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EUROPE'S LANDSCAPE HOTSPOTS
POKRAJINSKE VROČE TOČKE EVROPE

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Contact of the Alps and the Mediterranean in Slovenia (the Gorica Hills).
Stik med Alpami in Sredozemljem v Sloveniji (Goriška brda).

Europe's landscape hotspots

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ABSTRACT: The main purpose of this analysis is to identify places in Europe that can be described as very diverse according to various natural landscape types or landscape regions. In order to obtain these »hotspots,« several geographical divisions of Europe were examined. The analysis was performed for most of Europe at 5 km resolution. First, maps of landscape variety were produced based on each division of Europe taken into account. This step was carried out for each cell by counting the number of different unique natural landscape types or regions that are present in a radius of 50 km around the cell. Several maps of landscape diversity were produced using this method. Each of them was then weighted; the cell values were divided by the number of all unique types or regions in a division. In the final stage, all of the maps were synthesized (averaged) into one map showing landscape diversity for Europe. With this data it was possible to determine Europe's landscape hotspots and to define the most naturally heterogeneous countries. Among all of the European countries, Slovenia has the highest average landscape diversity; the highest absolute landscape diversity is located in the Norwegian part of southern Scandinavia.

KEY WORDS: geography, landscape hotspot, natural landscape, diversity, geographic information system, Europe, Slovenia, Norway.

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Contents

1 Introduction

The area of central Europe where Slovenia lies, with a radius of 150 km, is at the intersection of the high Alps with their pre-Alpine hills and basins, the level land of the Pannonian Plain with its hilly margin, the karstified area of the Dinaric mountains with its karst plateaus, and the Mediterranean hills with the balmy effect of the Adriatic Sea. This is also the meeting point of four cultural areas – Slavic, Germanic, Romance, and Hungarian – and so this small area has seen the formation of many types of natural and cultural landscapes (Kladnik & Perko 1998). Despite its small size, Slovenia is therefore very diverse.

Geographical studies of Slovenia show that it is precisely the contact points between various landscape types that prove to be especially interesting, and that the area along the borders between different landscape types can be defined as a kind of landscape hotspot. The goal of the study was to determine whether it is also possible to define European landscape hotspots (Ciglič & Perko 2013) based on various classifications of Europe (typifications and regionalizations).

Various landscape classifications are common in geographical research. This is not surprising because it is normal for people to seek some kind of order in the landscape (Haggett 2001). Classification is one of the most basic human mental activities, which is used to organize the information that we receive because memorizing the features of every individual is impossible. Therefore people combine objects, other people, and events into groups according to some shared feature (Theodoridis & Koutroumbas 2006).

Landscape classifications are important for preserving the landscape and planning its development (Romportl 2007; Bernert et al. 1997). Defining ecoregions can serve several purposes: monitoring, management, planning, inventorying, presenting facts, assessment, measuring, studying scenarios, specifying sample areas, transferring models into physical space, showing the diversity of a landscape, showing the connection between land and water systems, analyzing impacts on the environment, and so on (Loveland & Merchant 2004; Mücher et al. 2003; Bastian 2000; Bailey 1996, 146–152; Runhaar et al. 1994; Bunce et al. 1996). Although landscapes are not static and they change, an overview of landscape types is essential (Mücher et al. 2003) because space should be organized such that it enables the economical use of natural resources and thus their renewability. It is necessary to have a good knowledge of natural processes and how they function (Plut 1999). Classifying space based on natural geography features is a foundation for optimal spatial organization. Not least of all, environmental issues are also more suitably defined through natural features than through administrative boundaries (Bailey 1996; Olson et al. 2001). The absence of a common spatial unit also hinders multidisciplinary research (Bailey 1996), and such research could be facilitated by uniform landscape classification, in which studies would focus on a common spatial unit (Brabyn 2009). With a common ecosystem unit, data collection and analysis would apply to an area of the same spatial size (Bailey 1996). This is also one of the challenges of multidisciplinary studies on managing natural resources (Axelsson, Angelstam, & Törnblom 2010). Therefore spatial classifications created based on natural features are being used with increasing frequency because their users are seeking a classification that is better than a political one and better expresses natural conditions (Bernert et al. 1997). Thus, for example, the NUTS3 coastal regions in the Mediterranean often include rural and urban areas (Hazeu et al. 2010), which differ by both physical geography and human geography features. Plut (1999) used a combination of physical geography and human geography elements in his proposal for the administrative division of Slovenia. Realizing the principle of sustainability in business, social, and environmental areas necessitates the ongoing adaptation of an organization and the functioning of the social environment (Plut 2005, 59), which must therefore be understood as well as possible.

Published research and online material include many classifications of countries, continents, and also smaller areas created based on natural and social features. Examples of such landscape classification can be found for various countries around the world (e.g., Van Eetvelde & Antrio 2009; Bryan 2000; Burrough et al. 2001; Soto & Pintó 2010; Hargrove & Hoffman 2005; Castillo-Rodríguez, López-Blanco, & Muñoz-Salinas 2010; Wolock, Winter, & McMahon 2004; Zhou et al. 2003; Leathwick et al. 2003; Breskvar Žaucer & Marušič 2006; Perko 1998; Špes et al. 2002; Renetzeder et al. 2008). There is also a rich selection of European landscape classifications (Mücher et al. 2003; Metzger et al. 2005; Jongman et al. 2006; Mücher et al. 2003, 2006, 2009; Digital map … 2009; Bohn et al. 2002/2003; Meeus 1995; Europe's … 1995; Rivas-Martínez, Penas, & Díaz, 2009; Biogeographical regions … 2013) and also for the entire world (Olson et al. 2001; Bailey 1996; Udvardy 1975). It must also be remembered that all of these classifications involve a certain abstraction. Namely, a model is a simplified representation of the real world (Demeritt & Wainwright 2005), and so there are also differences among landscape classifications for the same areas.

2 Purpose

This article analyzes various digital natural landscape classifications for Europe and determines which areas of Europe can be characterized as having greater landscape diversity. The basic purpose is to find areas where different European natural landscape units (types or regions) meet. Areas where there is a mix of various natural factors are important from the aspect of biodiversity because landscape diversity has an important impact on biodiversity (i.e., habitat and species diversity; Dramstad et al. 2001; Hou & Walz 2013; Walz & Syrbe 2013). Areas with landscape diversity may also have an advantage in economic development, and especially in tourism, because »human perception values diversity, complexity, patterns, and local character« (Erhartič 2012, 36). Gray (2004) believes that the significance of diverse types of relief and richness of terrain details for the popularity of tourism areas is greatly underestimated. On the other hand, areas where various natural influences intertwine can also be areas where it is not simple to transfer best practice because of the varying response of the landscape to human influences. This article seeks to draw attention to such areas in Europe and also to determine whether »hotspots« at the intersection of units appear in the classifications of various authors; that is, whether they are marked as diverse in several sources.

3 Selection and description of classifications

This analysis includes various landscape classifications, which are primarily based on natural landscape elements and are accessible in digital format. For this analysis, classifications were chosen that have a similar number of types or regions (Table 1, Figure 1).

Table 1: Selected European landscape classifications.

classification (source)	number of categories	classification level	classification categories; categories that are not inside research area are put in brackets
Environmental stratification of Europe Mücher s sod. 2003; Metzger s sod. 2005; Jongman s sod. 2006)	6	second level (first level has two categories*)	List of all biogeographical regions: Alpine, Anatolian, Atlantic, Boreal, Continental, Mediterranean
European landscape classification (Mücher s sod. 2003; Mücher s sod. 2006; Mücher s sod. 2009)	8	first level	List of all types: Atlantic, Boreal, Continental, Arctic, Mediterranean, Steppic, Anatolian, Alpine
Biogeographical regions (Biogeographical regions … 2013)	11	classification has only one level	List of all biogeographical regions: Alpine, Anatolian, Arctic, Atlantic, Black Sea, Boreal, Continental, (Macaronesian), Mediterranean, Pannonian, Steppic
Terrestrial ecoregions of the World** (Olson et al. 2001)	14	this is first level that divides Europe into different units	List of all biomes: (tropical and subtropical moist broadleaf forests); (tropical and subtropical dry broadleaf forests); (tropical and subtropical coniferous forests); temperate broadleaf and mixed forests; temperate coniferous forests; boreal forests/taiga; (tropical and subtropical grasslands, savannas and shrublands); temperate grasslands, savannas, and shrublands; (flooded grasslands and savannas); (montane grasslands and shrublands); tundra; mediterranean forests, woodlands, and scrub; (deserts and xeric shrublands); (mangroves); lakes etc.***; (rock and ice)

* Classification was made using computer applications such that Europe was first divided into north and south based on climate data, and then a classification was carried out for both units based on various natural data.

** The DMEER classification (Digital map … 2013) was excluded because, in comparison to other classifications, it has a much larger number of units. The Terrestrial Ecoregions of the World classification is based on it also.

*** This category was not included in the analysis.

3.1 Environmental stratification of Europe

This division of Europe was worked out for defining the units used for sampling, various models, and environmental reports (Metzger et al. 2005; Mücher et al. 2003). They were classified in several steps. First, principal component analysis was applied to multiple data layers (elevation, inclination, distance from the sea, latitude, and several climate variables for January, April, July, and October) in order to determine three principal components. Then the principal components were used to classify the cells into groups. Europe was divided into eighty-four environmental classes, and these were then combined into thirteen environmental zones and further into six biogeographic regions. The entire division was worked out with a spatial resolution of 1 km^2 (Metzger et al. 2005; Jongman et al. 2006; Mücher et al. 2003). Territory was classified between 11° W and 32° E and between 34° N and 72° N (Metzger et al. 2005). Because of the great differences, the entire area was divided based on climate and treated as two divisions: north and south (Metzger et al. 2005), which could also be understood as division at the highest level.

3.2 European landscape classification

This landscape classification was made based on physical geography and human geography data. Individual steps used a segmentation method and a group classification of the segments obtained. The data used covered climate, elevation, soils, and land use. Major urban areas, bodies of water, and tide areas were defined separately (Mücher et al. 2003; Mücher et al. 2006). Based on the data on elevation, soil, and land use, Europe was first divided into smaller segments, and then climate data were used for further classification (Mücher et al. 2009). For classifying segments at the first level, climate was taken into account and eight types were defined, for classification at the second level elevation was also taken into account and thirty-one types were defined, for the third level soil was added and seventy-six types were defined, and for the fourth and lowest level special land-use areas were also taken into account and 350 landscape types were defined (Mücher et al. 2006).

Data analysis took place at a resolution of 1 km^2, and the polygons or units obtained that were smaller than 11 km^2 were subsequently combined with neighboring ones. The final map was created at a scale of 1 : 2,000,000 and covers all of Europe up to the Urals in the east, Azerbaijan in the southeast, and Novaya Zemlya in the northeast, although Cyprus is not included (Mücher et al. 2006).

3.3 Biogeographic regions (version 2011)

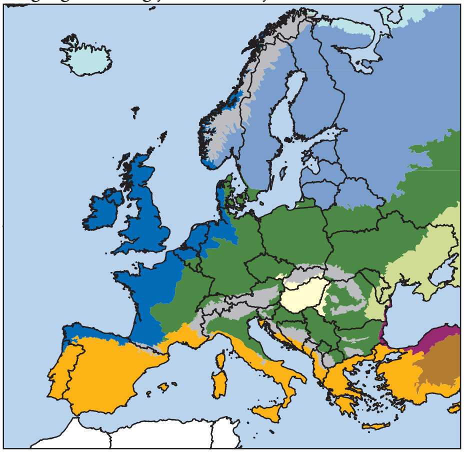
The borders between biogeographic regions were also used in the text of the *Council Directive 92/43/EEC of 21 May 1992 on the Conservation of Natural Habitats and of Wild Fauna and Flora* (COUNCIL DIRECTIVE 92/43/EEC) and in preparing the EMERALD network (Biogeographical … 2013). The latest version from 2011 included all of Europe, including Iceland, Turkey, the Caucasus and western Russia, the Canary Islands, and the Azores. Both archipelagos are included in the biogeographic region of Macaronesia (Biogeographical regions … 2013). The first versions were based on a combination of natural vegetation of countries in the European Community and the Council of Europe (Noirfalise 1987). Forest communities were combined into biogeographic regions (these also included azonal units) and the map was generalized; later versions also used a map of potential vegetation, which was prepared by the German Federal Environment Agency (The Indicative Map … 2006). The classification from 2011 has eleven biogeographic regions. In principle, it relies on natural vegetation, although some borders run along administrative or national borders (e.g., for Hungary and Greece), which distances it from a completely natural division.

3.4 Terrestrial ecoregions of the world

The map of terrestrial ecoregions was created based on biogeographical information, and it relatively precisely shows the broad range of various flora and fauna. Ecoregions denote proportionally extensive units with a special combination of natural communities and species. Their borders correspond to the natural state of affairs before human intervention (Olson et al. 2001). According to this division, the land is divided into eight geographic realms (Oceania, Neoarctic, Neotropic, Afrotropic, Palearctic, Indo-Malay, Australasia) and fourteen biomes. In addition to biomes, the categories of major lakes and of cliffs and ice were also

Figure 1: Presentation of individual classifications. ➤ p. 122

Biogeographical regions/ Biogeografske regije oz. območja

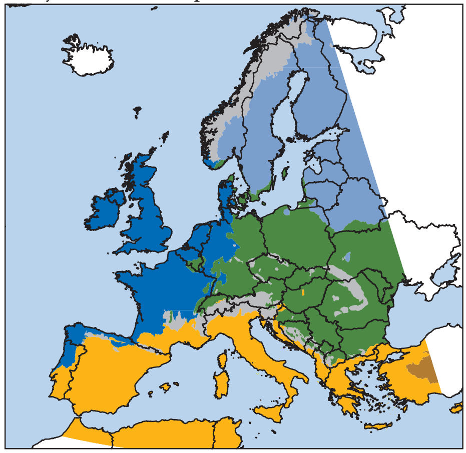


Biogeographical regions/biogeografske regije oz. območja:

- Alpine/alpsko
- Anatolian/anatolski
- Arctic/arktični
- Atlantic/atlantski
- Black Sea/črnomorski
- Boreal/borealni
- Continental/celinski
- Mediterranean/sredozemski
- Pannonian/panonski
- Steppic/stepski

Source/Vir: Biogeographical regions ... 2013

Environmental stratification of Europe/ Okoljska členitev Evrope

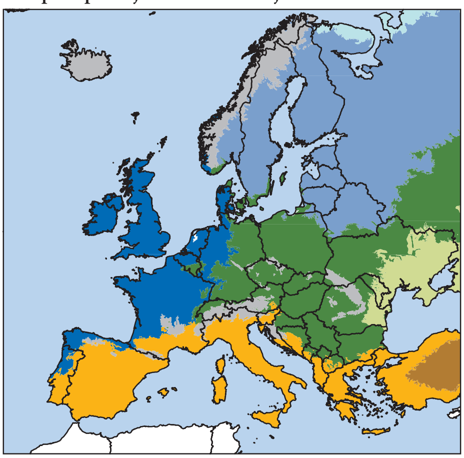


Biogeographical regions/biogeografske regije oz. območja:

- Alpine/alpsko
- Anatolian/anatolsko
- Atlantic/atlantsko
- Boreal/borealno
- Continental/celinsko
- Mediterranean/sredozemsko

Source/Vir: Mücher et al. 2003; Metzger et al. 2005; Jongman et al. 2006

European landscape classification/ Evropska pokrajinska klasifikacija



Types/tipi:

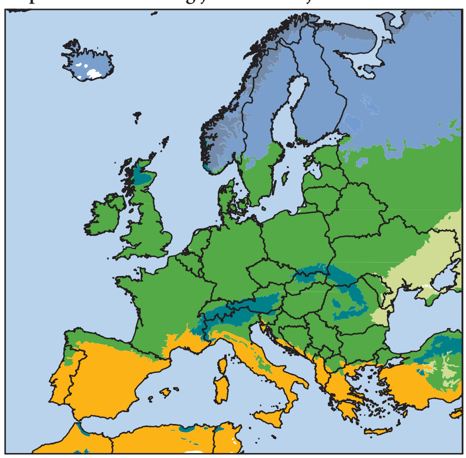
- Atlantic/atlantski
- Boreal/borealni
- Arctic/arktični
- Mediterranean/sredozemski
- Steppic/stepski
- Continental/celinski
- Anatolian/anatolski
- Alpine/alpski

Source/Vir: Mücher et al. 2003; Mücher et al. 2006; Mücher et al. 2009

0 300 600 900 km

Author of map/Kartograf: Rok Ciglič

Terrestrial biomes of the World/ Kopenske ekološke regije oz. območja sveta



Biomes/biomi:

- Temperate Broadleaf and Mixed Forests/ širokolistni in mešani gozdovi zmernih geografskih širin
- Temperate Coniferous Forests/iglasti gozdovi zmernih geografskih širin
- Boreal Forests; Taiga/borealni gozdovi; tajga
- Temperate Grasslands, Savannas, and Shrubland/ travniki, savane in grmičevja zmernih geografskih širin
- Tundra/tundra
- Mediterranean forests, woodlands, and scrub/ sredozemski gozdovi, dobrave in grmovja
- Water/voda
- Rocks, ice/skalovje, led

Source/Vir: Olson et al. 2001

separated. At the most detailed level, 867 ecoregions are identified altogether. The division was carried out based on various sources (for more information, see Olson et al. 2001); for the western Palearctic, which also includes Europe, the DMEER (Digital Map of European Ecological Regions, Digital Map … 2013) was used. The divisions were corrected in places. The division of regions for which existing biogeographic classifications were not found was based on relief and vegetation (Olson et al. 2001).

4 Defining the study area and selecting geoinformation tools

The part of Europe covered in all four classifications was analyzed. This ensured that the entire area analyzed had data for all classifications (Figure 2); extreme eastern Europe, Iceland, and Cyprus were excluded.

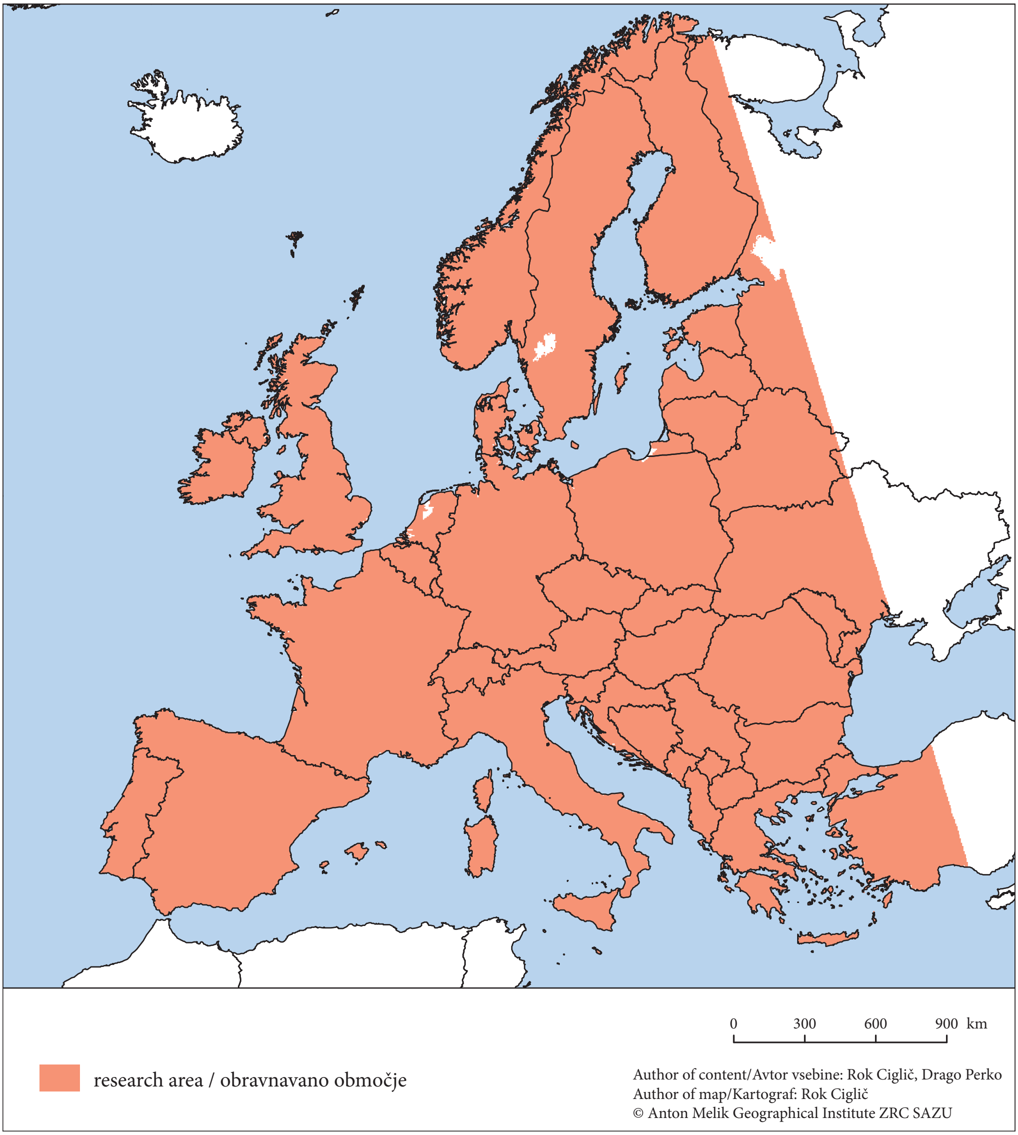


Figure 2: Area of Europe studied.

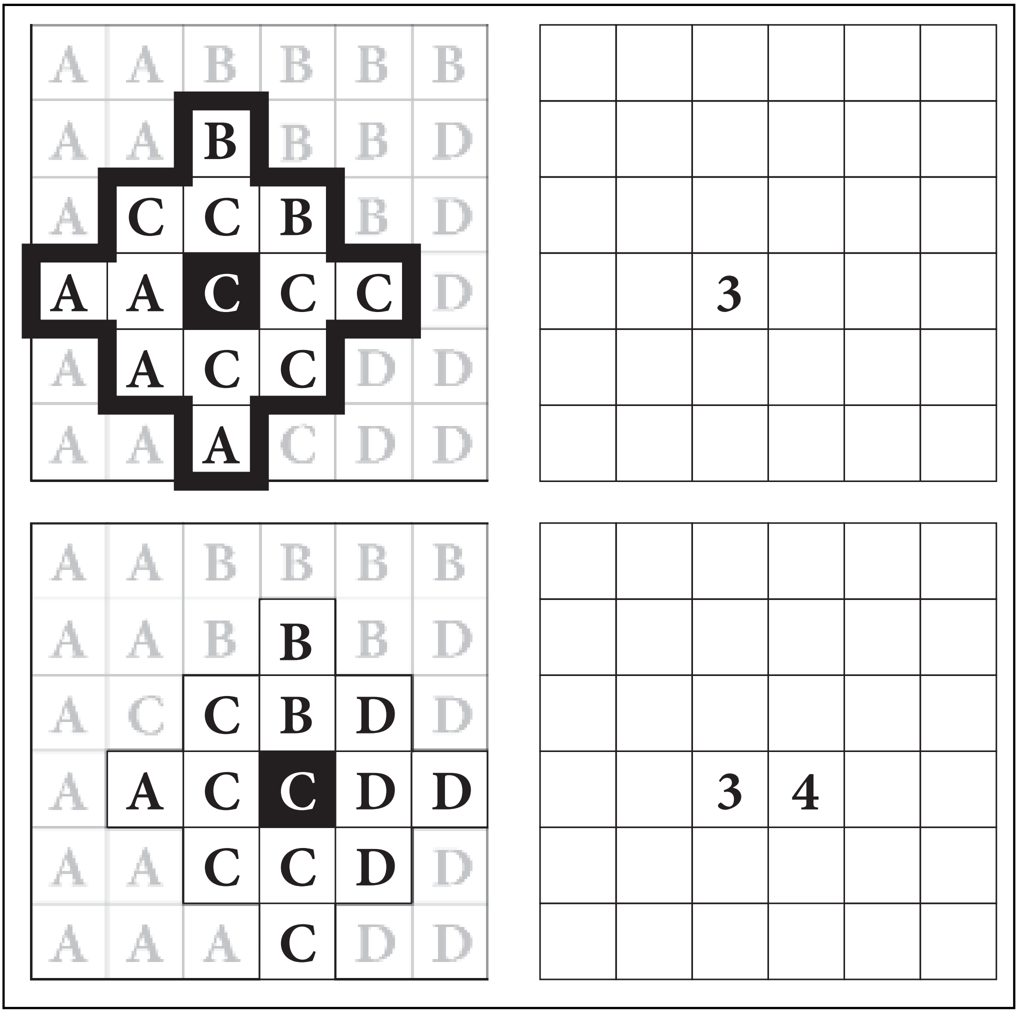


Figure 3: Calculation of various unique values (of types or regions) around the cell (example for two cells).

All of the classifications were transformed from vector file format to raster file format because the remainder of the study used geoinformation tools for processing raster data layers. A 5 km resolution was used for rasterization, which is sufficiently precise for a general overview of landscape diversity in Europe.

After preparing the data layers for each classification in the raster notation, the number of types appearing in a ten-cell or 50 km radius was calculated for each cell (Figure 3 shows a smaller radius simply for illustration). The radius was defined subjectively (a smaller radius would yield similar results, but landscape diversity would be limited to a smaller area, and a larger radius would yield higher landscape diversity). Thus some sort of landscape diversity map was obtained for each of the four classifications.

After creating the landscape diversity maps for each classification analyzed, all of them were joined into a combined landscape diversity map. This was done such that each landscape diversity map was first divided by the number of all possible classification categories (landscape types or regions) in the study area. This therefore showed the share of all landscape categories in the study region of Europe in a radius of 50 km for each cell within a specific classification. Then all of the weighted landscape diversity maps were used to calculate an average, which is also the final result.

5 The results of defining Europe's landscape diversity

The map of average landscape diversity in Europe (Figure 4) shows the percentage of landscape categories that appear in a radius of 50 km around each cell on average with regard to all of the classifications used.

From the map it is clear that the points of contact of various landscapes, including the most diverse landscapes, are primarily along chains of mountains (the Pyrenees, the Alps, the Dinarides, the Carpathians, and the Massif Central), in southern Scandinavia, and in western Anatolia. These areas have on average contact of at least 30% of all categories that appear in individual landscape classifications. There is a clear reduction in the central region of the Alps (even below 15%), which is understandable because

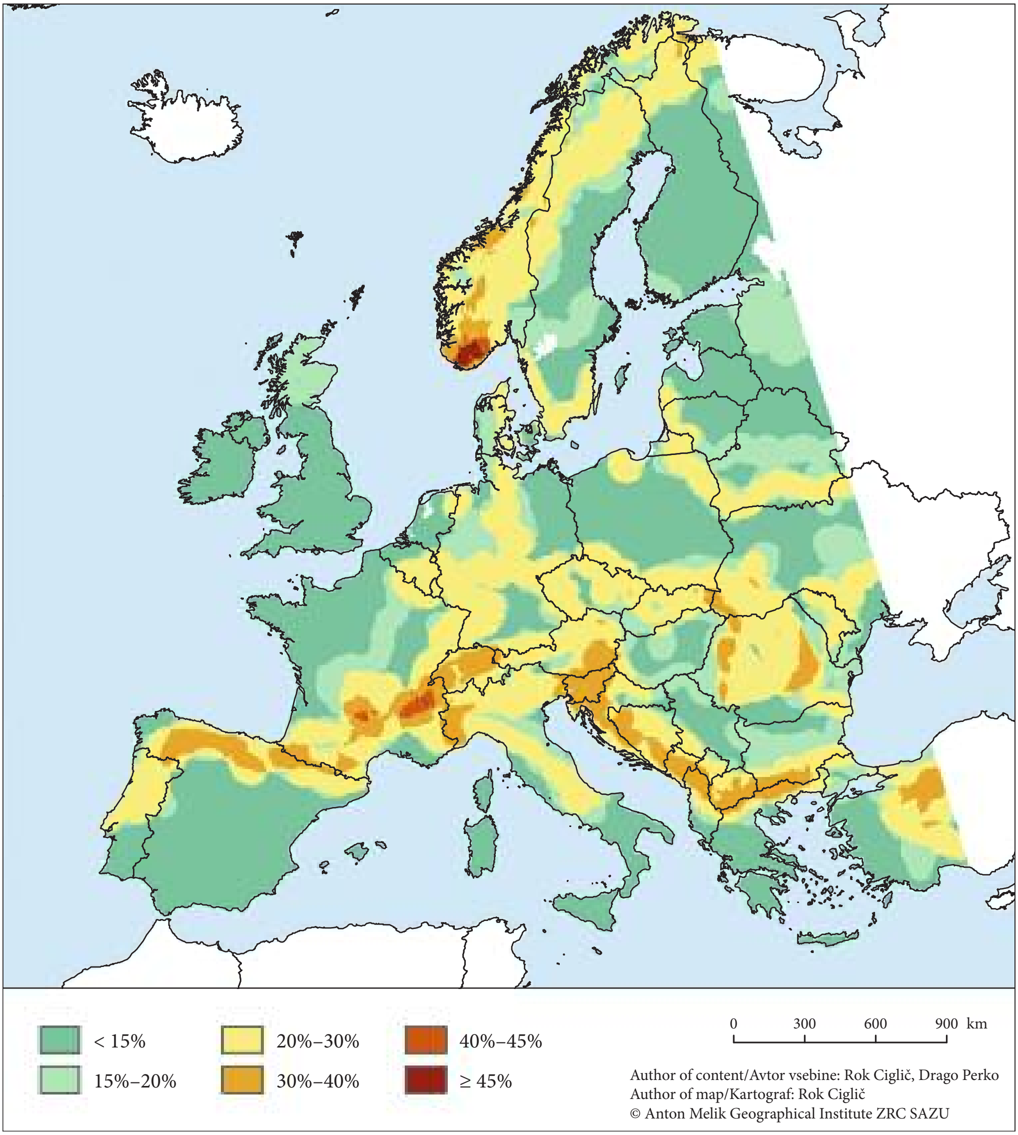


Figure 4: Europe's landscape diversity (share of landscape categories in percentages appearing in a 50 km radius of each cell, average for all classifications used).

the central parts are remote from other landscape categories. Less than 20% is reached in the majority of the Iberian Peninsula, the southern parts of the Italian and Balkan peninsulas, the French lowlands, a large part of the German-Polish Plain, the East European Plain, the Finnish Lake District, the Pannonian and Wallachian plains, the British Isles, the large Mediterranean islands of Sicily, Sardinia, Corsica, and Crete, and eastern Scandinavia. The area where the most different types intersect is, somewhat surprisingly, extreme southern Scandinavia, where on average 49% of all landscape categories mix. Only a small area of the Massif Central and the western Alps also exceed 40%. These two areas can be characterized as true landscape hotspots of Europe because they include very diverse landscapes.

Analyzing diversity by individual countries (Table 2) shows that small countries have the most landscape diversity (Slovenia, Liechtenstein, Montenegro, Switzerland, Macedonia, Andorra, Bosnia-Herzegovina, Austria, and Croatia average over 25%); however, many small countries (e.g., Malta, Ireland, Estonia, Latvia) do not exceed 15%. The fact that area is not a decisive factor was also confirmed mathematically. Spearman's coefficient showed that the average share of landscape categories and area of countries weakly correlate; a weak negative correlation was determined (Table 3). There is also weak correlation between the highest value within a country and the size of the country. The coefficient is positive, which means that larger countries have higher maximum values. This is understandable because the probability is greater that a larger country will have some kind of contact between several different landscape categories.

From the perspective of the diversity of the entire country, an example of a hotspot is Slovenia, which is the most diverse country on average. Within Slovenia, in a 50 km radius the cells have an average of 32.5% of all categories defined for the European study area. The highest absolute value is in Norway, at 49.2%. Only France also exceeds 40%. These are absolute hotspots, already mentioned in the previous paragraph, and they are also apparent on the map (Figure 5). The highest among the lowest values is in Liechtenstein, at 32.1%.

Table 2: Lowest, highest, and average share of landscape categories in Europe in a 50 km radius around an individual cell for all cells within individual countries.

country	minimum in %	maximum in %	average in %	country	minimum in %	maximum in %	average in %
Slovenia	24.8	39.4	**33.2**	Portugal	14.0	32.1	19.7
Liechtenstein	**32.1**	32.1	32.1	Italy	14.0	35.2	19.6
Montenegro	18.1	34.6	30.1	Germany	14.0	32.1	19.6
Switzerland	14.0	39.4	29.8	Sweden	14.0	30.4	18.8
Macedonia	14.0	34.6	29.6	Denmark	14.0	23.8	18.3
Andorra	26.3	30.4	29.5	San Marino	18.1	18.1	18.1
Bosnia and Herzegovina	14.0	37.7	26.6	Spain	14.0	37.7	17.7
Austria	14.0	35.2	26.0	Greece	14.0	34.6	17.2
Croatia	14.0	37.7	25.2	Hungary	14.0	34.6	16.8
Norway	14.0	**49.2**	25.0	Poland	14.0	30.4	16.5
Kosovo	14.0	34.6	24.9	Lithuania	14.0	23.8	16.2
Romania	14.0	37.7	24.2	Serbia	14.0	27.9	15.7
Slovakia	14.0	30.4	22.9	Finland	14.0	31.0	15.6
Albania	14.0	34.6	22.8	Netherlands	14.0	23.8	15.3
Luxembourg	21.3	21.3	21.3	United Kingdom	14.0	18.1	14.8
Moldova	14.0	23.8	20.8	Latvia	14.0	21.3	14.7
Czech Republic	14.0	30.4	20.8	Estonia	14.0	18.1	14.2
Bulgaria	14.0	34.6	20.4	Ireland	14.0	14.0	14.0
France	14.0	46.0	20.1	Malta	14.0	14.0	14.0
Belgium	14.0	23.8	19.8				

Table 3: Correlation between country size and greatest, and average value for the country.

	Correlation between country size and greatest landscape diversity value	Correlation between country size and average landscape diversity value
Spearman's coefficient	0.315	–0.333
Miscalculated coefficient risk (statistical significance), %	5.1	3.9

6 Comparison of hotspots

The most interesting examples of European landscape hotspots are Norway (or the part of its territory in southern Scandinavia with the highest landscape diversity value) and Slovenia as an example of a country with the highest average landscape diversity in Europe.

6.1 A hotspot in southern Scandinavia (example of a physical geography region)

The highest landscape diversity value was recorded in Norway, in southern Scandinavia, where nearly 50% of all landscape categories that the map creators defined for Europe appear in the hotspot area. After examining individual landscape classification maps, one sees that this is where the Atlantic (ocean), alpine (mountain), boreal, and continental types of landscapes meet (Table 4). Contact between continental and ocean features can also be confirmed by Peel et al.'s (2007) climate classification of southern Norway as Cfb and Dfb in the updated Köppen-Geiger climate classification–that is, as a temperate climate without a dry season and with a warm summer (Cfb) and a cold climate without a dry season and with a warm summer (Dfb). Nearly the entire area between Germany and Russia is also classified as type Dfb. In addition, southern Norway is primarily naturally covered with deciduous trees and not with conifers (Diekmann 1994).

Table 4: Overview of units by individual classifications of southern Scandinavia.

classification	portion of all categories in Europe	categories in the hotspot area and its surroundings
Environmental stratification of Europe	4/6	Alpine, Atlantic, Boreal, Continental region
European landscape classification	4/8	Alpine, Atlantic, Boreal, Continental type
Biogeographical regions	3/10	Alpine, Atlantic, Boreal region
Terrestrial biomes of the World	4/7	temperate coniferous forests, boreal forests/taiga, tundra, temperate broadleaf and mixed forests

6.2 Slovenia as a hotspot (example of a country)

Among all of the countries, Slovenia has the highest average landscape diversity, which Slovenian researchers have long emphasized. Melik (1935) characterized Slovenia as a »land of contacts,« and Gams (1998), Perko (1998), and Plut (1999) emphasized the intersection of four European physical geography regions (the Alps, the Dinarides, the Mediterranean, and the Pannonian Basin). They all confirm that Slovenia is at the intersection of various European macroregions. An examination of European territory classifications prepared by Ciglič (2009) and by Ciglič and Perko (2012) shows that non-Slovenian researchers also place Slovenia at the intersection of various European landscape categories. With regard to the classifications that were examined in this analysis, it can be concluded that Slovenia is at the intersection of the mountain (Alps and Dinarides), continental (Pannonian Plain), and Mediterranean landscape types (Table 5).

Table 5: Overview of units by individual classifications of Slovenia.

classification	portion of all categories in Europe	categories in the country
Environmental stratification of Europe	3/6	Alpine, Continental, Mediterranean region
European landscape classification	3/8	Alpine, Continental, Mediterranean type
Biogeographical regions	3/10	Alpine, Continental, Mediterranean region
Terrestrial biomes of the World	3/7	temperate coniferous forests, temperate broadleaf and mixed forests, mediterranean forests, woodlands, and scrub

7 Conclusion

The landscape diversity map of Europe that was created using relatively simple methods offered by geographic information systems and its analysis by country showed that as a rule the areas with the greatest landscape diversity are near mountains. The extensive plains in northern and eastern Europe, the British Isles, and parts of the Mediterranean are less diverse based on the analysis. The Massif Central, the western Alps, and southern Scandinavia stand out in terms of landscape diversity. The analysis was carried out based on research-based and officially recognized landscape classifications of Europe, which show various categories of landscapes (regions or types) at the highest level. It is therefore necessary to also be aware that research findings are relevant only at the highest level because it is apparent that within regions at lower levels landscapes can be considerably more or less diverse (e.g., the Sierra Nevada in southern Spain, mountainous Corsica, etc.).

For individual regions and countries that were defined as having the greatest landscape diversity or as some kind of landscape hotspots, it can be concluded that, alongside minimal human development, they have extensive biodiversity, greater economic potential (especially due to tourism), and a greater likelihood of utilizing diverse natural resources. Alongside the advantages, it is also necessary to point out the dangers hidden primarily in the fact that in such regions it is more difficult to transfer best practices from one region to another because regions have different ecosystems that respond differently to various human interventions, which also encumbers regional planning.

An examination of the cases of two hotspots (southern Scandinavia and Slovenia) showed that all of the classifications analyzed place them at the intersection of various landscape categories, which means that they are confirmed as landscape hotspots by multiple sources. Of course, agreement between sources increases their objectivity and raises their value.

8 Acknowledgement

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Pokrajinske vroče točke Evrope

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IZVLEČEK: Namen analize je poiskati območja v Evropi, ki so z vidika različnih naravnopokrajinskih tipov in regij izjemno raznolika. V prispevku smo za določitev »pokrajinskih vročih točk« analizirali različne geografske členitve Evrope. V analizo smo večino Evrope vključili v 5 km ločljivosti. Najprej smo na podlagi vključenih pokrajinskih klasifikacij izdelali zemljevide pokrajinske raznolikosti. Za vsako celico smo prešteli število različnih naravnopokrajinskih tipov oziroma regij, ki so v okolici celice v razdalji 50 km, in izdelali več zemljevidov pokrajinske raznolikosti. Vsakega smo obtežili tako, da smo vrednosti celic delili s številom vseh različnih tipov oziroma regij v členitvi. V zadnjem koraku smo iz vseh zemljevidov raznolikosti izračunali zemljevid s povprečnimi vrednostmi, ki prikazuje pokrajinsko raznolikost Evrope. Nato smo na podlagi tega podatka določili pokrajinske vroče točke Evrope in ugotovili najbolj raznolike države. Med vsemi evropskimi državami ima največjo povprečno pokrajinsko raznolikost prav Slovenija, sploh največja pokrajinska raznolikost pa je značilna za norveško ozemlje na jugu Skandinavskega polotoka.

KLJUČNE BESEDE: geografija, pokrajinska vroča točka, naravna pokrajina, raznolikost, geografski informacijski sistem, Evropa, Slovenija, Norveška.

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Vsebina

1 Uvod

Sredi Evrope se v krogu s polmerom 150 km, kjer leži Slovenija, prepletajo visokogorske Alpe s predalpskimi hribovji in kotlinami, ravninska Panonska nižina z gričevnatim obrobjem, zakraseli svet Dinarskega gorovja s kraškimi planotami in podolji ter sredozemska gričevja z blažilnimi vplivi Jadranskega morja. Ker se tu stikajo tudi štirje kulturni prostori, slovanski, germanski, romanski in madžarski, so se na majhnem območju izoblikovali številni tipi naravnih in kulturnih pokrajin (Kladnik in Perko 1998), Slovenija je zato kljub majhnosti zelo raznolika.

Geografska preučevanja Slovenije kažejo, da so prav stiki različnih pokrajinskih tipov običajno še posebej zanimivi, oziroma, da območja vzdolž mej med posameznimi pokrajinskimi tipi lahko opredelimo kot neke vrste pokrajinske vroče točke.

Zanimalo nas je, ali je na temelju različnih klasifikacij (tipizacij, regionalizacij) Evrope (Ciglič in Perko 2012) možno določiti tudi evropske pokrajinske vroče točke (Ciglič in Perko 2013).

Različne pokrajinske klasifikacije so v geografski znanstveni literaturi pogoste. To ne preseneča, saj je običajno, da človek v pokrajini vedno išče nekakšen red (Haggett 2001). Klasifikacija je ena od najbolj osnovnih mentalnih človekovih dejavnosti, s katero urejamo informacije, ki jih dobimo, saj bi bilo pomnjenje lastnosti vsakega posameznika nemogoče. Zato ljudje objekte, osebe, dogodke združujemo v skupine po neki skupni lastnosti (Theodoridis in Koutroumbas 2006).

Pokrajinske klasifikacije so pomembne za ohranjanje pokrajine in načrtovanje njenega razvoja (Romportl 2007; Bernert s sod. 1997). Določitev ekoloških območij ima lahko več namenov: spremljanje stanja, upravljanje, načrtovanje, inventarizacija, predstavitev dejstev, vrednotenje, izvajanje meritev, študija scenarijev, določanje vzorčnih območij, prenos modelov v prostoru, prikaz raznolikosti pokrajine, povezava med kopenskimi in vodnimi sistemi, analiza vplivov na okolje in podobno (Loveland in Merchant 2004; Mücher s sod. 2003; Bastian 2000; Bailey 1996, 146–152; Runhaar s sod. 1994; Bunce s sod. 1996). Čeprav pokrajine niso statične in se spreminjajo, je pregled nad pokrajinskimi tipi nujen (Mücher s sod. 2003), saj naj bi bil prostor organiziran tako, da omogoča varčno rabo naravnih virov in s tem njihovo obnavljanje. Poznavanje naravnih procesov in delovanja družbe sta nujna (Plut 1999). Klasifikacija prostora na podlagi naravnogeografskih značilnosti je temelj optimalne prostorske organizacije. Nenazadnje so tudi okoljski problemi ustrezneje opredeljeni z naravnimi značilnostmi kot pa z administrativnimi mejami (Bailey 1996; Olson s sod. 2001). Odsotnost skupne prostorske enote otežuje tudi multidisciplinarno raziskovanje (Bailey 1996) in prav enotna pokrajinska klasifikacija, po kateri bi se raziskave osredotočile na skupno prostorsko enoto, bi tovrstno raziskovanje olajšala (Brabyn 2009). Z skupno ekosistemsko enoto bi se namreč zbiranje in analiza podatkov nanašala na območje enakega prostorskega obsega (Bailey 1996). To je tudi eden izmed izzivov multidisciplinarnih raziskav upravljanja naravnih virov (Axelsson, Angelstam in Törnblom 2010). Zato so vse pogosteje v uporabi na podlagi naravnih dejavnikov izvedene prostorske klasifikacije, saj njihovi uporabniki iščejo razvrstitev, ki je boljša od politične in bolje odraža naravne razmere (Bernert s sod. 1997). Tako na primer obalne regije NUTS3 v Sredozemlju pogosto vključujejo podeželska in mestna območja (Hazeu s sod. 2010), ki se razlikujejo tako po naravnogeografskih kot družbenogeografskih lastnostih. Povezovanje naravnogeografskih in družbenogeografskih prvin je za svoj predlog upravne členitve Slovenije uporabil Plut (1999). Uresničevanje načela trajnostnosti na gospodarskem, družbenem in okoljskem področju pomeni trajno prilagajanje organizacije in delovanja družbe okolju (Plut 2005, 59), ki ga je torej treba čim bolje poznati.

V znanstveni literaturi ter na spletnih straneh je predstavljenih precej klasifikacij držav, celin in tudi manjših območij, izvedenih na podlagi naravnih in družbenih dejavnikov. Primere tovrstnih pokrajinskih klasifikacij lahko najdemo s celega sveta, za različne države (na primer Van Eetvelde in Antrio 2009; Bryan 2000; Burrough s sod. 2001; Soto in Pintó 2010; Hargrove in Hoffman 2005; Castillo-Rodríguez, López-Blanco in Muñoz-Salinas 2010; Wolock, Winter in McMahon 2004; Zhou s sod. 2003; Leathwick s sod. 2003; Breskvar Žaucer in Marušič 2006; Perko 1998; Špes s sod. 2002; Renetzeder s sod. 2008). Prav tako obstaja pester nabor klasifikacij pokrajin Evrope (Mücher s sod. 2003; Metzger s sod. 2005; Jongman s sod. 2006; Mücher s sod. 2003, 2006 in 2009; Digital map … 2009; Bohn s sod. 2002/2003; Meeus 1995; Europe's … 1995; Rivas-Martínez, Penas in Díaz, 2009; Biogeographical regions … 2013) in tudi celega sveta (Olson s sod. 2001; Bailey 1996; Udvardy 1975). Ne smemo pozabiti, da gre pri vseh teh klasifikacijah tudi za določeno abstrakcijo. Model je namreč poenostavljen prikaz resničnega sveta (Demeritt in Wainwright 2005), zato tudi med pokrajinskimi klasifikacijami istih območij prihaja do razlik.

2 Namen

Prispevek analizira različne digitalne naravnopokrajinske klasifikacije Evrope in ugotavlja, kje v Evropi so območja, ki jih lahko označimo za pokrajinsko bolj pestra. Temeljni namen je poiskati območja, kjer se stikajo različne evropske naravnopokrajinske enote (tipi ali regije). Območja, kjer se prepletajo različni naravni dejavniki, so pomembna z vidika biodiverzitete, saj pokrajinska raznolikost pomembno vpliva na biodiverziteto oziroma raznolikost habitatov in vrst (Dramstad s sod. 2001; Hou in Walz 2013; Walz in Syrbe 2013). Pokrajinsko pestra območja imajo lahko tudi prednost v gospodarskem razvoju, še posebej v turizmu, saj »… *človekovo zaznavanje ceni raznolikost, kompleksnost, vzorce in lokalni značaj* …« (Erhartič 2012, 36). Gray (2004) meni, da je pomen različnih tipov reliefnih oblik in bogastva površinskih detajlov za priljubljenost turističnih območij močno podcenjen. Po drugi strani pa so območja, kjer se prepletajo raznoliki naravni vplivi, lahko tudi območja, kjer prenos dobrih praks zaradi različnega odziva pokrajine na človekove posege ni preprost. V prispevku želimo opozoriti na takšna območja v Evropi, hkrati pa ugotoviti, ali se »vroče točke« na stičišču raznih enot pojavljajo pri klasifikacijah različnih avtorjev, torej, ali so kot raznolike označene v več virih.

3 Izbor in opis klasifikacij

V analizo smo vključili različne pokrajinske klasifikacije, ki temeljijo predvsem na naravnih pokrajinskih sestavinah in so dostopne v digitalni obliki.

Za našo analizo smo izbrali klasifikacije s podobnim številom tipov ali regij (preglednica 1 in slika 1).

Preglednica 1: Izbrane evropske pokrajinske klasifikacije.

klasifikacija (vir)	število kategorij	raven znotraj klasifikacije	kategorije klasifikacije; v oklepaju so kategorije, ki niso na obravnavanem območju analize
Okoljska členitev Evrope (Mücher s sod. 2003; Metzger s sod. 2005; Jongman s sod. 2006)	6	druga raven klasifikacije (prva raven ima le dve enoti*)	Vse biogeografske regije oziroma območja: alpska, anatolska, atlantska, borealna, celinska in sredozemska
Evropska pokrajinska členitev (Mücher s sod. 2003, 2006 in 2009)	8	prva raven klasifikacije	Vsi tipi: arktični, borealni, atlantski, alpski, sredozemski, celinski, anatolski in stepski
Biogeografske regije oziroma območja (Biogeographical regions … 2013)	11	klasifikacija ima le eno raven	Vse biogeografske regije oziroma območja: alpsko, anatolsko, arktično, atlantsko, črnomorsko, borealno, celinsko, (makaronezijsko), sredozemsko, panonsko in stepsko
Kopenske ekološke regije oziroma območja sveta** (Olson s sod. 2001)	14	prva raven klasifikacije, ki deli Evropo na enote	Vsi biomi (14): (tropski in subtropski vlažni širokolistni gozdovi); (tropski in subtropski sušni širokolistni gozdovi); (tropski in subtropski iglasti gozdovi); širokolistni in mešani gozdovi zmernih zemljepisnih širin; iglasti gozdovi zmernih zemljepisnih širin; borealni gozdovi/tajga; (tropski in subtropski travniki, savana in grmičevja); travniki, savana in grmičevja zmernih zemljepisnih širin; (poplavni travniki in savane); (gorski travniki in grmičevja); tundra; sredozemski gozdovi, dobrave in grmovja; (puščave in sušno grmičevje); (mangrove), jezera oziroma večje vodne površine***; (skalovja in ledeniki)

* Klasifikacijo so izvedli računalniško, tako da so Evropo na podlagi podnebnih podatkov najprej razdelili na severno in južno, nato pa so za obe enoti izvedli klasifikacijo na podlagi različnih naravnih podatkov.

** Izločili smo klasifikacijo DMEER (Digital map … 2013), ker ima v primerjavi z ostalimi klasifikacijami veliko večje število enot. Na njej temelji tudi klasifikacija Kopenske ekološke regije oziroma območja sveta.

*** Ta kategorija ni vključena v analizo.

3.1 Okoljska členitev Evrope

Členitev Evrope so izdelali za določitev enot, uporabnih za vzorčenje, razne modele in poročila o okolju (Metzger s sod. 2005; Mücher s sod. 2003). Klasificirali so v več korakih. Najprej so z metodo glavnih komponent več podatkovnih slojev (višina, naklon, oddaljenost od oceana, zemljepisna širina in več podnebnih spremenljivk za mesece januar, april, julij in oktober) nadomestili z le tremi glavnimi komponentami. Nato so z glavnimi komponentami celice klasificirali v skupine. Evropo so razdelili na 84 okoljskih razredov, nato pa so te združili v 13 okoljskih con in nadalje v 6 biogeografskih regij oziroma območij. Celotna členitev je izdelana s prostorsko ločljivostjo 1 km^2 (Metzger s sod. 2005; Jongman s sod. 2006; Mücher s sod. 2003). Klasificirali so ozemlje med 11° zahodne zemljepisne dolžine in 32° vzhodne zemljepisne dolžine ter 34° in 72° severne zemljepisne širine (Metzger s sod. 2005). Zaradi velikih razlik je bilo celotno območje na podlagi podnebja razdeljeno in obdelano v dveh delih: severnem in južnem (Metzger s sod. 2005), kar bi lahko razumeli tudi kot členitev na najvišji ravni.

3.2 Evropska pokrajinska členitev

Ta pokrajinska klasifikacija je bila izvedena na podlagi naravnogeografskih in družbenogeografskih podatkov. Snovalci so znotraj posameznih korakov uporabili metodo segmentacije in klasifikacijo dobljenih segmentov v skupine. Uporabili so podatke o podnebju, nadmorski višini, prsteh in rabi tal. Posebej so določili večja urbana območja, vodne površine in območja plimovanja (Mücher s sod. 2003; Mücher s sod. 2006). Na podlagi podatkov za nadmorsko višino, prsti in rabo tal so Evropo najprej razdelili na manjše segmente, nato pa so za nadaljnjo tipizacijo upoštevali še podatke o podnebju (Mücher s sod. 2009). Pri klasifikaciji segmentov na prvi ravni so upoštevali podnebje in določili osem tipov, pri razvrstitvi na drugi ravni so upoštevali še nadmorsko višino in določili 31 tipov, pri tretji ravni so dodali prst in določili 76 tipov, pri četrti, najnižji ravni, pa so upoštevali še posebna območja rabe tal in določili 350 pokrajinskih tipov (Mücher s sod. 2006).

Analiza podatkov je potekala v ločljivosti 1 km^2, dobljene poligone oziroma enote, ki so bili manjši od 11 km^2, pa so naknadno združili s sosednjimi. Končni zemljevid je bil narejen v merilu 1 : 2.000.000 in pokriva celotno Evropo do Urala na vzhodu, Azerbajdžana na jugovzhodu in Nove dežele na severovzhodu, vendar Ciper ni vključen (Mücher s sod. 2006).

3.3 Biogeografske regije oziroma območja (različica 2011)

Meje biogeografskih regij oziroma območij so uporabili tudi v besedilu Habitatne direktive – *COUNCIL DIRECTIVE 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora* (COUNCIL DIRECTIVE 92/43/EEC) ter pri pripravi omrežja EMERALD (Biogeographical … 2013). V zadnjo različico iz leta 2011 so vključili celotno Evropo, vključno z Islandijo, Turčijo, Kavkazom in zahodnim delom Rusije ter s Kanarskimi otoki in Azori. Obe otočji sta vključeni v biogeografsko območje oziroma regijo Makaronezija (Biogeographical regions … 2013). Prve različice so temeljile na združevanju naravnega rastlinstva članic Evropske skupnosti in Sveta Evrope (Noirfalise 1987). Gozdne združbe so združevali v biogeografske regije oziroma območja (mednje so vključili tudi aconalne enote) ter zemljevid posplošili; pri poznejših različicah so uporabili tudi zemljevid potencialne vegetacije, ki ga je pripravil nemški Zvezni urad za varstvo okolja (The indicative map … 2006). Klasifikacija iz leta 2011 ima 11 biogeografskih regij oziroma območij. Načeloma se opira na naravno rastlinstvo, vendar nekatere meje potekajo po administrativnih oziroma državnih mejah (na primer pri Madžarski in Grčiji), kar jo oddaljuje od povsem naravne delitve.

3.4 Kopenske ekološke regije oziroma območja sveta

Zemljevid kopenskih ekoloških regij oziroma območij je bil izdelan na podlagi biogeografskega znanja in razmeroma natančno prikazuje širok razpon raznovrstne favne in flore. Ekološke regije oziroma območja avtorji označujejo kot sorazmerno prostrane enote s posebno kombinacijo naravnih združb in vrst. Njihove meje ustrezajo naravnemu stanju pred večjimi posegi človeka (Olson s sod. 2001). Po tej členitvi je kopno razdeljeno na 8 geografskih območij (Oceanija, Nearktika, Neotropi, Afrotropi, Palearktika, Indo-Malaja, Avstralazija) in 14 biomov. Poleg biomov so ločili še kategoriji večja jezera ter skalovje in led. Na najbolj podrobni ravni je določenih skupno 867 ekoloških regij oziroma območij. Delitev so izvedli na podlagi različnih virov (za več informacij glej Olson s sod. 2001); za zahodno *Palearktično območje*, kamor spada tudi Evropa, so uporabili zemljevid DMEER (Digital map of European ecological regions; Digital map … 2013). Členitev so ponekod popravili. Pri členitvi območij, za katera niso našli že obstoječih biogeografskih klasifikacij, so se oprli na relief in vegetacijo (Olson s sod. 2001).

Slika 1: Prikaz posameznih klasifikacij.
Glej angleški del prispevka.

4 Določitev območja preučevanja in izbor geoinformacijskih orodij

Analizirali smo le tisti del Evrope, ki ga pokrivajo vse štiri klasifikacije. S tem smo zagotovili, da ima celotno analizirano območje podatke za vse klasifikacije (slika 2), izločili pa smo skrajni vzhodni del Evrope, Islandijo in Ciper. Vse klasifikacije smo iz vektorskega zapisa prenesli v rastrski zapis, saj smo v nadaljevanju uporabili geoinformacijska orodja za obdelavo rastrskih podatkovnih slojev. Pri rasterizaciji smo izbrali 5 km ločljivost, ki je za splošen pregled raznolikosti pokrajin v Evropi dovolj natančna.

Slika 2: Obravnavano območje Evrope.
Glej angleški del prispevka.

Po pripravi podatkovnih slojev za vsako klasifikacijo v rastrskem zapisu smo znotraj posamezne klasifikacije za vsako celico izračunali število tipov, ki se pojavljajo v radiju 10 celic oziroma 50 km (na sliki 3 je zgolj za ponazoritev prikazan manjši radij). Radij je bil določen subjektivno (pri manjšem radiju bi dobili podobne rezultate, a raznolikost pokrajin bi bila omejena na manjša območja, pri večjem radiju pa bi se raznolikost pokrajin na splošno povečala). Tako smo za vsako od štirih klasifikacij dobili nekakšen zemljevid pokrajinske raznolikosti.

Slika 3: Izračun različnih unikatnih vrednosti (tipov ali regij) okrog celice (primer za dve celici).
Glej angleški del prispevka.

Po izdelanih zemljevidih pokrajinske raznolikosti za vsako analizirano klasifikacijo smo vse združili v skupen zemljevid pokrajinske raznolikosti. To smo naredili tako, da smo najprej vsak zemljevid pokrajinske raznolikosti delili s številom vseh možnih kategorij klasifikacije (tipov pokrajin, regij) na obravnavanem območju. Tako smo glede na posamezno klasifikacijo za vsako celico prikazali, koliko odstotkov od vseh pokrajinskih kategorij na obravnavanem območju Evrope je v radiju 50 km. Nato smo na podlagi vseh obteženih zemljevidov pokrajinske raznolikosti izračunali povprečje, kar je tudi končni rezultat.

5 Rezultati določanja pokrajinske raznolikosti Evrope

Zemljevid povprečne pokrajinske raznolikosti Evrope (slika 4) prikazuje, koliko odstotkov pokrajinskih kategorij se pojavlja v radiju 50 km okrog vsake celice povprečno glede na vse upoštevane klasifikacije.

Slika 4: Pokrajinska raznolikost Evrope (delež pokrajinskih kategorij v odstotkih, ki se pojavljajo v radiju 50 km okrog vsake celice, povprečno glede na vse upoštevane klasifikacije).
Glej angleški del prispevka.

Po pregledu zemljevida je opazno, da so stičišča različnih pokrajin, s tem pa tudi najbolj raznolike pokrajine, predvsem vzdolž gorstev (Pireneji, Alpe, Dinarsko gorovje, Karpati, Centralni masiv), na območju južne Skandinavije ter na območju zahodne Anatolije. Našteta območja so v povprečju na stiku vsaj 30 % od vseh kategorij, ki se pojavljajo pri posameznih pokrajinskih klasifikacijah. Opazno je zmanjšanje na osrednjem območju Alp (tudi pod 15 %), kar je razumljivo, saj so osrednji deli odmaknjeni od drugih pokrajinskih kategorij. Manj kot 20 % imajo večina Pirenejskega polotoka, južna dela Apeninskega in Balkanskega polotoka, Francosko nižavje, velik del Nemško-Poljskega nižavja, Rusko nižavje, Finsko pojezerje, Panonsko in Vlaško nižavje, Britansko otočje, veliki sredozemski otoki Sicilija, Sardinija, Korzika in Kreta ter vzhodna Skandinavija. Pokrajina, kjer se stika največ različnih tipov, je, nekoliko presenetljivo, na skrajnem jugu Skandinavije, kjer se v povprečju prepleta 49 % od vseh pokrajinskih kategorij. 40 % presegata le še manjše območje Centralnega masiva in zahodni del Alp. Ti dve območji lahko označimo kot pravi pokrajinski vroči točki Evrope, saj so tamkaj zelo raznolike pokrajine.

Če analiziramo raznolikost po posameznih državah (preglednica 2), ugotovimo, da so pokrajinsko najbolj raznolike površinsko manjše države (Slovenija, Lihtenštajn, Črna gora, Švica, Makedonija, Andora, Bosna in Hercegovina, Avstrija in Hrvaška imajo povprečno vrednost nad 25 %), vendar na drugi strani precej manjših držav (na primer Malta, Irska, Estonija, Latvija) ne presega vrednosti 15 %. Da površina ni odločilen dejavnik, smo potrdili tudi računsko. Z izračunom Spearmanovega koeficienta smo namreč ugotovili, da sta povprečen delež in površina držav šibko statistično povezana; ugotovljena je bila blaga negativna povezanost (preglednica 3). Šibka povezanost je tudi med največjo vrednostjo znotraj države in velikostjo države. Koeficient je sicer pozitiven, kar pomeni, da imajo večje države višje maksimalne vrednosti. To je razumljivo, saj je verjetnost, da bomo znotraj velike države naleteli na kakšen stik več različnih pokrajinskih kategorij, večja.

Z vidika raznolikosti celotnih držav bi lahko kot vročo točko izpostavili Slovenijo, ki je povprečno najbolj raznolika država. Celice znotraj Slovenije imajo v svojem radiju 50 km v povprečju 33,2 % vseh kategorij, ki so določene na obravnavanem območju Evrope. Najvišja absolutna vrednost pa je na območju Norveške, in sicer 49,2 %. Več kot 40 % doseže le še Francija. Gre za absolutni vroči točki, ki smo ju omenili že v prejšnjem odstavku, opazni pa sta tudi na zemljevidu (slika 5). Najvišja izmed najnižjih vrednosti je v Lihtenštajnu, in sicer 32,1 %.

Preglednica 2: Najnižji, najvišji in povprečni delež pokrajinskih kategorij Evrope znotraj radija 50 km okrog posamezne celice za vse celice znotraj posameznih držav.

država	najnižja vrednost v %	najvišja vrednost v %	povprečna vrednost v %	država	najnižja vrednost v %	najvišja vrednost v %	povprečna vrednost v %
Slovenija	24,8	39,4	**33,2**	Portugalska	14,0	32,1	19,7
Lihtenštajn	**32,1**	32,1	32,1	Italija	14,0	35,2	19,6
Črna gora	18,1	34,6	30,1	Nemčija	14,0	32,1	19,6
Švica	14,0	39,4	29,8	Švedska	14,0	30,4	18,8
Makedonija	14,0	34,6	29,6	Danska	14,0	23,8	18,3
Andora	26,3	30,4	29,5	San Marino	18,1	18,1	18,1
Bosna in Hercegovina	14,0	37,7	26,6	Španija	14,0	37,7	17,7
Avstrija	14,0	35,2	26,0	Grčija	14,0	34,6	17,2
Hrvaška	14,0	37,7	25,2	Madžarska	14,0	34,6	16,8
Norveška	14,0	**49,2**	25,0	Poljska	14,0	30,4	16,5
Kosovo	14,0	34,6	24,9	Litva	14,0	23,8	16,2
Romunija	14,0	37,7	24,2	Srbija	14,0	27,9	15,7
Slovaška	14,0	30,4	22,9	Finska	14,0	31,0	15,6
Albanija	14,0	34,6	22,8	Nizozemska	14,0	23,8	15,3
Luksemburg	21,3	21,3	21,3	Združeno kraljestvo	14,0	18,1	14,8
Moldavija	14,0	23,8	20,8	Latvija	14,0	21,3	14,7
Češka	14,0	30,4	20,8	Estonija	14,0	18,1	14,2
Bolgarija	14,0	34,6	20,4	Irska	14,0	14,0	14,0
Francija	14,0	46,0	20,1	Malta	14,0	14,0	14,0
Belgija	14,0	23,8	19,8				

Preglednica 3: Povezanost med velikostjo države ter največjo in povprečno vrednostjo za države.

	povezanost med velikostjo države in največjo vrednostjo pokrajinske raznolikosti	povezanost med velikostjo države in povprečno vrednostjo pokrajinske raznolikosti
Spearmanov koeficient	0,315	–0,333
tveganje napačno izračunanega koeficienta (statistična značilnost) v %	5,1	3,9

6 Primeri vročih točk

Najbolj zanimiva primera evropskih pokrajinskih vročih točk sta Norveška oziroma del njenega ozemlja na jugu Skandinavskega polotoka z najvišjo vrednostjo pokrajinske raznolikosti in Slovenija kot primer države z najvišjo povprečno pokrajinsko raznolikostjo v Evropi.

6.1 Vroča točka na jugu Skandinavskega polotoka (kot primer naravnogeografske regije)

Najvišjo vrednost pokrajinske raznolikosti smo zabeležili na ozemlju Norveške v južnem delu Skandinavskega polotoka, kjer se na območju vroče točke pojavi skoraj 50 % vseh pokrajinskih kategorij, ki so jih snovalci zemljevidov določili za območje Evrope. Po pregledu posameznih zemljevidov pokrajinskih klasifikacij vidimo, da je na tem območju stičišče atlantskega (oceanskega), alpskega (gorskega), borealnega in celinskega tipa pokrajin (preglednica 4). Stik celinskih in oceanskih lastnosti lahko potrdimo tudi s tem, da so Peel in sodelavci (2007) v posodobljeni Köppnovi in Geigerjevi podnebni klasifikaciji jug Norveške klasificirali kot Cfb in Dfb, torej kot zmerno podnebje brez sušne dobe in s toplim poletjem (Cfb) oziroma hladno podnebje brez sušne dobe in s toplim poletjem (Dfb). V tip Dfb se uvršča tudi skoraj celotno območje med Nemčijo in Rusijo. Razen tega je jug Norveške naravno poraščen predvsem z listavci in ne iglavci (Diekmann 1994).

Preglednica 4: Pregled enot po posameznih klasifikacijah južnega dela Skandinavskega polotoka.

klasifikacija	delež kategorij od vseh v Evropi	kategorije na območju ali v bližini vroče točke
Okoljska členitev Evrope	4/6	alpsko, atlantsko, borealno, celinsko območje
Evropska pokrajinska členitev	4/8	alpski, atlantski, borealni, celinski tip
Biogeografske regije oziroma območja	3/10	alpsko, atlantsko, borealno območje
Kopenske ekološke regije oziroma območja sveta	4/7	iglasti gozdovi zmernih zemljepisnih širin; borealni gozdovi/tajga; tundra; širokolistni in mešani gozdovi zmernih zemljepisnih širin

6.2 Vroča točka Slovenija (kot primer države)

Med vsemi državami ima najvišje povprečje pokrajinske raznolikosti Slovenija, kar slovenski znanstveniki poudarjajo že zelo dolgo. Melik (1935) je Slovenijo označil kot »*zemljo stikov*«, stik štirih evropskih naravnogeografskih regij (Alpe, Dinarsko gorstvo, Sredozemlje, Panonska kotlina) pa so izpostavili Gams (1998), Perko (1998) in Plut (1999). Vsi trdijo, da je Slovenija na stiku različnih evropskih makroregij. Po pregledu klasifikacij evropskega ozemlja, ki sta ju pripravila Ciglič (2009) ter Ciglič in Perko (2012), je očitno, da tudi tuji znanstveniki Slovenijo umeščajo na stičišče različnih evropskih pokrajinskih kategorij. Glede na klasifikacije, ki smo jih preverili v tej analizi, lahko sklenemo, da je Slovenija na stičišču gorskega (Alpe in Dinarsko gorovje), celinskega (Panonsko nižavje) in sredozemskega (Sredozemlje) pokrajinskega tipa (preglednica 5).

Preglednica 5: Pregled enot po posameznih klasifikacijah Slovenije.

klasifikacija	delež kategorij od vseh v Evropi	kategorije znotraj države
Okoljska členitev Evrope	3/6	alpsko, celinsko, sredozemsko območje
Evropska pokrajinska členitev	3/8	alpski, celinski, sredozemski tip
Biogeografske regije oziroma območja	3/10	alpsko, celinsko, sredozemsko območje
Kopenske ekološke regije oziroma območja sveta	3/7	iglasti gozdovi zmernih zemljepisnih širin; širokolistni in mešani gozdovi zmernih geografskih širin; sredozemski gozdovi, dobrave in grmovja

7 Sklep

Zemljevid pokrajinske raznolikosti Evrope, do katerega smo prišli z uporabo sorazmerno preprostih metod oziroma tehnik, ki jih nudi geografski informacijski sistem, in njegova analiza po državah sta pokazala, da so pokrajinsko praviloma najbolj raznolika območja v bližini gorovij. Obsežne ravnine na severu in vzhodu Evrope, Britansko otočje in deli Sredozemlja so, po analizi sodeč, manj raznoliki. Po pokrajinski raznolikosti izstopajo Centralni masiv, zahodni del Alp ter južni del Skandinavskega polotoka. Analiza je bila izvedena na podlagi znanstvenih in uradno priznanih pokrajinskih klasifikacij Evrope, ki prikazujejo različne kategorije pokrajin (regije, tipe) na najvišji ravni. Zato se moramo zavedati, da so tudi izsledki raziskav relevantni le na najvišji ravni, saj se zavedamo, da so znotraj območij na nižjih ravneh pokrajine lahko še precej bolj ali precej manj raznolike (na primer gorovje Sierra Nevada v južni Španiji, gorata Korzika …).

Za posamezna območja in države, ki smo jih določili kot pokrajinsko najbolj raznolike oziroma kot nekakšne pokrajinske vroče točke, lahko sklepamo, da imajo ob ne prevelikih posegih človeka veliko biodiverziteto, večji gospodarski potencial (zlasti zaradi turizma) in večjo verjetnost izkoriščanja raznolikih naravnih virov. Ob prednostih je treba izpostaviti tudi nevarnosti, ki se skrivajo predvsem v dejstvu, da je na takih območjih težji prenos dobrih praks z enega območja na drugega, saj imajo območja različne ekosisteme, ki se različno odzivajo na razne posege, zato je oteženo tudi regionalno planiranje.

Pregled primerov dveh vročih točk (južni del Skandinavskega polotoka in Slovenija) je pokazal, da ju na stik različnih pokrajinskih kategorij uvrščajo prav vse analizirane klasifikacije, kar pomeni, da jih kot pokrajinske vroče točke potrjuje več virov. Usklajenost med viri seveda zvišuje njihovo objektivnost in povečuje vrednost.

8 Zahvala

Prispevek temelji na raziskovalnem projektu Določanje naravnih pokrajinskih tipov Slovenije z geografskim informacijskim sistemom (L6-3643), ki ga je financirala Javna agencija za raziskovalno dejavnost Republike Slovenije.

9 Literatura

Glej angleški del prispevka.