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Assessment of Selected Cultural Ecosystem Services: Benefits of Land Cover Ecosystems for Ecological Models of Tourism Development (Case Study of Devín, the District of Bratislava IV)

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Abstract

Cultural ecosystem services in particular represent immaterial benefits derived from aesthetic and other experiences, recreation, cognition and spiritual enrichment, as the ability to distinguish values. The character of tourism and landscape interactions could be solved through the development and the application of new quantification methods for natural and cultural—historical benefits of ecosystems, which is the aim of our study, using Bratislava IV as a case study. In our approach, landscape-ecological evaluation of landscape structure and appropriate tourism forms and activities taking into account the landscape diversity, genofond significance, generic rarity and biotope vulnerability is considered as the essence of tourism ecological model creation. The basis for spatial representation of ecosystems was the processing of secondary landscape structure map based on landscape cover classes. As the attractive and important landscape segments were identified elements representing the first (e.g., alluvial forests, oak-hombean forests, wetlands), second (e.g., bank growth) and third (e.g., vineyards, recreational areas) category of landscape-ecological significance. We have created an algorithm that takes into account the significance of the nature of the natural and cultural-historical sites in the landscape and showing and presenting 14 categories of ecological forms of tourism.

Keywords: cultural ecosystem services, quantification evaluation procedures, land cover elements, landscape-ecological significance, ecological forms of tourism

1. Introduction

Ecosystem services represent the benefits that people obtain from natural ecosystems and are broadly understood as ecosystem processes which keep society alive. Ecosystem services are products or services provided by nature to keep people on the Earth alive. They include ecological and socio-economic aspects of ecosystems and demonstrate the dependency of people on ecosystems.

In our environment, where all social, economic and cultural (as well as immoral, uneconomic and uncivilized) activities take place, different services are provided by different kinds of ecosystems.

1.1. International classifications of ecosystem services

The overview of the source literature about economic, social and ecological assessment of ecosystem services can be found in [1]. The basic information about the assessment of ecosystem services is provided by [2]. In general, it can be stated that a huge amount of studies focused on the assessment of ecosystem services were published in the last decades. The Economics of Ecosystems and Biodiversity (TEEB) is a joint initiative of the European Commission and the United Nations Environment Programme [3] and is of considerable importance in Europe. It was arranged by the European Commissioner for Environment with the aim to draw attention to the global economic contribution of biodiversity and to the expenses connected to biodiversity loss and ecosystem degradation [4].

Nowadays, there are three international classifications of ecosystem services: the Millennium Ecosystem Assessment (MEA), the Economics of Ecosystem and Biodiversity (TEEB) and Common International Classification of Ecosystem Services (CICES). Depending on a specific context, each classification has its positive and negative sides [5].

Millennium Ecosystem Assessment [6] is based on the interconnection of people and ecosystems. Therefore, the changes of living conditions of society have a direct or indirect impact on ecosystem changes and vice versa. According to the MEA, there are several kinds of services: supporting, providing, regulating and cultural (which include also recreational services).

In the second half of the twentieth century, ecological economics started to be formed as a scientific field in the USA and Europe. It considers the benefits of nature to be utilizable and exchangeable [7–10]. After establishing the Millennium Ecosystem Assessment, there was a need to include this idea in the assessment of ecosystem services.

The Economics of Ecosystems and Biodiversity [4] is focused on the evaluation of expenses created when adopting insufficient measures to reduce biodiversity loss and the decrease in ecosystem services.

The study entitled “The Economics of Ecosystems and Biodiversity: Ecological and Economic Foundations” [4] divides ecosystem services to provisioning services, regulating services, cultural services and supporting services. The last ones are inevitable for maintaining the previous three types of services.

The development of the Common International Classification of Ecosystem Services (CICES) in 2011 was the result of the absence of standardized methodology for the classification of ecosystem services. It is connected to the framework of the System of Environmental-Economic Accounting (SEEA) of the United Nations. It is a recommended methodology of the EU Biodiversity Strategy to 2020 [11]. CICES distinguished ecosystem services as provisioning, regulating and maintenance services and cultural services.

1.2. Cultural ecosystem services

Cultural ecosystem services represent nonmaterial benefits provided by esthetic and other experiences, recreation, excursions and spiritual enrichment and by the ability to distinguish values.

TEEB [4] suggests that cultural benefits and ecosystem services also include:

1. Cultural diversity as a result of ecosystem diversity (environmental diversity, biological diversity and landscape diversity).
2. Knowledge developed by different cultures based on the influence of ecosystems on them.
3. Aesthetical values (the perception of the beauty of ecosystems and its components).
4. Recreation, ecotourism and geotourism (ecosystems as places for spending free time and recovery).
5. The values of cultural heritage created by the influence of ecosystems and their components.

According to the Convention on Biological Diversity from 1992, biological diversity or biodiversity is described as the variety of all living organisms (including terrestrial and aquatic organisms), the variety of species and the variety of organisms belonging to a particular species as well as the variety of ecosystems. According to UNEP from 2009 defined by the Council of Europe, landscape diversity represents numerous relationships between an individual or a society and a topographically defined area at a certain time. The landscape view of this area is the result of the combination of the influence of natural and human factors at a particular time.

Cultural landscape diversity (preserving traditional tangible or intangible cultural forms of a nation that are the results of a long-term development) significantly contributes to the maintenance of variety of living conditions and life forms on the Earth. The advantage of this connection between cultural and natural phenomena is that it also secures the connection of history with ecological, landscape and aesthetical values of an area. This contributes to the variety of living conditions and life forms and sustains natural and cultural heritage in Slovakia [12, 13].

Cultural ecosystem services provide services and benefits for tourism development by means of landscape, biological diversity and preserved values of cultural heritage.

From a broader point of view, tourism is the summary of phenomena and relations, while people stay and travel outside their home. These people represent consumers of cultural and economic goods.

Based on the conclusions of the conference of United Nations World Tourism Organization (UNWTO) in Ottawa in 1993, the UN accepted the following definition: “tourism involves people travelling and staying in places outside their usual environment for not more than one consecutive year for leisure, business and other purposes.”

In the first place, tourism is mentioned as a system of services where the most important role is played by commercial establishments such as food, accommodation, cultural, social but also additional establishments and services [14].

Vegetative, social, cultural and ecological factors which determine the maximal ability of an area to have an impact on people and their recreational activities are defined as recreational potential of an area. This potential is created by recreational infrastructure and recreational activities [15].

1.3. Possibilities of tourism from the point of view of spatial division

Many authors paid attention to the possibilities of tourism from the point of view of spatial division by assessing the recreational potential of a landscape, for example, [16–27].

The potential of a landscape represents the ability of a landscape to offer certain possibilities and prerequisites of its different uses with the aim to satisfy the needs of human society. Based on an anthropocentric point of view, ecosystem services represent advantages and benefits for society and nature. Ecosystems provide benefits such as water, food, wood, soil formation, purification of water and air, flood and drought protection, crop pollination and others [28]. However, human activity can destroy biodiversity and decreases the resistance and the ability of healthy ecosystems to provide a wide range of goods and ecosystem services. If anthropocentric approach considered the basis for perceiving the benefits, it can also lead to an imbalance of utilization of natural resources [3].

The assessment of recreational land potential is mentioned by many authors [29–32]. Ref. [31] is mentioned as an example of assessment. Their assessment is based on the attractiveness of basic forms of land utilization. The decisive role for the attractiveness of an area is played by the primary, natural supply of a land which is represented by grass covers, recreational areas, forest covers and conservation areas. The secondary supply of a land, which is created by humankind, and the criterion of material-technical facility and the attractiveness of cultural-historical buildings are also taken into consideration.

From this point of view, undivided and extensive forests, submontane and mountain plants, wetlands, the occurrence of protected flowers, trees, almost extinct mammals and rare birds are attractive for tourism. Abiotic conditions of landscape-morphometric parameters of the relief are as much important as the previous factors. When considering what a land can offer to tourism, natural conditions but also preserved cultural-historical buildings, cultural establishments and cultural and sports events play a significant role. When determining particular demonstrations of its basic functions, one must also have a comprehensive knowledge of natural and cultural-historical environment of a recreational area. The environment helps tourists to get to know the history, the architecture, the technical sights and the culture of an area.

An example of such an area is Devin—the borough of Bratislava, the capital city of Slovakia, which was the subject of our observations.

This study is aimed at the mapping of land cover classes with a focus on the research of biological, land diversity and cultural-historical values of the area. It includes preparations of maps of the character and qualities of ecosystems, their landscape-ecological importance for the assessment of cultural benefits of an area and suggestions of ecologically suitable tourism forms and activities.

2. Methods

The basic database was the current land cover—secondary landscape structure. The current state and the characteristic patterns of the current land cover were mapped on the third, fourth and fifth levels based on CORINE Land Cover Technical Guide—Addendum 2000 legend [33]. The land cover classes are arranged in a vector format which was created by the synthesis of thematic and relevant layers discussed in the fundamentals for geographic information system (ZB GIS, 2012) and licensed updated databases of identified buildings based on the Corine Land Cover legend derived from vector databases of orto-maps from aviation photographs (EUROSENSE Ltd., 2014). These were supported by the field research of habitats of European and national importance in 2014–2016. The database of land cover classes includes precious information about the character of habitats, the level of soil anthropization, socioeconomic actions of people in landscape and the characteristics of the current tourist infrastructure. The updated database of land covers enables the selection of natural, seminatural, socioeconomic and fabricated cultural-historical resources. It also provides sufficient characterization for the assessment of cultural benefits and ecosystem services (the scale of 1:5000).

The landscape-ecological importance (LEI) represents the benefits of a land based on the qualities of land cover classes. It is defined as an inherent quality of ecosystems (land cover classes). Degrees of naturalness, indigenusness and the current state of vegetation, the overall biodiversity, gene pool importance, and rare and endangered species are assigned to ecosystems. It is all based on the degree of vegetation hemeroby based on the studies of [34].

Smejkal [35] reminds us that the level of hemeroby must be assessed separately for each society and an important factor is the degree of direct human actions influencing the society. The assessment of hemeroby level has a critical role for nature conservation and is also connected to the assessment of stability and resistance of associations, soil retention, the degree of biodiversity and others. It is used to express biological balance or to describe different functions of vegetation in landscape (**Table 1**).

When assessing the LEI of particular landscape elements, the current state of vegetation and the degree of hemeroby are taken into account. The degree of hemeroby is the degree of anthropogenic impact on vegetation cover in relation to soil qualities.

A degree of LEI is being assigned to the elements of land cover. There are five degrees in the scale from “an element with a very low LEI” to “an element with a very high LEI.” There are suggestions about appropriate forms of tourism and frame measures for increasing or maintaining the overall biodiversity and its function for each degree of LEI.

In the quantification of landscape-ecological significance and in the quantification of level of vegetation hemeroby, we were based on [35], which we have modified according to our above-mentioned criteria.

Landscape elements	Description	Degree of hemeroby	Degree of LEI
Built-up areas	Built-up areas and asphalt and concrete roads	Devastated	1
Legal or managed disposal sites	Disposal sites, rubble heaps, slag heaps, etc.	Devastated	1
Cemeteries	Cemetery areas, often overgrown with woody plants	Fabricated	1; 2
Fields	Intensely used and annually plowed agricultural lands	Unnatural	1; 2
Vineyards	Intensive and extensive farming	Unnatural	1; 2
Hop gardens	Intensive farming	Unnatural	1
Orchards	Intensive and extensive farming	Unnatural	1; 2
Gardening and cottage settlements	Patchwork of special fruit and vegetable plants and trees, flower beds, etc., and built-up areas	Unnatural	1; 2
Gardens	Gardens near houses	Unnatural	1; 2
Grassland	Intensive farming in meadows and pastures	Unnatural	2
Grassland	Extensive farming in meadows and pastures	Seminatural	3
Grassland	Natural xerothermic, subalpine, alpine meadows, salt marshes	Almost natural	4; 5
Grassland	Other plant and herb vegetation	Unnatural—seminatural	2; 3
Water areas and streams	Artificial water areas and regulated streams	—	2; 3
Water areas and streams	Natural water areas and streams	—	3; 4; 5
Wetland	Wetlands created in anthropogenic sunken areas, abandoned quarries, etc.	Seminatural	3; 4;
Wetland	Naturally created wetlands, including spring associations	Almost natural	5
Forest	1. Cultivated monocultures of exotic trees and other kinds grown outside a natural area of their propagation, 2. <i>Picea abies</i> grown in the first, second and third forest vegetation levels (FVLs)*	Unnatural	2
Forest	1. Pioneering trees spreading naturally, 2. Vegetation of <i>Picea abies</i> grown in the fourth and fifth FVLs, 3. Vegetation of <i>Pinus sylvestris</i> in other places, 4. Vegetation of <i>Larix decidua</i> in the original places, 5. Vegetation of <i>Populus nigra</i> , <i>P. alba</i> and other species of poplar tree grown in other places, 6. indigenous species of <i>Salix</i> grown in other places	Seminatural	3
Forest	1. Oak and beech vegetation with naturally occurring <i>Ruscus</i> (<i>Carpinus</i> , <i>Acer</i> , <i>Fraxinus</i> , <i>Tilia</i>), 2. Vegetation of <i>Fagus sylvatica</i> in the second and third FVLs, 3. Vegetation of <i>Fagus sylvatica</i> in the sixth FVL, 4. Vegetation of <i>Picea abies</i> grown in the sixth and seventh FVLs, 5. Vegetation of <i>Quercus robur</i> and <i>Q. petraea</i> grown in other places, 6. Vegetation of <i>Alnus glutinosa</i> , <i>A. incana</i> grown in other places	Seminatural—almost natural	4
Forest	1. Scree forests, 2. Vegetation of <i>Fagus sylvatica</i> in the fourth and fifth FVLs, 3. Vegetation of <i>Picea abies</i> grown in the eighth FVL (in flood places), 4. Vegetation of <i>Pinus sylvestris</i> at extreme places, 5. Vegetation of <i>Quercus robur</i> and <i>Q. petraea</i> and also <i>Quercus pubescens</i> in the first and second FVLs and natural vegetation in the third and fourth FVLs, 6. Vegetation of <i>Quercus cerris</i> in the Pannonian region in the first FVL, 7. Vegetation of <i>Populus nigra</i> , <i>P. alba</i> and other indigenous species of topolar trees grown in alluvial forests, 8. Vegetation of <i>Alnus glutinosa</i> , <i>A. incana</i> grown in alluvial forests and at	Almost natural—natural	5

Landscape elements	Description	Degree of hemeroby	Degree of LEI
	flood places, 9. Indigenous species of <i>Salix</i> grown in alluvial forests and at flood places		
Brownfield lands	Not used cropland	Unnatural	2

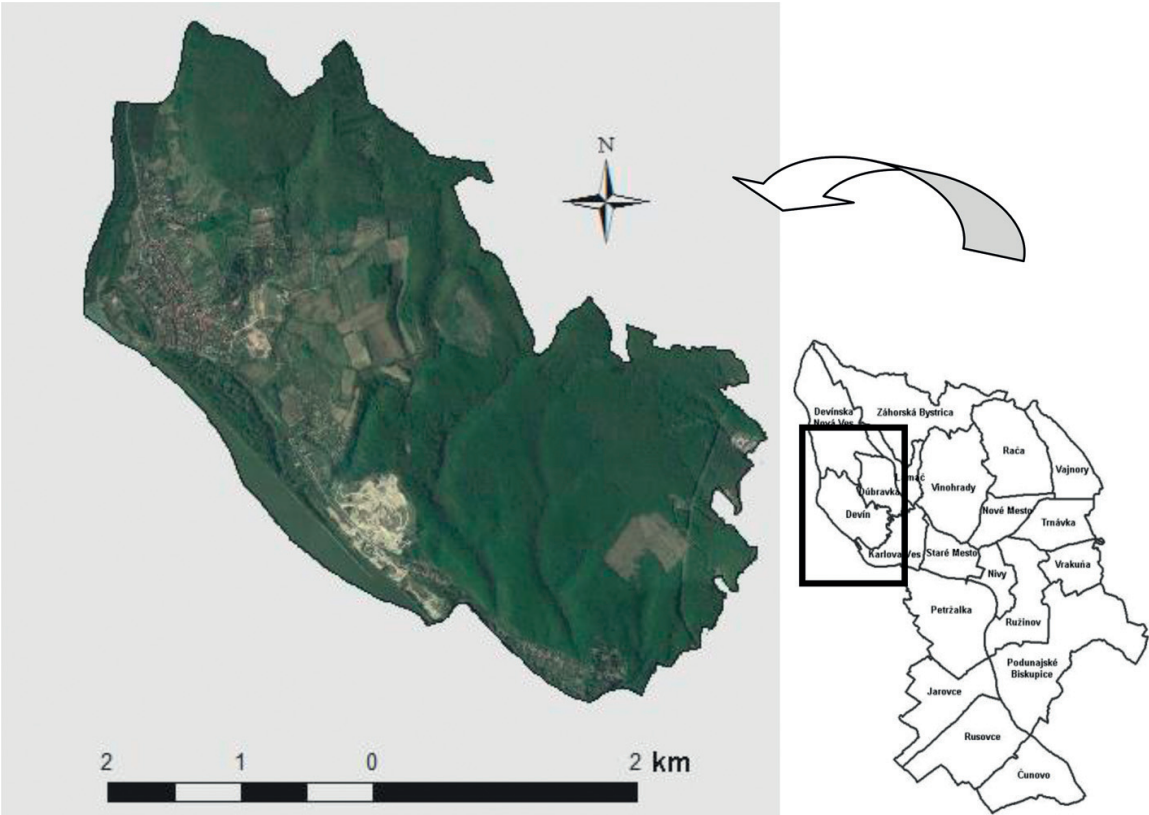
Table 1. Degrees of ecological importance (LEI) of individual landscape elements [35].

3. Model territory

The land cover of Bratislava IV is comprised in the central part of relatively extensive forest ecosystems in the Little Carpathians Protected Landscape Area. In the southeastern part, there are vast urban areas of the cadastral municipality of Karlova Ves and Dubravka. In Devinska Nova Ves, there is not only an industrial zone but also agricultural soil. However, this soil is being overbuilt with the Bory Mall polyfunctional complex.

The cadastral municipality of Devin (**Picture 1**) is situated at the confluence of the Danube and Morava rivers. National nature reserve Devínska Kobyla, natural monument Devín and conservation area Slovanský ostrov are important biotopes in this area.

The land cover of Devin is presented in **Picture 2**. At the foot of Devinska Kobyla, there is a strip of vineyards, gardens and unique buildings. This area can be considered as an ecotone



Picture 1. Model territory Devin—Bratislava IV district.

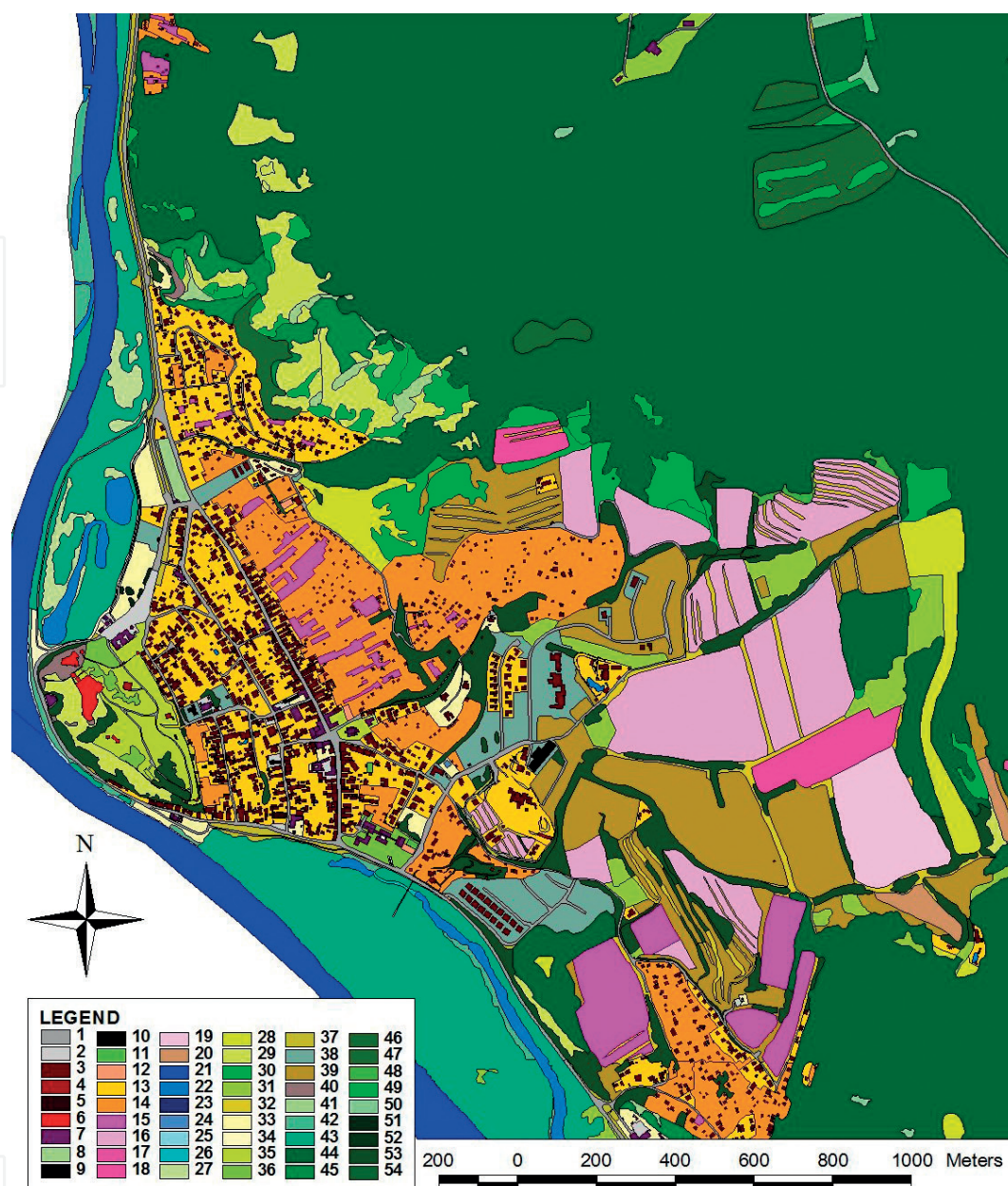


Picture 2. Protected area The Floodplain of the Morava river in Devin (the archive of the city of Bratislava, 2015).

and is surrounded by rare biotopes. It serves as a transition zone. The cultural-historical core of this area is a Slavic fortified settlement Devin which represents the place of prehistoric settlement. From agricultural point of view, vineyards and gardens are preferred in this area, which makes it slightly inappropriate for family houses. It is very important to preserve the original character of the landscape connected to the cultivation of vineyards. The model territory has a high recreational potential which is conditioned by ecological, gene pool and landscape potential with the connection to forest, cultural-historical and vineyard potential.

Despite a strong anthropic pressure of the city of Bratislava, many types of endangered but well-preserved habitats have been retained in the peripheral parts of this area. The rare habitats in this area are mainly the forests and the meadows of the Danube and Morava rivers. It has a very high degree of LEI, for example, Protected area The Floodplain of the Morava river in Devin, Nature reserve Fialkova dolina, National natural monument Devinska hradna skala, The Zahorske Pomoravie Special Protection Area, National nature reserve Devinska Kobyla, and The Little Carpathians Protected Landscape Area. The most important protected areas are Protected area The Floodplain of the Morava river in Devin and National natural monument Devinska hradna skala.

The Floodplain of the Morava river in Devín was announced by the regulation of the Regional Authority of Bratislava in 1999. Grasslands, wetlands and forests with many protected and endangered plants and animals are protected here. The area comprises 253.16 ha. It is located in the district of Devin and Devinska Nova Ves. There are many types of plant communities which show a high and very high degree of LEI based on the ratio of originality and naturalness of land cover classes (**Picture 3**).



Picture 3. Land cover of Devin (scale of 1:5000). Legend: 1. Roads (asphalt—Road of class I, II, and III, local road, semipaved roads); 2. Paved areas (parking, concrete areas, loading ramps); 3. Individual housing; 4. Cottages, garden cottages, private garages, small structures, sheds, greenhouses in gardens; 5. Public housing; 6. Cultural monuments; 7. Objects of services, administration, education, health services, culture, religious buildings, and so on; 8. Cemetery; 9. Industrial and storehouse objects; 10. Small technical structures; 11. Playgrounds—grassy; 12. Tennis courts with clay; 13. Gardens near the houses; 14. Gardens, gardening settlements; 15. Vineyards; 16. Abandoned vineyards; 17. Abandoned orchards and gardens; 18. Small vineyards; 19. Abandoned small vineyards; 20. Backyards; 21. Water stream; 22. Water area, dead arm of the river; 23. Swimming pool; 24. Water source; 25. Artificial gravel banks; 26. Wetland; 27. Reed and flood-meadows; 28. Meadows (slope); 29. Xerothermophilous grassland vegetation; 30. Forest-steppe vegetation; 31. Overgrown grasslands; 32. Grassy overgrown unowned balks to bounds with nonforest vegetation; 33. Ruderal grasses; 34. Grassy flood-control dam; 35. Park grasses with a minimum of woody plants; 36. Park grasses with nonforest vegetation; 37. Grasses on banks near roads and railways; 38. Devastated areas with ruderal vegetation; 39. Outfield, meadow outfield; 40. Rocks, rock reefs; 41. Rocks and scree with vegetation; 42. Waterside vegetation—natural woods or grasslands; 43. Soft alluvial forest; 44. Oak-hornbeam forest; 45. Xerothermic oak forest; 46. Pine forest; 47. Spruce forest; 48. Locust forest; 49. Young unspecified forest; 50. Cut-down forest; 51. Nonforest vegetation—solitary trees; small group of woody plants; 52. Nonforest vegetation—linear vegetation, tree lines; 53. Nonforest vegetation—surface, variety of species; 54. Nonforest vegetation—woody plants on banks and on cut-down areas.

National natural monument—Devínska hradná skala was announced in the regulation of the Municipal Executive Board of Bratislava in 1990 and in the regulation of the Ministry of the Environment of the Slovak Republic in 1996. The subject of protection is a significant geological, botanical and zoological area which covers 0.70 ha. The natural monument Devínska lesostep was announced by the decision of the Environment Agency of Bratislava in 1992 and by the regulation of the Ministry of Environment of the Slovak Republic in 1996. The subjects of protection are critically endangered species of important plant associations. The area extends over 5.09 ha (Statistical Yearbook of Bratislava, the capital city of the Slovak Republic, 2015). It has a very high degree of LEI.

4. Results

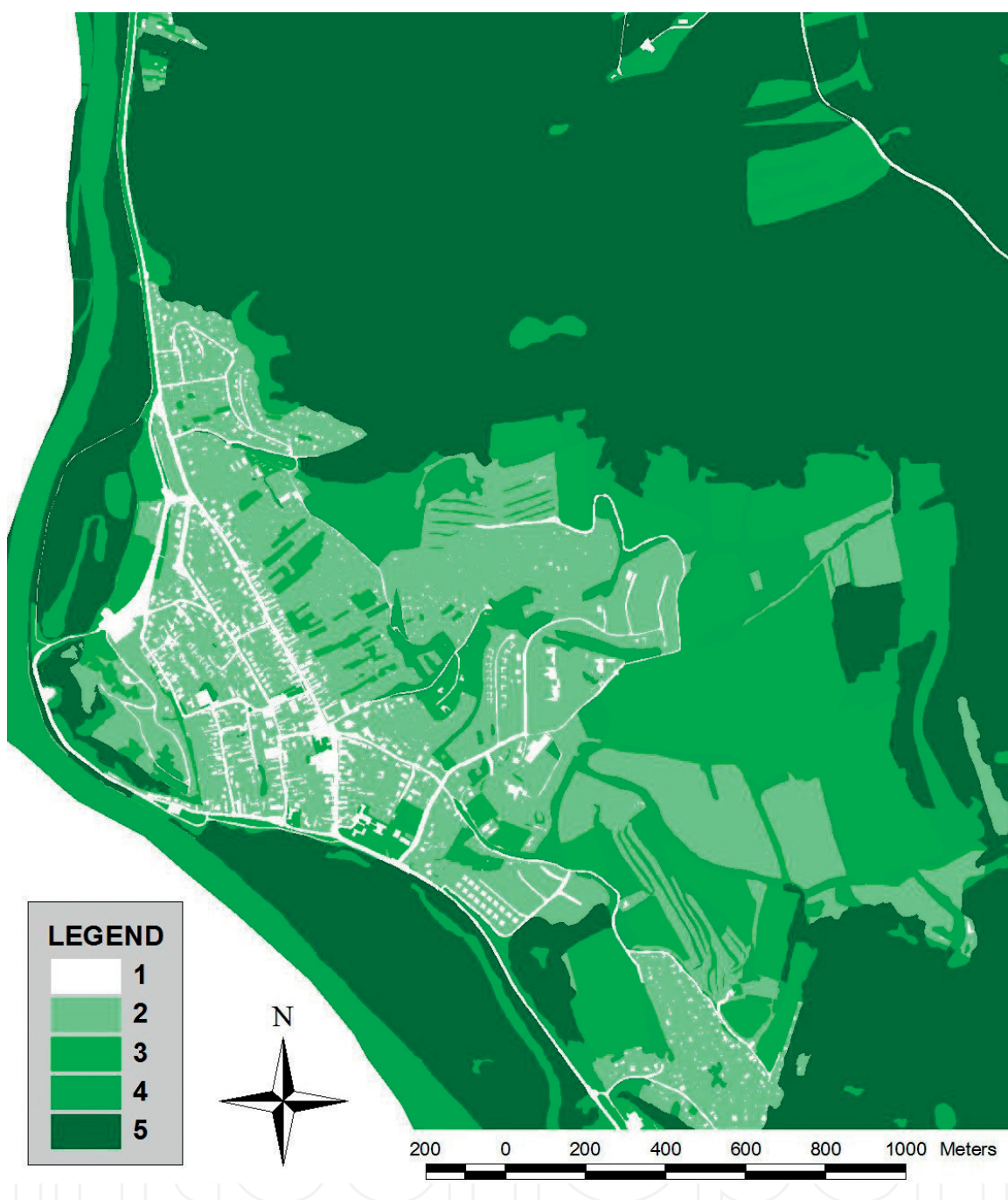
The landscape-ecological importance of landscape utilization (LEI) is based on the biological-ecological processes in ecosystems. It is represented by the elements of landscape utilization (by land cover classes in this case). They are being assigned degrees of naturalness (originality) that is determined by the degree of vegetation hemeroby based on the studies of [34, 35]. The opinions of scientists vary when assessing what can be considered natural, original and not touched by humankind and to what extent anthropic actions suppress the naturalness and where the limits of natural and fabricated (anthropogenic) phenomena are, since man is also a natural species of biosphere. But there are still certain pragmatic, conventionally established limits. A general agreement is that if original phenomena are only those which are uninfluenced by humans at all, then original ecosystems do not actually exist nowadays as the whole biosphere is directly or at least indirectly influenced by anthropogenic changes of the atmosphere. Moreover, global water circulation is influenced by human actions as well. But if anthropic impact is not seen in such a fundamental way, we can talk about the remains of original ecosystems in such regions, which were never a part of an ecumene in the past—they were not directly influenced by humans (not even by an extensive use).

As a criterion of such naturalness, the preservation of basic functional ecosystem relations can be applied. These relations guarantee a spontaneous regeneration of an ecosystem after anthropic pressure. The quality of such natural ecosystems is drawing nearer to the quality of natural ecosystems from which they are derived. They can be also labeled as “almost natural” or “natural,” but not “original” [36].

The assessment of the landscape-ecological importance of land cover classes in Devin is depicted in **Picture 4**.

The landscape-ecological importance was determined based on:

1. The character of landscape from the point of view of its anthropogenic origin (fabricated land cover classes without natural parts were assessed as negative; natural, almost natural and original were assessed as positive)
2. The percentage of classes based on their originality, naturalness or importance for nature protection (a natural forest with original species gets a better assessment than a modified forest or a forest that is not original based on the given conditions; natural meadows are assessed better than reclaimed meadows)



Picture 4. The landscape ecological importance of land cover classes. Legend: 1—very low, 2—low, 3—medium, 4—high, 5—very high.

3. When assessing the importance, it was not taken into account whether the area belongs to a protected area or the NATURA 2000 system (xerothermic vegetation has the same value in a protected area as well as outside)
4. Cultural-historical importance of anthropogenic classes was partly taken into consideration as well. It would be more evident after a more detailed division (historical areas, areas around castles, etc., have a higher significance than individual or housing structures or industrial objects).

Land cover class	ID	LEI	Tourism
Roads, train routes and bridges			
Highway	1	1	7
Roads (mainly asphalt)—road of class I, II, and III, local road	2	1	7
Bridge—road	3	1	7
Railway	4	1	7
Bridge—railway	5	1	7
Paved areas—car park, concrete areas	6	1	7
Built-up areas			
Individual housing	10	1	—
Cottages	11	1	10
Public housing	12	1	—
Cultural sights—tower house, castle, museum, watermill	13	2	2
Objects of services (restaurant, shop, market)	130	1	9
Objects of administration (office building, municipality, government building)	131	1	9
Objects of education and science (observatory, meteorological station, library)	132	1	9
Cemetery, crematorium	133	3	9
Healthcare services (retirement home, hospital, children's home)	134	1	9
Religious buildings—church, chapel, morgue	135	1	9
military objects	136	1	—
Cultural buildings—museum, cinema, theater, gallery, library	137	1	4
Aviation objects	138	1	—
Railway objects, railway station, bus station, bus stop	7	1	7
Industrial objects and warehouses	8	1	—
Agricultural buildings	9	1	—
Sewage treatment plant	110	1	7
Waste dumps, material repository	111	1	7
dunghill	112	1	7
Small technical objects (shared garages, boiler house, gas regulating station)	113	1	7
Others—gamekeeper's lodge, wine cellar	139	1	7
Sports and culture			
Playgrounds—grassy	100	2	3
Playgrounds—concrete, asphalt	101	1	3
Clay tennis courts	102	1	3
Sports buildings (grandstand, swimming pool, hall, ice hockey arena)	103	1	3
Shooting range	104	1	3
Playground—children	105	2	3

Land cover class	ID	LEI	Tourism
Horse races, show-jumping	106	2	3
Agricultural land			
Gardens near houses	14	3	10
Gardens, gardening settlements	15	3	10
Vineyard	16	3	—
Abandoned vineyards	166	3	10
Orchards	17	3	10
Abandoned orchards, gardens	177	3	10
Backyards	18	2	10
Extensive arable land	19	2	—
Small settlements	160	3	10
Abandoned small settlements	169	3	10
Water			
Water stream	20	4	6
Water area, dead arms	21	4	6
Pool	22	1	6
Water source	23	2	7
Dam	24	1	7
Artificial gravel banks	25	2	7
Wetland	27	5	5
Grasslands			
Reed and flood—meadows	28	5	5
Meadow—alluvial—reclamation	29	3	5
Meadow—alluvial	30	4	5
Meadow—slope	31	4	5
Ruderal grasses	32	3	5
Grasses on banks near roads and railways	33	3	8
Park grasses with a minimum of woody plants	34	3	1
Park grasses with nonforest vegetation	35	4	8
Grassy flood-control dam	36	3	8
Outfield, meadow outfield	37	2	—
Grassy overgrown balks	38	3	8
Devastated areas with ruderal vegetation	39	2	—
Overgrown rocks, ruins	40	5	5
Xerothermophilous grassland vegetation	41	5	5
Forest-steppe vegetation	42	5	5
Overgrown grassland	43	4	6
Rocks, rock reefs	44	5	6
Sands (Sandberg)	45	5	5

Land cover class	ID	LEI	Tourism
Forest and nonwoody vegetation			
Waterside vegetation—unoriginal (fruit) trees		48	4
Waterside vegetation—natural woods or grasslands	49	5	8
Alluvial forests—soft wood	50	5	6
Poplar-ash forests—hard wood	51	5	6
alder forests	52	5	6
Monocultures—mainly poplar trees	53	4	6
beech forests	54	5	6
Oak-hornbeam forests	55	5	6
Xerothermic oak forests	56	5	6
Pine forests	57	4	6
Spruce forests	57	3	6
Locust forests	58	3	6
Young unspecified forests	59	3	6
Cut-down forests	60	3	6
Nonforest vegetation—solitary trees, small groups of woody plants	61	3	8
Nonforest vegetation—linear vegetation, tree lines	62	3	8
Nonforest vegetation—surface, variety of species	63	4	8
Nonforest vegetation—woody plants on banks and cut-down areas	64	4	8
Extraction areas			
Quarry	150	2	—
Wall of quarry	151	2	—
Extraction area—brickyard	152	2	—
Wall of an extraction area	153	2	—
Remains of vegetation in a quarry	154	3	8

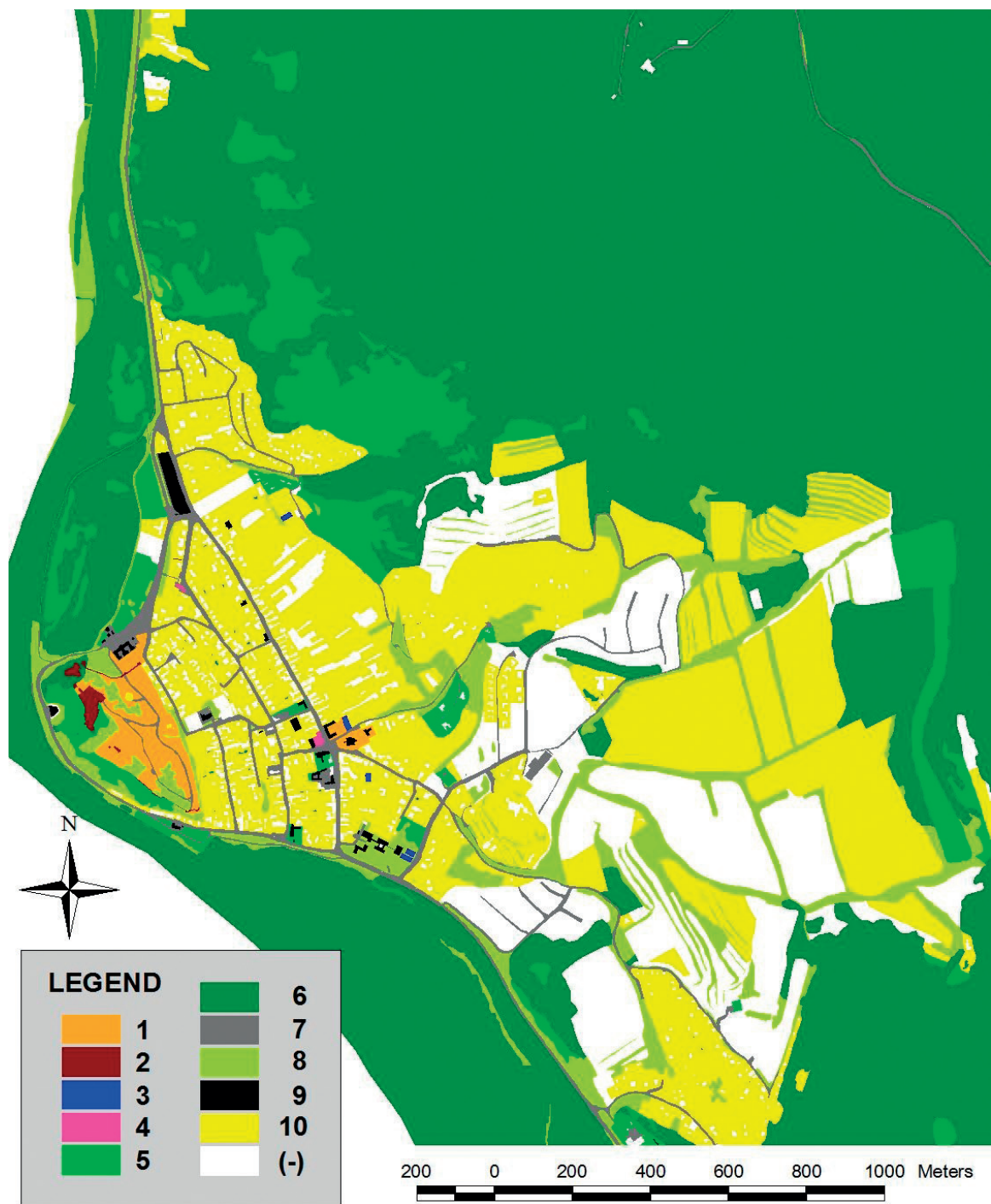
ID—identification number of a land cover class in map; LEI—degree of landscape-ecological importance; and Tourism—suggested types of ecological forms and infrastructure of tourism.

Table 2. The overview of land cover classes, the degree of LEI and a suggestion of ecological forms of usage and infrastructure of tourism.

Table 2 and **Picture 5** represent the overview of land cover classes, the degree of LEI and a suggestion of ecological forms of usage and infrastructure of tourism.

Based on the analyses, the Bratislava district of Devin has a high potential to develop cultural ecosystem services such as recreation, ecotourism and geotourism (ecosystems as places for spending free time and recovery).

From the point of view of assessing the landscape-ecological importance of land cover classes, the development of cultural tourism is the most promising option when focused on visiting natural and cultural-historical attractions and relaxation-sports tourism. The first one has the



Picture 5. Design of diversified ecological forms of tourism for the high landscape cultural and natural value. 1—recreational tourism, 2—cultural tourism, – visiting cultural-historical objects, 3—sports tourism, 4—social tourism, 5—cultural tourism – visiting natural attractions, 6—relaxation and sports tourism, 7—technical infrastructure, 8—green infrastructure, 9—civic amenities, 10—individual relaxation-social tourism, (–)—not rated.

ideal conditions in protected areas as there are attractive undivided and extensive forests, submontane and mountain plants, wetlands, forest-steppe vegetation, protected plants and wood plants, almost extinct mammals and rare birds. Devín also offers some relaxation-sports activities such as beautiful views, interesting cycle and tourist paths and the nearby Little

Carpathians Protected Landscape Area. Devin is considered one of the most beautiful parts of Bratislava. Devin Castle is also a tourist attraction and belongs to the favorite places for short walks in the capital city. One can not only visit the castle, but also have a walk on the Danube riverbank underneath the castle rock, along the Morava river and in the adjoining streets of the district of Devin. As tourists visit this place very often, the offer of restaurant services (directly at the car park next to the site entrance as well as at the riverbank) is appropriately adapted as well.

5. Conclusion and discussion

The achieved results of our analyses correspond with the results of a research conducted in 2014–2015 [37]. Its aim was to research the interest of 100 respondents in tourism in Devin. Their answers showed that the most important reasons were relax (64%), the beauty of nature (54%), culture and history (39%) and sports (19%).

In Devin, the visitors admired mainly the surrounding nature (52%), and they positively assessed the activities organized at the castle (11%), cultural events (6%), tourist paths (4%) and signboards (2%). There were also some visitors who were satisfied with the services (3%) and traffic (2%). On the contrary, the main deficiencies were a low quality of food services (14%), a lack of waste bins (9%), poor information system (8%), poor rest rooms (7%), waste (3%), poor transport to the site (3%) and a lack of sports possibilities (2%) [37].

It is obvious that more methods must be combined in the final suggestions for developing the ecosystem services (and also recreation). It is also important to take into account the conceptual documents as well as regional plans. In this case, regulations on tourism development in the conditions of the Bratislava Self-Governing Region must also be taken into consideration.

A functional-chorological approach was used in this chapter to assess the natural prerequisites of tourism, which makes it possible to arrange the territorial model of tourism more accurately. It provides a complex look at the system of relations between tourism and landscape and is a methodical base for the creation of ecological models of tourism development. An ecological approach is based on the selection and application of assessment methods for development requirements and on the suggestion of appropriate tourism forms and activities for selected naturally and cultural-historical valuable landscape elements. The essence of the creation of an ecological tourism model is the landscape-ecological assessment of landscape potential and suggestion of appropriate touristic forms and activities which take into account landscape diversity, gene pool importance, rarity of species and habitat vulnerability.

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