography, soil), *components of the systems* (landscapes in biostasis, rhexistasy or parastasis), *social dynamic* (landscapes with ascended social dynamic, stationary social dynamic or descendent social dynamic (Tudoran, 1976; Ciocănea, 2013).

The *spatial and temporal dynamic* of landscapes depends on the resistance of their components to the *natural modifying factors* and their rapport with the *fundamental human requirements* and its capacity as individual or human communities to intervene in changing the aspect of the natural landscape. This approach was adopted by Zonneveld (1989), which affirms that the landscape represent “tangible ecosystems that include all biotic and abiotic aspects that can be visually recognized visually on Earth’s surface” (fig. 2).

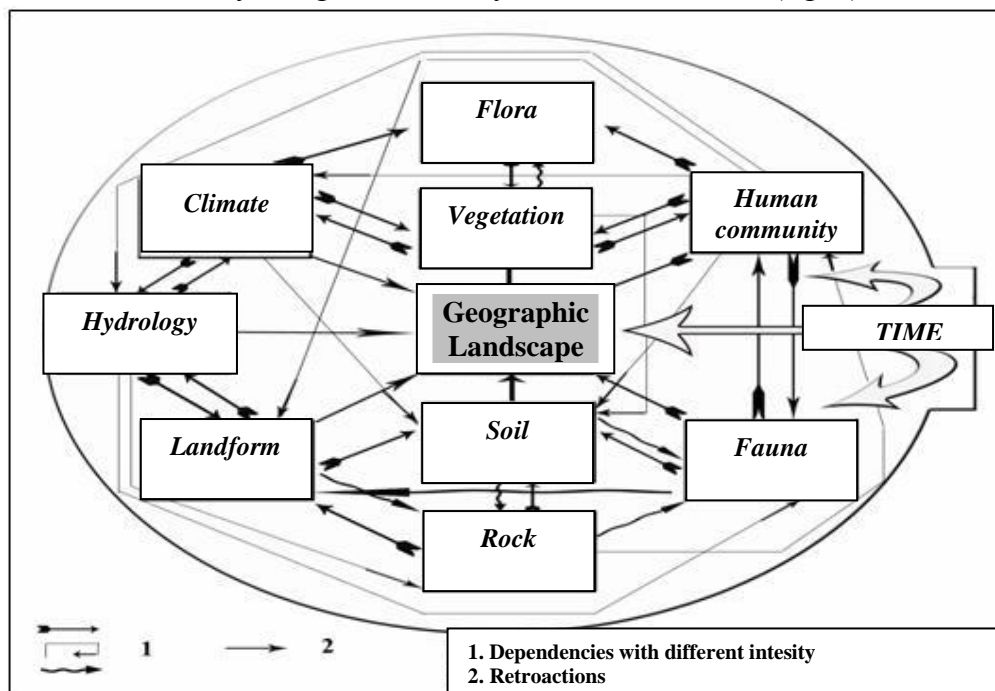


Fig. 2 Landscape model in ecologic framework (after Zonneveld,1972, quoted by Rougerie & Beroutchavili, 1991; Dumitrașcu, 2006)



Another aspect regarding the definitions of landscape was highlighted by FAO (1976), underlining that landscapes contain the physical environment (including climate, relief, soil, hydrology and vegetation elements) and the manner in which they affect the potential of land use. One can observe that the FAO concept regards the landscape as result of past and present human activities on the soil and vegetation, ignoring the social and economic characteristics of human communities.

Drăguț (2000) describes the landscape as a spatial structure, expressed by its own philosophy, determined following the interactions between biotic, abiotic and human factors and valorized different according to its perception.

## **1.2. Legislative framework for the natural protected areas from Serbia and Romania in the present study**

The provisions regarding the legislation for natural protected areas are divided into several fields of action:

- Framework legislation with general character;
- Legislation for defining notions and concepts concerning protected areas;
- Legislation on the main categories of protected areas;
- Legislation for the establishment and delineation of protected areas;
- Legislation for the improvement or modification of past provisions;
- Legislation concerning the effective functioning of protected areas.

Certain legislation parts, especially from the category of general framework legislation, due to the relative novelty of field ensure in the same time the legal reason for the establishment of protected areas, but also their inclusion in a certain category of protected area, defining the main concepts use, enforcing a managing authority and its specific instruments, or any other functions.

Moreover, Romanian legislation is almost entirely doubled by the European legislation, a requirement that in Serbia is not always met, although the Serbian government makes efforts in enforcing the principles of European legislation in the field of conservation at national level.

### ***General legislative framework in Romania***

The Government Ordinance no. 57/2007 regarding the regime of natural protected areas, conservation of natural habitats, wildlife flora and fauna, approved with modifications and notes by the Law no. 49/2011 represents a document by which natural protected areas, such as the Iron Gates Natural Park are classified and analysed in a detailed manner. The provisions of this legislative act are directly influencing the landscapes.

The methodological contributions of the Government Ordinance no. 57/2007 approved with modifications and notes by the Law no. 49/2011 to the landscape field is expressed by the classification of four main types of natural protected areas, according to their level:

- a) National interest, including scientific reserves, national parks, nature monuments, natural reserves, natural parks;

- b) International interest, such as natural sites of the universal heritage, geoparks, wetlands of international importance and biosphere reserves;
- c) Communitarian interest or Natura 2000 sites, respectively special areas of conservation (SAC), sites of communitarian importance (SCI) and special protection areas (SPA);
- d) County or local interest.

In the *Iron Gates Natural Park* are present protected areas from all of the four categories mentioned above. The framing in a certain class determines for the protected area a special manner of management and the delineation of specific objectives. The management type can determine direct effects on the landscapes, such as the conservation of certain types of landscape, direct or indirect measures for the modification of others so that they correspond to specific criteria, the support or control of actions for the modifiers of the landscape (species of animals and plants, geomorphological processes, climate phenomenon, human communities, etc.).

The Government Ordinance no. 57/2007 approved with modifications and notes by the Law no. 49/2011 mentions that the establishment of protected areas is made through specific legislation:

- a) Law, for natural sites of the universal heritage;
- b) Government decision for scientific reserves, national parks, nature monuments, natural reserves, natural parks, wetlands of international importance, biosphere reserves, geoparks, special areas of conservation, special protection areas;
- c) Order of the public central authority for environmental protection for sites of communitarian importance, with advice from the Romanian Academy.

*Natural parks* are defined as representing “those natural protected areas whose purposes are mainly the protection and conservation of landscape ensembles in which the interaction of human activities with the nature over time created a distinct area, with a significant landscape and/or cultural value, often with a high biological diversity”. One can notice that natural parks represent the protected area category concentrating in the highest degree on landscape values, seen as a resultant of the interactions between human activities and nature.

In many cases, natural protected areas are considered to regard especially the conservation of certain landscape components, mostly natural. Corroborating these elements with international legislation, natural parks correspond to the **V IUCN** category: “Protected landscape – protected area managed especially for landscape conservation and recreation”.

*The Iron Gates Natural Park* represents a territorial entity with a large surface and complex characteristics, increased by the presence of other categories of protected areas (Table 1) which overlap totally or partially its perimeter. Some of these categories of protected areas are in a subordination and inclusion relation with the natural park regime, while others function in quasi-independence.

The Iron Gates Natural Park was established through Law no. 5/2000 regarding the Plan of the national territory, 3<sup>rd</sup> Section- Protected areas. Under this law, protected areas are natural or built areas, delineated geographically or topographically, containing values of natural or cultural heritage, and that are declared for achieving the specific objectives of

conservation. This law realises only an inventory and location of the protection areas, without interfering with their regime or management.

Table 1 Natural Protected Areas in the Iron Gates Natural Park

No	Protected area	Surface	Established through
1	Natural reserve Balta Nera - Dunăre	10 ha	Law no. 5/2000
2	Natural reserve Baziaș	170.9 ha	Law no. 5/2000
3	Special Protection Area – Calinovăț wetland	24 ha	Government Decision 2151/2004
4	Natural Reserve Râpa cu lăstuni	5 ha	Caraș Severin County Decision 8/1994, confirmed by Government Decision 2151/2004
5	Special Protection Area Divici – Pojejena	498 ha	Government Decision 2151/2004
6	Natural Reserve Valea Mare	1179 ha	Law no. 5/2000
7	Natural Reserve Peștera cu apă din Valea Polevii	3.2 ha	Government Decision 2151/2004
8	Special Protection Area - Ostrovul Moldova Veche	1627 ha	Government Decision 2151/2004
9	Natural Reserve Locul fosilifer Svinița	5 ha	Law no. 5/2000
10	Natural Reserve Cazanele Mari și Cazanele Mici	215 ha	Caraș Severin County Decision 18/1980
11	Natural Reserve Locul fosilifer Bahna	10 ha	Council of Ministers Decision 1625/1955
12	Natural Reserve Dealul Duhovnei	50 ha	Caraș Severin County Decision 18/1980
13	Natural Reserve Gura Văii - Vârciorova	305 ha	Law no. 5/2000
14	Natural Reserve Fața Virului	6 ha	Law no. 5/2000
15	Natural Reserve Cracul Crucii	2 ha	Law no. 5/2000
16	Natural Reserve Valea Oglănicului	150 ha	Law no. 5/2000
17	Natural Reserve Cracul Găioara	5 ha	Law no. 5/2000
18	Natural Reserve Dealul Varanic	350 ha	Law no. 5/2000

According to the Government Decision 1284/2007 two new special protection areas have been established overlapping the Iron Gates Natural Park, respectively: ROSPA0026 The Danube Watercourse – Baziaș – Iron Gates (10124.4 ha) and ROSPA0080 Almaj-Locvei Mountains (118141.6 ha), and through the Order of the Ministry of Environment and Sustainable Development 1964/2007 was established the Site of Communitarian Importance ROSCI0206 Iron Gates (124293.0 ha).

The presence of NATURA 2000 sites require an obligation of applying the provisions for the strategic environmental assessment for programs and plans, as well as the environmental impact assessment for any project or plan that will be deployed in sites of communitarian importance.

The Government Ordinance no. 57/2007 regarding the regime of natural protected areas, conservation of natural habitats, wildlife flora and fauna, approved with modifications

and notes by the Law no. 49/2011 contains numerous regulations of general character on the definition and classification of protected areas, their establishment, the responsible institutions, management instruments, zonation of protected areas, the regime of deploying activities, sanctions.

All the regulated aspects have ultimately effects on the landscape. Therefore, the zonation of protected areas seals certain territorial homogenous characteristics and imposes their maintenance or even emphasis. The territories protected by the regime of special conservation become real sanctuaries of undisturbed natural landscape, in a clear contrast with the neighbouring unprotected areas. The inclusion of an area in a certain category of protected area will ensure the priority conservation of certain aspects, without denying the positive global effect of the protection regime, especially as each component is in a direct dependence to the other.

*Landscape aspects* are mentioned directly in the Article 2 (g), the Ordinance mentioning that it regulates the measures for protecting the landscape formations of ecologic interest. Article 4 – 15 mentions that the landscaping value of certain elements makes them susceptible to be included as values of the natural heritage. At 4 - 16 the Ordinance defines the landscape as being “the area perceived by the population as having specific characteristics resulted from the action and interaction between natural and/or human factors”. The Ordinance includes in the natural areas spaces with landscape elements of ecologic, scientific and cultural value. Annex 1 of the Government Ordinance no. 57/2007 defines the natural park as being a protected area designated to the conservation of distinct landscape features resulted from the interactions between humans and nature.

A series of legislative act development after the Government Ordinance no. 57/2007 are worth mentioning:

- Government Ordinance 68/2007 for the modification of Government Ordinance no. 57/2007 regarding the regime of natural protected areas, conservation of natural habitat, wildlife flora and fauna;
- Government Ordinance 154/2008 for the modification of Government Ordinance no. 57/2007 regarding the regime of natural protected areas, conservation of natural habitat, wildlife flora and fauna;
- Government Decision no. 230/2003 regarding the delineation of biosphere reserves, national and natural parks, and establishing their administration contains also the delineation of the Iron Gates Natural Park.
- Order no. 552/2003 of the Ministry of Environment for approving the internal zonation of national and natural parks according to the necessity of conserving their biological diversity, realizes an additional difference in the management regime of a protected area. In the case of the Iron Gates Natural Park it delineates areas of special conservation in the spaces where landscapes have suffered the least transformations. The inclusion in the protected areas determines restrictions in the utilisation of the surfaces, and a long term conservation of landscapes with an important natural character.
- Government Decision 2151/2004 regarding the establishment of new protected areas, ensuring the conservation of habitats with specific landscapes (including speleological).

- Government Decision no. 918/2010 regarding the reorganisation of the National Environmental Protection Agency and other public institutions offers the organisation framework for managing protected areas.

The Iron Gates Natural Park is managed according to Government Ordinance no. 57/2007, and based on the Management plan and the statute of the park, mandatory for the Administration and physical and juridical persons in its surface. According to article 21 of the Ordinance management plans of natural parks are established by their administrators, approved by the scientific and consultative councils and by the national agency for natural protection areas, also approved by a Government Decision based on a proposal by the central authority for environmental protection.

***Elements of administrative regulation specific to the Iron Gates Natural Park.*** The functioning and administration of the Iron Gates Natural Park as a protected area is realised based on a series of documents elaborated by the authorities. The Administration of the Iron Gates Natural Park is established following a management contract between the Ministry of Environment and the National Forest Administration – Romsilva. The other institutions governing activities in the Iron Gates Natural Park are the Consultative Management Council (governmental bodies, NGOs, local communities, economic agents, etc.) and the Scientific Council (experts and scientists in different fields of conservation).

The management plan represents the document containing the general framework for developing actions that aim at fulfilling the conservation objectives of the protected area. It contains also the general principles that will integrate the conservation and protection of both environmental and cultural elements with the social and economic development in the Iron Gates Natural Park.

***General legislative framework in Europe.*** At European level the legal framework for conservation activities of habitats and wildlife species of flora and fauna is established by a series of documents as the Habitats Directive (92/43/EEC), the Birds Directive (79/409/EEC) or the Forests protection Directive (86/3228/EEC), Water Framework Directive 2000/60/CE. The Habitats Directive (92/43/EEC) presents a significant importance in the Iron Gates Natural Park through the establishment of the Sites of Communitarian Importance (SCI) included in the Natura 2000 network. ROSCI0206 Iron Gates has a larger surface than the Natural Park and this overlapping of conservation forms can only bring benefits to their efficiency. The protection regime of the Habitats Directive is favourable to the development of functional landscape as human activities are allowed as long as they do not interfere with conservation objectives.

The Birds Directive (79/409/EEC) leads to the establishment of special protection areas for avifauna. In the Iron Gates Natural Park five sites are present from the Natura 2000 network: Calinovat wetland, Divici-Pojejena, Moldova Veche isle, Danube Watercourse Bazias- Portile de Fier and Almaj-Locvei Mountains.

Another set of regulations come from the RAMSAR site status of the Iron Gates Natural Park. In the sense established by the Ramsar Convention in 1971 wetlands are represented by moors, swamps, peat bogs, natural or artificial watercourses, permanent or temporary, regardless of the salinity and other characteristics of the water. The limits of the Ramsar site overlap the Park limits.

### ***General legislative framework in Serbia***

In Serbia, the institution with the highest attribution in the field of nature protection and conservation is the Ministry of Energy, Development and Environmental Protection. In this institution, the Environmental Protection Department has attributions regarding their participation to the elaboration of strategic documents, plans and programmes; scientific component for different legal regulations in the field; enforcement of international conventions and legislation in the field; protection and conservation of nature, and resources such as water, air, soil, etc. (<http://www.merz.gov.rs/en>).

The Environmental Protection Department contains a series of specific collectives, of interest for the natural protected areas being those for Biodiversity Protection, Protected Areas, Natura 200 and Legislative and Administrative services in the field of natural resources.

In addition, the Department of Environmental Planning and Management is responsible for the identification, coordination and development of environmental politics with the purpose of sustainable development. The Department for International Cooperation and Project Management deals with harmonising the environmental legislation for integration in the European Union, and the Monitoring and Control Department verifies the fulfilment of specific requirements (<http://www.merz.gov.rs/en>).

For achieving its conservation objectives, the Ministry cooperates with other institutions such as the Ministry of agriculture, forestry and waters or the Ministry of investments. In the past years, Serbia has been in a process of harmonizing and enforcing European legislation in the field of environmental protection, environmental impact assessment or integrated control of pollution (Bajic, 2011). The institutional capacity of Serbia at different levels (national, regional or local) and the differenced responsibility determines problems in the management of the protected areas (Vasovic & Stankovic, 2011).

The categories of protected areas in Serbia are established in the Law of nature protection, adopted in 2009. The law defines protected areas as surfaces with a high geological, biological, ecosystems or/and landscape diversity and are declared by a legal document as protected areas of general interest. Protected areas are generally classified based on their importance and value, although classifications based on the management principles exist as well (Sekulic, 2011).

The Habitats and Birds Directives that represent the centrepieces of conservation efforts at European level are being transposed in the national legislation in Serbia, and will be totally implemented by the end of 2015. The Law of nature protection, in its 38<sup>th</sup> Article presents the legal framework for the Natura 2000 network, sustained by the Regulation regarding the ecological network that describes the methods of establishment, management and funding of the network, with emphasis on the network being constituted from areas of ecological importance, corridors and buffer areas.

The categories of protected areas from Serbia are described in Article 27 from the Law of nature protection, in relation to the IUCN categories. If we compare the definition and characteristics of national parks in Serbia, we cannot equate them with a certain IUCN category. Considering the naturalness and the ecosystems, Serbian national parks would correspond to the IIa IUCN category (Milijkovic & Zivkovic, 2012), but the high percent of

surfaces where natural resources are used through traditional practices and their cultural heritage would lead them more towards the V category.

In the Law of nature protection, national parks are defined as a surface with a diversity of ecosystems of national importance, with special features of the landscape and cultural heritage, and in which humans live in harmony with the nature. The purpose of national parks is to conserve existing natural resources and values, the landscape in its integrity, biologic and geologic diversity, and to promote scientific, education, spiritual, aesthetic, cultural, tourism or recreation activities, or any others in concordance to the principles of nature protection and sustainable development.

Practically, in order to achieve these objectives, national parks have a series of characteristics:

- Large surface (to sustain ecosystems diversity) – until 1981, national parks from the former Yugoslavia should have had a surface of minimum 5000 hectares (Sekulic, 2011);
- A diversity of well-preserved natural ecosystems, although the definition of the term natural ecosystem is a little ambiguous;
- Inclusion of both cultural heritage and local traditions in their objectives.

The process of protecting national parks includes the enforcement of strategic approaches, with a preventive and integrated character, and the establishment of economic and environmental objectives that would lead them to a sustainable development (Bajic, 2011).

**National Park Djerdap** is located in the north-eastern part of Serbia, at the Romanian border, and has a surface of approximately 63680 hectares, being the largest one in Serbia. In addition, the park has a protection area covering over 93968 hectares. It lies on a length of 100 km alongside the right bank of the Danube, between Golubac and Karatas (near Kladovo), and contains the Iron Gates Gorges. It was declared protected area in 1974, two years after the Iron Gates Dam was built, and included in the UNESCO list in 2002.

The park contains three types of areas according to their protection regime. The first protection level (strict protection of natural and cultural heritage) covers 8.83% of the total surface and the second (protection of specific natural elements – ecosystems, landscapes and natural spaces in the proximity of cultural monuments) covers 21.03%. The third protection level (allowing activities such as tourism, sports and leisure, forestry, utilisation of water or mineral resources, development of settlements) the remaining 70.14%.

The park contains the following main types of ecosystems: forests (44851 ha), pastures and grasslands (6337 ha), orchards (4559 ha) and aquatic ecosystems (5882 ha). It sits on the border between two floristic regions, namely the temperate and steppe ones. The national park Djerdap contains over 900 species and subspecies of vascular plants (of which 43 are strictly protected and 124 with a protection regime) and over 50 types of forestry and brush vegetation from the tertiary period, 35 of these being relict. The fauna is diverse and contains over 170 species of birds, mammals (lynx, bear, wolf, jackal, deer, black goat, otter, etc.), insects, amphibians and reptiles.

The National Park Djerdap contains **8 natural reserves** and **a natural regional park** (Veliki and Mali Strbac – 899 ha – including the riparian area of the Danube). These areas are the most interesting ones in the gorges from both scientific and tourism perspective. The 8 natural reserves are: Goluvacki Grad (24 ha – including the medieval fortress), Bosman-

Sokolovac (281 ha – riparian area of the gorges, brushes with lilac and hazelnut), Bojana (27 ha – forestry area), Coka njalta (354 ha – low brushes), Ciganski potok (18 ha – forestry area), Somrada (14 ha – relict coniferous species), Boljetinska – Greben (100 ha – geologic and geomorphologic elements), Lepenski vir (21 ha – numerous species of relict plants, the oldest Neolithic settlement in Serbia).

*At international level* the National Park Djerdap is nominated as an important bird area (IBA), important plant area (IPA), important butterfly area (PBA), cross-border reserve (Transboundary Protected Area) and part of the European green belts. In addition, the area is part of the Carpathian Network of protected areas.

Being a national park its surface is under the incidence of *national legislation*, local authorities having only the role of approving the annual management plan. This is realised based on the management plan of the Djerdap National Park for the 2011-2020 period, and elaborated according to Article 54 from the Law of nature protection and in concordance with the spatial plan of the National Park Djerdap in 2012. Serbian legislation recognises the role of local communities as legal actors in the management of national parks through the Law of National Parks (Official Monitor of the Serbian Republic no. 39/93, 44/93, 53/93, 67/93, 48/94, 101/2005) and the Law of nature protection (Official Monitor of the Serbian Republic no. 36/2009). The Djerdap National Park is administrated by the Public Company National Park Djerdap, with the headquarters in Donji Milanovac.

Serbia has not yet joined the Natura 2000 network, but by implementing the project “Consolidating the capacity of government and civil sector in Serbia and Montenegro for adjusting to the acquis of nature protection in the European Union” significant progress was recorded in this direction.

### **1.3. Legislative framework for landscape protection and conservation in the study areas from Serbia and Romania**

The legislative framework regarding the landscape starts from its definition in different acts and normative. Starting from the international level a series of approaches of the protection and conservation of landscapes are present.

The first and until now only international treaty dedicated to the landscapes is the *European Landscape Convention*, adopted in the year 2000 in Florence, Italy. The main objective was to promote the protection, management and arrangement of European landscapes, creating the same time a framework for cooperation in the field.

By this Convention, the landscape gets a new vision as a common European heritage and resource for local development (Pătru-Stupariu, 2011). According to the European Landscape Convention, the landscape designates a part of the territory perceived by the population, and with a character resulted from the action and interaction between natural and human factors. Visible part of the space, the landscape represents a cultural and social construction corresponding to a social and economic requirement, the human impact on the landscape becoming a spatial inscription of a culture.

Pătrescu (2000) (quoted by Dumitraşcu, 2006, and Pătru-Stupariu, 2011) expresses synthetically the new dimension of the landscape according to the concept and objectives of the convention:



- The landscape through its elements represents support for life, the environment in which the human perceives its contact with the surrounding environment;
- The landscape is an important part in the quality of life, in both urban and rural areas, and landscape transformation is extremely rapid due to the evolution of production techniques in agriculture, forestry, industry, mining and the politics in the fields of planning, transportation, and infrastructure.
- The landscape is heritage; it includes the natural, historical, architectural, ethnographic, and agricultural values. It can represent an element of collective memory of the society or community in a certain region.
- Landscapes represent resources, becoming a market value for major economic activities.
- The landscape is an identity value, as it allows the human and inhabitants as a whole to situate in space and time.

For the final objectives and text of the European Landscape Convention a series of prior legislative documents have been considered and mentioned in the historical section. It covers themes as varied as the protection and conservation of the environment, and different elements from the natural and cultural world heritage, as well as aspects related to the access to information in the environmental field, local autonomy, etc. Some of this legislative documents are:

- *The European Cultural Convention* (1954) – each state should take optimal measure for the protection and maximization of the national contribution in the cultural European heritage.
- *The United Nations Convention for environmental protection* (Stockholm, 1972) – concentrated on the human interaction with the environment and resulted in a declaration containing over 26 principles of the environment and development.
- *Convention of the protection of cultural and natural world heritage* (Paris, 1972) – each signing state aims to assure the identification, protection, conservation, presentation and transmission to the future generations of the natural and cultural heritage, according to the definitions presented in the Convention.
- *Convention on the preservation of natural habitats and wildlife in Europe* (Berna, 1979) – the purpose of preserving wildlife flora and fauna and natural habitats, especially of those species and habitats whose conservation requires cross-border cooperation. Special attention is given to endangered or vulnerable species, especially migratory.
- *European framework convention on cross-border cooperation territorial authorities* (Madrid, 1980) – each signing party will facilitate cross-border cooperation between local communities or authorities.
- *European charter of local autonomy* (Strasbourg, 1985) – each signing party will recognise the principles of local autonomy, including administrative and financial aspects.
- *Convention on the preservation of European architectural heritage* (Granada, 1985) – designates the framework for the conservation of architectural heritage, its physical integrity, protection, maintenance and restoration, and adopting fiscal measures or promoting private investments for its conservation.
- *Convention on wetlands of international importance* (Ramsar, 1971) – represents a treaty aimed at preserving and ensuring the optimal use of all wetlands through actions at local,

regional and national level, as well as international cooperation with the purpose of sustainable development.

- *European convention on the protection of European archaeological heritage* (La Valletta, 1992) – regarded the preservation of the archaeological heritage as a source of collective European memory and an instrument for historical and scientific studies.
- *Convention on biological diversity* (Rio, 1992) – with the objective of preserving biological diversity, sustainable using the resources and sharing in an equitable manner the benefits resulted from resources, considering the rights over them and the existing technologies.
- *Convention on the access to information, public participation in the decision process and access to justice for environmental issues* (Aarhus, 1998) – In order to protect the right of each person from present or future generations to live in an adequate environment, the signing parties will guarantee the access to information, public participation in the decision-making process and access to justice on environmental issues.

Ten years after the European Landscape Convention its implementation was accelerated with the development of the *European Landscape Network*, an international network of local and regional authorities promoting the Convention. The most important implementation actions were made with the help of the European Council – CEMAT (European Conferences of Ministries responsible with Territorial planning and Landscape). Following were elaborated numerous politics and strategies with direct effect on the development of landscapes at communitarian level.

Annually, after the enforcement of the European Landscape Convention took place a series of *conferences, seminars* and work meetings focused on enforcement of the Convention: Landscape heritage, territorial arrangement and sustainable development (Lisbon, 2001); The role of local and regional authorities in cross-border cooperation in the regional development, territorial arrangement and landscape (Dresda, 2002); Guide for the evaluation of European rural patrimony (Ljubliana, 2003); Conference defining the terms of natural, cultural and immaterial heritage (Erevan, 2004); The network for sustainable territorial development of the European continent (Moscow, 2005); Cities as engines of development (Bratislava, 2006); Accessibility and attractiveness of rural territories (Andora, 2007); Strategies for metropolis – valorising cultural heritage, modifying urban landscapes and developing sustainable energies (Sankt Petersburg, 2008); Sustainable territorial development of the European continent in a changing world (Kiew, 2009); Cultural heritage as a factor of territorial cohesion (Moscow, 2010); Natural and cultural heritage (Athens, 2011); Landscape and future strategies for territorial planning (Thessaloniki, 2012).

Other *legislative regulations at international level* regarding the landscape:

- *Agenda 21* (Rio Summit, 1992) – describes the politics necessary for governments in realising the sustainable development.
- *Convention on the protection and sustainable development of the Carpathians* (Carpathian Convention, Kiev, 2003) ratified by Law 389/2006 with the objective of cooperation for maintaining and sustainable developing the Carpathians and improving the quality of life, straightening economy and local communities and preserving natural values and cultural heritage.

- *The Pan-European strategy and action plan regarding the conservation of biological diversity and landscapes* (Sofia, 1995) establishes an international framework for the cooperation, consolidation and expansion of programmes in the field of conservation biology, with the main aim of finding the optimal answer to the decline of biological and landscape diversity in Europe and ensuring the sustainability of natural environments.
- *The new chart of Athens* (2003) with the objective of sustainable development for the integration through the conservation of the cultural heritage and its connection in a functional network, increasing the quality of life and integrating natural and artificial elements in the environment.
- *UNESCO recommendation regarding the maintaining of beauty, landscape and sites characteristics* (1962).
- *European chart of Architectural Heritage*, Amsterdam (1975).
- *European chart of territorial arrangement – CEMAT*, Torremolinos (1983).
- *International charter ICOMOS regarding the preservation of historical cities and urban areas*, Washington Chart (1987).
- *Habitat Agenda* (1996).
- *European Perspective regarding the spatial development*, Postdam (1999).
- *Recommendation of the Committee of Ministry of member states of the European Council regarding the directory principles for a spatial sustainable development of the European continent (CEMAT, 2002)*.
- *European Territorial Agenda* (2007).
- *Leipzig Chart on the sustainable development of cities* (2007).

Landscape approach in European legislation in connection to the natural protected areas begins with the Habitats Directive – 92/43/EEC regarding the conservation of natural habitats and wildlife flora and fauna, adopted on May 21, 1992. It mentions in Article 10 that “where necessary, in their territorial arrangement and development politics, especially for the improving the coherence of the Natura 2000 ecologic network, member states can encourage the management of landscape elements of high importance for wildlife flora and fauna. These elements are those that by their linear and continuous nature are essential for the migration, geographical distribution and genetic changes of wildlife species”. The planning of land uses and the development of politics should encourage the management of landscape features that are important for the wildlife flora and fauna.

### ***Landscape conservation in Romania***

Romania embraced with ease landscape legislation, ratifying or signing the instruments aimed at the protection and conservation of landscapes, but the juridical measures adopted at national level are still poorly developed.

Romania ratified the European Landscape Convention, known under the name of the Florence Convention and adopted in 2002, through the Law 451/2002, published in the Official Monitor part I. It also signed numerous conventions and international treaties that refer to the landscape notion and regulate its protection and conservation. Part of these treaties and conventions were transferred in the national legislation being incorporated in diverse legislative acts, such as:

- Law no. 190/2013 for the approval of Government Ordinance no. 7/2011 for the modification of Law 350/2011 regarding territorial arrangement and urbanism;
- Law no. 422/2001 for the protection of historical monuments;
- Law of the Mountain no. 347/2004 published in 2009, regarding the modalities for developing and protecting the mountain area by valorising its resources, stabilising the population, increasing economic power at local and national level in the context of maintaining the ecologic equilibrium and protecting the natural environment;
- Law no. 49/2011 for approving the Government Ordinance no. 57/2007 regarding the regime of natural protected areas, conservation of natural habitats, wildlife flora and fauna.

International treaties and conventions in the field of protected areas are extremely important for landscapes as they usually establish targets not yet included in the national legislation, but which in the near future can be implemented. Most of the international treaties are already transposed into national legislation.

Law no. 13/1993 for the adherence of Romania to the Berna convention is oriented on the conservation of significant landscape elements, respectively species of animals and plants and their habitats, especially of those whose conservation requires international cooperation. The Iron Gates Natural Park and the Djerdap National Park can be included here. Law no. 69/1996 for the approval of the CITES Convention (Convention on International Trade in Endangered Species of Wild Fauna and Flora) ensures an indirect protection to landscapes in the Iron Gates Natural Park through the conservation of species. Law no. 58/1994 for the Convention on biological diversity, signed at Rio de Janeiro in 1992, represents a legislative piece with strategic character and whose content was already transposed in the national legislation. In the same perspective is the Law no. 13/1998 for the Bonn Convention.

As the human component represents an important part of the landscape, international conventions and treaties regarding this issue are also important. The human heritage in the *Iron Gates Natural Park* contains numerous elements of traditional civilization that integrate in remarkable manner with the natural environment. Its inclusion in the category of natural parks, aimed at preserving landscapes resulted from human and nature interactions underline the value of human heritage in the area of the park.

Article five of the Government Ordinance no. 57/2007 mentions that it will ensure a corresponding regime of protection, conservation and utilisation for specie and habitats, biogeographic resources but also for “elements and natural formations of geomorphological, landscape, geologic, and other characters, with values of the natural heritage”. The landscape is mentioned among the important items worth preserving. The maintaining or rehabilitation to a favourable state of natural habitats and wildlife species of flora and fauna has an important impact on the landscapes. The landscape itself is mentioned as object of conservation measures in the Ordinance 57.

Legislative elements regarding the human heritage, of importance for the Iron Gates Natural Park:

- a. Law no. 79/1993 for the Convention on the illegal operations of import, export and transfer of property over cultural goods;
- b. Law no. 157/1997 for the Convention on the protection of European architectural heritage;
- c. Decree no. 187/1990 for the UNESCO Convention on the protection of natural and cultural world heritage.

### ***Landscape conservation in Serbia***

The continuous dynamic and diversity of European landscapes and the complexity of their functions pose difficulties in applying the principles and obligations foreseen by the European Landscape Convention. Serbia signed the European Landscape Convention in 2007 and ratified it in 2011.

The law of nature protection in 2009 represents the central element of the legislative framework specific to the protection and conservation of landscape in Serbia (Simic, 2011). This law aims at developing an integrated system of environmental protection as well as developing measures and instruments for a sustainable management of natural resources and cultural heritage.

The landscape notion is formally mentioned in the environmental principles and strongly correlated with that of natural heritage. The Law establishes especially obligations for the preservation of landscapes and their characteristics in the large framework of the environmental protection measures (Maksin & Milijic, 2010).

In article 26, the Law of nature protection defines the preservation of landscapes as a set of measures for planning and implementation aimed at averting adverse effects upon the landscape, its diversity, unicity or aesthetic values, and ensure a traditional usage of landscapes. The same article classifies the landscapes, the main difference being between natural and cultural ones.

The law of territorial planning (2010-2020) includes references to landscapes by mentioning the fact that the value of natural and cultural heritage, as well as landscapes should be considered as an indicator of territorial development. Regional and local diversity, unicity, represent instruments for straightening the competitiveness of regions and municipalities.

## II. METHODOLOGY FOR LANDSCAPES IDENTIFICATION, CHARACTERIZATION AND CLASSIFICATION

### 2.1 Identifying the defining elements of the landscapes

Landscape composition consists of units containing the aggregated volumes of its elements (the structure and morphology), but also from activities, processes, biological communities or human collectivities residing in the area and using its resources.

Therefore, according to the typology of elements that compose the landscape unity, landscapes can be *natural* or *anthropogenic*, the last category being differentiated according to the impact into rural or urban landscapes. The analysis of landscape composition should consider a multitude of physical, geographical, ecological, environmental, historical, economic, social, cultural and functional aspects (Donisă, 1979; Roşu, 1983; Muică, 1995; Drăguţ, 2000; Drăguţ et al, 2002; Mac, 2000; Pătroescu et al., 2000; Niculae, 2012; Ciocănea, 2013; Enache&Craciun, 2013).

Landscape composition generally identifies a spatial structure with its own physiognomy, resulting from the interaction of *abiotic, biotic and anthropogenic* factors (Fig. 3). This interaction is differentiated according to its perception (Drăguţ, 2000). *The structural elements* of the landscape of *primary nature* are represented by the abiotic factors which project in the landforms and climate, on which *secondary structural elements* develop – of both biotic (soils, vegetation, fauna) and anthropogenic (environmental artificialisation, human activities) nature (Mücher et al., 2003; Dumitraşcu, 2006; Pătru-Stupariu, 2011).

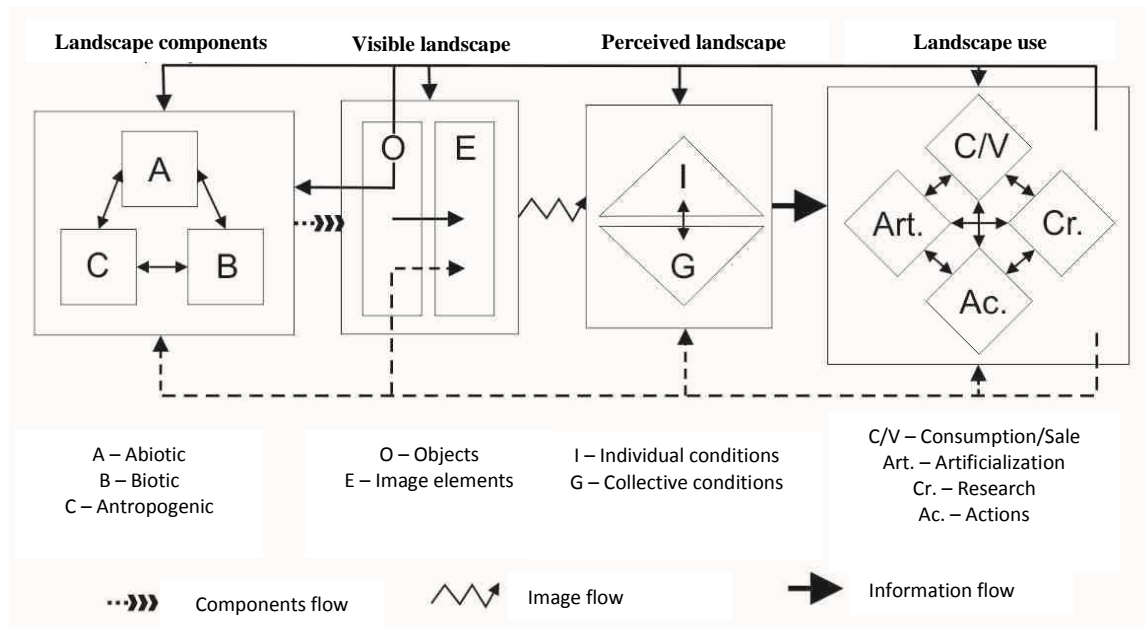


Fig. 3 The Landscape – composition, perception and utilization (Griselin et al., 2008; quoted by Ciocănea, 2013)

Part of a territory, the landscape has a heterogeneous character due to the nature of its components (abiotic, biotic, anthropogenic) but in the same time homogenous by the relations between parts (morphological and structural). Landscape elements are aggregated in an ensemble (Meyer et al, 2008), and the relationships between them give the landscape a certain

structure and a dynamic character due to the permanent flows of matter, energy and information.

Determining the components of a landscape, their weight in the in the structure of the ensemble, the dynamic and modelling of present and future taxonomic heterogeneity and our perceived reality, all represent stages in the analysis and interpretation of the geographic landscape (Popescu, 2010).

The base framework of the landscape (Turner, 2005) includes abiotic elements (such as the climate, geology, topography, hydrology, soil) representing natural gradients of the landscape (Antrop et al., 2004). Over these, the second biotic level overlaps, including elements of flora and fauna, regarded in the framework of complex interactions between them and their environment.

The final stage is represented by the cultural level in which the human factor intervenes (both positively and negatively) upon the landscape, as a key element for landscape modification (McDonnell & Pickett, 1997; Drăguț et al, 2006). The indifference of the defining elements for the three reference stages shapes in a certain moment the physiognomy and characteristics of a landscape unit.

After the nature of their components, landscapes contain the following categories of elements (Popescu-Criveanu et al., 2008):

- Physical-geographical elements, *geodiversity*
- Biotic elements, biodiversity
- Natural and anthropogenic resources generating *specific land uses*.

Landscape elements can also be classified according the origin of the components (Drăguț, 2000; Dincă, 2005):

- Fossil elements (related to the geological evolution, formed and functioned in anterior landscapes, maintained for control),
- Relict elements (developed in anterior landscapes, functioning different in the present),
- Legacy elements (or which adjusted to the new conditions of manifestation and relations),
- Present elements (characteristic to the present landscape),
- Progressive elements (in course of development as a materialization of the temporal dynamic of the landscape).

**Natural landscapes** represent parts of the territory perceived by the population and whose character is a result from the action and interaction between natural and/or human factors (as defined in the European Landscape Convention).

**Anthropogenic landscapes** are the result of a long creation process, continued in the present, in which different generation have succeeded by the means of destruction, amelioration, improvement or adding elements, to confer a sense and a value to the new landscape (Budișteanu și David, 2010). We can therefore explain the transformation in the territory, such as demographic changes (Drăguț et al, 2006), and the creation/destruction of agricultural surfaces, buildings, communications and transportation infrastructures, green areas, land uses, etc. (Ciocănea, 2013).

Permanent landscape transformation, either structural or functional, are and will be influenced by human decisions resulted from the life style and consumption patterns of

society, from local communities, politic and economic interests (Ciocănea, 2013). From this perspective, sustainable landscapes might seem as a utopic objective (Antrop, 2006), hard to identify in the territory (Luginbihl, 2006).

## **2.2. Characterization and classification of landscape elements**

Both at local and regional level landscape units and their typologies should be known for a better understanding of the interdependencies between their components (Dumitrașcu, 2006). Through the natural, historical, ethnographic values that express the identity of the space in the collective memory of the society or community in a certain region, the landscapes acquires a patrimonial value.

It is of great importance to spatially represent the phenomenon and synthetize the three levels (abiotic, biotic and cultural) in order to be able to define landscape types that are specific to the area of interest.

Numerous papers consider the landscape characterized by three types of features: *present, relict and progressive* (Dincă, 2005; Dumitrașcu, 2006). The landscape has the required characteristics in order to be delineated qualitatively using specific typologies. A predominant feature, either natural or anthropogenic, defines these imposing individuality and functionality to the landscape units (Avocat, 1982; Mac, 1990; Zăvoianu & Alexandrescu, 1994; Drăguț et al, 2002; Dumitrașcu, 2006).

For identifying the specific landscapes in the Iron Gates Natural Park and Djerdap National Park, geodiversity resources (lithology and geological structures) should be considered as they condition the landforms of the area. The relief represents a material support for the landscape, and conditions the quality of all other landscape features, either natural or anthropogenic. Geodiversity and landforms impose originality in the territorial ensemble, other authors considering it presents variety and complexity (Pătru-Stupariu, 2011). An important element in landscape analysis is represented by the limits between different landscape types. These are not materialized in a line but are composed by a series of transition elements compiling in a different and continuous moving composition (Arnot et al., 2004; Stan, 2009).

Meeus (1995) elaborated a pan-European typology of landscapes, identifying 30 landscape types for the entire continent, defined especially by classical elements (climate, vegetation, etc.). This typology was continued after 2002 by complex approaches that resulted in the elaboration of LANMAP2 (European Landscape Map) including the four main components of the landscape (climate, topography, geology and land use) (Mücher & Wascher, 2007).

The map synthetizes the character of landscapes at the continental level, representing an important step for a homogenous definition of European landscape typologies. It was only normal that it would derive from secondary types specific to each country. In the European Union national maps of different landscape types exist, realized in concordance with the national pattern and in differentiated periods without having a unitary methodology (Austria, Belgium, Switzerland, Germany, Italy, Hungary, Romania, etc.) (Pătru-Stupariu, 2011).

Morphologically, the landscape represents a system resulted from relations of structural, functional and aesthetic order between natural elements (landforms, soils,



hydrology, vegetation) and human modifications (landscape structures resulted from anthropic activities, agricultural cultures, constructed spaces, transportation infrastructures, vehicles, urban patterns, inhabitants and activities).

Landscape components are arranged on the primary structure (geologic and geomorphologic elements) and secondary one (biotic and environmental artificialization) of the geographic area. Landscape elements are represented by elementary landscape units (Drăguț et al, 2002) relatively homogenous that can be recognized in a mosaic (Skånes, 1996). In the case of natural protected areas, we can identify natural, rural and urban landscapes, each with a multitude of landscaping types, according to the characteristics of dominant components in the elementary landscape units (Drăguț et al, 2002).

### Classification of landscape types

Landscapes can be classified according to a series of different characteristics (Dincă, 2005). Determining the landscape typology is a long and complex process. Collecting data necessary for understanding landscape history and patterns of evolution is an important step. To properly analyze a landscape, different kinds of documents and maps have to be used. Among these are *topographic maps* at multiple scales (100 000, 50 000 and 25 000), offering information about many major landscape components (relief, hydrography, slope orientation and gradient, forested or cultivated fields, residential areas); *geological maps*, allowing to correlate topographical units with surface, subterranean strata, but also with the forest or agricultural cover; *vegetation maps*, showing the dominant characteristic of spontaneous or cultivated vegetation at different spatial scales. *Aerial imagery* is an excellent way to assess the landscape, but it is not always accessible to the interested. *Regional maps* prove also very useful for classifying landscapes, combining geographical information about the physical components of the environment with socio-economic ones, thus offering a complete vision about landscapes at regional level (Lizet and Ravignan, 1987).

The landscape assessment and classification can be realized by using a wide variety of methods that are based on remote sensing tools. The results have to be tested by comparison against field observations. Remote sensing offers many competitive advantages, compared to other methods (fast, affordable, accurate, reliable etc).

Lizet and Ravignan, (1987), have identified four different sources of data: digital elevation model (DEM), Corine Land Cover, soil maps and high resolution satellite images (ex. LANDSAT) (Table 2).

Table 2 Quantitative data used currently in landscape classification

Characteristic	Data	Scale/ Resolution
Land cover	Satellite imagery	Multiple
	Aerial photography	1/25 000
	Corine Land Cover	1/100 000
Vegetation	Satellite imagery	Multiple
Altitudes/ Slopes	Digital elevation model (DEM)	50m
Geology	Geological maps	1/50 000
Pedology	Soil maps	1/100 000
Climate	Satellite imagery	Multiple
Demography/ Economy	Statistical maps	Multiple

In relation to the number of the used data sources, variables can be adapted to specific classification methods. Variables differ as the scale of analysis and site characteristics are different.

Variables can be selected by using different techniques. Some of the most used of these techniques are *overlapping layers* and *cluster classification* (by pixels classification into classes defined by the user or considering the most representative pixels) (Lizet and Ravignan, 1987).

Choosing the data sources and type of classification is done by the data operator based on the knowledge of terrain and landscape type. The results will present specific aspects of the landscape and have accuracy related to the aforementioned aspects.

The described methodology is based on a remote sensing approach (classification of MODIS and DEM data), bettered in successive steps and taking full advantage of expert knowledge we have consulted. Data is classified and integrated, before being used to produce the first version of the landscape map.

A data base is built at the same time in order to orderly keep track of the data used to construct the landscape maps. This data base will allow classifying landscape variation, considering different resolutions or components. Quantitative data can add more information to the landscape representations.

According to existent methodologies, the starting point in landscape classification is often constituted by MODIS images, slope and altitude data from DEM (50 m). CLC classification do not allows subtypes of agricultural landscapes differentiation, as these are considered altogether in a large class – *heterogeneous agricultural areas*. We have chosen because of this limitation to introduce further detail. Spatial resolution of MODIS images is 250 m, making them extremely useful for regional scale analysis, offering a first-hand model of the landscape (Lizet and Ravignan, 1987).

The used methodology underlines regional landscape differentiation, based mainly on relief characteristics. The maps obtained by this method are one of the first modern instruments made available to the decision makers, private interests and general audiences.

Applying a methodology based on MODIS images has to take into consideration the fact that these images are difficult to handle, considering the expertise available to a natural area administration, if not applying for external grants.

For the specific objectives of the present study, applying the methodology from MODIS images is difficult by the lack of necessary software.

After extracting data form MODIS, CLC or other primary source of information, the next step is to regroup homogenous elements in landscape units, then ensembles. There are multiple ways to do so, the most important aspect being the operators' knowledge of the terrain. Each step must be carefully performed by the team that handles the whole process. The included model (Fig.4) presents the steps from the collecting data stage to perfected landscape map (subject to continuous upgrading).

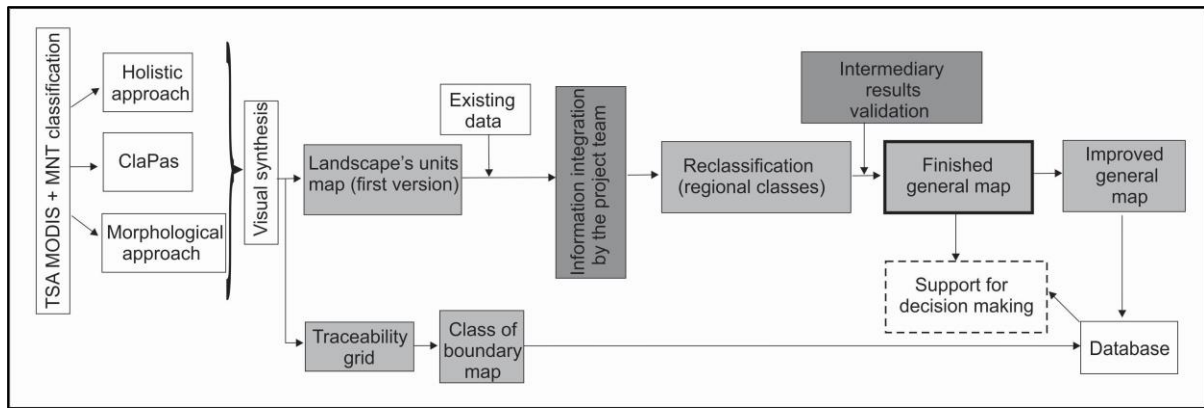


Fig. 4 Work model for landscape map production, starting with MODIS imagery (after Bourget and Le Dû-Blayo, 2010)

This model can be adapted considering the specific characteristics of the analyzed region, available data and aimed purposes (Fig.5). The main factor that have to be considered in the classification and mapping of landscape is the level of accuracy.

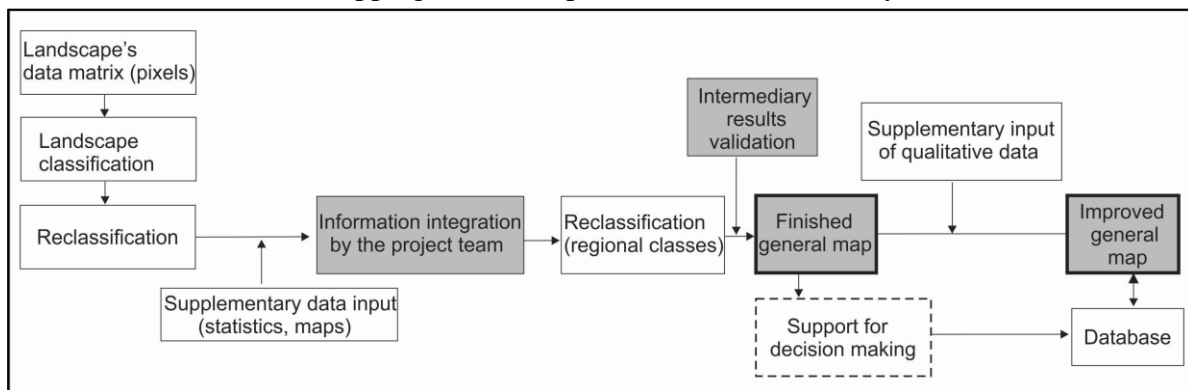


Fig. 5 Work model for landscape map production (after Bourget and Le Dû-Blayo, 2010)

After the *equilibrium or stability* (stable, relative equilibrium Landscapes can be classified according to a series of characteristics (Dincă, 2005) according to elements such as the *stability or balance* of relations between the components and results (stable landscapes, relatively balanced and instable landscapes), *territorial relations* between landscapes (clearly individualized, with elements of interference, integrated landscapes), *self-regulation capacity* (landscape with normal self-regulation, with precarious self-regulation and landscapes regulated artificially), after the *artificial degree* (landscapes with artificial modifications in the hydrography, topography, soil), components of the systems (landscapes in biostasis, rhexistasy or parastasis), social dynamic (landscapes with ascended social dynamic, stationary social dynamic or descendent social dynamic).

The methodology for identifying and classifying landscapes is a complex one (Fig. 6), the criteria of delineating and separating landscapes types and subtypes are diverse both in objectives and subjective, in a structural, functional, spatial, temporal and aesthetic nature (Călin, 2011; Ciocănea, 2013).

In addition, every characteristic of a landscape that differentiates it from others can represent a criteria of classification, besides the one listed above, as long as it approaches an objective reality specific to each territory (Ciocănea, 2013).

The landscape should be regarded and analyzed through its structural, functional, spatial and temporal characteristics.

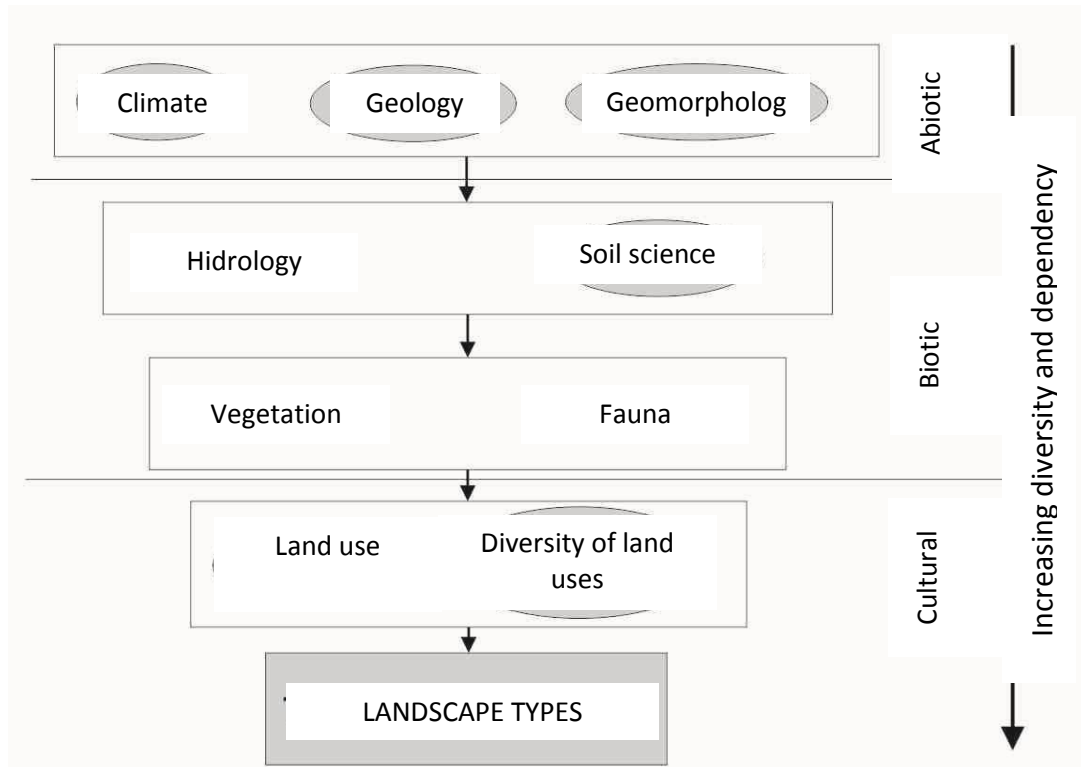


Fig. 6 Relations between components allowing the identification of landscape typologies (Mücher et al., 2003, quoted by Ciocănea, 2013)

**Structural characteristics.** Landscape structure consists mainly of stable and repetitive components that can be associated in spatial and temporal configurations. Traditionally, the structure refers to the organization or spatial ordering of geographic phenomenon and elements (Drăguț, 2000). Landscape structure is mainly based of morphological criteria such as the form, type and texture, but also of its components (natural and/or anthropogenic) (Ciocănea et al., 2011). Therefore we can separate *homogenous spaces* (uniform) and *heterogeneous spaces* (in opposition to the previous category and characterized by differentiated spaces).

**Functional characteristics** are especially useful in the analyze of the anthropogenic landscapes as they allow its classification according to the functional areas of the space, their delineation being made according to the dominant activity and specific land uses.

These areas overlap in the territory, although we can still differentiate areas with clear functions, such as agricultural, transportation, industrial or touristic (Ciocănea, 2013). Considering this, *economical factors* have a significant influence on the landscape, justifying the functional dynamic of the settlements and their spatial organization as activity sectors evolve and adjust to the policies of territorial planning at a certain moment. The analysis of economy can sometimes explain the continuous reorganization of the space for satisfying the needs of human collectivities (Jucu, 2010).

**Spatial and temporal characteristics** regard the organization of landscapes according to factors such as time, form, geographical location and model of territorial development. Using chronological analyses, we can obtain relevant information on the existence and aspect of the landscape, as well as the particular modes in which it evolves as a system. Therefore, the study of historical periods and life styles, from the pre-modern era until present times, can reveal how past heritages integrated in the present configuration generating sites, models and landscapes influenced by the dynamic of the society (Jucu, 2010).

A defining characteristics is represented by *landscape phenology*, useful especially in evaluating the aesthetic dynamic of the landscapes. Their aesthetics represents a determining element regarding the valorization and capitalization of landscapes according to the concordance and pace of the seasons (Niculae, 2012) corroborated with the cultural identity of the landscapes.

### Classification of landscape types in the two protected areas

The identification, characterization and prioritization of landscape types characterizing the two protected areas, the Iron Gates Natural Park and the Djerdap National Park, requires a complex approach, landscapes representing materializations of the spatial and temporal interactions of the environmental components and human activities.

The types of rural and urban landscapes identified in the park are defined by the influence of physical, geographical, economic and demographic factors, and can be framed into three main categories of landscapes: *natural landscapes*, *human modified landscapes* and *anthropogenic landscapes* (Mac, 1990).

In this study, we analyzed landscapes types that bring a specific contribution to the general landscape portfolio of both the analyzed protect areas as well as other protected areas existing at regional level (Fig. 7).

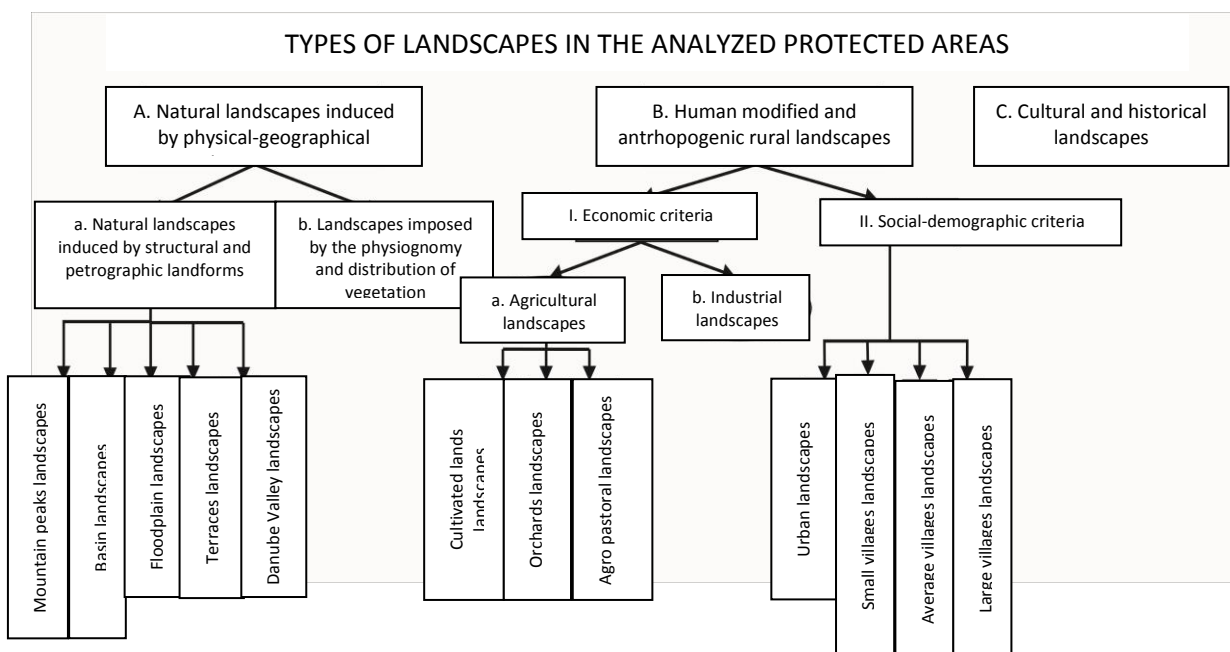


Fig. 7 Types of landscapes identified in the two protected areas

## A. Natural landscapes induced by physical – geographical characteristics

Landscapes from this category are characterized by the absence of major forms of human intervention on the environment. Certain footprints of human presence are present, but they have not determined major transformation in the initial structure and physiognomy of the landscapes.

We identified in the two protected areas several subtypes of natural landscapes induced by the physical – geographical characteristics:

### a. Natural landscapes imposed by structural and petrographic landforms

The geologic and lithological mosaic of the area has a direct projections in the diversity of landforms, as a series of its quantitative and qualitative characteristics reveal subtypes of the natural landscapes, presented as follows.

#### Landscape of the mountain peaks

This type of landscapes is present especially in the mountain peaks of the Locvei Mountains (represented by crystalline rocks with granite intrusions and sedimentary rocks such as limestone), the Almaj Mountains and the southern peaks of the Mehedinti Mountains – in the Iron Gates Natural Park, and by those of the Liškovac and Miroč Mountains in the Djerdap National Park.

In the *Locvei Mountains*, in the limestone areas, landscapes are characterized by large peaks and limestone plateaus, with several intrusions of magmatic and banatites rocks.

The lithological constitution of the *Almaj Mountains* (crystalline, sedimentary and magmatic rocks) is materialized in a complex landscape, characterized by the presence of limestone ridges and abrupt, gorges and numerous caves (Fig. 8,a).

*Mehedinti Mountains* are individualized in the landscape by slow peaks, with numerous deep valleys forming keys in the limestone areas.

In the case of the Djerdap National Park the landscape of mountain peaks is represented by the Veliki Štrbac, with abrupt slopes and formed from limestone (Fig. 8,b).

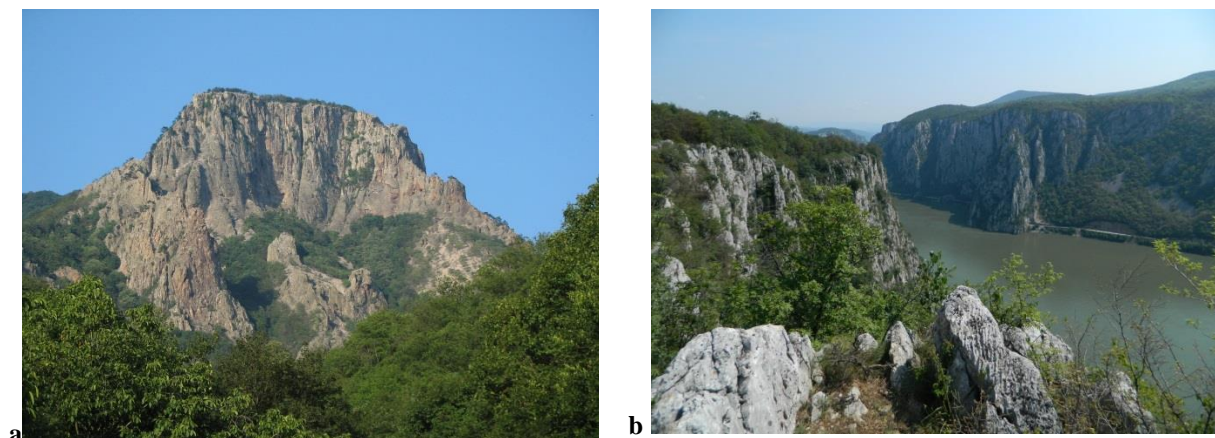


Fig. 8 Trescovat- rhyolite dome (a); Ciucarul Mare Plateau and Veliki Štrbac (b)

### **Landscape of tectonic and sedimentary basins**

These are well revealed in the landscape, through their hilly aspect and the presence of agricultural cultures and a large density of human settlements. The following important units are imposed in the field: Moldova Nouă Basin, Liubcova Basin (with a hilly aspect), Milanovăț Basin, Tectonic Basin Dubova, Ogradena-Orșova Basin, Severin Basin, Donji Milanovac Basin and the Ljubovska Basin.

### **Floodplain landscapes**

Are encountered especially in the large valleys, such as Nera, Radmina, Liborajdea, Berzasca, Sirinia and Camenița valleys in the Iron Gates Natural Park and the Porečka valley, Kosovica Valley, Brnjicka Reka River, Dobranska Reka River in the Djerdap National Park. Floodplain sectors have a higher incidence in the Iron Gates Natural Park especially in the lower part of the watersheds, in the confluence area with the Danube or in the sedimentary basins, they cross (Tetelea, 2005).

The specific character of the landscape is induced by the greater width of the meadows, the dynamic of river beds being revealed by a series of geomorphological elements and the specific human usage.

The Danube floodplain, and its tributaries, suffered an increased human impact through the appearance of diverse tailing deposits (Moldova Nouă) or construction material deposits (Moldova Veche, Svinița-Stariște, Brnjica) and coal (Tișovița).

Presently, the initial floodplain landscape has almost disappeared due to the development of the lake behind the Iron Gates hydropower station.

### **River terrace landscapes**

This type of landscape is induced by the presence of Pleistocene rocks, respectively deposits of gravel, sands and clay, with a larger extension in basins from the two protected areas (per example in the Liubcova Basin). Rural settlements and agricultural fields, imposing a specific character to the landscape, occupy these terraces.

### **The landscape of Danube valley and defile**

The course of the Danube creates a distinctive landscape (Fig. 9) in the two protected areas, in the form of the longest and most studied Defile in Europe – the Danube/Djerdap Defile.

According to the lithological and geological structure, the Danube valley in the two protected areas changes its shape, with narrow sectors and wide sectors in the Basins.

In the Iron Gates Natural Park, from the western part of the park the following sectors have been identified: Nera valley- Ralii valley (narrow), Moldova Noua basin (wide), Belobreșca and Coronini, Coronini- Alibeg (narrow), Liubcova Basin (wide), Berzasca-Greben (narrow), Greben- Plavișevița, Danube Defile, Ogradena- Orșova Basin and the Vârciorova- Gura Văii narrow sector (Posea et al, 1963).

In the Djerdap National Park Stankovic (2002) identified the following sectors: Golubacka (narrow), Ljubovska valley, Gospodjin vir (narrow), Donji Milanovac Basin, Veliki and Mali Kazan (narrow), Orsava and Sip (narrow).



Fig. 9 Danube Defile seen from the Ciucarul Mare peak (a, b)

## **b. Natural landscapes imposed by the physiognomy and distribution of the main vegetation formation**

### **Forest landscapes**

The spatial distribution and the characteristics of vegetation formations (physiognomy) in the two protected areas generated a variety of landscape types. The most important ones are the landscapes represented by forests on the two Danube banks, in the neighboring mountain units.

Framing this type of landscape in the natural category is justified by the distribution and quality of forest surfaces that generally represents an important indicator of the naturalness of a region, although a large part of the present forests are planted or their structure has been modified in order to correspond to their present role of protection forests for the Iron Gates reservoir.

**Forest landscapes** are defined by the existence of lands covered by forest, especially deciduous forests, and in some places mixt with spontaneous coniferous species (black pine – Cioaca Borii) or planted ones (Tisovita valley) (Fig. 10,a).

In this category, besides the forest landscapes, another type can be delineated and perceived as a natural landscape imposed by the architectural model and floristic composition of the vegetation, respectively **șibleac** (Fig. 10,b). These thermophile shrubs represent a vegetation association specific to the Danube Defile, resulted from the clearing of initially existing thermophile forests, and from which only the shrub and herbaceous layers remained (Călinescu et al, 1964; Matacă, 2005).

An apart subtype is represented by the **forested meadows**, but their accentuated fragmentation and reduced surface makes this landscape scarce in the Locvei and Almaj Mountains.





Fig. 10 Forest landscape – black pin forests at Cioaca Borii (a); shrub formation (șibleac) (b)

## **B. Human modified and anthropogenic rural landscapes**

**I. The first criteria used in the identification and classification of these landscape types are the economic criteria.**

### **The main types of agricultural landscapes induced by the land uses**

In the last two centuries, the forms of human pressure on the environment diversified and intensified in the same time, forest surfaces and natural meadows being replaced with arable fields and orchards (Perșu and Nancu, 2009). The development of agricultural activities is influenced by the characteristics of natural factors, modified by the intensification of demographic, social, economic or technical factors (Câdea and Isbașoiu, 1999; Pătroescu and Niculae, 2010).

In the two protected areas, agricultural lands occupy small surfaces, although the settlements are characterized by a high rural degree. Arable lands are dominant in the basins along the Danube, but also in the floodplains of its tributaries and on the mountainous plateaus, characterized by a high fragmentation (fig. 5a).

We have identified the following categories of landscapes according to the main land use.

### **Landscape of cultivated fields**

Occupies reduced surfaces, in settlements with a higher percent of arable land (Sichevița, Coronini, Gârnic, Berzasca, Golubac, Donji Milanovac, Kladovo), in the larger basins (Moldova Nouă, Liubcova, Donji Milanovac), on Danube's terraces and on the mountainous plateaus (Sfânta Elena, Gârnic, Bigăr), characterized by the presence of soils with high fertility and humidity (Fig. 11a,b).

### **Landscape of orchards**

These landscapes are induced by surfaces cultivated with fruiters, especially plum and apple trees, specific to basins, valleys, versants with a reduced slope, and mountainous plateaus.



Fig. 11 Terenuri utilizate arabil pe Platoul Gârnic (a) și Sfânta Elena (b)

### **Agro-pastoral landscape of mountain plateaus and basin areas**

These types of landscapes are encountered especially in the rural settlements from the two protected areas (Fig. 12 a.b). Surfaces occupied by meadows and grasslands expanded their surface in the last century detrimental to forests and recently to abandoned orchards in the Iron Gates Natural Park.



Fig. 12 Sheepfold in Baziaș (a) and on the Ribiș Valley (b)

Livestock activities represented a main occupation in the rural communities from the two protected areas since historical times, the presence of sheepfolds and their constructions representing integrated elements in this type of landscape.

### **Landscape types generated by secondary activities**

Industrial activities from the two protected areas individualized a series of landscapes characterized by diversity and reduced spatial distribution.

### **Industrial landscape**

Present both in the rural and urban environments the industrial landscape has diverse causes and a temporal and spatial dynamic imposed by the social and economic changes. The restructuring of industrial activities in both Romania and Serbia is noticeable and can be explained by the residual industrial landscapes of the former exploitation of nonferrous ore

(Moldova Nouă, Maidanpek- Fig. 13 a,b), coal (Eibenthal, Baia Nouă, Cozla), kaolin (Sichevița), serpentine (Berzasca, Șvinița), colored clay (Coronini).



Fig. 13 Industrial landscape of former Moldova Nouă Moldova Nouă (a) and Maidanpek (b) non-ferrous exploitation and processing plant

To this we can add the construction materials quarries, and numerous processing points that left their mark on the industrial landscape.

Presently, of high distribution are the activities for the extraction of sands, gravel, rocks, most of them being quarry exploitations (Fig. 14).



Fig. 14 Exploitation of construction materials (a) in the Djerdap National Park; open pit exploitation at Gura Văii (Iron Gates Natural Park)

The industrial landscape is completed by the harbor activities in Orșova, Drencova, Moldova Nouă (shipyards, loading and unloading of raw materials, metallic wastes etc).

A residual landscape in the verge of developing is found at Tișovița, represented by the port where coal from Baia Nouă and Eibenthal was loaded into ships.

Energetic industry is represented by the Iron Gates energy system, with the hydro plant modifying the landscape since 1969 (Fig 15,a).

In the past years, the landscape of the energetic industry recorded a diversification through the construction and exploitation of wind farms, as sources of renewable energy (Fig. 15,b).

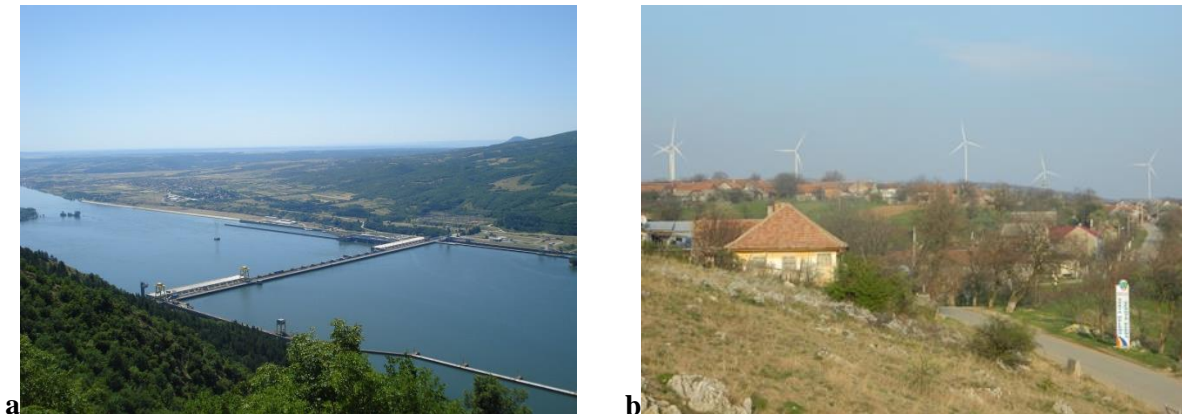


Fig. 15 The Iron Gates Dam (a); Wind farm at Coronini commune, Sf. Elena village (Romania)

**II.** A second criteria used in the delineation of human modified and anthropogenic landscapes is represented by the **social** and **demographic** factors.

The demographic factor represents a fundamental element in the case of rural and urban landscapes, being directly correlated to natural factors and the economic component (Perșu and Nancu, 2009). In the two protected areas exist a series of human settlements, with a territorial distribution resulted from both natural and human factors. Demographic changes in the two protected areas were imposed mainly by the construction of the Iron Gates reservoir (Drăguț et al, 2006), but also by the development of extractive industry requiring a numerous work force.

Analyzing the demographic size of urban and rural settlements, the morphological, structural and functional characteristics and their geographic distribution we identified the following types of landscapes:

### **Urban landscapes**

In the Iron Gates Natural Park and the Djerdap National Park these types of landscapes are imposed by the following urban centers Orșova, Moldova Nouă, Majdanpek and Donji Milanovac. Drobeta Turnu Severin is situated outside the park, only areas of its administrative territory being included in the park (Gura Văii, Dudașu Schelei and Bahna).

### **The landscape of small villages**

This type of landscapes is frequent in rural localities with under 500 inhabitants, representative being Cârșie, Zăsloane, Valea Ravensca, Eibenthal, Brnjica, Petrovo Selo etc.

### **The landscape of medium villages**

Is encountered in localities with a number of inhabitants 500 and 1000 de inhabitats such as Dobra, Boljetin, Mosna, Golubijne, Tekija, Novi Sip, Gornea, Svinita, Pojejena, etc.

### **The landscape of large villages**

In this category landscapes correspond to localities over 1000 inhabitants, such as Eșelnița, Berzasca, Coronini, Sichevița etc.

### C. Cultural landscapes

Cultural and historical landscapes represent a category defined by the variety and magnitude of the elements characterizing the material and immaterial patrimony (Schreiber et al, 2008). They bring a special aspect to the local identity of the population from the two protected areas.

Cultural landscapes are defined by a series of components grouped into: historical monuments, archeological sites, religious monuments, memorial houses, elements of ethnography and folklore, elements of the little patrimony, etc.

Data existing in specialized literature, corroborated with research activities on the field allowed us the classification and characterization of these elements that define the cultural and historical landscapes (Fig. 16).

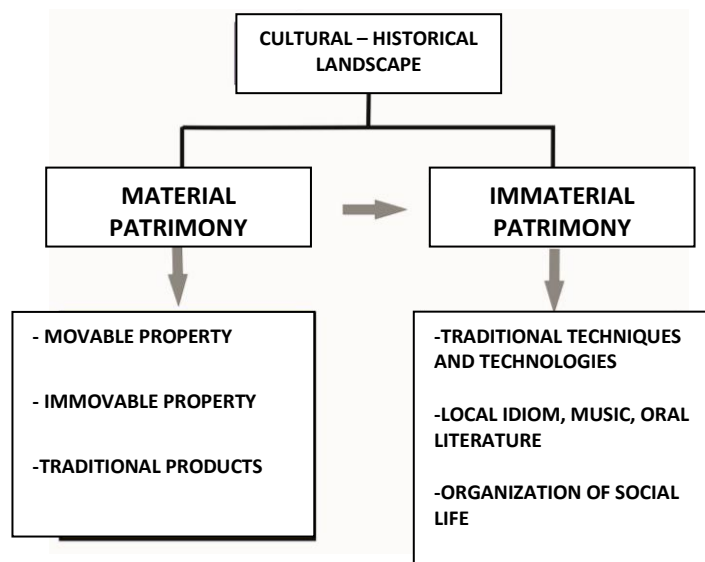


Fig. 16 Components of the rural patrimony (after Grigorovschi et al., 2007)

**The material patrimony**, known also as visible represents the easily identifiable part of the cultural patrimony.

The constructed patrimony is completed by other elements of exceptional value, such as buildings of historical value, monuments, archeological sites, ruins, strongholds and small castles, towers, buildings of architectural value, traditional households, crafting objects, etc. (Fig. 17).

In the Djerdap National Park a series of Neolithic sites were found, among which the best known is that of Lepenski Vir, situated on a terrace of the Danube (Fig. 18,a). This archeological site is recognized at European level as an unique cultural center of high importance (Srejovic, 1969), being considered the oldest permanent settlement in this part of Europe. The resulting landscape has an important attraction point in this protected area.



Fig. 17 Traditional temporary dwellings at Švinița (a); Ancient dwellings at Lepenski Vir Museum

The Hajdučka Vodenica archeological site, located in the proximity of Mali Strbac is important for the archeological discoveries represented by the remains of buildings and pottery objects. Traces of the prehistorically period were also found in the Pecka area, close to Veliki Strbac, and in the proximity of Mrfija- Mosna, close to the Porecka valley. Objects from the bronze era were discovered in the localities of Veliki Grada, Tekija, etc.

An important landscape element is represented by Tabula Traiana, carved in marble with inscriptions in Latin and dedicated to the memory of the Emperor Traian following the construction of the road along the Danube.

Elements of material patrimony are represented also by the traces of roman fortifications discovered at Malo Golubinje and Veliko Golubinje, Gradac and Mali Gradac. The central element of the historical cultural landscape is represented by the Golubač stronghold (Fig. 18,b), mentioned beginning with the 14<sup>th</sup> century, and situated in the western part of the Djerdap National Park.

The Diana Camp represents the largest and well conserved roman fortress, located in a strategic position and constructed in the period of the Emperor Traian.

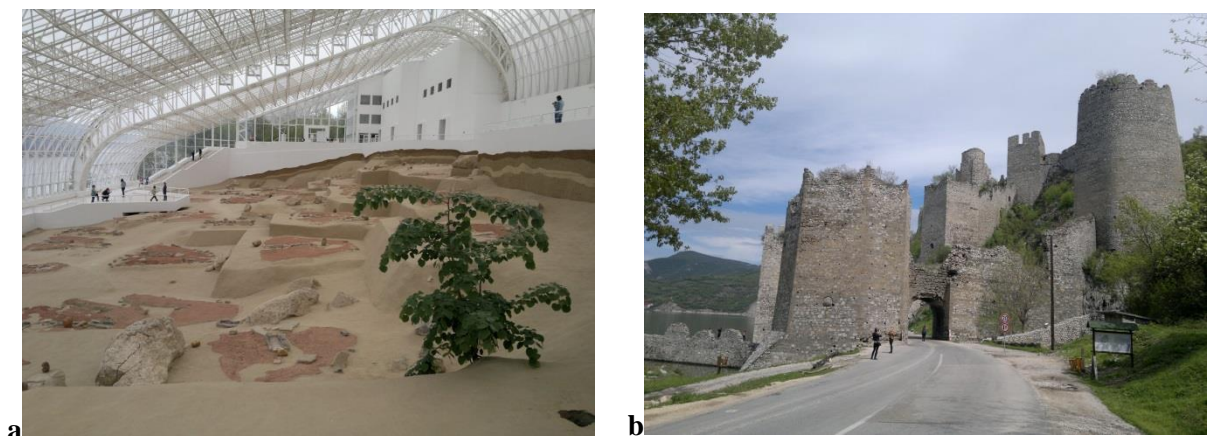


Figure 9 Archeological site “Lepenski Vir” (a); Ruins of the Golubač stronghold (b)

In Romania, in the Iron Gates Natural Park, elements of the cultural and historical patrimony are represented by different evidences from the Paleolithic and Neolithic era, such as remains of the humans living in the protected areas: strongholds, monasteries and churches, traditional houses, watermills, etc.

The oldest trails of humans in the area date back to the Paleolithic era, with the renowned archeological sites of Sichevița, Gornea, Dubova and the Ada- Kaleb island (today covered by the water of the reservoir), and a series of caves in the Ciucarul Mare massif. The archeological site near Schela Cladovei revealed one of the oldest permanent settlements in Europe (CCMESI, 2004).

The fortresses built by the roman army along the Danube (Moldova Veche, Coronini, Pojejena) add value to the cultural landscapes. Numerous remains of the strongholds are still visible today inducing a defining note in the cultural landscape (Drencova, Divici, Pojejena, Trikule- Fig 19,a, Ladislau,- Fig. 19,b, Lylka).



Fig. 19 Ruins of the Trikule stronghold, Svinița (a) and of the Ladislau stronghold, Coronini (b)

The large number of monasteries and churches completes the material patrimony: Vodița Monastery, St. Ana Monastery (Fig. 20,a), Mraconia Monastery, Romano-Catholic cathedral in Orșova, Orthodox Church Eșelnița, Baziaș Monastery (Fig. 20,b) etc.



Fig. 20 St. Ana Monastery, Orșova (a); Baziaș Monastery, Baziaș (b)

These elements of the constructed patrimony are completed by a series of elements of the small patrimony, such as crosses, triptychs, landmarks, watermills, charcoal furnaces, statues, commemorative plaques, etc. (Fig. 21, 22).

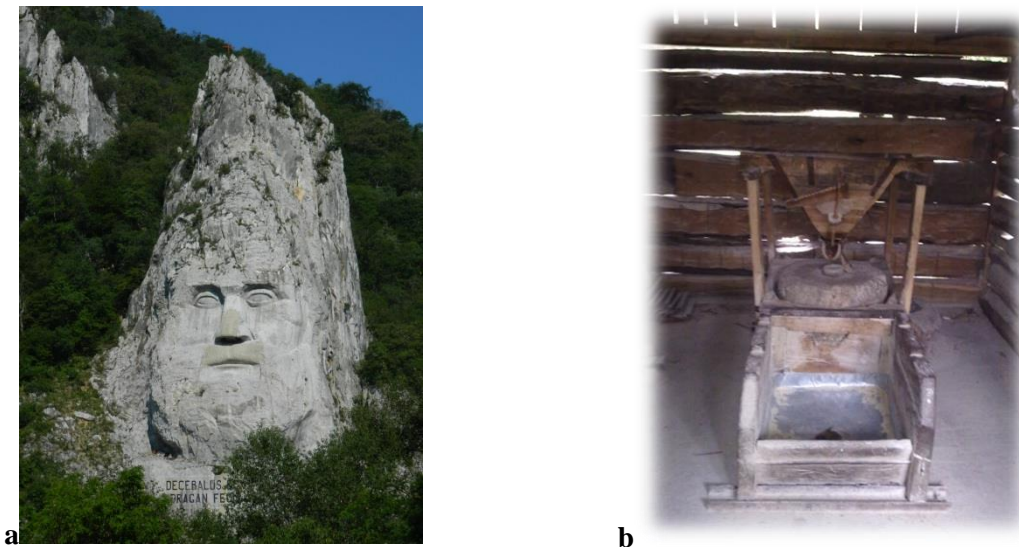


Figure 21 "Decebal" sculpture in a limestone abrupt (a); Watermill, Sichevița Valley (b)



Fig. 22 Furnaces for charcoal production in the Djerdap National Park

The private space contributes to shaping the identity of local communities and represents a component of the material patrimony, individualized in the private and social life of inhabitants and expressed especially through the organization of families and elements corresponding to it: photography, documents, furniture, etc. (Niculae, 2011).

Traditional products and crafts, analyzed as an integrated part of the rural life (clothing, footwear, decorations, tools, livestock, wooden products, glass, metal, fabrics, and pottery), represent another element.

**Immaterial patrimony** consists of the totality of immaterial and intangible goods specific to a certain territory and expressed in the landscape. The communitarian lifestyle is remarked through a large number of traditions and feasts, festivals, fairs, markets and



commercial activities, of both local, regional and national importance that bring unicity to the cultural landscape in certain moments of their existence.

Local communities specific to the analyzed area are characterized by the existence of a community culture represented by oral literature, music, dances and traditional games, traditional costumes, musical instruments and other that bring identity to the protected areas. For exemplification we can enumerate a series of traditions specific to the communities in the Iron Gates Natural Park and Djerdap National Park: the festival of Danube villages (Svinița), Festivals of minorities (Bigăr), Nedeia – festival of the villages, Sons of the village (Ilovița), popular beliefs existing in the Danube villages from the Djerdap National Park (aquatic mythical creatures named Kemdža) etc.

## 2.3 Elaborating the procedure for assessing landscape elements at multiple scales

### Visual evaluation of the landscape in the Iron Gates Natural Park and Djerdap National Park

In Romanian legislation, the landscape is defined as an area with specific structure and characteristics in which natural and cultural elements overlap, interact and influence each other (Legea 345/2006). The result of these relations is perceived by the population as being a territory with homogenous characters and elements of unicity. Their report with the perception of landscapes by human factors becomes essential in any landscape analysis.

The visual evaluation of the landscape represents an in situ qualitative method, in which the subjective perception of the landscapes is transposed to an objective level (Pătru-Stupariu 2011). The evaluation assumes a quantification of each landscape elements through a numerical value and according to a scale of state or importance. The result will be interpreted according to the European Landscape Convention (Table 1).

The assessment is made by filling a sheet for the landscape survey, in concordance with the reality in the field. Each analyzed parameter  $V_P$  (items A→G) has an associated variable  $X$  ( $V_{PX}$ ). If the variable is of type 1, the corresponding  $V_{PX}$  variable is equal to the arithmetic mean of the points recorded. If the variable is of type 2, we can use the formula

$$V_{PX} = f_{PX} * \sum_{Y \text{ of type 1}} V_{PY}$$

in which:  $V_{PX}$  –variable associated to the parameter (e.g. for the *Landforms*, variables are *Type*, *Subtype*, *Actual processes*);

$f_{PX}$  - the multiplicative factor of variable  $X$  for the parameter  $P$   
(e.g. values 1, 0.5, 1.5, etc.)

$V_{PY}$ - the score for the variable  $V_{px}$

This points are calculated by adding them thus obtaining the  $V_P$  value corresponding to parameters from **A** to **G**.

$$V_P = \sum_X V_{PX},$$

in which:  $V_P$  – analyzed parameter (e.g. landforms, water bodies);

$V_{px}$  –variable associated to the parameter (e.g. for the *Landforms*, variables are *Type*, *Subtype*, *Actual processes*);

The final score of V in one point is determined by a weighted average of the values obtained for each parameter:

$$V = (\sum_P \mu_P * V_P) / \sum_P \mu_P,$$

in which: **V**- total score of the point of analysis;

**$\mu_1 \dots \mu_n$**  weights of the  $V_P$  parameters

**$\sum_P \mu_P$**  – sum of the parameters weights

## Workflow

1. Establishing the points in which the survey sheets will be applied  
Prior to the field work, a number of observation points will be established, so that they are distributed relatively uniform on the surface of the park, in concordance with the presence of the landscape types. The number of points should be large enough to allow a view of the landscapes' complexity. The methodology recommends using as observation points those with a good and open view, such as belvedere points.
2. Applying in the field the sheets for landscape survey
3. Aggregating the scores and framing the landscape in a class (Table 3).

The classes have a significant importance in establishing the conservation value of the landscapes, their patrimony value, and a directory line for shaping the territorial planning strategies.

Table 3 -Landscape classes and corresponding intervals

<i>V score</i>	<i>Landscape class</i>
<b>0-20</b>	Degraded
<b>21-50</b>	Ordinary
<b>51-65</b>	Good
<b>66-80</b>	Very good
<b>80-100</b>	Remarkable

## Parameters used in the visual landscape survey

### A. Landform

Total score	Variable x	Value	Score	$f_{px}$	Type
	Type (A)	Mountain			1
		Defile			
	Subtype (B)	Mountain peak		1	2
		Defile		1	
		Mountain valley		0.5	
		Golf		0.5	
	Actual processes (C)	Absent		1	2
		Reduced		0.5	
		Accentuated		-0.5	

## B. Water bodies

Total score	Variable x	Value	Score	$f_{px}$	Type
	Type (A)	Danube			1
		River order 1			
		River order 2 / Creek			
		Golf			
		Wetland			
	Banks (B)	No vegetation		1	2
		Common vegetation		1	
		Luxuriant vegetation		0.5	
	Movement (C)	None		0	2
		Easy		0.5	
		Meander		0.5	
		Rapid		1	
	Quantity(D)	Small		-0.5	2
Average			0.5		
Large			1		

## C. Vegetation

Total score	Variable x	Value	Score	$f_{px}$	Type
	Type (A)	Forests with high tree density			1
		Rare forests and shrub areas			
		Meadows			
		Grasslands			
		Permanent fields / orchards			
		Cliffs			
	Diversity(B)	Reduced		0.5	2
		Average		1	
		High		1.5	
	Quality (C)	Luxuriant		1.5	2
		Good		1	
		Regular		0.5	
		Degraded		-0.5	
	Covering (D)	Small		-0.5	2
		Average		0.5	
		Large		1	

## D. Fauna

Total score	Variable x	Value	Score	$f_{px}$	Type
	Presence (A)	Present			1
		Occasional			
		Absent			
	Diversity (B)	Reduced		-0.5	2
		Average		0.5	
		High		1	
	Interest (C)	Reduced		0	2
		Average		0.5	
		High		1	

### E. Visibility

Total score	Variable x	Value	Score	f <sub>PX</sub>	Type
	Opening (A)	<45° (linear)		-1	2
		45-90° (partial)		-0.5	
		90-180° (normal)		0	
		180-270°(ample)		0.5	
		>270° (panoramic)		1	
	Interest (B)	Reduced		0	2
		Average		0.5	
		High		1	

### F. Elements altering the visual perception

Total score	Variable x	Value	Score	f <sub>PX</sub>	Type
	Presence (A)	Present			1
		Absent			
	Fragmentation (B)	Reduced		0	
		Average		0.5	
		High		-1	
	Covering the horizon line (C)	Reduced		0	2
		Average		0.5	
		High		-1	
	Affecting visibility (D)	Reduced		0	2
		Average		0.5	
		High		1	
	Perturbation elements	Degraded slopes		-0.5	2
		Degraded buildings		-0.5	
		Wastes		-0.5	

### G. Elements of unique character

Total score	Variable x	Value	Score	f <sub>PX</sub>	Type
	Presence (A)	Present			1
		Absent			
	Remarkable element (B)	Golf areas		1	2
		Valleys		1	
		Viaducts		1	
		Areas of paleontological interest		1.5	
		Special anthropogenic elements (buildings, monuments)		1.5	
		Endemic vegetation		1.5	
		Avifauna importance		1.5	

### Naturalness index

The methodology for landscape assessment in the two protected areas (Iron Gates Natural Park and the Djerdap National Park) can be completed by evaluating the naturalness of the landscapes, and therefore revealing their homogeneity.

This evaluation can be easily done by calculating the synthetic *naturalness index* of the landscapes (Dumitrascu, 2006, Niculae, 2012). The values of the index represent the percent of surfaces covered by forests from the total surface of the analysed territorial unit.

Several methods of computation for the naturalness index exist. One requires calculating the index for each territorial administrative unit. Nevertheless, using statistical

data (for the total surface and that of forests) does not allow a correct evaluation of the spatial distribution of forest surfaces.

For this purpose we suggest using spatial databases on the distribution of forest surfaces in relation to equal surfaces. For the present example we reported the forest surfaces in the two protected areas to squares with a surface of 25 km<sup>2</sup>, in a system of grids (5km x 5km for each cell) (Fig. 23).

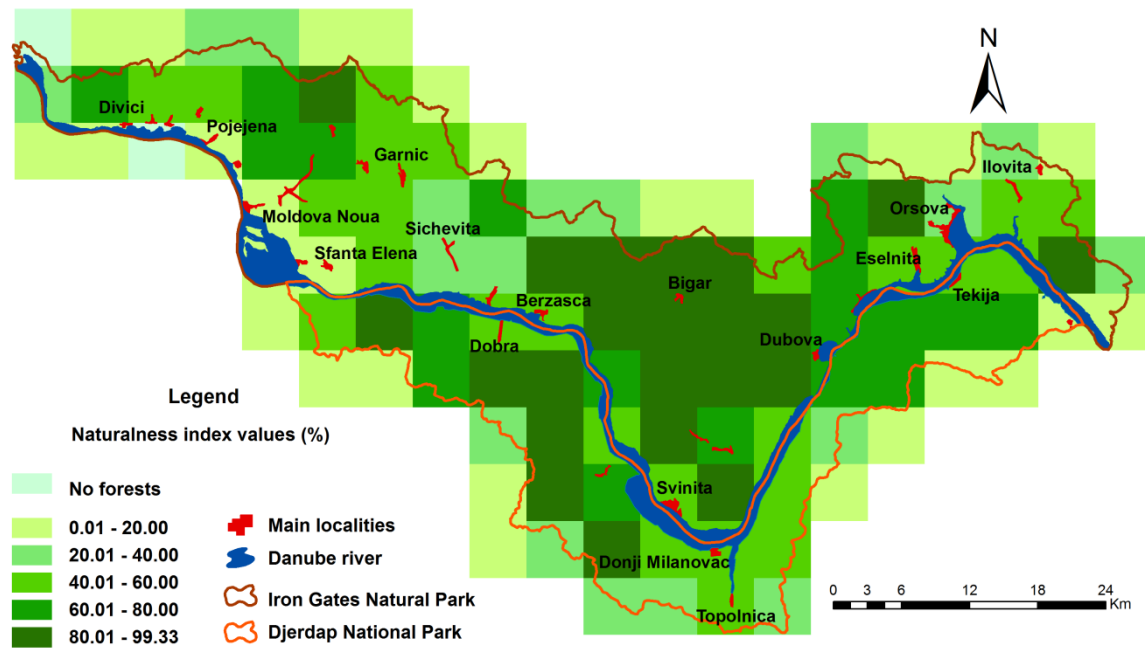


Fig. 23 Value of the naturalness index in the two protected areas

Analysing the map, one can evaluate the spatial dynamic of the naturalness index for the two protected areas, in a direct relation with a scale of interpretation (Table 4). Landscapes were classified according to the ecological equilibrium following the diversification and intensification of human pressures on the environment (Dumitraşcu, 2006).

Table 4 Scale for the ecological equilibrium of landscapes

Naturalness index (%)	Ecological equilibrium
0 - 20	Very high affected
20 - 40	High affected
40 - 60	Moderate affected
60 - 80	Low affected
80 - 100	Very low affected

## 2.4 Human impact

### Human modification of the landscape in *Iron Gates* Natural Park (Romania) and *Djerdap* National Park (Serbia)

The human modification of the landscape in the study area can be observed through the change in the land cover and land use, but also through loss of quality for the

environmental components. It initiates causal chains that have consequences for the climate at global scale (altering the carbon biogeochemical cycle, nutrients cycles as nitrogen and phosphorous), water resources (degradation by excessive fertilisation and pesticides, discharge of untreated sewage), air quality (pollution determined by some economic activities, accented by loss of forest cover), habitat (loss and fragmentation due to more land being converted for human use), biodiversity conservation (Foley et al. 2005).

From another perspective, landscape changing by human modification of the landscape has numerous consequences at local scale, among which the loss of aesthetic qualities is the least important, although the most visible. The impact of human activities over the landscape finally results in increased degree of artificiality, implications being mostly negative. This is the case for activities that reduce forest cover and aquatic environments extension, unbalance some natural systems and initiate geomorphological processes like landslides or soil erosion.

The protected areas, as one of their most important characteristics, display landscape with less human modification, compared with areas situated in proximity, but without the same status of conservation. This is also true for the landscape of Iron Gates Natural Park (Romania) and Djerdap National Park (Serbia). Classification as a protected area is an acknowledgement of the superior status of conservation for the natural elements, but at the same time ensures this will continue in the future.

We also have to underline that inclusion into a protected area category, while ascertains the compliance with a set of criteria, doesn't mean that the landscape is entirely untouched by human modifications.

According to *OUG no. 57/2007, regarding the regime of protected areas, conservation of natural habitats of wild vegetation and animals, approved with modifications by the Law no. 49/2011*, the Iron Gates Natural Park is focused on the protection and conservation of areas with considerable landscape and cultural value, seldom with high biodiversity, created through the interaction between the human communities and natural elements.

*The Djerdap* protected area is classified as a national park. According to the Serbian Law for Protection of the Nature, national parks are areas with high biodiversity and ecosystems of national importance, with special landscape characteristics and valuable cultural heritage, where the people live in harmony with nature. The objectives of a national park are to conserve natural resources and capital, including landscape, geological and biological diversity. Its existence provides for different scientific, educational, spiritual, aesthetic, cultural, touristic, sanitary and recreational needs on a sustainable development basis.

The Serbian definition for the national parks it is not the same as the IUCN one for the specific category, considering the management objectives and resource use. It is a definition that focus more on objectives related to landscape protection and protected areas with sustainable natural resources.

These definitions acknowledge the outstanding value of the landscape, but also a degree of modification by local communities. Furthermore, some activities are accepted as positive, those being the traditional ones, while others are deemed negative, such as the majority of modern activities or activities that make use of modern techniques of exploitation.

Operating with this kind of differentiation (traditional versus modern), we can realize a clear classification of the different human modifications of the landscape. A second criterion we can use is the number of natural components of the environment that are modified. The easiest way to assess the human impact over the landscape is to analyse the land use, in relation to the land cover. The land use is correlated with the needs of the local communities, as these needs evolve over the time. The local and regional development stage and the expansion of areas for human use are factors that change the land use, and thus the landscape.

We have identified and classified a number of specific human modifications of the rural and urban landscape inside the two protected areas (Fig. 24).

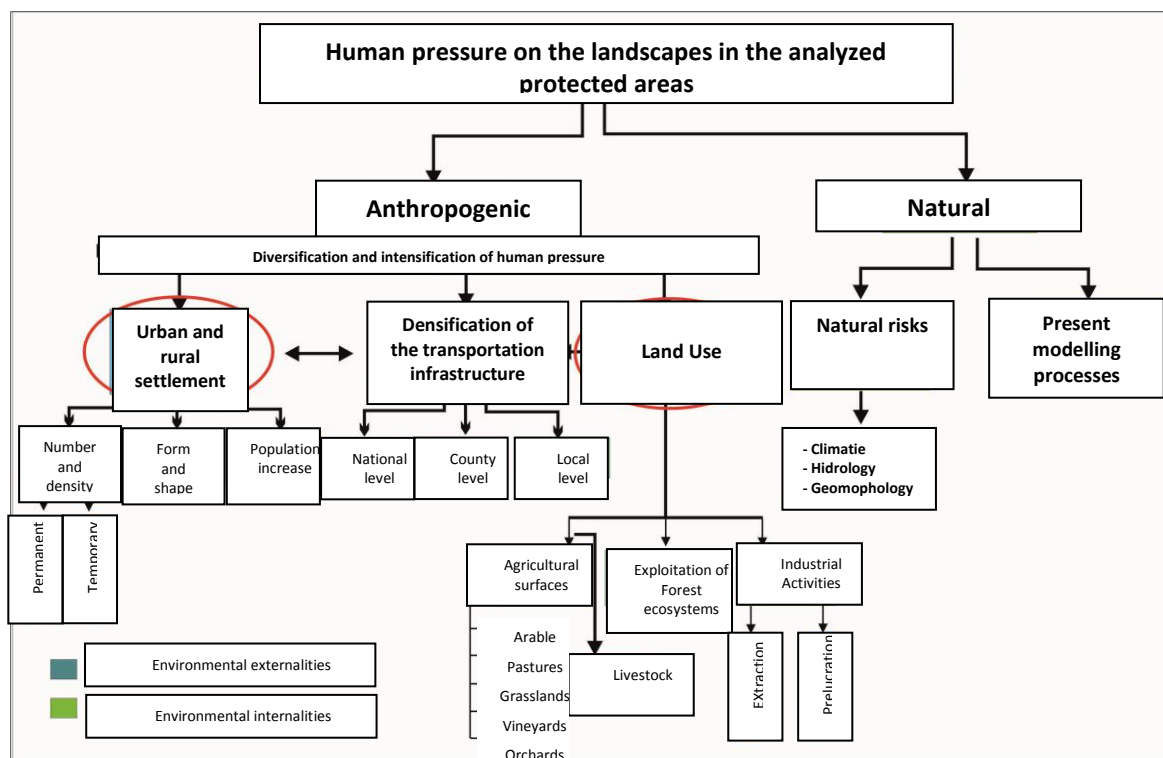


Fig. 24 Degradation model of the landscape (Niculae, 2012; Patroescu et al., 1999-2000; CCMESI, 1999)

### Human activities that change the landscape

The territory of the *Iron Gates* Natural Park and *Djerdap* National Park displays an outstanding degree of naturalness, an important condition for the inclusion in the protected areas category. The existence of human communities for thousands of years in the area induced significant changes in the environment, but the communities also had to acquire an in depth knowledge of the local environment and to adapt.

The local communities integrated into the environment and the traditional activities withstood the test of time. New economic activities, in particular the resource exploitation ones (wood, minerals, water), but also the use of more efficient modern techniques, needed to ensure increasing demand, change the environment and the landscape faster and profoundly.

The activity that caused the most important and rapid landscape change is the construction of Iron Gates dam and lake, finalised in 1972. This extremely large project determined the flooding of **12** human settlements, situated on both sides of the Danube and of **14 500** ha of land (EPS, 2009), considerable loss of habitats, natural and cultural resources. Archaeological sites along the shore were also totally or partially flooded, as it is the case for the roman road, others were moved on higher grounds (Tabula Traiana, Lepenski Vir).

Building the dam and the establishment of the two protected areas were some of the causes that initiated a population decline (Macura et al, 2012). This process determined negative changes of the environment and landscape by turning the existent infrastructure into a source of degradation. Abandoned agricultural fields lead to increased soil erosion and to the spread of invasive plants (MacDonald et al, 2000). Other consequence of the population decline was the loss of valuable cultural landscape (Gârnic, Bigăr, Liubcova, Berzasca etc.). By relocation, many settlements lost important architectural and traditional ways of life (Vârciorova, Orșova, Svinița, Ada- Kaleh etc.) which enriched the landscape and marked the historical evolution of the area.

Considering the IUCN Threats Classification Scheme, we have identified the following categories of activities that significantly change the landscape of the two protected areas:

**1. Residential and commercial development** is done with an almost total removal of some landscape components (soil, vegetation, animal life etc) or considerable alterations for other components (water drain for example). Settlements in *Iron Gates* and *Djerdap* protected areas are predominantly displaying rural landscape, with traditional ways of land planning (single family homes with a courtyard and/or garden, everything surrounded with agricultural fields).

The construction of the Iron Gates dam and the subsequent formation of the lake caused profound landscape change, including the relocation of localities. More recently, the border lake landscape is undergoing a new stage of change. Residential and commercial development is massively changing the landscape, sometimes illegally, inside vulnerable areas of conservation (as an example SPA Divici-Pojejena).

Building secondary homes on the Danube shores (Fig. 25, 26) is a direct threat to the landscape of mountainous (Dubova) and forest (Eșelnița, la baza Ciucarului Mic, Mraconia, Mala etc.) type, by the major influx of tourist, destruction of riparian ecosystems and waste water discharge. Since 1995, a large number of secondary homes and guest houses had been built in the last decade, even in sites of community importance (Divici, Tișovița etc.).

This type of development is found around Danube's inlets (Bahna, Cerna, Mraconia, Dubova), in Baziaș-Măcești wet lands, on Sf. Elena plateau, etc. (Rozyłowicz, 2008). It attracts important flows of tourists.

The traffic increase and collection of species by tourists (*Testudo hermanni* tortoise, plants) is a considerable threat to the biodiversity (Rozyłowicz, 2008) and the landscape as. Visitors also camp in vulnerable areas and leave waste behind, further influencing the characteristics of the environment and the landscape.





Fig. 25 Arrangement of individual residential areas in Şvinița and Coronini on the Danube banks (CCMESI, 2013)



Fig. 26 Residential areas on the Danube banks

**2. Agriculture and aquaculture** necessitate considerable change of topographical surface, soil quality and vegetation composition. Agriculture is, taking into consideration the large tracts of land used, the main way of changing the landscape. The lower, flat and fertile land is more susceptible to agricultural use and thus the most heavily functionally, structurally and aesthetically modified.

Where the relief is more rugged, of mountain type, agricultural fields occupy less ground, landscape being the less changed. Most of the arable land in the Danube floodplain was flooded when the Iron Gates dam had been built. What is left of the arable land in the region only allows subsistence crop cultivation. More fields are used for grazing as natural pasture, since livestock farming increased. This is modifying the landscape in specific ways, for example turning some forest into pasture.

**3. Energy production and mining** are activities with a long history in the study area and the subsequent landscape changes are significant. The coal mining was stopped in 1989. The main sites for coal mining were Cozla, Bigăr, Eibenthal, Baia Nouă (Fig. 27,a). After extraction, coal was transported towards the Danube for shipment.

The resulting dry stack tailings are causing important environmental problems. Mining complex ores at Moldova Nouă left tailings covering 414 ha and 16,909 million m<sup>3</sup> (Marinică și Borza, 2010) (Fig. 27,b). There are such deposits form mining ore in pasture or forest landscape. Quarrying has also left scared landscapes.

To revert this landscape to natural state takes huge amount of time and resources. Cost is often so high that natural regeneration is the only used method.



Fig. 27 **Old coal sorting station in Cozla (a); Tailing dumps in Moldova Nouă (b)**

Landscapes, including the cultural heritage, are important objectives to consider when planning large projects and infrastructures, as the energy generating ones (Faburel, 2013). The hydroelectric power plant *Porțile de Fier* caused major landscape modification when was built (1964-1972), as the average of the created lake surface is 700 km<sup>2</sup>. Large tracts of land, important habitats and some settlements were completely flooded, losing their landscape value.

Another form of electricity generation that is presently gaining momentum in the *Iron Gates* Natural Park is **wind farming**.

Equipment's for energy production and transportation are some of the most important causes of rapid structural and functional landscape degradation. It is a source of conflict as it is creating obstacles for agricultural, touristic, forestry use of the landscape (Labussiere, 2007). Landscape planning must take into consideration the presence of these artificial structures, how the locals perceive the new landscape and if or not accept it, also the visitor's perception.

The lithological diversity is exploited by the locals also with many small improvised quarries, the majority illegal. Quarries change the landscape cover, the habitats' spatial and quality, slope stability, continuity and aesthetics, level of toxic compounds found in environment (heavy metals).

These problems influence the landscape seasonally and also have long range effects, as it is the case for particulate matter air pollution from the Moldova Nouă dry stack tailings.

**4. Transport and service corridors** modify the landscape by specific infrastructures. The roads and railway on both sides of Danube (TEN-T VII corridor), were constructed with considerable effort, visible in the changed landscape. Vegetation removal, slope change, insertion of water drainage pipes, bridge building, tunnel boring, shore protection is

associated with the construction of the transport network and exert considerable pressure over the landscape.

For the road and railway network that is connecting interior sites, habitat fragmentation is also to be considered. Road and rail transportation is a source of pollution and noise.

There are at the moment some projects to create a cycling corridor along Danube, from Budapest to the Black Sea (Macura et al, 2012) as a segment of the Euro Velo no. 6 cycling corridor (Atlantic Ocean – Black Sea). Infrastructure for this corridor will further change some aspects of the landscape, even if the changes will not be major ones.

**5. Using biological resources** is transforming the landscape in many ways (Fig. 28). The harvesting of wood resources is the most striking visual change, but the landscape suffers also important structural and functional alterations. Hunting and collecting animal life, plant harvesting (medicinal ones for example), and fishing are also contributing to the landscape change. Selective extraction, in order to avoid depletion of the production base and the key species in the trophic chains of ecosystems is paramount for future use.



Fig. 28 Forestry exploitation and landscapes

**6. Human intrusions and disturbance** are related in the study area to the presence of mostly rural as settlement and activities. The human presence in the two protected areas is different. *Iron Gates* Natural Park is the home for **47377** inhabitants (INS, 2011). There are two cities, Moldova Nouă (**12350** inhabitants) and Orșova (**10441** inhabitants). **24586** inhabitants live in rural communities. The population decreased from 2002 and subsequently also the pressure over the landscape. Assessing the human pressure over the environment by landscape use will allow us to hierarchize the factors of landscape change and different categories of landscapes by state of change.

Degradation of the landscape have to be evaluated, not only considering the naturalness indicators, but also using the fragmentation index, to be determined by assessing the distribution of the transport network, settlements and economic activities.

There are 9 villages and one city in Djerdap National Park, along territories of administrative units only partially inside (Macura et al, 2012). Kladovo, Negotin and Golubac are situated at the park's periphery (outside), but have an extended influence area. In 2011 there were **7706** inhabitants (Statics Office of the Republic of Serbia, 2012), **2410** of which in the city Donji Milanovac. **5296** inhabitants live in the countryside.

**7. Natural system modification** is a consequence of all human activities, either voluntary, by accident or as a side effect. An example is forest fires started by human actions, with dramatic consequences for the landscape. Inventorying fire's frequency and calculating areas is a tool to assess the landscape change rate.

**8. Invasive and other problematic species, genes and diseases** pose considerable threat to the landscape's structure and functionality of the two protected areas. To manage these problems, is critical to locate and estimate the landscape patches that underwent modifications in the structure and vegetal composition, due to invasive species presence. Some of the frequent invasive plants are *Robinia pseudoacacia*, *Rhus hirta*, *Alianthus altissima*, but the Danube corridor allows the easy intrusion of invasive aquatic animals (as it is *Ameiurus nebulosus* in the Iron Gates Lake).

**9. Pollution** determines considerable change in the landscape's structure and functionality. Residential waste water, industrial effluents, farm sewage, fertilisers and pesticides' runoff is a cause for major changes in aquatic processes. Water eutrophication is one of the consequences. Solid waste needs storage spaces as it moves along the management system from production site to permanent storing. The landscape is modified by inclusion of the necessary infrastructure. Some of the waste changes the landscape in specific ways, as it is the plastic, that do not decomposes naturally, or the toxic waste, that can insidious transformation.

In both protected areas there are controlled waste management sites, but also numerous illegal ones, in particular in the forest landscape. Making an inventory of all these sites is useful for assessing the balance of trophic chains, ecosystems and landscapes.

**10. Climate change and weather conditions** are not at the moment easy to spot as a cause of landscape change, but could intensify some of the side-effects associated with human activities (as are forest fires started by accident or voluntarily). Draught frequency and duration is an important factor for evaluating the biological weathering, as this has consequences for the landscape stability.

#### **Landscape modification determined by the landscape use**

The **forest land** is the most large category of land use in the *Iron Gates* Natural Park areas (**75476.6** ha), which is **65.26** % of the total. **Agricultural land** is the second largest category with **28500** ha, **24.6** % of the total park's area. **Agricultural land** includes the following sub-categories: **44.6** % pasture, **29.1** % arable land, **24.9** % hayfields, **1,5** % vineyards and orchards. The **water and wetlands** cover **8900** ha, **7.7** % of the total. **Built-up land and transport infrastructure** cover **2789** ha (**2,4** %).

In the *Djerdap* National Park the situation is similar, with the forest land covering **44851** ha, which is **70.43**% of the total area. Pasture and hay fields cover **6337** ha (**9.95**%), agricultural land and orchards **4559** ha (**7.15**%), water and wetlands **5882** ha (**9.23**%). Built-up land and transport infrastructures cover **2051** ha (**3,22**%) (Medarevic, 2001).

The main landscape changes in **forest areas** are:

- forest thinning and removal through wood harvesting and where it is allowed, leading to lower tree density, up to total clearance/other plants extraction;
- removal of vegetation (shrubs) by forestry works;
- loss of plant biodiversity through selective extraction;
- introduction of new species, later turning into non-controlled invasive species (*Robinia pseudoaccacia*, *Rhus hirta*, *Alianthus altissima*);
- establishment of plantations for exploitation, protection against flooding, improving slope stability, stabilising dry tailings and river shores etc.

Wood harvesting also necessitates buildings and equipment that further change the landscape. The wood harvesting activity and other plant collection (medicinal plants, wild berries etc.) have numerous side effects in the landscape through waste generation and storing, different extraction and transport, some of the techniques being very damaging to the landscape. For example, some wood extraction techniques involve soil disturbance, siltation and riparian ecosystem disturbance.

**Agricultural fields** change the landscape in a major way, specific modifications depending on the crop. Some crops allow the conservation of important tracts of land with predominant natural landscapes. In the *Iron Gates* Natural Park, **18%** of the total area is occupied by pastures and hayfields, while in Djerdap National Park, **9.95%**.

The most important landscape modifications determined by human activities in pasture and hayfields are:

- removal of shrubs and other woody plants as these hinder efficient exploitation;
- loss of biodiversity by overgrazing (also cause soil erosion);
- selective extinction of plant formations;
- increased density and occurrence for some plants, due to applying improvement techniques or due to input of animal waste (*Urtica dioica*, *Rumex sp.*, *Veratrum album*, other ruderal species);
- introduction by voluntary or by accident of invasive species;
- reduction in soil humidity by drainage.

The agricultural terraces of Divici are occupied by pasture vegetation. This is where one of the most emblematic species of the *Iron Gates* Natural Park – Hermann tortoise is found, increasing thus the importance of this specific landscape.

**Arable land** is 29.1 % of the total agricultural area of Iron Gates Natural Park. In the Djerdap National Park it is 7.15% together with the orchards. Although arable land is 7.16% in Iron Gates Natural Park, the footprint is considerable. The impact is highly diversified, consisting of removal of vegetation cover, total loss of plant biodiversity, leveling of the terrain and soils, consequence of agricultural practices (ploughing, etc.); terracing.

**Vineyards and Orchards** occupy a reduced percent of the total agricultural surface (1.5% in the Iron Gates Natural Park), but in the general land uses project an extremely strong impact. Among the aspects characterizing the impact upon the landscapes, one can consider:

- Removal of the natural vegetation, both in the phase of establishing the plantation and in the maintenance of the cultures;
- Reducing the vegetation biodiversity by replacing native vegetation formations;
- Introduction of support elements (such as espaliers) and terracing the slopes.

**Roads and other built areas** have a total surface of 2789 ha in the Iron Gates Natural Park (representing 2.4% of the total surface of the protected area) and 2051 ha in the Djerdap National Park (3.22%). They represent the land use with the highest impact on the landscape. In fact, the highest proportion of landscape components are either modified, either covered by modified elements, so that the natural and initial structure is hard to identify. The main categories of landscape impacts are considered to be: habitat fragmentation and destruction, vegetation deforestation, soil destruction, leveling and reducing slopes, covering fields with built elements.

An inventory of built up areas after 2015 would allow the identification and assessment of conflict areas with natural habitats and wildlife species of communitarian importance (Eşelnița, Dubova, Divici etc.).

## **2.5 Methods for reducing the human impact on the structure, aesthetic, value and functions of the landscape**

An essential instrument in the protection of landscapes inside protected areas is represented by their internal zonation, allowing the restriction of human activities according to their impact.

According to the management plan approved through HG 1048/2013 in the case of the Iron Gates Natural Park the zonation was established initially through the Order of Ministry no 552/2003 and later modified by a Governmental Ordinance no. 57/2007. By the Government Decision no. 2151/2004 the number of reserves in the Iron Gates Natural Park reached 18.

In the Government Decision no. 1284/2007 in the Iron Gates Natural Park have been declared another two special protection areas ROSPA0026 Danube watercourse Baziaș-Portiile de Fier and ROSPA0080 Almăjului-Locvei Mountains, as an integrated part of the European ecological network Natura 2000 in Romania, with a surface of 10124.4 ha, and respectively 118141.6 ha.

In the Order of Ministry of Environment no. 1964/2007 ROSCI0206 Portiile de Fier was declared as a site of communitarian importance, integrated part of the Natura 2000 ecological network, with a surface of 124293 hectares (larger than the surface of the Iron Gates Natural Park).

Starting with January 18, 2011 the surface of the Iron Gates Natural Park was declared a **RAMSAR Site**, with the identification code 1946 (ANPM, 2013).

According to the normative acts mentioned in the management plan and proposals that would be enforced with its approval, the Iron Gates Natural Park contains the following categories of areas: *areas of integrate protection, areas of sustainable management and areas of sustainable development.*

The Nature protection Law in Serbia does not establish different zonation principles for different categories of protected areas (Sekulic, 2011). The three protection levels apply to all types of protected areas in Serbia, with differences in the surfaces occupied by each category. Areas with different protection levels define the management objectives for certain surfaces.

Djerdap National Park contains three types of areas according to their protection regime – the first protection level (strict protection of natural and cultural patrimony) occupies 8.83% of the total surface of the park. The second level (protection of special natural elements – ecosystems, landscapes and natural spaces in the proximity of cultural monuments) cover 21.03% of the total surface, while 70.14% correspond to the third level (allowing activities such as tourism, sports and recreation, forestry, use of water resources, exploitation of mineral resources, urban development).

In the Djerdap National Park exist 8 natural reserves and a natural regional park. No protected areas are included in the Natura 2000 network, but Serbia recorded significant progresses in the direction of enforcing the European legislation in the field of protected areas. When the park was established, from the 44851 ha of forests, 7018 ha corresponded to private properties. At the same time, only 5.88% of the forest surface was situated in the strictly protected area, 28.53% in the second protection area and 65.59% in the third (Macura et al, 2010).

Besides the control of landscape degradation by applying zonation to the protected areas by the administrators, a series of measures for stimulating ecological behaviors or sanctioning others, can be used as complementary measures.

Due to the important presence of agricultural fields, the management of techniques is extremely important. Until recently, agriculture was realized with traditional methods, with a reduced environmental impact (although the high impact comes from the conversion of forest surfaces into agricultural ones).

A measure for sustaining the structure, aesthetic, patrimony and functionality of the landscapes is related to the conservation and stimulating the expansion of surfaces covered by forests containing autochthonous species. This type of vegetation is a major contributor to the formation of habitats, regulating water flow, soil fixation, climate moderation, all of these representing essential ecological services.

In the same time, is extremely important to integrate the infrastructure of local communities. Measures can be varied, from promoting localities with a compact spatial footprint and blocking the construction in sensible areas, to a better design and planning of the transportation infrastructures, with benefits in increasing their sustainability and their resilience.

Another important direction in reducing the human impact upon the landscapes regards the efficient management of wastes.

The presence of invasive species in the two protected areas should determine measures of reduction or removal, due to their destructive potential. Measures can be varied, such as the physical destruction of exemplars, or the sustaining of autochthonous species (plantations with local species).

The framework chart regarding the management for the conservation of cultural patrimony in landscapes, realized by Hutchings și Cassar (2006) (Fig. 29), and adjusted to the

particularities of the two protected areas evidences the potential indicators that can be used in selecting conservation activities and actions, and in the same time describes the requirements, actions and objectives of the management.

Decision factors are those who guide conservation activities for the components of cultural patrimony, their decision making being in concordance with the role of the cultural patrimony, both at local, national and communitarian levels.

Activities identified and defined at priority by the decision factors are: conservation activities, documentation, investigation and reduction of the possible threats, as well as control activities. All these represent the central part of the conservation management, results being analyzed according to a series of performance indicators (Niculae, 2011).

The connection between the identified decision factors and external ones imposes the need to monitor these conservation activities, with the purpose of achieving performance indicators using the available resources for local communities.

A series of measures should be undertaken by local and regional authorities, with the purpose of attracting European and national funding, measures regarding landscape rehabilitation, including of representative elements with cultural value, with the purpose of increasing the quality of life and sustainable development of rural communities (Niculae, 2011).

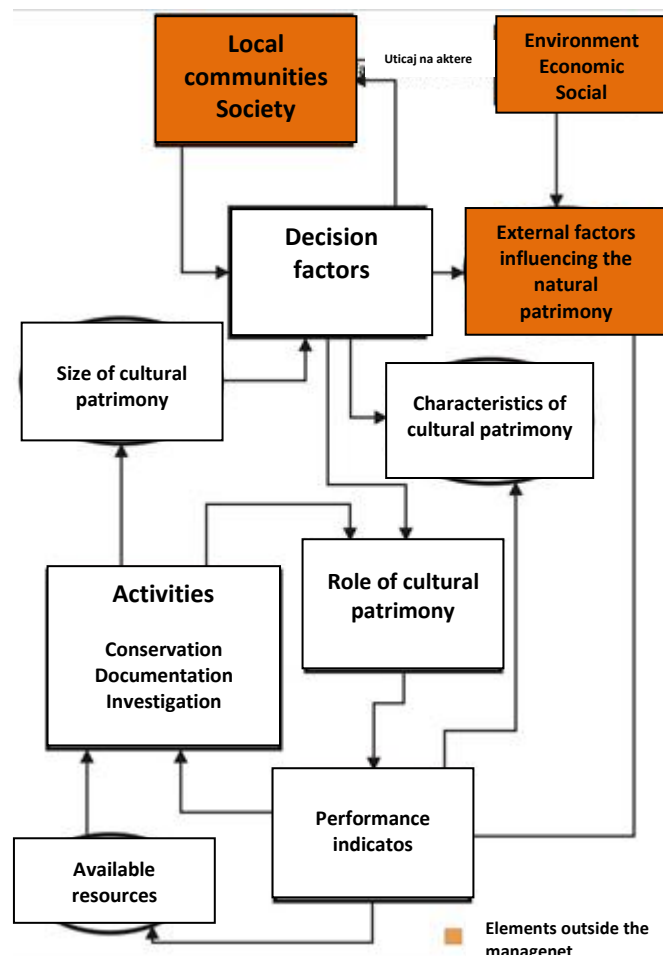


Fig. 29 – Management for the conservation of cultural patrimony in landscapes (adjusted after Hutchings and Cassar, 2006)



### **III APPLYING THE METHODOLOGY FOR LANDSCAPES CLASSIFICATION IN PROTECTED AREAS. CASE STUDY: DJERDAP NATIONAL PARK- IRON GATES NATURAL PARK**

#### **3.1. Main characteristics of the protected areas territory**

Iron Gates Natural Park is situated in the south-west of Romania, in a peripheral position inside the country from a geometrical perspective, but also if distance to the main centres of administrative and economic importance is considered. This peripheral position can explain to some measure the low degree of social-economic development in this area. Natural components are extremely attractive. The Danube Gorge is evidently the most striking, but complex and diverse relief (Locvei Mountain, Almăjului Mountains, Mehedinți Mountains, Mehedinți Plateau), high biodiversity and mild climate are also favourable factors for development, if not for the aforementioned isolation. At the same time, we have to underline that this isolation, due to peripheral position, is actually responsible for the well preserved natural elements, but also for the cultural originality.

Djerdap National Park is situated in north-east of Serbia. As it is the case with the Romanian counterpart, the Serbian protected area is also peripheral. Natural characteristics are similar to Iron Gates Natural Park, with spectacular forms of relief, as it is the Danube Gorge and the neighbouring mountainous areas and a rich biodiversity. Presence of different ethnical groups, consequence of an interesting historical evolution, is also of considerable value. Unlike the Iron Gates Natural Park, Djerdap National Park is closer to Belgrad, the Serbian capital and is easier to access from this populated area.

The national road DN 57 crosses and ensures accessibility to the whole Iron Gates Natural Park territory, linking the cities of Orșova, Moldova Nouă and Oravița, up to Moravița, in Timiș County, where it connects to DN 59 (this leads to Timișoara). DN 57 follows the Danube, passing by the Great and the Small Kazan gorge. Through Naidaș, by the DN 57 C, a ramification of the DN 57, one can reach the Serbian side, specifically the city Bela Crkva. Communities in the area are also using roads of secondary importance to circulate. The Iron Gates Natural Park is accessible by train, stations being present at Orșova, Gura Văii and Drobeta Turnu Severin. The Danube limits the Natural Park towards the south and represents an important way of transport for people and goods. Closest airports are Traian Vuia International Airport (Timișoara) at 190 km from the protected area territory and Craiova Airport at 175 km.

There are three major accesses for Djerdap National Park: two entrance points, near Golubac and Diana Karataš, on the national road M 25, and the regional road R 106 Porečki Most–Klokočevac. Most of the visitors come from Belgrad, Vojvodina, Sumadija, Pomoravlje and the eastern part of Serbia (Stankovic 2002). The most important airport used for accessing Djerdap National Park is Nikola Tesla Airport, Belgrad.

The natural heritage of the Iron Gates Natural Park and the Djerdap National Park, as the base of the landscape frame, has remarkable climate, geological, relief, aquatic and biological characteristics.

The climate of the two protected areas is temperate continental with Mediterranean influences (Bâzac and Moldoveanu 1996). The influences are a consequence of warm and wet

air advections from west and tropical air from south-west. Annual average temperature is 11°C in the Gorge, slightly higher on the Serbian side and with lower values in the mountain areas. Early springs and mild winters are frequent. Precipitations are between 800-900 mm annually. The differences in the atmospheric pressure on the sides of Danube Gorge determine the formation of cold air currents in the winter. Among the local winds, the most known is Coșava, blowing from SE-NV, with speeds exceeding 20 m/s, causing significant drops in temperature. These climatic characteristics, along with the complex relief and presence of water surfaces, allow the differentiation of many ecological niches, with rich vegetation, condition for extremely complex landscapes.

Considering the geological aspects, there are many areas of considerable value in both protected area, as a consequence of tumultuous structural, tectonic and sedimentary processes (Popa 2003). There are numerous mineralogical, structural, stratigraphic, paleontological geo-sites in the two protected areas. The geo-sites Saraoschi, Bahna, Boljetin have officially acknowledged status. The Danube Gorge in itself is an extraordinary “collection” of very interesting geological.

The relief varies greatly and includes as the key attraction the Danube Gorge, with a total length of over 134 km between Baziaș and Gura Văii (on the Serbian side the Gorge is estimated at 100 km between Golubac and Tekija). The Gorge has a number of *basins*, where the rivers crosses over crystalline and magmatic rocks, intercalated by *narrow sections*, where the river crosses limestone (sedimentary deposits at Reșița-Moldova Nouă at Șvinița-Svinecea Mare) (Ianovici 1969). On the Serbian side, the Gorge it is being segmented into four sections: Gornja Klisura, Gospodin Vir, Veliki and Mali Kazan (Small and Great Kazan) and Sipska Klisura. The most spectacular section considering the landscape is Veliki and Mali Kazan (Small and Great Kazan), formed by crossing the limestone formations at Ciucaru Mare-Veliki Strabak and Ciucaru Mic-Mali Strabak. This is the narrowest section, with 150-200 m, looking like deep gorges (maximum 82 meters form water level) with abrupt limestone slopes of up to 300 meter in height. Between the Veliki and Mali Kazan (Small and Great Kazan), on the Romanian, side lays Dubova basin. The mountain areas to the north and south of the Danube Gorge also present interesting landscapes. Most attractive ones are sculpted in limestone, as are in the Iron Gates Natural Park the dolines, doline valleys on the Sf. Elena-Cărbunari plateau, limestone pavements, deep dolines and plateaus in Ciucaru Mare and Ciucaru Mic, gorges on smaller rivers (Sirinia, Alibeg), caves (Gaura cu Muscă and Vranovăț in Sf. Elena plateau, caves like Ponicovala, Peștera Veteranilor, Peștera lui Climente in Ciucaru, Peștera Zamonița in Sirinia bassin).

Considering the geographical position, the complex geological structure, the fragmented relief and the various climatic influences, vegetal formation in both parks are of extreme diversity, over 60 types of forest and shrub associations being identified, some of them relict formations. There are inventoried over 1000 plant varieties, among wich *Corylus colurna*, *Acer intermedium*, *Celtis australis*, *Ilex aquifolium*, *Ceterach officinarum*, etc. Animals like the bear, linx, wolf, jakal etc and many birds are also present here.

The cultural heritage formed over a long period of time by many historical contributions. Lepenski Vir is the archaeological site of an extremely important settlement, whose beginnings date since 7000 years BC, with traces of permanent living since 8000 BC. 136 residential, religious and administrative buildings have been excavated. Remarkable are

the megalithic sculptures discovered at this site, prove of an exceptional civilisation. On the Romanian side, the artefacts of same period civilisation have been excavated at Schela Cladovei (8 000 and 5 500 BC). In both parks there are multiple dacian and roman historical sites, most significant at Dierna (106 BC), Kladovo (Diana Castrum), Moldova Nouă and Pojejena, Trajan Bridge etc. From the Medieval Age there are interesting artefacts found where Golubac and Festislam (on the Serbian side), Orşova, Ada-Kaleh (now covered by water), Pojejena, Tri Kule (close to Donji Milanovac), Ladislau (near Coronini), Peci, Lylka (between Dubova and Planişeviţa) settlements and fortifications once stood.

The presence in the area of many ethnic groups is an important element in defining the landscape, as each community has its own traditions. The territory of both parks is home to Romanian, Serbian, Czech, Roma, German, Hungarian, Turk, Ukrainian, Slovak, Bulgarian communities, living in peace. A nice example is set by the Czech villages of Eibenthal (1807), Sf. Elena (1825), Gârnic (1828), Bigăr etc, separated for two centuries and a long distance from the departure area, but still speaking their native language and still keeping their traditions.

Beside the immaterial cultural values these communities created, they also actively modified the natural surroundings according with their needs. The agriculture, by cultivating plants and raising livestock, forestry, water management systems etc brought important landscape changes, reducing the wild character of these areas. Some of the most amazing things are the water mills placed along the smaller rivers. Agricultural activities are of the subsistence type, because of fragmented relief and use of traditional methods of cultivation (Necşuliu 2007). Creating Iron Gates dam and lake profoundly marked the landscape, by flooding a large area, including some settlements that had to be moved to higher ground.

### **3.2 Applying the visual assessment of the landscape methodology for representative sites inside the two protected areas in a demonstrative way**

Evaluating the landscape of a region necessitate the assessment and classification of every identifiable landscape component (natural, social and cultural ones). Visual assessment of the landscape is a method that focuses on the qualitative evaluation of the natural and human modified components in the environment. The main tool is the visual classification by using a scoring system.

The visual assessment methodology of the landscape allows:

- the classification of the physical attributes of the landscape: water sheds, topographical surface, vegetation, animal species, land cover;
- the assessment of the attributes related to visibility and perception of the landscape: complexity, fragmentation, sightline, skyline visibility, general visibility, detail perception;
- the scoring and assessment of the spectacular elements: presence/absence; weight in the landscape.

Applying this method inside the two protected areas consists of several steps:

- identification of representative types of landscapes inside the protected areas and setting a number of observation points where the landscape will be assessed;
- placing the observation points on the maps;

- field trips in area and performing the observations; observation points must allow increased view perspective and cover the whole study area (patch);
- scoring the landscape elements on the field, calculating the final score and comparing the obtained values against standard landscape classes.

As an example, we have applied this particular methodology for six observation points, two inside Djerdap National Park and the other four in Iron Gates Natural Park.

### Observation point no. 1

This observation point is located in the Djerdap National Park, close to its western extremity, near Golubac, providing a large perspective over the Golubac fortress, situated on the Danube shore (Fig. 30 a,b).

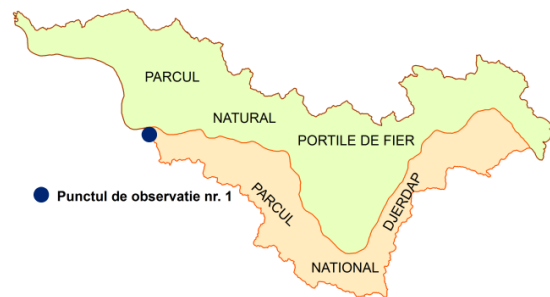


Fig. 30 Golubac Fortress, Djerdap National Park (a); Location of observation point no. 1 (b)

The landscape is of cultural type, the presence of the Golubac fortress being an indicator of important human impact over the environment, but also has natural value, with the most significant element being the Danube and the structural relief (with complex rock composition) visible on the Danube Gorge. The score given is 70 points. This classifies the area as a **landscape in very good condition**.

### Observation point no. 2

The observation point no. 2 is situated south of Djerdap National Park, at Majdanpek (Fig. 31 a,b). The landscape is of urban type. The score is 56 points, and the landscape is considered in **good condition**.



Fig. 31 Majdanpek City, in the proximity of Djerdap National Park (a); Location of observation point no. 2 (b)

### Observation point no. 3

This observation point is situated in Iron Gates Natural Park (its eastern side), inside Orșova city administrative boundary (Dealul Moșului), with a large perspective over Orșova Inlet and Orșova city (Fig. 32a,b). The landscape is of the human-modified type.

The obtained score is 82 points and the landscape is **remarkable**.

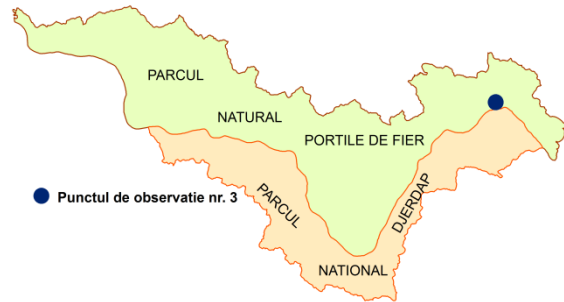


Fig. 32 Orșova City, Iron Gates Natural Park (a); Location of observation point no. 3 (b)

### Observation point no. 4

Observation point no. 4 is situated in the south-west of Iron Gates National Park, on the territory of Coronini village (Coronin plateau), on road leading to Sf. Elena village (Fig. 33 a,b).



Fig. 33 Coronini Plateau, Iron Gates Natural Park (a); Location of observation point no. 4 (b)

Three types of landscape are evident: the rural landscape (specific to the big villages), as we can observe Coronini village, the industrial landscape, in the form of the wind farm, and the agricultural landscape, with cultivated fields.

The score is 58 points. This value means that the landscape is in **good condition**.

### Observation point no. 5

Situated close to Eșelnița, the observation point no. 5 looks over Eșelnița village and Dealul Moșului, hill situated between Eșelnița and Orșova city. (Fig. 34 a,b).



Fig. 34 Eșelnița village, Iron Gates Natural Park (a); Location of observation point no. 5 (b)

The landscape type is rural, specific, for big villages, surrounded with agricultural and forested landscapes. The score is 49 points and the landscape is **ordinary**.

### Observation point no. 6

The observation point is located at Moldova Nouă city, Caraș- Severin county, inside the Iron Gates Natural Park, next to the settling of the former non-ferrous extraction plant (Fig. 35 a,b).

The landscape is degraded of industrial type and the score is 33 points, which gives it an **ordinary** aspect, with tendencies to further degrade.



Fig. 35 Non-ferrous extraction plant Moldova Nouă, Iron Gates Natural Park (a); Location of observation point no. 6 (b)

Analysing the six observation points and the scores, for sites inside Djerdap National Park and Iron Gates Natural Park, we have inventoried **two ordinary landscapes, two landscapes in good condition, one landscape in extremely good condition and one remarkable landscape**.

The remarkable landscape was situated near Orșova village (Orșova Inlet), while the landscape in good condition near Golobac Fortress. The aspects with positive influence were the Danube (and the Danube Gorge), Orșova Inlet, mountainous cliffs, large angles of perspective and spectacular perspective.

As for the ordinary landscape, it is located at Moldova Nouă, next to the settling pond and non-ferrous extraction plant buildings. The value for this landscape was diminished by the low and degraded vegetation cover, lack of cultural heritage elements of value, absence of water bodies, low touristic attraction, and intense degradation of natural and manmade components.

## CONCLUSION

The present report synthesizes the main *methodological terms and concept* used in landscape research, but also realizes a primary landscape typology according to their elements of interest. In addition, the report presents different *landscape definitions*, from scientific and administrative fields and sources.

The report also presents *legislative elements regarding the establishment and management of natural protected areas at national and European level*, focusing on the categories and typologies of natural protected areas from the present contract, and realizing a continuous comparison of approaches in the two states.

*The legislative elements regarding landscape protection and conservation* are presented at both national and international level, in concordance with the specific character of national legislation in the field, and with the provisions of the European landscape convention.

The quantitative and qualitative evaluation of the landscape resulted in a well-balanced classification of landscape typology of the two protected areas. The methodology we presented can be applied at regional scale for landscape classification. This method is based on the visual assessment of the landscape and it is thus subjective, relying on the observer's perception. To obtain a more accurate landscape classification, it is recommended that a mix of methods should be used for identification, assessment and classification, based on different data sources, such as maps, satellite imagery, aerial photography, statistical data.

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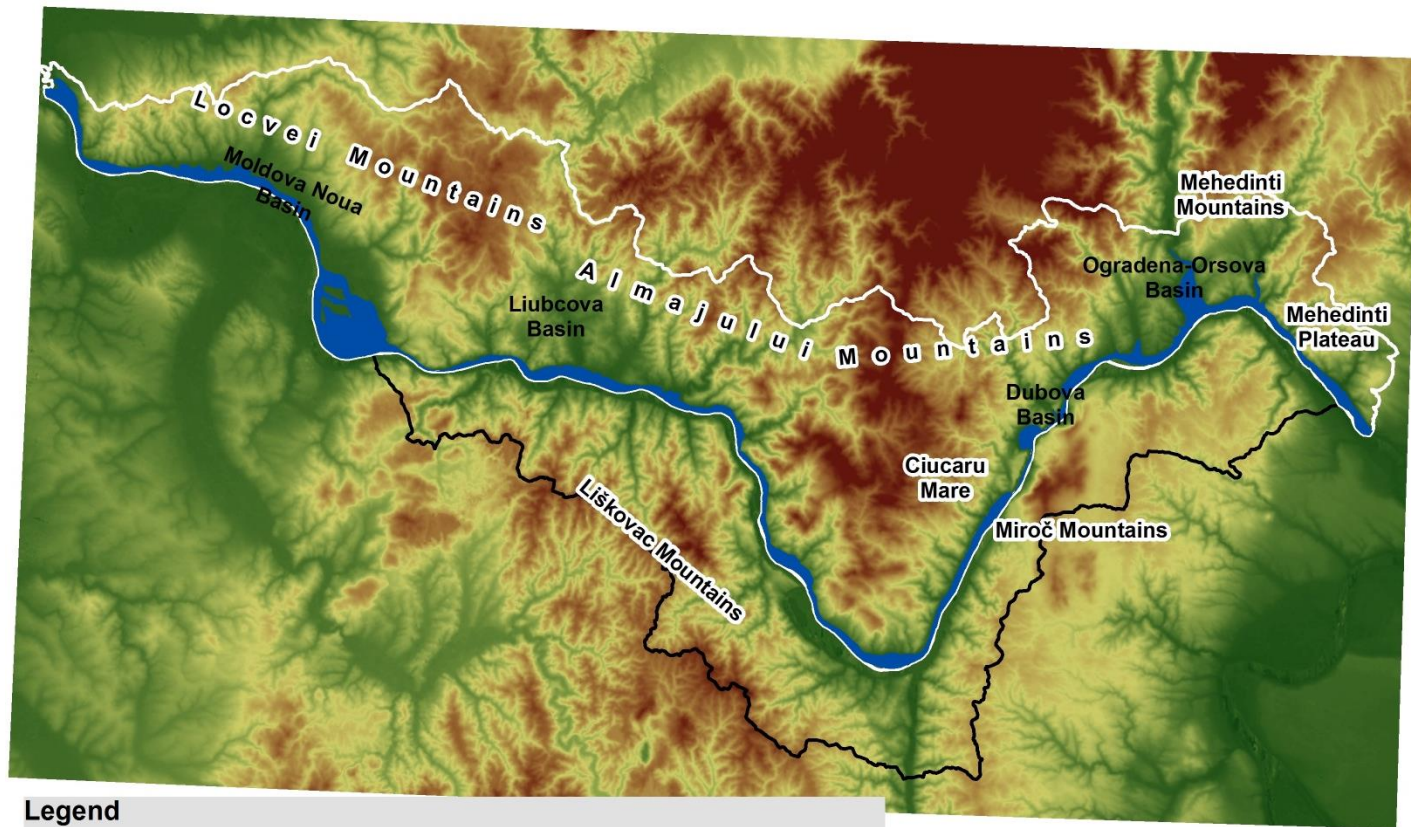
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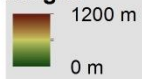
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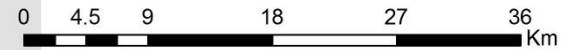
**Legend**

Natural landscapes determined by structural and petrographic relief

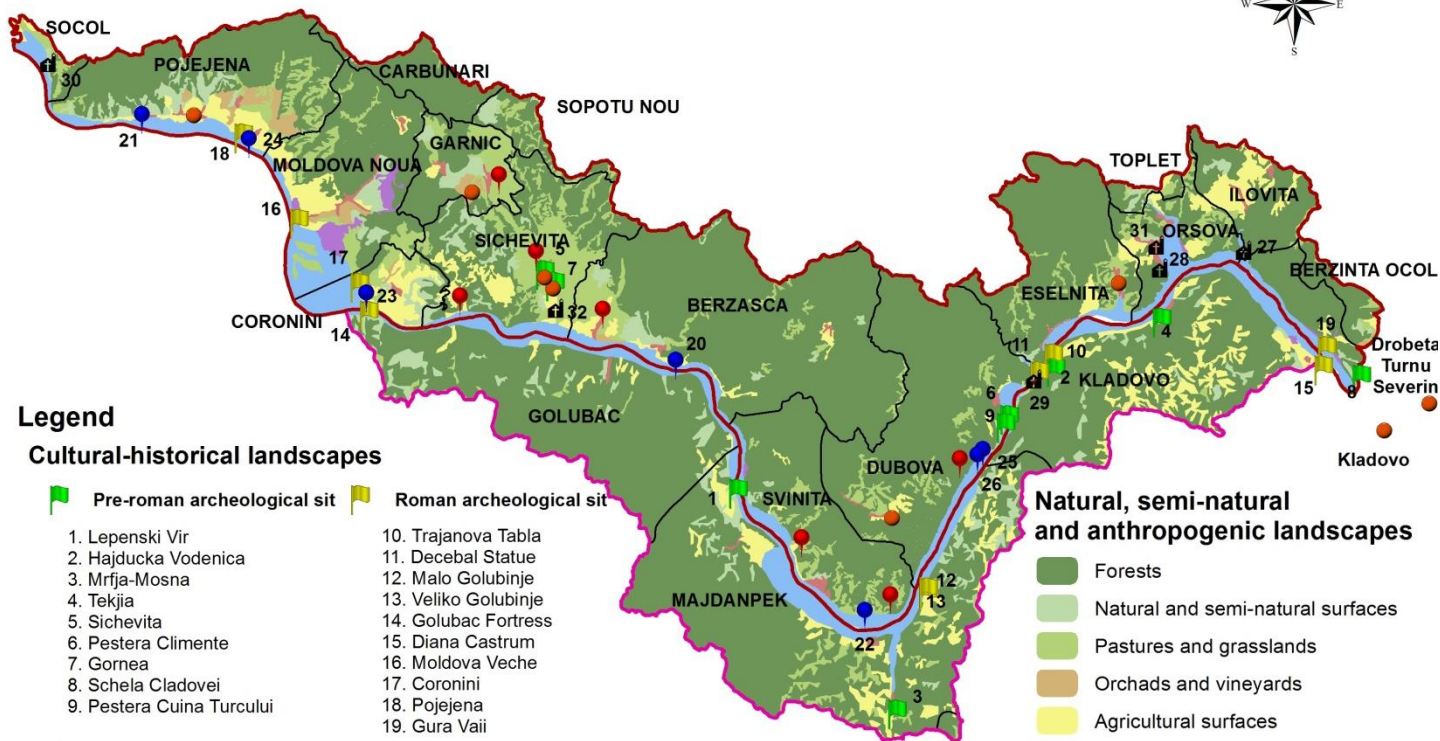
**Height**



-  Danube
-  Iron Gates Natural Park
-  Djerdap National Park







### Legend

#### Cultural-historical landscapes

- |                             |                                  |
|-----------------------------|----------------------------------|
| Pre-roman archeological sit | Roman archeological sit          |
| 1. Lepenski Vir             | 10. Trajanova Tabla              |
| 2. Hajducka Vodenica        | 11. Decebal Statue               |
| 3. Mrfja-Mosna              | 12. Malo Golubinje               |
| 4. Tekija                   | 13. Veliko Golubinje             |
| 5. Sichevita                | 14. Golubac Fortress             |
| 6. Pestera Climente         | 15. Diana Castrum                |
| 7. Gornea                   | 16. Moldova Veche                |
| 8. Schela Cladovei          | 17. Coronini                     |
| 9. Pestera Cuina Turcului   | 18. Pojejena                     |
|                             | 19. Gura Vaii                    |
| Stronghold                  | Monastery                        |
| 20. Drencova                | 27. Vodita Monastery             |
| 21. Divici                  | 28. Sfanta Ana Monastery         |
| 22. Trikule                 | 29. Mraconia Monastery           |
| 23. Ladislau                | 30. Bazias Monastery             |
| 24. Pojejena                | 31. Catholic Cathedral in Orsova |
| 25. Peci                    | 32. Gornea Monastery             |
| Water mill                  | Museum                           |

#### Natural, semi-natural and anthropogenic landscapes

- Forests
- Natural and semi-natural surfaces
- Pastures and grasslands
- Orchards and vineyards
- Agricultural surfaces
- Artificial surfaces
- Industrial areas
- Water bodies and swamps
- Administrative units
- Iron Gates Natural Park
- Djerdap National Park

